DEPARTMENT OF MINERAL RESOURCES AND ENERGY

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MINE HEALTH AND SAFETY ACT, 1996 (ACT NO. 29 OF 1996)

GUIDELINE FOR A MANDATORY CODE OF PRACTICE ON THE PREVENTION OF FIRES AT MINES

I **DAVID MSIZA**, the Chief Inspector of Mines, in terms of section 49 (6) read together with sections 9 (2) and 9 (3) of the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) as amended, hereby issue the Guideline for a Mandatory Code of Practice on the Prevention of Fires in Mines, as set out in the schedule below.

DAVID MSIZA
CHIEF INSPECTOR OF MINES
DEPARTMENT OF MINERAL AND PETROLEUM RESOURCES

SCHEDULE

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DEPARTMENT OF MINERAL AND PETROLEUM RESOURCES

MINE HEALTH AND SAFETY INSPECTORATE

GUIDELINE FOR THE COMPILATION OF A MANDATORY CODE OF PRACTICE ON

THE PREVENTION OF FIRES AT MINES

CHIEF INSPECTOR OF MINES

mineral & petroleum resources
Department:
Mineral and Petroleum Resources
REPUBLIC OF SOUTH AFRICA

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PART A: THE GUIDELINE

1. FOREWORD

1.1 **Fires** in **mines** or excavations, such as a transportation tunnel, is a serious **fire hazard** that could result in the loss of life and revenue for the enterprise concerned. **Mines** contain significant amounts of fuel sources such as flammable material, fuels, lubricants, timber, rubber, plastics, paint and packaging materials. Coupled with these are numerous ignition sources such as self-heating of coal, flame from oxy-acetylene cutting and welding equipment, sparks, electrical short-circuits, machinery hot surfaces and friction that can initiate a **fire**.

1.2 Basic **fire** theory suggests that **fires** occur when three constituents are present simultaneously: a fuel source, an ignition (heat) source and oxygen (air). At **mines**, oxygen will normally be present in the air as it is required to sustain human life and enable the operation of combustion engines.

1.3 The identification of **fire hazards** should focus on the following key considerations:

1.3.1 The presence of fuel sources such as combustible materials, flammable substances, volatile chemicals, etc.

1.3.2 The presence of ignition or heat sources such as hot surfaces on equipment, electrical sparks, naked flames, explosives, exothermic chemical reactions, etc.

1.3.3 A chemical chain reaction in metallic **fires** known as class D **fires**.

1.4 The **fire** risk in any **mine** has to be managed properly. This is achieved by an assessment of the risks involved, the monitoring of **fire** risk **controls**, good **mine** and ventilation system design, equipment and material selection as well as the preparation, implementation and enforcement of formal appropriate **mine**-specific standards.

1.5 The South African mining industry has in the past experienced several underground **fire** incidents. Underground **fires** are particularly dangerous due to the confined nature of excavations, the quantity of smoke and noxious fumes produced in relation to the limited quantity of fresh air present and the restricted ability to escape quickly from the **mine**.

1.6 Between 2019 and 2023, there were 584 **fire** incidents that were reported. The majority of the **fire** incidents were reported from the Northern Cape, Mpumalanga, Limpopo and North-West: Rustenburg regions. These incidents occurred because of mobile machinery, conveyor belts, electrical cables, substations, cutting and welding and **spontaneous combustion**. The majority of the **fire** incidents were reported as unclassified **fires**.

1.7 **MHSA** regulations pertinent to the prevention of underground **fires** include:

1.7.1 Regulation 5.1(1)(b) requires an employer to ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the **mine's**

risk assessment, on the adequacy of measures in place to prevent, detect and combat the start and spread of **mine-fires**.

1.7.2 Regulation 8.9(3) requires an employer to take reasonably practicable measures to prevent persons from being exposed to flames, fumes or smoke arising from a conveyor belt installation catching **fire**, including instituting measures to prevent, detect and combat such **fires**.

1.7.3 Regulation 9.1(2) requires an employer, where the risk assessment indicates a significant risk of a **fire** and/or explosion and/or toxic release, that could lead to an irrespirable atmosphere or an atmosphere immediately dangerous to life or health, to provide an early warning system or systems at all working places.

1.7.4 Regulation 16.1(1) requires an employer to ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the **mine's** risk assessment, on the adequacy of escape and rescue procedures at the **mine** relating to explosions, **fires** and flooding.

1.8 The main aim of this guideline is to provide employers with a framework to assist in the preparation of a **COP** on the **fire** prevention measures at a **mine** to reduce significant risks associated with **fires** and the protection measures to reduce damage.

2. SCOPE

2.1 The scope of this guideline relates to measures or procedures that should be established to prevent the occurrence of **fires** at a **mine**, which is the preferred way of managing the risks associated with **fires** in underground and surface operations at a **mine**.

2.2 This guideline does not replace existing guidelines dealing with related topics, e.g. the Guidelines on the Prevention of Flammable Gas and Coal Dust Explosions in Collieries and the Prevention of Flammable Gas Explosions in Mines Other Than Coal Mines.

2.3 The **COP** to be drawn up by the employer in compliance with this guideline should take all other **COPs** drawn up by the employer into account.

2.4 All the **COPs** and other related **mine** standards should be reviewed concurrently in order to avoid any conflict of requirements as laid down by the **mine**. The objective would be to have an integrated system.

3. LEGAL STATUS OF GUIDELINES AND COPS

3.1 The main aim of this guideline is to provide employers with a framework to assist in the preparation of a **COP** on the **fire** prevention measures at a **mine** to reduce significant risks associated with **fires** and protection measures to reduce damage.

3.2 In accordance with Section 9(2) of the **MHSA**, an employer must prepare and implement a **COP** on any matter affecting the health or safety of employees and other

persons who may be directly affected by activities at a **mine** when the **CIOM** requires it.

3.3 The **COP** must comply with any relevant guidelines issued by the **CIOM** in accordance with Section 9(3) of the **MHSA**.

3.4 Failure by the employer to prepare or implement a **COP** in compliance with this guideline is a breach of the **MHSA**.

4. OBJECTIVE OF THE GUIDELINE

4.1 The main objective of this guideline is to enable the employer at every **mine** where a **fire** could pose a significant risk to the health or safety of persons, to prepare a **COP** which, if properly implemented and complied with, would improve control measures aimed at preventing **fire** incidents.

4.2 The guideline provides guidance of a general nature on the required format and content for the **COP** and details sufficient technical background to enable the drafting committee at the **mine** to prepare a comprehensive and practical **COP** for the **mine**.

5. DEFINITIONS AND ACRONYMS

5.1 **Abandoned area** means an area defined in the latest:

5.1.1 Guideline for the Compilation of a Mandatory Code of Practice for the Prevention of Flammable Gas and Coal Dust Explosions in Collieries.

5.1.2 Guideline for the Compilation of a Mandatory Code of Practice for the Prevention of Flammable Gas Explosions in Mines Other Than Coal Mines.

5.2 **Confined space** means a space defined in the latest Guideline for the Compilation of a Mandatory Code of Practice for the Management of Working in **Confined Spaces** at Mines.

5.3 **COP(s)** means Code(s) of Practice.

5.4 **Controls** means the actions or interventions whose integrity will ensure that the hazard will not cause harm and should be recognised as such in the **controls** register.

5.5 **Critical control** means a control that is essential in preventing a **fire** which, if absent or fails, will result in a significant increase in the risk despite the existence of the other **controls**.

5.6 **DMPR** means the Department of Mineral Petroleum and Resources.

5.7 **Fire** means a rapid oxidation process in which a chemical reaction results in the evolution of light, gases and heat energy varying in intensity.

5.8 **Fire alarm system** means a system or portion of a combination system that consists of components and circuits arranged to monitor and announce the status of a **fire** condition or of supervisory signal-initiating devices to initiate the appropriate response to those signals.

5.9 **Fire detection system** means the combination of **fire** alarm systems and **fire** detectors which are designed to detect the presence of a **fire** and initiate action.

5.10 **Fire hazard** means a condition that presents the potential for harm to people and damage to property, or the environment, because of a **fire**.

5.11 **Fire prevention measures** means actions deemed necessary and suitable to inhibit the initiation of a **fire** or stop the evolution of a developing **fire**.

5.12 **Fire protection** means actions deemed necessary and suitable to safeguard the life and health of individuals and/or the integrity of equipment, machinery and infrastructure that may be exposed to a **fire**.

5.13 **Fire risk** means a measure of the probability and severity of adverse effects on persons, equipment, machinery, infrastructure and the environment that may result from a **fire** on a **mine**.

5.14 **Fire suppression system** means a system designed to extinguish, control and prevent **fire** from spreading by the localised application of extinguishing agents.

5.15 **Fire zoning** means a system that is used to prevent or limit the spread of a **fire** to or from one part of the **mine** to another as informed by the **fire hazard** register.

5.16 **Flame retardant** means a substance or material that inhibit or delay the spread of a **fire** by suppressing the chemical reactions in the flame or by the formation of a protective layer on the surface of a material.

5.17 **Hot work** means work involving burning, heating, welding, grinding or a similar operation that is capable of initiating **fires** or explosions.

5.18 **MHSA** means the **Mine** Health and Safety Act, 1996 (Act No 29 of 1996) as amended.

5.19 **Mine** as defined in the **MHSA**.

5.20 **OEM(s)** means original equipment manufacturer(s).

5.21 **SABS** means the South African Bureau of Standards.

5.22 **SANS** means the South African National Standard.

5.23 **SDS(s)** means [material] safety data sheet(s) [solids, liquids and gases].

5.24 **Smoke detector** means an automatic device designed to detect the presence of smoke and initiate action.

5.25 **Spontaneous combustion** means an oxidation reaction occurring without an external heat source that results in an increase of temperature leading to the propagation of an open flame.

6. MEMBERS OF THE TASK TEAM

6.1 The members of the task team that reviewed the guideline were:

CHAIRPERSON
N. Mokhonoana

STATE	EMPLOYER	ORGANISED LABOUR
B. Mongoma	J Maass	H. Van Vuuren
S. Kekana	Q. Saunders	H. Strydom
G. Mthombeni	J. Herbst	J. Mostert
N. Khaba	B. Yates	B. Prinsloo
P. Uthini	C. Malebanye	L. Morake
A. Nkosi		

PART B: AUTHOR'S GUIDE

1. The **COP** must, where possible, follow the sequence laid out in Part C: Format and Content of the Mandatory **COP**.

2. The pages as well as the chapters and sections must be numbered, where possible, to facilitate cross-referencing.

3. The wording used must be unambiguous and concise.

4. Unless otherwise indicated, for the purpose of crafting a **COP**, the meanings of the words mentioned in this guideline will also have the same meanings as those assigned to them in this document.

5. It must be stated in the **COP** whether:

5.1 The annexure forms part of the guideline and must be complied with or incorporated in the **COP**, or whether aspects thereof must be complied with or incorporated in the **COP**.

5.2 The annexure is merely attached as information for consideration in the preparation of the **COP** (i.e. compliance is discretionary).

6. When annexures are used, the numbering should be preceded by the letter allocated to that annexure, and the numbering should start at one again (e.g. A1, A2, A3, etc.).

7. Whenever possible, illustrations, tables, graphs and the like, should be used to avoid long descriptions and/or explanations.

8. When in-text referencing that relates to sources such as publications, and reports, have be done, these sources must be included in the text, as footnotes or side notes, as well as in a separate bibliography section.

PART C: FORMAT AND CONTENT OF THE MANDATORY COP

1. TITLE PAGE

1.1 The **COP** should have a title page reflecting at least the following:

1.1.1 The name of the **mine**.

1.1.2 The **mine** code number.

1.1.3 The heading: *Mandatory Code of Practice on the Prevention of Fires at Mines*.

1.1.4 A statement to the effect that the **COP** was drawn up in accordance with the guideline with reference number **DMPR** 16/3/2/4-B9 issued by the **CIOM**.

1.1.5 The **mine** reference number for the **COP**.

1.1.6 The effective date of the **COP**.

1.1.7 The revision dates of the **COP** (if applicable).

2. TABLE OF CONTENTS

2.1 The **COP** must have a comprehensive table of contents.

3. STATUS OF THE COP

3.1 Under this heading the **COP** must contain statements to the effect that:

3.2 The **COP** was drawn up in accordance with the guideline with reference number **DMPR** 16/3/2/4-B9 issued by the **CIOM**.

3.3 This is a mandatory **COP** in terms of sections 9(2) and (3) of the **MHSA**.

3.4 The **COP** supersedes all previous relevant **COPs**.

3.5 All managerial instructions or recommended procedures (voluntary **COPs**) and standards on the relevant topics must comply with the **COP** and must be reviewed to assure compliance.

3.6 The **COP** may be used in investigations or inquiries in terms of the **MHSA** to ascertain compliance and to establish whether the **COP** is effective and fit for purpose.

4. MEMBERS OF THE DRAFTING COMMITTEE

4.1 In terms of section 9(4) of the **MHSA** the employer must consult with the health and safety committee on the preparation, implementation or revision of any **COP**.

4.2 It is recommended that the employer should, after consultation with the employees in terms of the **MHSA**, appoint a committee responsible for the drafting of the **COP**.

4.3 The members of the drafting committee assisting the employer in drafting the **COP** should be listed giving their full names, designations, affiliations and experience.

4.4 This committee should include competent persons sufficient in number to effectively draft the **COP**.

5. GENERAL INFORMATION

5.1 General relevant information relating to the **mine** must be stated in this section of the **COP**.

5.2 The following minimum information must be provided:

5.2.1 A brief description of the **mine** and its location.

5.2.2 The commodities produced.

5.2.3 The mining methods or mineral excavation processes.

5.2.4 A description of the systems in use on the **mine** relating to **fire** prevention measures.

5.2.5 The unique features or special conditions of the **mine** that have a bearing on this **COP**.

5.2.6 Other relevant and applicable **COPs**.

6. TERMS AND DEFINITIONS

6.1 Any word, phrase or term with a meaning that is not clear, or which will have a specific meaning assigned to it in the **COP**, must be clearly defined.

6.2 Existing and/or known definitions should be used as far as possible.

6.3 The drafting or reviewing committee should avoid jargon and abbreviations that are not in common use or that have not been defined.

6.4 The definitions section should also include acronyms and technical terms used.

7. RISK MANAGEMENT

7.1 Section 11 of the **MHSA** requires the employer to identify hazards, assess the health and safety risks to which employees may be exposed while they are at work, record the significant hazards identified and risk assessed.

7.2 The employer must determine how the significant risks identified in the risk assessment process must be dealt with, having regard to the requirement of section 11(2) and (3)

that, as far as reasonably practicable, attempts should first be made to eliminate the risk, thereafter to control the risk at source, thereafter to minimise the risk and thereafter, insofar as the risk remains, to provide personal protective equipment and to institute a programme to monitor the risk.

7.3 The risk assessment must follow the **mine** risk management procedure:

7.3.1 With due consideration given to the composition of the required competent team.

7.3.2 Consultation with and collaboration between the relevant mining technical disciplines and subject matter experts on the **fire** risk assessment aspects during the design, planning, implementation and operational phase(s).

7.4 To assist the employer with the risk assessment, all possible relevant information should be obtained and considered for the prevention of **fires** at mines such as:

7.4.1 **Fire** incidents, research reports, manufacturers' specifications, approvals, design criteria and performance figures for all relevant equipment.

7.4.2 Investigation and enquiry outcomes, statutory instructions and previous **MHSA** regulation 5.1 reports.

7.5 In addition to the periodic review required by section 11(4) of the **MHSA**, the **COP** should be reviewed and updated if relevant after every serious incident relating to a topic covered in the **COP** or if significant changes are introduced, to procedures, processes, process layout, process methods, ventilation layouts, plant or equipment and material.

7.6 In terms of this **COP**, any interventions arising from the risk assessment must be implemented following a structured management of change procedure.

8. ASPECTS TO BE ADDRESSED IN THE COP

8.1 In order to manage the risks associated with **fires** at a **mine**, the **COP** should set out a structured fire risk management programme covering at least the steps and measures envisaged in this guideline. Figure 1 below shows diagrammatically the fire risk management programme covered in this guideline.

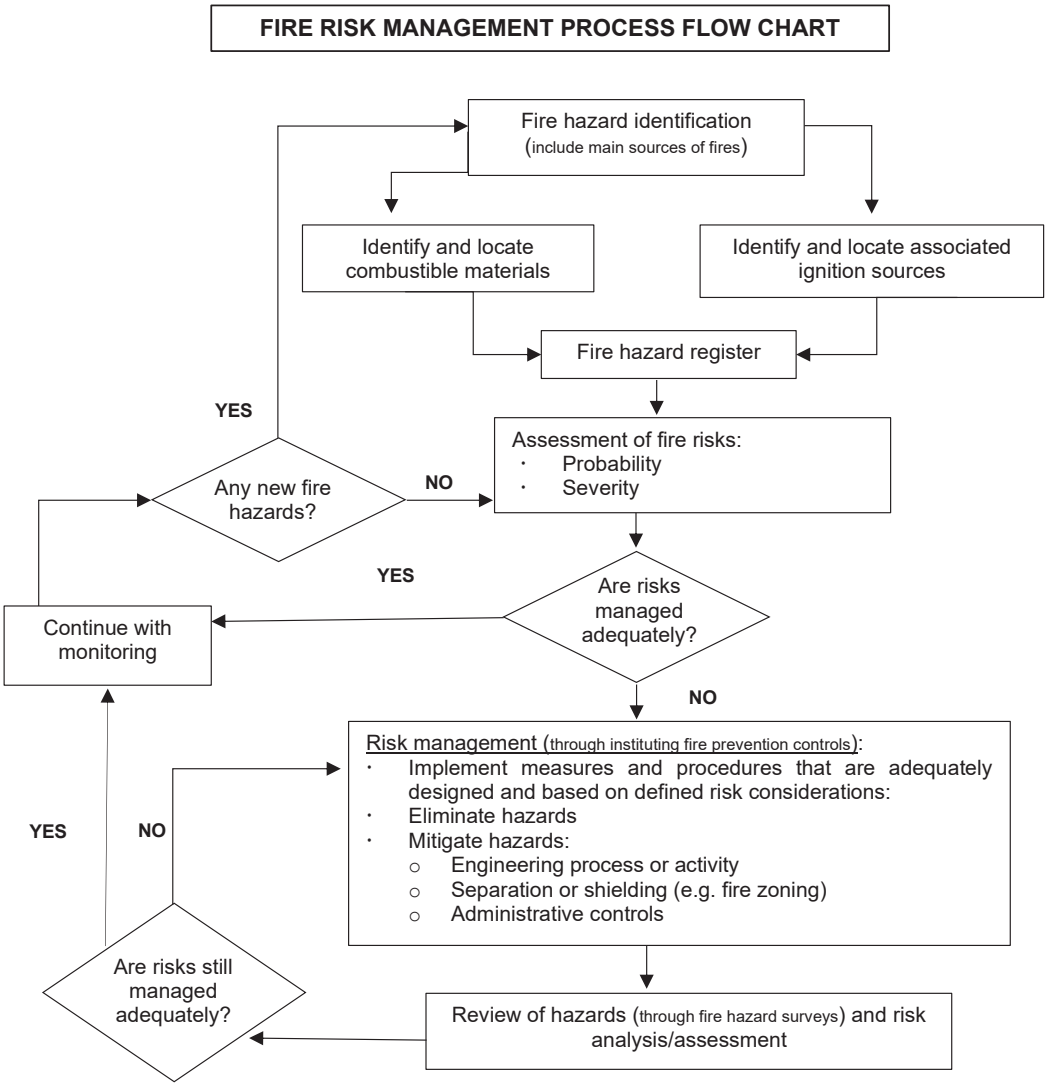

Figure 1: Diagrammatic representation of fire risk management

8.2 Fire risk management

8.2.1 The **COP** shall set out, as the first element of a fire risk management programme, the requirement to identify **fire hazards** and then **fire** risks. The **COP** shall require these to be continuous activities covering the following:

8.2.2 **Fire hazard** identification process

8.2.2.1 The **COP** shall set out the **fire hazard** identification process that requires a physical inspection of all current surface and underground working places and abandoned infrastructure and workings, travelling ways, hoisting and conveying infrastructures and of equipment and machinery used at a **mine** to identify and

list all recognisable fuel and ignition sources. In addition, the identification process shall include a review of processes employed at the **mine** to assess the probability of a **fire** being caused as the result of operational malfunctions or of process design failures.

8.2.2.2 In the hazard identification process, particular attention should be paid regarding the applicable main sources of **fires**, considering the following as identified through various industry fire incidents:

a) Trackless mobile machinery.

b) Conveyor belts.

c) Electrical equipment.

d) Cutting and welding processes.

e) **Spontaneous combustion** of coal.

f) Unclassified.

g) Timber.

h) Poor housekeeping and waste management.

i) Surface vegetation or veld **fires**.

j) **Abandoned areas** (**fires** due to un-reclaimed flammable material and illegal activities).

8.2.2.3 The identified hazards shall be classified as either a fuel source or an ignition source (under certain circumstances, timber, coal and other organic materials may be both) or both. The location of all possible ignition sources, at fixed sites should be established. Records of mobile or semi-mobile equipment operating at a **mine** should be kept.

NOTE 1:
Fires will occur if these two sources are present simultaneously in time and space. Preventative measures may be put in place to prevent such interactions to take place and, under certain conditions, suitable physical barriers may be introduced to prevent the two sources from interacting. These are classified as protective measures against **fires**. Other actions and procedures, such as emergency evacuation procedures and the use of refuge bays, for example, are seen as measures needed to mitigate the impact following from the ignition of combustible material to protect workers. This **COP** shall concentrate predominantly on preventative measures and on some protective measures aimed particularly at separating effectively the two sources.

NOTE 2:
Refer to Annexure A about generic notes on **fires** which provides more information on the stages of fire, covering the nature and development thereof.

8.2.2.4 Classification of sources

8.2.2.4.1 **Fire hazards**: fuel sources

a) The **COP** should classify the identified fuel sources in terms of the **fire** classes defined by the combustion process associated with it:

i. Class A - Materials (ordinary combustibles):

These are solid materials, usually of an organic nature, in which combustion normally results in the formation of glowing embers. These include combustibles such as wood, paper, fabric, plastics and most kinds of solid waste materials.

ii. Class B - Materials (flammable liquids and gases)

These are non-solid fuels consisting of flammable or combustible liquids or gases such as petrol or propane gas.

iii. Class C - Energized electrical equipment

Electrical **fires** involve potentially energised electrical equipment. This sort of **fire** may be caused by short-circuiting or overloaded electrical networks.

iv. Class D - Combustible metals

Combustible metals mostly encountered are magnesium, potassium, titanium and zirconium. Except for the metals that burn in contact with air or water (for example potassium and sodium), combustible metals on their own do does not represent unusual **fire** risks because it can conduct heat away from hot spots efficiently. However, when combustion is induced, the **fire** is self-sustaining: rapid combustion (oxidation) of magnesium induced by an external source may result in a fiercely exothermic process.

v. Class F - Cooking oils and fats (kitchen **fires**)

These include unsaturated cooking oils in well-insulated cooking appliances located in commercial kitchens. Though such **fires** are technically a sub-class of the flammable liquid or gas category, the special characteristics of these types of **fires**, namely the lower flash point, are considered important enough to re-classify these separately. Water mist can be used to extinguish such **fires**.

8.2.2.4.2 **Fire hazards**: Ignition sources

a) The **COP** should identify potential sources of ignition at a **mine** including, but not limited to, the following energy sources:

i. Heat energy: The presence of heat energy is often characterised by high temperature surfaces (e.g. exhaust systems of internal combustion engines, pumps, turbochargers, electric motors, gearboxes, heat exchangers, bearings, rubbing surfaces such as brakes, cigarette butts, naked flames from the use of welding equipment and matches or cigarette lighters).

ii. Electrical energy: Switch gear, motors, retarders, transformers, lights, cables; short-circuit arcs, earth-faults, static electricity discharge, induction heating, thyristor drives, batteries and battery charges.

iii. Mechanical energy: Friction (e.g. conveyor belt drives, winch ropes), mechanical impact (e.g. coal-cutting picks) and grinding.

iv. Chemical energy: Self-heating, auto-ignition, exothermic reactions, **spontaneous combustion** of coal and induced pyrolysis of vehicle tyres (lightning).

8.2.2.5 **Fire hazard** location

a) The **COP** should identify and list all locations for all possible ignition and/or fuel sources. The location of a **fire hazard** could have a significant impact on the level of risk:

i. **Fires** located in a main intake airway (e.g. main decline) are likely to pose a higher risk than if located in a return airway.

ii. **Fires** located close to the main working areas are likely to provide less time for affected personnel to respond timely and adequately (i.e. there will be limited time for employees to evacuate to a place of safety such as fresh air bases and refuge bays).

iii. **Fires** on surface close to fresh air or compressed air intakes to underground workings or offices on surface can pose a significant risk.

iv. **Fires** located close to or within hazardous material and combustible liquids storage enclosures have the potential to pose a risk to other neighbouring areas.

8.2.2.6 **Fire hazard** register

a) The outcomes of the **fire hazard** identification process should be recorded in a dedicated **fire hazard** register that identifies the hazard together with its classification (fuel source, ignition source or both) and location of the hazard at the **mine**.

b) The latter should distinguish whether the **fire hazard** is fixed or mobile, as might be the case for vehicles.

c) The location of fixed hazards should be deemed to be particularly hazardous where these are located in or in close proximity to intake airways, at sites containing other **fire hazards** (e.g. transformer stations adjacent to fuel storage areas) or sites that might be adversely affected directly or indirectly by a fire (e.g. major oil-filled transformers adjacent to sub-vertical shafts, sub-declines or other fresh air intakes).

d) The latter is of particular importance where mobile equipment is operated.

8.2.3 Assessment of **fire** risks

8.2.3.1 The **COP** should ensure that all identified **fire hazards** as listed in the **fire hazard** register are analysed to assess its contribution to the overall fire risk. In the assessment of **fire** risks, the following should be included:

a) The identified fuel and potential ignition sources, and other factors that can have an impact on the type and magnitude of the risk.

b) The evaluation of the **fire** risk based on the assessed consequence and likelihood of a particular **fire** event.

c) The input from a number of specialist areas, including occupational hygiene or **mine** ventilation, and emergency response as part of the risk mitigation process.

8.2.3.2 Where appropriate, similar **fire hazards** or classes of **fire hazards** may be analysed in logical groupings as might be determined by the **mine's** infrastructure, process or design.

8.2.3.3 **Fire risk** assessment tools

a) The **COP** should outline measures to ensure that the selected risk assessment tools should be applicable for the intended function and should provide effective indication of:

i. The actual risk as understood at the time of the assessment.

ii. Any intervention deemed to be feasibly effective in reducing such risk (preventative measures).

iii. The effect of any corrective interventions (preventative measures) being considered.

iv. The impact of any residual risk after the application of the preventative measures.

v. Any (further) protective measures that might be considered to manage any residual risk (e.g. including **fire** detection and **fire**-fighting measures).

vi. Monitoring criteria that will determine the effectiveness of anticipated or implemented risk reduction **controls**.

b) The assessment of the **fire** risks should take into consideration impacts and consequences of any **fire** incident on the health and safety of workers, on neighbouring communities, on the environment and on the future viability of operations (e.g. material and reputational damage).

c) Any mitigating preventative and/or protective measures proposed for identified **fire** risks, should be recorded formally to an adequate level of detail, should be approved by management and be assigned to competent persons for completion within a specified period of time consistent with the level of the identified risk rating assigned to the corresponding **fire hazard**.

8.2.3.4 Risk analysis

8.2.3.4.1 The **COP** should ensure that the risk analysis section includes information on the type and nature of **fire hazards** and any contributing operational and environmental factors for consideration in the structuring of adequate preventative and protective measures. Risk analyses should focus on the following but should not be limited to:

a) Potential for **fires**

i. The **COP** should ensure that the potential for **fires** at a **mine** is determined using the **fire hazard** identification process described in Section 8.1.1 above. Where specialised processes are undertaken, the assistance of recognised experts in the field of **fire** engineering should be sought.

b) Characterising potential **fires**

i. Once the fuel and ignition sources have been identified, the **fire** risk should be characterised for each using information such as:

- The quantity of fuel available for combustion.

- “Fuel loading” or the relative mass of the fuel (or potential calorific energy) per unit volume of the occupied space (high, moderate or low fuel loading).

- The chemical composition and intensity of smoke and fumes or gases likely to be generated by a **fire** (this information should be used for the selection of a suitable emergency evacuation procedure).

- The location of fuel and combustible material storage areas relative to other areas.
- The route that will be followed by any smoke generated by a **fire** (to define possible escape routes).
- The presence of further fuel sources that might participate in an extended **fire** scenario.

c) Ventilation

i. Ventilation systems, natural or induced, serving underground working places or buildings, will be affected by **fires** and may contribute to the spread of smoke, gases and hot air. Factors that should be considered when deciding how to manage ventilation systems during a **fire** include: the prevailing air flow, oxygen feed to the **fire**, the rate of contamination downstream and **fire** spread beyond the source particularly in situations where employees may still be trapped by the **fire**.

ii. The impact of ventilation system operation on the behaviour of **fires** is likely to differ for each location and for each application. It is essential that persons competent in the design and operation of ventilation systems (e.g. **mine** ventilation engineer or ventilation officer) be involved in the assessment of **fire** risks at mines.

8.2.3.5 Risk assessment output

8.2.3.5.1 The **COP** should ensure that the **fire** risk assessments shall yield the following information that shall not be limited to:

a) Locations throughout the **mine** where fuel and ignition sources exist.

b) Types and extent of **fire** events considered.

c) Consequence and likelihood of each **fire** event.

d) The resulting **fire** risk (e.g. based on a consequence and likelihood risk matrix).

e) **Controls** and associated monitoring criteria currently in use to minimise the risk.

f) Any additional actions to further reduce risk by either improving existing **controls** or by providing additional **controls** or actions (included in authorised work programmes assigned to a competent person for completion).

g) Any additional actions aimed at mitigating or reducing the impact of the outcome.

NOTE:
The composition and quantity of smoke and fumes generated in a **fire** are likely to have a significant impact on the consequence of the **fire** and hence the level of the risk. The impact of heat generated by an incipient **fire** should also be considered as a small **fire** in a "critical" location may provide sufficient heat to initiate a much larger conflagration.

8.2.3.6 **Fire hazard** surveys

8.2.3.6.1 Routine **fire hazard** identification

a) The **COP** should set out measures ensuring that in the event of any changes in the equipment operated, systems or processes employed at the **mine**, additional surveys should be performed to supplement the available **fire** risk assessment.

b) The outcomes of the surveys recorded shall be used to update the **fire hazard** register and identify actions required. The register will provide comprehensive information for consideration and identification of possible **COP** reviews. In the absence of these changes, **fire** risk assessment should be reviewed at intervals in line with the review of the **COP.**

c) These reviews could include but are not limited to items identified during:

i. Employee **fire hazard** identification and reporting procedures.

ii. Workplace inspections and observations.

iii. Equipment and plant inspections.

d) The **COP** should include a record of any instances where operational standards and procedures have been amended following such reviews.

NOTE:
Refer to Annexure B about examples of **fire** hazards at mines.

8.3 **Fire zoning plan**

8.3.1 The **COP** should address:

8.3.1.1 The identification of a **fire zone** for the purpose of preventing the spread of **fire** to or from another part of the **mine** informed by the **fire hazard** register.

8.3.1.2 The **fire** zone should be the smallest possible and practical area that can be effectively separated from one ventilation district to the other considering the following:

a) Existing ventilation districts (ventilated independently from other areas with common dedicated intake and return airways) at least one **fire zone** and cannot be over multiple vent districts.

b) Natural barriers like faults and dykes.

c) Artificial barriers, solid backfill paddocks, strategic quick seals and **fire** doors.

8.4 **Fire prevention controls**

8.4.1 In this section of the **COP**, the application of adequate **controls** for fire prevention at mines is described by considering the systems, processes and equipment employed at the **mine**. These can take the form of a process or equipment re-design, implementation of different material selection criteria or of adequate operational standards.

8.4.2 Any mitigating preventative and/or protective measures proposed for identified **fire** risks should be recorded formally to an adequate level of detail, should be approved by management and be assigned to competent persons for completion within a specified period of time consistent with the level of the identified risk rating assigned to the corresponding **fire hazard**.

a) **Controls** shall be assigned to each **fire hazard** and corresponding risks identified and defined in the **fire** risk management section. The number and degree of the coverage of **controls** shall be commensurate with the level of anticipated risk.

b) All **fire** prevention **controls** should be listed in the **COP** and must be aligned with the findings of the various **fire** risk assessments. **Critical controls** should be prioritised. To this end, the **COP** should include a register listing all **fire** prevention **controls** (in place or planned) including risk-based monitoring criteria together with the reference risk assessment document to which it is linked.

c) Monitoring criteria for the effectiveness of **critical controls** should be employed. Regular monitoring and recording of the performance of defined **critical controls** should take place.

8.4.3 Design, construction and operation

8.4.3.1 In order to prevent **fires**, the following should be considered in the design, construction and operation of any process or system employed at any **mine**:

a) The design, construction and operation to regulated standards of all equipment, machinery and systems must conform to regulated standards and design codes in compliance with the **MHSA**. In addition, the design, construction and installation of any equipment and machinery in use at **mines** must comply with national standards, applicable design codes.

b) Any persons who design, manufactures, repairs, imports or supplies any article for use at the **mine** must ensure that as far as reasonably practicable the article is safe and without a **fire** risk when used properly.

c) Where a fire could pose a significant risk to the health and safety of a person, the employer must take reasonable measures to ensure that flammable liquids, gases and materials in use, are transported, stored, deposited, used and disposed of in such a way to prevent the starting or spreading of a **fire**.

d) The installation of infrastructures that could pose a **fire** risk should only be undertaken following a formal assessment and consideration of the **controls** necessary to minimise risk.

e) Wherever possible, infrastructures that pose significant **fire** risk should be located near or preferably in the return airways, or near to facilitate exhausting of smoke and gases directly to return in the event of a fire and/or be equipped with suitably designed **fire** doors that would shut-off in the event of a **fire** thereby limiting or reducing smoke contamination of fresh air streams.

NOTE:
Refer to Annexure C about the general design requirements for mobile equipment and Annexure D about the general design requirements for fuel storage areas, fuel transfer equipment and refuelling bays which provide principles against which design, construction and operational parameters may be assessed in relation to **fire hazards** for inclusion in the **COP**.

8.4.4 **Mine** infrastructure and fixed plants

8.4.4.1 The **COP** should identify and implement minimum standards or requirements to prevent **fires** on the following **mine** infrastructure and fixed plants, but is not limited to:

a) Fuel storage and transfer sites, and associated equipment.

b) Refuelling bays.

c) Main electrical substations and switchgear installations.

d) Underground hoisting stations.

e) Workshops.

f) Densely timbered areas in intake airways.

g) Diesel fuel lines in main shafts and declines – where these lines are used for transport purposes.

h) Air, gas or refrigerant compressors.

i) Major electrical installations.

j) Crushers (surface and underground).

k) Mineral processing plants inclusive of smelting and refinement processes.

l) Conveyor belt installations (underground and surface).

m) Hoist rooms and winding plant installations (surface and underground).

n) Pump stations.

o) Raise borers.

p) Shaft sinking equipment.

q) Material handling equipment.

r) **Fire** hazardous material and combustible liquid storage areas.

s) Any **fire** hazardous areas as classifiable by **SANS** 10108 (**fire** hazardous area classification).

t) High density surface storage area e.g. **fire** hazardous material and combustible liquid storage areas, timber yards, fuel storage tanks, liquid oxygen tanks, ammonia refrigeration plants, etc.

u) Waste disposal containers.

v) Underground vehicle battery recharging and/ or storage facilities

8.4.4.2 All fixed electrical and related equipment such as electrical sub-stations, switch-rooms and main distribution boards should be in accordance with applicable **SANS** standards (such as, but not limited to, **SANS** 60076 (power transformers), **SANS** 1029 (mini substations), **SANS** 62135 (resistance welding equipment) and **SANS** 10280 (overhead powerlines for conditions prevailing in South Africa) and:

a) Be designed, constructed and installed in accordance with the manufacturer's standard.

b) Be equipped with at least over-current, earth leakage and short circuit protection.

c) Be designed and constructed so that any oil leaking from transformers and switchgear installations is contained.

d) Consider the use of "dry", "inert gas" or emulsified (low flammability) coolant options for transformer and switchgear equipment.

8.4.4.3 **Fire prevention measures** and protection equipment considered for installations defined under this guideline (refer to 8.3.2.1) shall include details of any **fire** detection system installed in accordance with the respective **fire** risk assessment.

8.4.4.4 Where flammable liquid is stored, pumped or transferred fixed electrical equipment should:

a) Be designed, installed and operated in accordance with the **SANS** 10108 requirements.

b) Be provided with automatic **fire** suppression systems.

c) Be located so that the air current that flows over it passes direct to return.

d) Have aggregate bund walls capable of containing the total oil volume with a plus 10% excess to capture any oil spillage.

8.4.4.5 **NB**: This specialised equipment should be designed, installed and maintained in consultation with competent **fire** engineering experts.

8.4.4.6 Refer to Annexure E about **mine** infrastructure and fixed plant which provides examples of preventative **controls** that should be considered underground and on surface for fixed plant components as classified in **SANS** 10108 (**fire** hazardous area classification).

8.4.4.7 The **location** of fixed plant equipment in underground and **confined spaces** should consider the normal flow of fresh air to guide the type, size and location of any **fire** detection and **fire**-fighting equipment.

8.4.5 Workshops

8.4.5.1 The **COP** should outline the design and operation of workshops both on surface and underground. In preventing and managing **fires**, the following aspects should be included in the workshop standard and the operating procedures:

a) The quantity of combustible liquids (oils, lubricants, fuel, etc.) stored in underground workshops or any underground site shall be limited to three days as estimated to consumption.

b) Quantity of combustible liquids stored on surface shall be limited to the storage capacity under adequately designed **fire** protected infrastructure as informed by the outcome of the **mine** risk assessment.

c) Any combustible liquids should be stored in segregated locations from one another and any combustible material.

d) Appropriate signs as per **SANS** 1186-1: Symbolic safety signs (Part 1 standard signs and general requirement) and notifications should be installed at all entrances to workshops indicating:

i. No smoking or naked lights near flammables.

ii. **Hot work** in designated areas only.

iii. Housekeeping requirements.

iv. Emergency procedure in case of a **fire**.

e) The maximum mass of combustible materials stored or in use in a workshop in different subdivisions shall not exceed three days consumption (e.g. fuel, lubricants, grease, rubber filled tyres, paints, welding gas cylinders, etc.). This information should be used to determine the appropriate type and quantity of **fire**-fighting equipment as well as the location of any fire detection sensors.

f) The design of the ventilation system serving workshops must follow a risk-based approach that caters for:

i. The position of machinery, equipment, temporarily stored material (consumables), vehicles being serviced at any one time (e.g. diesel emissions, hydrogen liberated during battery charging, etc.) and the workshop volume taken-up by these under normal and exceptional circumstances. These will all affect air-flow patterns in the workshop, response of any smoke sensing equipment and effectiveness of any fixed **fire** suppression equipment;

ii. The positioning of the workshop in relation to intake and return airways. This is important to determine the strategy to be adopted in the event of a **fire** and the type of **fire** detection and **fire**-fighting tactic.

iii. Contingency arrangements that may be required in the event of power failures.

g) Where part of a workshop is earmarked for **hot work** (welding, grinding, cutting or heating, or burning using oxyacetylene or electric welding) separate locations (cutting bays, welding bays or grinding bays) should be provided and supplied with adequate flow of fresh air to dilute any smoke or fumes generated by such work. Standard operating procedures should reflect a blanket permission to allow **hot work** whenever this is performed in these locations.

h) **Hot work** permit systems must be implemented for **hot work** in any other area of the **mine**.

i) Chemicals in stores that are a **fire hazard** should be appropriately separated from workshops working areas.

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j) Sealed waste oil disposal systems and suitable containers for the disposal of other flammable waste should be used to minimise spillage.

k) Space heaters should not be used in workshops unless it has a surface temperature of less than 300°C and are kept clear of rags, paper and other flammable material.

l) Welding gases such as acetylene and oxygen should be stored and used in accordance with the **OEM** requirements.

m) Workshops should be provided with adequate spillage containment facilities (e.g. water hose, absorbent material, etc.) to contain or clean-up any fuel spills quickly and effectively.

n) Any waste (e.g. soiled absorbent material) should be placed immediately in clearly marked receptacles and be kept well away from any potential ignition source and these receptacles should be emptied at least weekly.

o) **Fire** extinguishers and **fire**-fighting equipment should be installed as required.

p) Suitable barriers or designated parking areas should be installed to provide for adequate separation of mobile equipment from flammable materials.

q) The following **SANS** standards shall be considered during workshop design:

i. **SANS** 10400 (national building regulations).

ii. **SANS** 10263 (the warehousing of dangerous goods).

iii. **SANS** 10232 (the transport of dangerous goods).

8.4.6 Lamproom, control room and offices

8.4.6.1 The following measures shall be included in preventing the risk of **fires** in the lamp room, control room and offices:

8.4.6.1.1 A flammable gas cylinder in the lamp room shall be stored in a well-ventilated area with appropriate signage (e.g. prohibiting smoking and the use of naked flames).

8.4.6.1.2 The application of **SANS** 10400 of the application of the national building regulations, part T on **fire** protection as amended. This includes, but is not limited to:

a) **Fire** detection monitoring and warning systems.

b) Appropriate and adequate **fire**-fighting equipment.

c) Have emergency exit points to prevent a person from being trapped in case of a **fire** emergency.

8.4.7 Mobile equipment

8.4.7.1 The **COP** shall address preventative measures related to the risk posed by the operation of self-propelled mobile equipment at a **mine** or in a **confined space** (e.g. a surface coal bunker) as determined by a number of factors such as:

a) The mass of flammable material on the vehicle. This may include, but is not limited to:

i. Fuel.

ii. Hydraulic oil.

iii. Tyres.

iv. The nature of the payload (more fuel, oil, timber, etc.)

b) The routing (mobility) of the vehicles particularly in main intake airways as a vehicle **fire** is likely to contaminate the air downstream of the event.

c) Propensity of a vehicle **fire** to involve other parts of the **mine** (e.g. coal seam in coal mines, plastic piping in roadways, timber support in drives, etc.).

d) The location of refuelling bays or places where (temporary) maintenance is done.

e) The air quantity flowing past a potential fire site and sites through which is coursed downstream.

8.4.7.2 The general design of vehicles shall conform to minimum **SANS** 868 compression (ignitions engine system and machines powered by such engine system, for use in **mines** with explosive gas) and plants as applicable or the manufacturer's specification. The routing of electrical (power) cables, fuel and hydraulic lines, particularly in engine bays, near brakes and pinch-points should be such that incidental damage and contact with hot surfaces is avoided. Pipes and hoses should be manufactured from high quality; durable materials and the piping layout should consider abrasive action and allow for adequate mobility.

8.4.7.3 The integrity of the original manufacturer's design as accepted by the **mine** and in line with this **COP**, amongst others, should be maintained for the life of the equipment.

NOTE 1:
Refer to Annexure C on general design requirements (mobile equipment) that provides a series of technical solutions and risks posed by the operation of self-propelled mobile equipment.

NOTE 2:
Refer to Annexure F about the safe use, transport and handling of explosives which provides examples of preventative **controls** that should be considered underground and on surface for the transport of explosives (referencing to the explosive procedure in terms of the **MHSA** regulation 4.2(b).

8.4.8 Conveyor belts

8.4.8.1 To prevent **fire hazards** and risks associated with the conveyor belt installation and operation, the following measures must be considered:

a) All conveyor belt installations in **confined spaces**, including underground workings, at both fiery and non-fiery mines, must be made of **fire** retardant textile or a steel reinforced design tested as per **SANS** 971-2013, as amended.

b) The employer must keep a record of procurement, toxicity tests, flame resistance and propagation tests, storage, installation, maintenance and discarding for all conveyor belts. The employer must ensure that all conveyor belts in confined mining spaces, including underground workings are tested for toxicity, flame resistance and propagation to verify that the belts are safe and **fire** retardant. These tests must be conducted in line with the relevant safety standards for assessment of **fire** propagation along the conveyor belt. The health and safety standards must be stipulated by the employer as part of the purchasing process. The results of these tests must be used to devise site specific **fire** protection measures.

c) The employer must ensure that when conveyor belts are procured, the conveyor belts to be procured have been tested by the manufacturer or the supplier and found to be compliant with the **SABS**/**SANS** 971 (as amended) requirements regarding the **fire** propensity of these conveyor belts and that the facility where the testing is being done, is **SABS**/SANAS approved or accredited.

d) A conveyor belt installation should be at a separate ventilation district and be ventilated directly to the return airway. Where this is not practicable, measures must be in place to ensure that fresh air is not contaminated.

e) A monitoring system must be put in place to monitor the conveyor belt whilst in operation. The practical operation of a monitoring system must be based on the risk assessment outcomes.

f) Ensure that the main service columns, electrical supply cables and communication systems are safely positioned in line with the **mine's** risk assessment in the conveyor belt area.

g) Ensure that electrical substations are safely constructed away from the conveyor belt area.

h) Install **controls** which will prevent the onset of a **fire**, because of the belt misalignment or belt slip, such as belt tear detection and bearing temperature monitoring devices.

i) Provide an effective communication system between the underground conveyor belt operator and the surface control room.

j) Provide self-closing travelling way doors at all access points to the conveyor belt where applicable.

8.4.9 **SPONTANEOUS COMBUSTIONS IN COAL MINES**

8.4.9.1 The **COP** shall put measures in place to manage the hazard and risk associated with **spontaneous combustion**.

8.4.9.2 Underground

a) Measures to be put in place to ensure that **controls** are implemented to prevent **spontaneous combustion** in underground operations.

b) Good housekeeping plays a significant role in the prevention of the **spontaneous combustion**. The employer should ensure that they continuously practice good housekeeping in the work area.

c) Areas where **spontaneous combustion** is likely to occur may include, but is not limited to:

i. Stowing areas.

ii. Accumulation of duff along the conveyor belts roads.

iii. Sealed off areas.

iv. **Abandoned areas**.

8.4.9.3 Opencast and/or surface operation

a) On surface, the major problems are usually associated with the stockpiling of coal, tailings or waste dumps containing rejected coal material, in unconsolidated heaps where oxygen (O2) can come into contact with the coal and heat cannot dissipate.

b) Preventing **spontaneous combustion** is a time dependent phenomenon. Early attention to the potential sources of problems may prevent occurrences of heating progressing to full scale **spontaneous combustion**.

c) Controlling **spontaneous combustion** and effective control of **spontaneous combustion** can be achieved by using a combination of

techniques. Control measures to reduce or eliminate oxygen from the process.

8.4.10 Abandoned or stopped areas

8.4.10.1 The **COP** shall put measures in place to manage the hazard and risk associated with abandoned or stopped areas.

a) Prior to an **abandoned area** being sealed off, electrical conductors, earthing and bonding of electrical equipment, and the accumulation of combustible material, shall be removed and any borehole sealed off (rehabilitated). A record of these actions shall be kept until **mine** closure.

b) If accumulation of combustible material prior to the sealing of the **abandoned areas** cannot be removed, the employer must put measures in place, informed by the outcome of the risk assessment.

c) Monitor and ensure that any build-up of flammable gas and presence of carbon monoxide does not contaminate the fresh air.

d) Working conditions for employees working near abandoned or stopped areas are safe.

8.4.11 Timber for support

8.4.11.1 The **COP** shall put measures in place to manage the hazard and risk associated with the use of timber.

a) Timber for use underground must be treated to be **fire** retardant as determined by the **mine** risk assessment.

b) Monitor the effectiveness of the **fire** retardancy of the treated timber supplied.

8.4.12 Surface vegetation or veld **fires**

a) The **COP** shall put measures in place to manage the hazards and risks associated with surface vegetation or veld **fires**.

b) In addressing these **fire hazards** and associated risks the following additional documents should be consulted:

i. National Veld and Forest **Fire** Act, 1998 (Act No 101 of 1998) as amended.

ii. **MHSA** regulation 5.1(3) as amended.

8.5 Managing flammable and combustible substances

8.5.1 The **COP** must indicate measures to address the storage and use of such substances or materials that have a flash point of below 60°C, including compressed gases such as acetylene and propane.

8.5.2 The use and presence of flammable substances at a **mine** is inevitable and therefore the risk posed by these must be managed adequately. The relevant **SDSs** in accordance with **SANS** 10234 (list of global harmonised classification and labelling of chemicals) must be consulted to determine the type of any precautionary measures that require implementation.

8.5.3 General requirements

8.5.3.1 The **COP** shall set out measures to minimise **fire** risk associated with the storage or use of flammable substances at the design or selection stage. The following shall be considered:

a) Wherever possible and reasonable, flame retardant materials shall be used in preference to flammable materials.

b) All combustible materials shall be stored in dedicated, clearly-marked storage areas.

c) The use and location of flammable substance storage areas shall only be undertaken following a formal assessment and consideration of the **controls** necessary to minimise risk.

d) Wherever possible and reasonable, flammable substance storage areas shall be ventilated into the return airways or have suitable **fire** doors installed to limit smoke ingress into working areas and intake airways. Flammable substance storage equipment should be constructed of non-flammable materials.

e) ‘No Smoking’ and ‘No Naked Flame’ signs shall be displayed at all flammable materials storage locations.

f) Flammable materials shall not be stored on or near heat or ignition sources.

g) The routing of electrical cable clusters, particularly high tension lines, shall not be allowed within close proximity from flammable materials. Each application shall be considered on merits dictated by risk considerations, good practice and the use, where necessary, of adequate protective (shielding or separating) measures.

h) Electrical switchboards shall not be placed in flammable material stores.

i) Wherever possible and reasonable, light fittings shall be mounted clear of flammable materials.

j) All electrical equipment shall meet relevant electrical standards for design and installation and shall be used as intended by the manufacturer.

k) Where necessary and as indicated by an assessment of the risk, smoke alarms and earth leakage protection shall be installed on electrical equipment that is left to operate unattended.

l) The quantity of flammable materials stored in any location, shall be kept to a minimum as per the **mine** risk assessment.

m) Flammable material storage equipment shall be located away from high traffic or collision-prone areas or be otherwise protected against vehicle collisions.

n) Wherever possible and reasonable, **hot work** shall not be done in or near flammable materials, in the presence of flammable gases or other such fluids. A permit system for **hot work** (inclusive of adequate preventative and protective measures) shall be in place for any such work outside the workshops.

o) Wherever possible and reasonable, vehicle access to combustible stores shall only be for the purpose of loading and unloading. Vehicles shall not be parked in tyre stores.

8.5.3.2 Combustible substances

a) The **COP** shall address measures for the storage and use of combustible substances or materials at **mines** that generally have a flash point below 60°C. This includes class 3 flammable liquids.

b) Foams and resins may be particularly volatile in its component form (i.e. prior to mixing). Where foams are used, it must comply with **SANS** 1867:2003 (sprayed plastic foams for use in mines).

8.5.3.2.1 Flammable solids

i. The **COP** shall address the following requirements related to the use and storage of flammable solid materials:

i. Where the large-scale use of timber support is necessary, the **COP** shall refer to identify densely timbered areas, particularly in intake airways and storage areas. The choice of any specific mitigating measure such as, for example, impregnating timber with **fire** retardant chemicals or coating of exposed timber with inert (intumescent) material, should be risk-based and specified accordingly in operating procedures.

ii. The **COP** shall outline any special measures for the prevention of **fires** in waste storage facilities. These could include, but not limited to:

- Adequate ventilation measures for some waste storage facilities.
- Displaying 'No Smoking' signs in the waste storage facilities and near refuse containers.
- The regular removal of waste materials from refuse containers and waste storage facilities at adequate intervals to prevent the accumulation or overflow of waste materials.

iii. The use, transport and handling of explosives pose a **fire** risk in mines. This **COP** shall refer to the relevant standard procedures and precautionary measures intended for the safe use, transport and handling of explosives used at a **mine**.

8.5.3.2.2 Flammable liquids

a) The **COP** shall reflect the following requirements related to the use and storage of flammable liquids:

i. All vessels containing flammable liquids shall be provided with clear and easily understood labels and respective **SDSs**.

ii. Only purpose-built containers, designed to prevent spillage, shall be used to transport flammable liquids. Diesel fuel shall only be transported in purpose-designed bowsers or jerry-cans, adequately secured to the vehicle's loading tub.

iii. Where large quantities of flammable fuels are stored e.g. diesel fuel storage tanks, oil cooled transformers, etc. and where it is justified by risk-based considerations, storage vessels shall be enclosed in a containment area (bund wall) where any spillage following the rupture of the containment vessel will be contained. The containment area shall be large enough to accommodate 110% of the maximum flammable liquid volume in storage at any time. In addition, if this area is filled with inert material such as gravel, consideration shall be given to the volume of flammable liquid in the storage vessel. If any drainage system is used it must be fitted with a device that is normally closed.

iv. The vehicles used for the transport of flammable liquids shall be appropriate for the task.

NOTE 1:
Refer to Annexure D about the general design requirements for fuel storage areas, fuel transfer equipment and refuelling bays which includes reference to a number of items relating to fuel storage areas, fuel transfer equipment and refuelling bays for possible consideration in structuring standards supporting the management of **fire** risks associated with these.

NOTE 2:
Refer to Annexure F about the safe use, transport and handling of explosives which provides suggestions that might be included in procedures for the safe transport handling and use of explosives. These are provided for possible reference and inclusion in operating procedures.

8.5.3.2.3 Flammable gases

a) The management of risks associated with the natural occurrence of flammable gases in underground operations, i.e. resulting from mining operations, is not included in this **COP**.

b) Reference should be made, however, to the respective **COPs** for the prevention of flammable gas explosions.

c) This **COP** is to address the use of industrially manufactured flammable gases that may be used in various processes at a **mine**, mainly welding.

d) The **COP** shall reflect the following requirements related to the use and storage of flammable gases used in **hot work**:

i. Flammable gas cylinders shall be stored in a well-ventilated area.

ii. Flammable gas cylinders shall be transported and stored in accordance with the relevant manufacturer's specification.

iii. Gas cylinders shall be secured so that it cannot fall over. In particular, cylinders containing acetylene shall always be stored in an upright position.

iv. When transporting cylinders, it shall not protrude over the vehicle's loading bed extremities.

v. Flash-back arresters shall be installed on all oxy-acetylene equipment.

vi. The contents of flammable gas cylinders shall not be decanted.

vii. Oxy-acetylene equipment shall only be used in accordance with accepted operational standards and only in designated **hot work** areas or when approved through the use of a **hot work** permit.

8.5.3.2.4 Operating and maintenance procedures

a) The **COP** shall reflect the following:

i. Operating procedures to be developed from the action plans drawn from the various **fire** risk assessments.

ii. Maintenance systems in place to ensure that all equipment, both mobile and fixed plant, is maintained properly and according to the manufacturers' recommendations, and that any defects are recorded and promptly repaired.

iii. Oversight procedures in place to ensure that:

- Regular maintenance of equipment for the prevention of **fires**, used for **fire** detection and **fire**-fighting is essential in the implementation of the various protection measures.

- All repair and maintenance activities for machinery, systems and equipment associated with **fire** risks and employed for **fire** prevention and protective measures shall be carried out at specified intervals, by suitably qualified individuals and in accordance with the **OEM** specification.

- Repair and maintenance activities must restore equipment to the intended design and operational functionality.

- Employees training for **fire** prevention procedures and awareness shall be aligned with the requirements and findings of the various **fire** risk assessments to ensure adequate levels of proficiency and effectiveness, and acceptable workmanship.

NOTE:
Refer to Annexure G about the generic operational and maintenance procedures which provides suggestions that might be included in procedures for generic operational and maintenance procedures. These are provided for possible reference and inclusion in operating procedures.

8.6 **Purchasing procedures**

8.6.1 The **COP** shall include the requirement that the **mine's** purchasing procedures be developed and implemented to ensure that any machinery, equipment or materials purchased for use at the **mine** comply with site standards. This procedure shall:

a) Require manufacturers or suppliers to provide evidence that **fire** risks associated with such machinery, equipment or materials have been considered and addressed (refer to Section 21 of the **MHSA**) and in compliance with applicable national standards at least.

b) Require manufacturers or suppliers to make the employer aware of any residual **fire** risk, either patent or potential that might be associated with the use of such machinery, equipment or materials.

c) Require manufacturers or suppliers of machinery to advise the employer of any **fire**-fighting equipment or additional **fire** protection requirements associated with the use of such machinery at a **mine**.

d) Ensure that **SDSs** are provided for any combustible or flammable materials supplied to the **mine**.

e) Require that manufacturers or suppliers of machinery or equipment provide adequate information on the operational procedures and maintenance requirements, particularly relating to any specific **fire**-detection or **fire**-fighting equipment custom built into the machinery. Alternatively, requirements and specifications for such **fire**-detection or **fire**-fighting equipment that might have to be provided separately by a third party need to be communicated adequately.

f) Require that manufacturers or suppliers of machinery or equipment provide adequate training and/or training material to ensure the proficiency of machinery or equipment operators.

g) Ensure that machinery and equipment specifications and maintenance and operational manuals are included in tender documents for any new contracts.

8.7 **Inspections**

8.7.1 The **COP** shall include the requirement that a series of inspections relating directly to **fire hazards** be performed as follows:

a) **Fire hazard** identification process: Intervals are to be stipulated in accordance with section 8.3.1.2 of this guideline;

b) Regular inspections of working areas to monitor compliance with **fire controls**, including preventative procedures and **fire** protection equipment.

c) Inspections aimed at identifying either substandard acts or work practices (behaviour) and substandard conditions (**fire hazards**).

d) There are usually two types of inspections:

i. Formal inspections of all workplaces that are undertaken on a regular (i.e. weekly or monthly) basis, depending on the level of risk (e.g. weekly explosives magazine inspections). Formal inspections generally involve the use of area-specific or task specific checklists to record any defects.

ii. Informal inspections that are undertaken by employees, supervisors and managers on a daily basis.

NOTE:
Refer to Annexure H about inspections which provide guidance for consideration during inspections.

8.8 **Reports**

8.8.1 The **COP** shall outline the following reports, which the employer shall compile and make readily available:

8.8.1.1 Regulation 5.1 of the **MHSA** report

8.8.1.1.1 The employer must ensure that a report required in terms of regulation 5.1(1) of the **MHSA** is:

a) Compiled by a competent person and submitted to the employer.

b) Compiled at intervals determined in accordance with the **mine's** risk assessment.

c) Demonstrate the effectiveness of the precautionary measures taken to prevent or suppress explosions of coal dust or flammable gas.

d) Demonstrate the adequacy of measures in place to prevent, detect and combat the start and spread of **mine**-**fires**.

8.8.1.2 Reports emanating from informal and formal inspections

8.8.1.2.1 Inspection outcomes or findings must be recorded as per Annexure H of the guideline. Any observed defects or deviations or irregularities are to be reported immediately verbally and then in writing to the legally appointed person – irrespective of the type or level of inspection being carried-out.

8.9 **Awareness training for fire prevention**

8.9.1 In all documents relating to training in elementary **fire**-fighting procedures, caution shall be exercised so as to prevent employees from being exposed to danger during **fire**-fighting operations. It is recognised that the dousing of an incipient **fire** is an effective measure to limit the impact of any such incident. However, employees must be warned of the dangers of going beyond their level of knowledge and proficiency in using **fire**-fighting equipment.

8.9.2 The **COP** shall set out measures to address awareness training under the following sub-headings:

8.9.2.1 General **fire** prevention awareness

8.9.2.1.1 Basic **fire** prevention awareness training shall be provided as part of the induction at the **mine**.

8.9.2.1.2 Refresher training shall then be conducted every 12 months as part of regular safety or tool-box meetings.

8.9.2.1.3 All personnel who work at the **mine** shall have a basic understanding of **fire** prevention measures and be trained in the following:

a) Basic **fire** theory.

b) Basic **fire hazard** identification.

c) Understanding of **fire** potential risks.

d) Basic **fire** prevention methods.

e) Use of the first response of basic **fire**-fighting equipment, including portable extinguishers, installed on-board vehicle **fire** suppression systems, etc.

f) Behaviour of **fire** in enclosed environments including the role played by ventilation systems.

g) Emergency procedures, including the use of self-rescuers, refuge chambers and emergency assembly points.

h) Reporting procedures during **fire** emergencies.

i) Distinguishing and identifying audio and visual **fire** alarms where provided.

8.9.2.2 Mobile equipment operators training

8.9.2.2.1 In addition to the general **fire** awareness training, all operators of mobile equipment at the **mine** shall be trained and assessed for competency, with the assistance of equipment manufacturers or suppliers where necessary, in the following preventative and precautionary measures:

a) The basics of conducting proper inspections.

b) Identification and understanding (temperature sensors) of overheating surfaces.

c) Requirements for minimising engine and equipment temperatures through the correct operating techniques.

d) Procedures to isolate on-board electrical power sources safely.

e) Electrical **fire hazards**.

f) Use of refuelling equipment and refuelling procedures.

g) **Fire prevention measures** of tyre **fires**.

h) Response to any **fire** that may occur on a vehicle based on the equipment available.

8.9.2.3 Fixed plant operators training

8.9.2.3.1 All personnel who operate a fixed plant at the **mine** shall be trained and assessed for competency with the assistance of equipment manufacturers or suppliers where necessary, in the following preventative and precautionary measures:

a) Identification of overheating surfaces.

b) Requirements of machinery or equipment electrical isolation also in accordance with regulatory provisions.

c) Equipment operational condition monitoring (e.g. normal operating temperatures, pressures and response to changing conditions).

d) Recognising mechanical and electrical **fire hazards**.

e) Where appropriate, safe emergency stopping of machinery using brakes in terms of regulatory provisions.

8.9.2.4 Mobile equipment and machinery maintenance awareness

8.9.2.4.1 All personnel involved in the maintenance of mobile equipment at the **mine** shall be trained and assessed for competency, with the assistance of the **OEMs** or suppliers where necessary in the following preventative and precautionary measures:

a) Use of the maintenance system check sheets.

b) Equipment pre- and post-maintenance inspections.

c) Equipment operational condition monitoring (e.g. normal operating temperatures, pressures and response to changing conditions).

d) Inspecting and checking of “V”-belts, rigid and flexible guards and hoses.

e) Installation and replacement of hydraulic and pneumatic hoses for specific equipment.

f) This should also include the correct use of hose crimping, where required and as per the **OEM** specifications.

g) Use of **hot work** permits and welding equipment, where required.

h) Maintenance of **fire** suppression systems where provided and necessary.

i) Importance of completing a pre-use checklist items pertaining to **fire** prevention measures.

j) The installation and maintenance of a cooling system provided for individual machines.

8.9.2.5 Electrical maintenance personnel

8.9.2.5.1 Personnel involved in the maintenance of electrical equipment or installations at the **mine** shall be trained and assessed for competency with the assistance of the **OEMs** or suppliers where necessary, in the following preventative and precautionary measures:

a) Conducting thermal imaging and electrical tests.

b) **Hot work** permits system requirements.

c) Live testing of equipment in line with procedures and legislated regulations.

d) Correct routing and wiring of electrical wires.

8.9.2.5.2 All personnel who undertake such work shall be appointed electricians qualified to work on the type of equipment (e.g. low voltage, high voltage, instrumentation, etc.).

8.9.2.6 Fuel storage operational personnel

8.9.2.6.1 Personnel involved in the transport, storage or handling of fuel, combustible materials and explosives at the **mine** shall be trained and assessed for competency in at least, but not limited to, the following:

a) Transport and storage procedures relating to fuel, combustible materials or explosives.

b) Use of specialised distribution or unloading equipment.

c) Procedures for the refuelling of vehicles conveying these materials.

d) Access procedures to combustible material stores or explosives magazines.

e) Isolation of equipment prior to maintenance.

f) Emergency procedures specific to fuel facilities, combustible materials or explosives storage areas.

g) Personnel responsible for the receipt of bulk diesel, shall be specifically trained in the receipt of dangerous goods and be "nominated" as the

"qualified person", referred to in **SANS** 10231:2010 (transport and dangerous goods).

h) To be trained in the **SDS** requirements.

8.9.2.7 Lamp room, control room and office personnel

8.9.2.7.1 Lamp room, control room and office personnel at the **mine** shall be trained and assessed for competency in at least, but not limited to, the following:

a) Storage, connection and use of flammable gas cylinders for instrument calibration purposes.

b) **Fire** detection on the applicable system at the **mine**.

c) Procedures to **fire** emergency response.

8.10 **Fire protection and emergency response**

8.10.1 The **COP** shall set out measures for underground and surface **fire hazards**:

a) **Mine's fire**-protection including regulation 5.1(3) requirements.

b) Emergency preparedness and response as per Chapter 16 of the **MHSA** and the Guideline for a Mandatory Code of Practice for Emergency Preparedness and Response.

8.10.2 In particular, this **COP** shall describe the principles used in the selection of each measure, the alignment of this with the respective **fire** risk assessment and any specialist inputs made in devising the protective measures and responses (e.g. **fire** engineering criteria to determine **fire**-fighting equipment specifications where deemed necessary, etc.).

8.10.3 The **COP** should further list and describe briefly the measures implemented for the early detection of **fires** at different locations on the **mine** based on the list of **fire hazard** locations referenced in paragraph 8.1.1.2 of this document.

NOTE 1:
This paragraph should be used in conjunction with the Guideline for Emergency Preparedness and Response to provide a comprehensive and coordinated approach in addressing the **fire** prevention measures and control of **fires**.

NOTE 2:
Under no circumstances should **fire** braziers (*mbaula*), (i.e. any fixed or portable solid fuel or gas fired equipment or appliance designed for heating and used outdoors) be used at the **mine**.

NOTE 3:
Under no circumstances shall the use of carbon dioxide (CO_2) **fire** extinguishers be allowed in **confined spaces**, as the sudden increase in CO_2 levels combined with the consequential displacement of oxygen, will make it harder to breathe, leading to asphyxiation for the user as well as other employees in a **confined space**.

8.11 Effective means of monitoring and communicating the possible presence of a fire

8.11.1 The **COP** shall set out measures to monitor and communicate the possible presence of **fires**. These measures should include the following:

8.11.1.1 A brief description of the method(s) employed to detect the occurrence of a **fire**, presence of noxious gasses or flammable gasses underground.

8.11.1.2 A brief description of the approach used to position the sensors to monitor the air flow in the underground workings effectively for detecting the presence of a **fire** and facilitate its location in the **mine**.

8.11.1.3 A description of the channels of communication that are to be used after a **fire** has been detected, including communication with neighbouring **mines** where secondary outlets or escape routes are shared.

8.11.1.4 The process for monitoring of underground environmental conditions during a **fire**.

8.11.1.5 A list of evacuation plans available in the control room that would include the following amongst others:

a) The location of various sensors.

b) The location of the refuge bays (inclusive of telephone numbers).

c) The identification of escape routes.

8.11.1.6 The control room operator

a) Shall be adequately and appropriately trained on the environmental management system and emergency procedures.

b) Appointed in the surface control room with sufficient and dedicated resources as per the **mine** risk assessment.

8.11.1.7 The refresher training courses for the control room operator shall be conducted yearly and retraining done in the event of any change in specifications of the relevant and applicable system and procedures.

8.11.2 The underground and surface control rooms must have backup power that will ensure sustained provision of power.

PART D: IMPLEMENTATION

1. IMPLEMENTATION PLAN

1.1. The employer must prepare an implementation plan for a **COP** that makes provision for issues such as organisational structures, responsibilities of functionaries and programmes and schedules for the **COP**, which will enable proper implementation of the **COP** (a summary of and a reference to, a comprehensive implementation plan may be included).

1.2. Information may be graphically represented to facilitate easy interpretation of the data and to highlight trends for the purposes of risk assessment.

2. COMPLIANCE WITH THE COP

2.1. The employer must institute measures for auditing, monitoring and ensuring compliance with the **COP**.

3. ACCESS TO THE COP AND RELATED DOCUMENTS

3.1. The employer must ensure that a complete **COP** and related documents are kept readily available at the **mine** for examination by any affected person.

3.2. A registered trade union with members at the **mine**, or where there is no such union, a health and safety representative on the **mine**, or if there is no health and safety representative, an employee representing the employees on the **mine**, must be provided with a copy. A register must be kept of such persons or institutions with copies to facilitate the updating of such copies.

3.3. The employer must ensure that all employees are fully conversant with those sections of the **COP** relevant to their respective areas of responsibilities.

ANNEXURE A: GENERIC NOTES ON FIRES

(For information purposes)

1. **Fire** triangle (oxygen, heat, fuel plus chain reaction):

1.1. **Fires** start when a flammable material or liquid, in combination with a sufficient quality of an oxidizer such as oxygen gas or oxygen-risk air is exposed to a source of heat or ambient temperature above the flash point for the fuel or oxidizer mix and is able to sustain a rate of rapid oxidation that produces a chain reaction.

2. Four stages of a **fire**:

2.1. By most standards including the International **Fire** Service Training Association, there are four stages of a **fire**. These stages are incipient, growth, fully developed and decay. The following is a brief overview of each stage:

2.1.1. Incipient – This first stage begins when heat, oxygen and a fuel source combine and have a chemical reaction resulting in **fire**. This is also known as “ignition” and is usually represented by a very small **fire** which often goes out on its own, before the following stages are reached. Recognising a **fire** at this stage provides the best chance at suppression or escape.

2.1.2. Growth – The growth stage is where the structures, **fire** load and oxygen are used as fuel for the **fire**. There are numerous factors affecting the growth stage including where the **fire** started, what combustibles are near it, ceiling height and the potential for “thermal layering”. It is during this shortest of the 4 stages when a deadly “flashover” can occur; potentially trapping, injuring or killing fire-fighters.

2.1.3. Fully developed – When the growth stage has reached its maximum and all combustible materials have been ignited, a **fire** is considered fully developed. This is the hottest phase of a **fire** and the most dangerous for anyone trapped within.

2.1.4. Decay – Usually the longest stage of a **fire**, the decay stage is characterised a significant decrease in oxygen or fuel, putting an end to the **fire**. Two common dangers during this stage are firstly – the existence of non-flaming combustibles, which can potentially start a new **fire** if not fully extinguished. Secondly, there is the danger of a back draft when oxygen is reintroduced to a volatile, **confined space**.

3. Flammable liquids are classified in terms of the latest version of **SANS** 10089-1:

3.1. Class 0: liquefied petroleum gases (LPG).

3.2. Class 1A/B: liquids with a closed-cup flash point below 23°C.

3.3. Class 1C: liquids with a closed-cup flash point between 23 and 38°C.

3.4. Class 2: liquids with a closed-cup flash point between 38 and 60,5°C.

3.5. Class 3A: liquids with a closed-cup flash point between 60, 5 and 93°C.

3.6. Class 3B: liquids with a closed-cup flash point of 93°C or above.

4. Physical and chemical properties of fuel sources can impact the level of a **fire** risk. These properties include flammability, ignitability, combustibility (**fire** spread capacity or **fire** retardant effect), self-extinguishing properties, toxicity of paralysis products and other unique characteristics. **SDSs** from suppliers in compliance with **SANS** 10234: 2008 (as amended): “Global Harmonized System of Classification and Labelling of Chemicals” and system or process design specifications from designers should be consulted to identify and categorise fuel sources.

ANNEXURE B: EXAMPLES OF FIRE HAZARDS AT MINES

(For information purposes)

1. The following is a list of typical **fire hazards** that could be considered for addition in the list of **fire hazards** of the **COP**. The list is intended as an *aide-memoire* and it is not exhaustive:

1.1. Underground

1.1.1. Fixed mechanical equipment or plant using mechanical friction such as mono-winches and associated winch rope systems, conveyor belt drives and pulleys.

1.1.2. Fixed electrical equipment: electrical short circuits or over heating of oil-filled transformers or switch-gear; (particularly where these are located in main intake airway systems).

1.1.3. Mobile equipment: fuel or oil leaks on hot exhaust manifolds or the surface of a turbocharger.

1.1.4. Re-fuelling bays and battery charging bays.

1.1.5. Underground workshop areas (storage of fuels, grease, oils, paint, tyres, hoses) in the presence of mobile equipment and also where extensive **hot work** is performed.

1.1.6. Combustible and flammable liquid stores.

1.1.7. Explosives storage areas.

1.1.8. Locations where combustible of flammable dust or gases can accumulate.

1.1.9. Flame cutting and welding operations, particularly near combustible material.

1.1.10. Abandoned panels or work-places: spontaneous ignition of support timber or coal.

1.1.11. Timber.

1.2. Surface:

1.2.1. Major transformer stations and electrical switchgear installations in or next to hoist rooms.

1.2.2. Storage installations for fuel or other flammable chemicals.

1.2.3. Overland conveyor belts.

1.2.4. Coal stockpiles or spoil piles (induced **fires** or self-ignition).

1.2.5. Explosives magazines.

1.2.6. Smelter granulation or casting process areas.

1.2.7. Ammonia refrigeration plants.

1.2.8. Waste storage or disposal areas.

1.2.9. Natural or agricultural areas near, plant/surface infrastructure, intake shafts or declines (plant material **fires**).

ANNEXURE C: GENERAL DESIGN REQUIREMENTS: Mobile equipment

(Mandatory)

1. The following is a series of technical solutions that shall be considered for addition in the **mine's** action plans and/or as part of the **COP**. This includes but not limited to the following:

1.1. Vehicles

1.1.1. An adequate number of **fire** extinguishers and **fire** suppression systems appropriate for the classification of **fire** for which it is to be used, including batteries for electric vehicles, must be provided for each vehicle.

1.1.2. In addition to the above, large mining vehicles used for ore loading and transport shall be provided with custom-designed on-board **fire** suppression equipment.

1.1.3. Where a vehicle has to pass under a power line, the line shall be raised to provide clearance in accordance with **MHSA** Regulation 3.29.

1.1.4. In relation to the layout of equipment in engine bays, the following shall be considered in relation to hydraulic hoses:

1.1.4.1. Hydraulic hoses should be flame-retardant and meet the requirements of **SANS** Hydraulic Hoses Parts 10a and 10b, **SANS** 347(2009) Categorization and conformity of all pressure equipment.

1.1.4.2. Securely clamped away from hot surfaces.

1.1.4.3. Located so that impact damage is minimized.

1.1.4.4. Provided with bulkhead fittings where they pass through bulkheads.

1.1.5. Flammable fluid containers shall be located such that any overflow should not contact a potentially hot surface.

1.1.6. Secure filler caps shall be provided that include tie straps.

1.2. Engine systems

1.2.1. Consider the use of powering-down systems to stop engines safely in the event of an emergency.

1.2.2. Engine control systems shall be designed so that the fuel system would be shut-off automatically if a fault occurs that requires the engine to stop.

1.2.3. Appropriate protection must be provided where this equipment is operated in explosive gas dust atmospheres (**SANS** 868-1-1 Compression-ignition engine systems and machines powered by such engine systems, for use in **mines** and plants with explosive gas).

1.2.4. The introduction of operational or automatic means for shutting-down engines when working pressures exceed recommended maximum values should be considered.

1.2.5. Bulkheads should be **fire**-proof.

1.2.6. Ideally all equipment surfaces onto which flammable liquids could spray should operate at temperatures less than the lowest flash-point of oil being used.

1.2.7. Consider installing **fire** monitoring sensors at points where the temperature of the hottest part of a diesel engine exhaust system and retarders can be measured as per **SANS** 868-1-1:2005 "Compression-ignition engine systems and machines powered by such engine systems, for use at **mines** and plants with explosive gas atmospheres or explosive dust atmospheres" or both Part 1-1: "**Fire** hazardous locations in underground **mines** – Basic explosion protected engines."

1.2.7.1. Part 1-2: "**Fire** hazardous locations in underground **mines** – Explosion protected engine systems".

1.2.7.2. Part 1-3: "**Fire** hazardous locations in underground **mines** – Machines".

1.2.7.3. Part 3-1: "**Fire** hazardous locations on surface – Basic explosion –protected engines".

1.2.7.4. Part 3-2: "**Fire** hazardous locations on surface – Explosion –protected engine systems".

1.2.7.5. Part 3-3: "**Fire** hazardous locations on surface – Machines".

1.2.7.6. Part 4: "Non -**fire** hazardous locations in underground coal **mines**".

1.3. Vehicle electrical systems:

1.3.1. Protection shall be provided against short-circuiting and over current.

1.3.2. Electrical cables shall be installed at safe distances from fuel lines.

1.3.3. Electrical systems shall be designed to prevent the occurrence of electrical sparks following a system malfunction or accident.

1.3.4. Consider the use of electrical systems that derive power from diesel engine alternators or batteries designed to AS4242 Earth-moving machinery and ancillary equipment for use in **mines** - Electrical wiring systems at extra-low voltage standard. All other electrical systems shall be designed to AS3000 Electrical Installations standard.

1.3.5. Where jump-starting systems are used, they shall be purpose-designed for all electrical start equipment and meet the requirements as specified by the **mine's** engineer.

1.3.6. Where electrical cables and hoses are to pass through bulkheads, they shall have rubber flame retardant connections (i.e. proper bulkhead connections) to which the cables and hoses are attached.

1.3.7. Protection against over current in low voltage (a nominal voltage level that are used for the distribution of electricity, the upper limit of which is an AC voltage of 1000V or a DC voltage of 1 500 V) circuits shall be considered, where practical, by using circuit breakers or encapsulated fuses.

1.3.8. Consider protecting all circuits, except starter motors, against short circuit and over current.

1.4. Vehicle fuel and hydraulic systems

1.4.1. Consider using steel lines for fuels, hydraulic and exposed lubrication systems.

1.4.2. Where flexible hoses are used, they shall limit the spread of **fires** (**SANS** 10177-9 **Fire** testing of materials, components and elements used in buildings – Part 9: Small-scale burning characteristics of flexible hoses).

1.4.3. Vent outlets or overflow points shall be directed away from hot surfaces.

1.4.4. Hoses, oil, fuel and hydraulics lines and fittings shall be installed as per **OEM** specifications, i.e. positioning of clamps, routing and length of hoses, replacement fittings and components.

1.4.5. Fuel or oil lines or hoses shall be kept separate from electrical cables.

1.4.6. Fuel or oil lines or hoses shall be routed away from moving parts.

1.4.7. Fuel, oil and hydraulic systems and associated distribution lines shall be free of leakages and protected from hot surfaces.

1.4.8. The flash points of liquids used by mobile equipment shall be below the maximum ambient temperature likely to be experienced.

1.4.9. Hoses shall be routed so that in the event of a burst or leaking hose, flammable liquid cannot come into contact with hot surfaces. Where routing away from hot surfaces is not possible, all hoses shall be securely clamped and shielded so that in the event of a burst or leaking hose, flammable liquid cannot come into contact with a hot surface.

1.4.10. Hoses to be:

1.4.10.1. Securely clamped away from hot surfaces.

1.4.10.2. Located so that impact damage is minimized.

1.4.10.3. Provided with bulkhead fittings where they pass through bulkheads.

1.4.11. Consider providing dry break filling connections where fuel tanks on vehicles are replenished in production areas or for vehicles that transport explosives.

1.4.12. Containers for combustible fluids shall be located so that any overflow cannot come into contact with hot surfaces. Where they are not provided with a dry break filler, they shall be provided with secured filler caps that are permanently connected to the container.

1.5. Tyres and power transmission

1.5.1. Tyres shall be selected to suit their intended application in accordance with the **OEM** design and specifications.

1.5.2. Consider fitting flame-retardant “V”-belts on mobile equipment.

1.6. Other mobile equipment requirements

1.6.1. Vehicle brake systems for mining equipment other than light vehicles (utility vehicles, small sport utility vehicles [SUV], small personnel carriers, etc.) shall be equipped with enclosed brake systems; or, where open discs are installed, residual pressure monitoring, brake drag or temperature monitoring and flame retardant brake hoses shall be considered.

1.6.2. Ideally, all equipment functions, including the retarder function shall be monitored.

1.6.3. A system that monitors engine oil pressure and stops the engine if pre-determined values are not maintained could be considered.

1.6.4. Turbocharger lubrication lines shall be made of steel. Flexible connections may be used provided they are **fire** retardant and located away from hot surfaces **SANS** 868 -1-2.

1.6.5. The operator’s cab shall be provided with a **fire**-wall to inhibit the passage of **fire** into the cab.

1.6.6. Covers on engine compartments shall be flame retardant.

1.6.7. Vehicles transporting dangerous goods (define) shall comply with **SANS** tanker standard.

1.6.8. Vehicles transporting combustible liquids shall comply with **SANS** tanker standard.

1.6.9. Explosives shall only be transported in separate enclosed compartments that meet the requirements of SAP Standard (Part 1 Explosives - Storage and Transport).

1.6.10. Further information regarding **fire** prevention measures for mobile equipment can be found in the trackless mobiles machines and underground rail bound equipment guidelines.

1.7. The **COP** shall set measures for the operation of all classes of mobile equipment. These procedures shall include provisions for the following:

1.7.1. Testing of brake functionality by the operator.

1.7.2. Correct brake use by the operator.

1.7.3. Safe parking of the vehicle when a brake fault is detected.

1.7.4. A vehicle with a flat tyre to be parked in the nearest safe and accessible place.

1.7.5. Safe parking of equipment when “V” belt fault detected.

1.7.6. Safe parking of equipment when tyre overheating or tyre **fire** is suspected.

1.7.7. The correct operation of retarder and equipment braking systems.

1.7.8. The provision of self-contained self-rescuers.

1.7.9. Housekeeping standards for operator cabs.

1.7.10. Checking equipment before use for the presence of oil or fuel leaks, combustible materials (e.g. rags, paper) and tyre condition.

ANNEXURE D: GENERAL DESIGN REQUIREMENTS: Fuel storage areas, fuel transfer equipment and refuelling bays
(For information purposes)

1. The following is a series of technical solutions that shall be considered for addition in the **mine's** action plans and/or as part of the **COP**. The inclusion of these suggestions in the **COP** is not mandatory. These suggestions are not intended to be complete or exhaustive:

1.1. Electrical control systems associated with fuel transfer and storage should comply with the above mentioned standard.

1.2. High voltage reticulation should not pass through a fuel storage area; **SANS** standard such as but not limited to **SANS** 10228 Identification and Classification of **Fire** hazardous Substances, **SANS** 10229 Transportation of dangerous goods, **SANS** 60079 Electrical apparatus for explosive gas atmospheres for a safe distance.

1.3. Diesel storage tanks (fixed or mobile) should comply with the above mentioned **SANS** standard as appropriate and should be regularly inspected and maintained to ensure continuing compliance.

1.4. Where a **mine** uses a surface to underground fuel delivery pipe, it should be:

1.4.1. Custom-designed.

1.4.2. Where possible, installed in an accurately drilled and surveyed borehole.

1.4.3. Where installed in a working shaft or material decline, it should be protected from incidental damage through contact with vehicles or moving conveyances.

1.4.4. Contained in a free draining borehole; and - Subjected to inspection and non-destructive testing at regular intervals.

1.4.5. Provided with a system preventing "runaway" flow of fuel into the **mine**.

1.5. Containers such as "Jerry cans" used for transporting fuel should be secured to the load-carrying area away from any potential impact damage.

1.6. The storage of flammable gas cylinders should be separated from oxygen cylinders by a distance of at least 3m or have steel plate barrier at least the height of the flammable gas cylinders next to the oxygen cylinders.

1.7. Appropriate signage should be installed at all entrances to fuel storage areas indicating:

1.7.1. Type and volume of fuel stored.

1.7.2. Prohibition of unauthorized persons.

1.7.3. Prohibition of smoking or naked lights.

1.7.4. Prohibition of any **hot work**.

1.7.5. Requiring the shutting down engines before refuelling.

1.7.6. Emergency procedures in case of **fire**.

1.8. All refuelling points should be separated from any connected supply points by the use of a physical barrier or adequate distances.

1.9. Any fuel supply or permanent refuelling location should be capable of being effectively and safely isolated from the **mine's** ventilation system in the event of a **fire** or situated in a manner that smoke can be effectively directed into the return airway.

1.10. Permanent storage, supply and refuelling stations should have an automatic **fire** detection and suppression system that complies with relevant parts of **MHSA** regulations 8.10.11.

1.11. Automatic **fire** suppression systems should include a **fire** alarm or other system to alert **mine** personnel in case of **fire** and be capable of being manually activated at a safe distance from the refuelling bay. Relevant part of **MHSA** regulation 8.10.11.

1.12. A minimum of two portable **fire** extinguishers with a suitable rating for the class of **fire** should be provided on the upstream side of all temporary fuelling areas.

1.13. Permanent fuel storage locations should be built on a bonded floor, impervious to fuel and provided with drainage facilities for handling fuel spillage. **SANS** 10089-3:2010 "The petroleum industry Part 3: The installation, modification and decommissioning of underground storage tanks, pumps/dispensers and pipe work at service stations and consumer installations" could be used as reference.

1.14. These sites should be adequately protected from incidental damage caused by vehicle movement in the vicinity. This implies that sites should be adequately selected in relation to vehicle traffic flow and that the erection of bollards or barriers should be considered.

1.15. Where a fuel storage location is temporary, a risk assessment that deals with fuel spillage should be conducted and control measures as identified by the risk assessment is implemented.

1.16. All equipment used to store, transfer or distribute fuel should meet all the relevant sections of **SABS** Standards, **SANS** 10089-3:2010 "The petroleum industry Part 3: The installation, modification and decommissioning of underground storage tanks, pumps or dispensers and pipe work at service stations and consumer installations.

1.17. Storage tanks, pipe work and fuel transport vehicles entering refuelling bays should be earthed in accordance with **SANS** 10089-3:2010 "The petroleum industry, Part 3: The installation, modification and decommissioning of underground storage tanks, pumps or dispensers and pipe work at service stations and consumer installations to dissipate static electrical charge.

1.18. All fuel transfer systems should be constructed with non-flammable materials and brass or non-metallic components and automatically shut off to stop flow.

1.19. Where practical, in underground applications, steel **fire** doors should be constructed to seal off the refuelling bay area to prevent smoke entering intake airways in the event of a **fire**.

1.20. No vehicle should park in a refuelling bay except for the purposes of refuelling or unloading of fuel.

1.21. Refuelling bays should be provided with adequate facilities (e.g. water hose, absorbent material) to quickly contain or clean-up any fuel spillage.

1.22. Any waste (e.g. soiled absorbent material) should be placed immediately in clearly marked receptacles and well away from any potential ignition source. These receptacles should be emptied at least weekly.

1.23. Electrical equipment, including lights, should meet the wiring requirements of **SABS** 10142: Wiring of premises, Part 1: Low voltage systems.

ANNEXURE E: MINE INFRASTRUCTURE AND FIXED PLANT
(Mandatory)

1. The following notes shall be considered for addition in the structuring of action plans or of associated preventative measures.

1.1. Fixed plant

1.1.1. Electrical cables and electrical equipment shall be located so that they cannot be damaged by impact from vehicle collision or blasting in accordance with **MHSA** regulation 3.22 and 3.23.

1.1.2. Fixed electrical installations shall be designed to minimize the need for maintenance personnel to work on live apparatus in accordance with **MHSA** regulation 3.13.

1.1.3. Oil-cooled transformers' sites shall be built on a bonded floor, impervious to fuel and provided with drainage facilities for handling spillage of cooling oil.

1.1.4. These sites shall be adequately protected from incidental damage caused by vehicle movement in the vicinity. This implies that sites should be adequately selected in relation to vehicle traffic flow and that the erection of bollards or barriers should be considered.

1.1.5. Reflectors shall be attached to fixed electrical installations and cables to make them clearly visible to operators.

1.1.6. Thermostats shall be provided on electrical motors to stop the motor being governed automatically if pre-set temperature requirements are exceeded.

1.1.7. Substations and transformers:

1.1.7.1. A minimum of two **fire** extinguishers rated for the classification of **fire** for which it is to be used must be provided for substations and transformers.

1.1.7.2. For sub stations one should be located on the inside of the sub and the other on the outside of the substation in an upwind position.

1.1.7.3. Transformers shall have a **fire** extinguisher on either side located as close as practical to the entry.

1.1.7.4. In newly designed **mines**, where underground substations with oil filled equipment are used, provision shall be made for automatic **fire** extinguishing equipment.

1.1.8. Electrical protection against earth leakage and overload shall be provided for all fixed mechanical equipment and electrical Trackless Mobile Machines. These installations shall be designed in such a manner so as to prevent a temperature rise in the cables that could lead to a **fire**.

1.1.9. Critical items of plant that are associated with potential fuel sources shall have thermal monitoring installed.

1.1.10. All materials used in the construction of fixed mechanical equipment shall be flame retardant.

1.1.11. As a reference, a number of **SABS** publications shall be considered:

1.1.11.1. **SANS** 484-1:2009 Conveyor belting – step splicing for multi-ply textile-reinforced rubber covered conveyor belting:

- Part 1: Hot-splicing method
- Part 2: Cold-splicing method

1.1.11.2. **SANS** 486-2:2009 Conveyor belting – Finger splicing of solid woven construction conveyor belting".

1.1.11.3. **SANS** 340:2006 Conveyor belts – Laboratory scale flammability characteristics – Requirement and test method.

1.1.11.4. **SANS** 968: 2013 Conveyor belting – Textile reinforced solid woven carcass Ed 1. Construction.

1.1.11.5. **SANS** 971: 2013 Conveyor belting – Methods of testing **fire** retardant properties of all conveyor belt construction.

1.1.11.6. **SANS** 54: 2009 Rubber, vulcanized or thermoplastic – Accelerated aging and heat resistance tests.

1.1.12. **MHSA** regulation 8.9(3) The employer must take reasonably practicable measures to prevent persons from being exposed to flames, fumes or smoke arising from a conveyor belt installation catching **fire**, including instituting measures to prevent, detect and combat such **fires**.

1.1.13. Conveyor belts shall be provided with a slip monitoring system that should stop the belt if a slip of 5% or greater is detected.

1.1.14. The drives, tail and transfer points of conveyor systems shall be provided with automatic **fire** suppression systems , this includes where flame retardant belts and drum frictional surfaces are used.

1.1.15. Equipment shall be designed to minimize the need for welding and flame cutting underground or in **confined spaces**.

1.1.16. Hydraulic and lubrication systems shall use steel piping wherever possible.

1.1.17. Belt drift switches shall be provided to stop the belt if excessive drift is detected.

1.1.18. Fluid couplings if used should not be source of ignition.

1.1.19. Idler bearings should be sealed.

1.1.20. Temperature monitoring devices and alarms shall be installed, in readily identifiable locations, on main bearings of conveyor drives.

1.1.21. Where possible, compressors shall be located on the surface rather than underground.

1.1.22. Compressors shall be designed so that in the event of a compressor **fire**, the amount of smoke entering the main intake is minimized.

1.1.23. Where compressors are operated underground, consider the following:

1.1.23.1. Thermal monitoring devices shall be installed on the output of the compressor screws that alarm and stop the compressor in the event of a temperature or oil pressure overload or high discharge air temperature being detected.

1.1.23.2. Compressors shall be installed so that the ventilating air flows over them directly to return.

1.1.24. Flow switches shall be provided to stop pumps in the event of low flow conditions.

ANNEXURE F: SAFE USE, TRANSPORT AND HANDLING OF EXPLOSIVES
(Mandatory)

1. The following is a series of technical solutions that shall be considered for addition in the **mine's** action plans and/or as part of the **COP**.

2. This includes but not limited to the following:

2.1. Explosives storage containers

2.1.1. Explosive storage containers shall be located away from main travelling ways to minimize the potential impact of explosion due to **fire** (Regulation 4.2).

2.1.2. A water hose and proper drainage shall be installed to allow for hosing down of spilt product or combustible liquids (e.g. oil leaking from explosives vehicles).

2.1.3. Appropriate signs shall be installed on all explosive storage containers indicating:

2.1.3.1. No smoking, naked lights or equipment within 8 meters of explosives.

2.1.3.2. The emergency procedure in case of **fire**.

2.1.4. Formal housekeeping requirements shall be implemented to ensure that no waste material is allowed to accumulate in the area where explosive storage containers are located.

2.1.5. Operating procedures shall be developed for the safe storage and transport of explosives to reduce the risk of **fire** involving explosives. These procedures should include provisions for the following:

2.1.5.1. Safe refuelling of vehicles carrying explosives (consideration should be given to removing explosives from the vehicle before refuelling).

2.1.5.2. Only purpose-designed and constructed explosives-carrying equipment entering magazines.

2.1.5.3. Access to explosive storage facilities including loading and unloading of vehicles carrying explosives, at the explosive storage facilities or elsewhere.

2.1.5.4. Vehicles carrying explosives being parked in designated areas that prevent uncontrolled access while left unattended.

2.1.5.5. Non-bulk explosives (e.g. detonators, primer plugs, boosters etc.) to be transported in separate enclosed compartments that meet the requirements of the Explosive Act (Act 15 of 1973) (Part 1 Explosives -Storage and Transport).

2.1.5.6. All procedures relating to the storage and transport of explosives shall meet the South African Police Service standards.

2.2. Prohibition requirements

2.2.1. Procedures shall prohibit

2.2.1.1. Access to explosive storage facilities except by purposely designed vehicles and only for the purpose of loading and unloading:

a) The presence of ignition sources including mobile and satellite phones, smoking, cigarette lighters and matches on or around explosives carrying machines, or in or around explosive storage facilities, explosives carrying machines and service equipment.

b) Diesel engines running whilst loading or unloading in an explosive facilities.

c) The presence of flammable goods in operators' cabins of vehicles conveying explosives.

d) Explosives carrying vehicles into maintenance areas prior to it having been washed down.

e) **Hot work** on or around vehicles carrying explosives and detonator until these have been removed, washed down.

f) The transport or storage of diesel around or into an explosive storage facility.

g) The transport or storage of flammable gases around or in explosive storage facilities.

h) Vehicles parked at a safe distance from explosive or other combustible materials (e.g. empty cartons) when inside explosive storage facilities.

i) Persons attempting to fight an explosives **fire** with portable extinguishers except to extinguish a small equipment or waste **fire** not involving explosives.

2.3. Other requirements

2.3.1. In addition to training requirements provided for mobile equipment operators, personnel who transport explosives or handle explosives inside explosive storage facilities shall also be trained and assessed for competency in at least the following:

2.3.1.1. Procedures for transport and handling of explosives.

2.3.1.2. Explosive **fire** prevention measures and response.

2.3.1.3. Refuelling of explosives carrying vehicles.

2.3.1.4. Access requirements for explosive storage facilities.

2.3.1.5. Compliance with fuel unloading and refuelling procedures.

2.3.2. The following supervisory activities are recommended:

2.3.2.1. Checks for the presence of correct signage (e.g. “Flammable Materials”, “No Smoking”, “Explosives”, etc.).

2.3.2.2. Compliance with maintenance procedures.

2.3.2.3. Pre-handover inspection on machine cleanliness.

2.3.2.4. Checks for adequate **fire** protection (e.g. sufficient number and correct type of **fire** extinguishers).

2.3.2.5. Checks of emergency equipment such as refuge chambers and the status of escape ways.

2.3.2.6. Layout of the explosive storage facilities (segregation of the explosives, detonators and bulk explosives).

2.3.2.7. Safe parking of explosive-carrying equipment.

2.3.2.8. Cleaning of explosives carrying equipment prior to hand-over to maintenance.

2.3.2.9. Specific emergency response procedures for explosive storage facilities or explosive-carrying equipment.

ANNEXURE G: GENERIC OPERATIONAL AND MAINTENANCE PROCEDURES

(For information purposes)

1. The following is a series of technical solutions that shall be considered for addition in the **mine's** action plans, as part of the **COP**, and/or operating standards associated with this **COP** including, but is not limited to, the following:

1.1. Good housekeeping practices in refuelling bays.

1.2. The safe operation of fuel transfer systems.

1.3. The refuelling of vehicles, equipment and fixed plant.

1.4. Fuel transfer between storage systems.

1.5. Replacement or changing of fuel cells or storage tanks.

1.6. The installation, location and maintenance of signage.

1.7. Management of data pertaining to vehicle and equipment maintenance.

1.8. Performing planned maintenance inspections and servicing of fuel transport and filling equipment.

1.9. Report on equipment condition and maintenance effectiveness and standards.

2. As part of the maintenance system, procedures shall be implemented that incorporate the following to reduce **fire** risk:

2.1. Daily equipment pre-use inspection shall include the removal of excess flammable materials (e.g. oil, grease) from the equipment before it is operated.

2.2. Maintenance work on equipment shall include the removal of excess flammable materials (e.g. oil, grease) from the equipment before it is operated.

2.3. Where an operator becomes aware that an equipment develops a condition where heat sources or fuel sources may lead to a **fire**, he/she must stop the machine immediately. These shall be rectified and repaired before further operation. This procedure should be included as part of the induction training Programme for engineering employees.

2.4. Daily equipment pre-use inspection shall ensure that lubricant and coolant levels in mobile equipment and fixed plant are adequate.

2.5. Any maintenance work undertaken involving the use of oxy-acetylene equipment shall be undertaken in a designated **hot work** areas or subject to a **hot work** permit.

2.6. Injector lines shall be changed out at intervals as per **OEM** specification, the **mine** standard informed by risk assessment outcomes as well as **mines** operating conditions such as haul road conditions. Injector pipes shall not be re-used unless they have passed a non-destructive test. Where this cannot be guaranteed, new pipes that comply with the **OEM** specifications shall be used.

2.7. A daily inspection of mobile equipment shall include the following:

2.7.1. A check for oil and fuel leaks.

2.7.2. A tyre inspection and pressure test.

2.7.3. Checking the integrity of the turbocharger and manifold guards (retrofit kits for older machines to minimise lines and hoses in hot zone where available).

2.7.4. An inspection of wiring systems.

2.8. Tests of temperature alarms shall be conducted as per **mine** standard.

2.9. Thermostats on electrical motors shall be tested at least monthly.

2.10. A 250-hour inspection of mobile equipment shall include the following inspections:

2.10.1. All sources of heat and all flammable materials.

2.10.2. “V" belts (and adjustment, where required).

2.10.3. Park brake operation.

2.10.4. Battery compartments.

2.10.5. Lubrication lines and fittings.

2.10.6. **Fire suppression systems**.

2.11. Brakes shall be dynamically tested at least as per **OEM** and **mine** standards, with visual inspection for excess wear on a regular basis.

3. Mobile equipment maintenance procedures (both rail bound and trackless transport machinery) shall include:

3.1. Monthly inspections of extra low voltage wiring to **OEM** requirements.

3.2. Standard procedure for the lubrication of equipment.

3.3. A procedure that requires maintenance personnel to remove excess lubricants and flammable materials following maintenance activities. This shall be recorded as part of the maintenance report.

3.4. Running up all equipment to normal operating temperature (20 min) inside the maintenance area before being returned back into service.

3.5. Maintenance inspections shall identify leaks on equipment, which shall not be operated until these are repaired satisfactorily.

3.6. Inspection of hydraulic and fuel hoses for damage and wear at least every 250 hours. These shall be replaced where required. Specific hose check sheets shall be developed for each class of machine as part of this process. Unplanned changes in hose specification and routes shall be avoided.

3.7. Ensuring no overloading of tyres and correct tyre inflation pressure;

3.8. Where auto-**fire** suppression systems are specified, **fire** extinguishing media shall comply to one of the following specifications:

3.8.1. **SANS** 7202:2012 **Fire protection** – **fire** extinguishing media – powder.

3.8.2. **SANS** 7203-1:2013 **Fire** extinguishing media – foam concentrate part 1: specification for low expansion foam concentrate for application to water immiscible liquids.

3.8.3. **SANS** 7203-2:2013 **Fire** extinguishing media – foam concentrate part 2: specification for medium and high expansion foam concentrate for top application to water immiscible liquids.

3.8.4. **SANS** 7203-3:2013 "**Fire** extinguishing media – foam concentrate part 3: specification for low expansion foam concentrates for top application to water immiscible liquids.

3.9. Explosives-carrying equipment shall not be allowed into maintenance areas until all explosives and detonators have been removed and washed down.

4. The **COP** shall address the following relating to electrical equipment maintenance:

4.1. Electrical equipment maintenance shall be included in a formal maintenance plan or schedule.

4.2. Only non-flammable sprays shall be used during electrical maintenance.

4.3. Only competent persons shall do electrical maintenance work.

4.4. Modifications to an electrical equipment or reticulation systems shall only take place with the approval of an electrical engineer or a statutory appointed person (e.g. electrical supervisor).

4.5. New installations should be tested to the requirements of **OEM** and checked for compliance with **fire** prevention **controls** (refer Section 2.3) prior to being commissioned.

4.6. Thermal imaging surveys of higher voltage cable joints and appliance shall be conducted every 12 months.

4.7. Electrical appliances in 'significant **fire** risk' locations (e.g. workshops, refuelling bays, etc.) shall be inspected on monthly basis.

4.8. The maintenance system shall ensure continuing compliance with IP 55 monthly inspection and testing of all electrical equipment associated with explosive storage facilities.

5. The following shall be considered to be formal maintenance procedures, including regular inspections:

5.1. Fuel storage systems.

5.2. Fuel distribution systems.

5.3. Fuel nozzles and connections.

5.4. Spillage fuel containment systems (e.g. bunds, drains, sumps, etc.).

6. The following pre-use checks by equipment operators shall include the following:

6.1. Integrity of wiring systems.

6.2. Tyre condition and damage (including rocks jammed in treads).

6.3. Presence of fuel or oil leaks.

6.4. Excessive lubricant levels.

6.5. The presence of rags and flammable materials (e.g. paper).

6.6. Condition of **fire** extinguisher and **fire** suppression system (e.g. charged or uncharged).

6.7. For heat sources and flammable materials(e.g. no combustible material in contact with lights).

6.8. That the outlets from the operator's cab are clear and useable.

7. Pre-use checks:

7.1. The results of pre-use checks shall be recorded (e.g. using a checklist) and any defects recorded by the operator.

7.2. Any dangerous condition shall be reported immediately to the supervisor and equipment use shall be suspended until condition is rectified.

7.3. Completed pre-use check sheets shall be provided to maintenance personnel and any defects recorded in the maintenance system.

7.4. All operators shall be trained or instructed in pre-use checks at induction.

8. **Hot work** activities

8.1. A **mine** shall designate areas where **hot work** may be performed, such as a welding bay in a workshop. In these areas a general risk assessment should be conducted and all the identified **controls** applied;

8.2. **Hot work** can be conducted in these areas without a permit only if the appropriate **controls** are implemented. Any **hot work** in other areas shall be controlled through the **hot work** procedure and associated permit; and

8.3. A **hot work** permit system shall be applied for any such activity in any part of a **mine** outside a designated **hot work** area. The system shall be based upon a procedure that at least include but not limited to the following requirements:

8.3.1. The work or procedure shall be authorized by an appointed person.

8.3.2. The provision of adequate flash-back arrestors for Oxy/acetylene equipment.

8.3.3. Inspection of the equipment for potential fuel sources prior to work commencing ("pre-work" inspection) must be performed.

8.3.4. The removal of any flammable materials in the immediate vicinity of the **hot work** site before the commencement of any work.

8.3.5. The provision and availability of **fire** extinguishers or other **fire**-fighting equipment in the immediate vicinity of the **hot work**site.

8.3.6. An adequate fresh air flow is present at the **hot work** site. **Hot work** shall stop in the event of any detectable weakening or stoppage of fresh air flow.

8.3.7. Thermal blankets shall be provided to shield any exposed equipment where **hot work** is conducted particularly where this contains flammable constituents. (focus on making available adequate means of extinguishing **fire** like water and water hoses).

8.3.8. The use of an observer or **fire**-watch, where required.

8.3.9. A thorough inspection of the equipment and work area after work has been completed ("Post-work" inspection).

8.3.10. All precautionary measures relating to the transport and storage of gas cylinders should be followed prior to and following the completion of **hot work**.

8.3.11. Use of the appropriate permit form or sheet and follow the standard procedure to record that the above checks have been undertaken.

9. The **COP** shall include reference to the maintenance of cutting and welding equipment. The following shall be considered:

9.1. The specifications of the period for the inspection of oxy-acetylene handsets, regulators and hoses.

9.2. The specifications of the inspections and tests periods of electrical welding transformers and leads.

9.3. In addressing the maintenance procedures for **fire** suppression systems, the **COP** shall cover the following:

9.3.1. The distribution piping of all automatic **fire** suppression systems shall be flushed on a routine basis in line with sound maintenance practices.

9.3.2. Visual inspections to check **fire** suppression system lines, nozzle alignment and that debris caps are in place shall be conducted on a routine basis in line with sound maintenance practices.

9.3.3. Full discharge tests (pressure test) shall be conducted of mobile equipment or fixed plant automatic **fire** suppression systems regularly.

9.3.4. Full discharge tests shall be conducted of automatic **fire** suppression systems on remotely operated equipment from the remote operating unit regularly as per **mine** standard or **OEM** specification) every three months.

9.4. **Fire protection** systems, including smoke or heat detectors, in high-risk areas (e.g. magazines, refuelling bays, workshops, combustible stores etc.) shall be inspected and tested every six months (alternatively as per **mine** standard or **OEM** specification.).

9.5. Full discharge tests shall be conducted on automatic **fire** suppression systems of fuel cells or fuel storage areas every six months and include a check that the operation of the equipment is inhibited following the test.

9.6. The maintenance of **fire** protection equipment shall be undertaken in accordance with relevant **SANS**.

ANNEXURE H: INSPECTIONS

(For information purposes)

1. In conducting formal inspections, the following shall be considered as minimum to assist in reducing **fire** risk:

1.1. Compliance with explosives transport and storage procedures.

1.2. The signage prohibiting smoking and naked flames in designated areas.

1.3. Checks for flammable materials on equipment or in engine bays.

1.4. Use of the **hot work** procedure and compliance with **hot work** permit requirements.

1.5. Compliance with site housekeeping standards.

1.6. Correct vehicle or parking requirements (e.g. only in designated areas).

1.7. Compliance with combustible storage standards (e.g. in workshops and fuel storage areas).

1.8. Competencies shall be provided through competency-based training delivered through the site's training system. This system shall include the proper recording of all training and competency assessments.

1.9. The level of (adequate) **fire**-fighting competencies required to help reduce **fire** risk shall include:

1.9.1. All employees who work at the **mine**.

1.9.2. Operators of mobile equipment and fixed plant.

1.9.3. Employees involved in the transport or handling of explosives in magazines.

1.9.4. Employees maintaining mobile equipment and fixed plant.

1.9.5. Electrical maintenance personnel.

ANNEXURE I: ADDITIONAL REFERENCES

1. **SANS** 543:

1.1. This standard specifies requirements for the construction and performance of **fire** hose reel systems with semi-rigid hoses for installation in buildings and other construction works, permanently connected to a water supply.

2. **SANS** 1128-1:

2.1. This part of **SANS** 1128 covers the construction and performance requirements of underground and above-ground hydrant assemblies.

3. **SANS** 1128-2:

3.1. This standard covers **fire** hose:

3.1.1. Delivery couplings to fit hose of nominal diameter 45 mm, 65 mm, 70 mm and 100 mm

3.1.2. Suction couplings to fit hose of nominal diameter 80 mm, 90 mm, 100 mm, 115 mm, 125 mm, 140 mm, and 150 mm.

3.1.3. Connectors.

3.1.4. Branch pipe and nozzle connections for delivery hose.

4. **SANS** 1151:

4.1. This standard specifies the characteristics of stored pressure, portable rechargeable **fire** extinguishers of the halogenated hydrocarbon type, of capacity not exceeding 12 kg and suitable for use on **fires** of classes A, B and C.

5. **SANS** 1322:

5.1. This standard covers class I and class II portable, non-refillable **fire** extinguishers of the stored pressure type and having a capacity of not more than 1,5 kg for use with all classes of **fire** other than class D.

5.2. This standard does not cover extinguishers having a high pressure liquefiable gas as the extinguishing medium.

6. **SANS** 1475-1:

6.1. This part of **SANS** 1475 covers the administrative and technical details and **controls** applicable to the acceptable reconditioning of any portable and wheeled (mobile) rechargeable **fire** extinguisher (Amendment 1).

6.2. It covers only those **fire** extinguishers that have been removed from service and have been presented for reconditioning.

6.3. It does not cover new **fire** extinguishers or a reconditioned **fire** extinguisher presented for sale.

7. **SANS** 1475-2:

7.1. This part of **SANS** 1475 specifies the procedures that apply to the effective reconditioning of **fire** hose reels and above-ground **fire** hydrants. It does not cover the replacement or installation of hose reels and above-ground hydrants.

8. **SANS** 1522:

8.1. This standard covers the requirements for **fire** extinguishing powders for **fires** of class A, class B and class C.

8.2. This standard does not cover the assessment of the performance of an extinguishing powder in a particular piece of equipment, other than the standard test extinguishers used in certain of the tests.

9. **SANS** 1567:

9.1. This standard specifies the characteristics of portable rechargeable **fire** extinguishers of the CO2 type, of charge mass not exceeding 9 kg and suitable for use on class BC **fires** (see 3.5.3).

10. **SANS** 1825:

10.1. This standard specifies minimum requirements for test stations for transportable gas cylinders of water capacity 0,5 L to 3 000 L, including CO2 gas cylinders used in **fire**fighting applications.

10.2. This standard excludes the testing of hand-held **fire** extinguishers with an operating pressure less than 2 000 kPa.

10.3. This standard does not apply to gas cylinder test stations that carry out the replacement of cylinder valves, or screw-on type valve guards, and the straightening of bent foot rings or valve guards without the application of heat.

11. **SANS** 1910:

11.1. This standard covers the principal requirements for the safety, reliability and performance of portable, stored pressure, refillable type **fire** extinguishers suitable for use on **fires** of classes A, B and C.

11.2. This standard covers the requirements for water type, foam type and dry chemical powder type **fire** extinguishers.

11.3. It does not cover the requirements for CO2 **fire** extinguishers. For the requirements of this **fire** extinguisher, refer to **SANS** 1567.

11.4. It does not cover Halon type extinguishers. (South Africa has agreed to abide by the Montreal Agreement on the use of CFC products. However, maintenance on this type of extinguisher is still carried out in terms of **SANS** 1475-1.)

11.5. It does not cover the cartridge operated extinguisher.

12. **SANS** 10019:

12.1. This standard covers the minimum requirements for the design, manufacture, use and maintenance of refillable and non-refillable pressure receptacles of water capacity 0,5 L to 3 000 L and cartridges of 0,5 L, and may include requirements over and above those contained within the cylinder design and manufacturing standards.

12.2. In addition to industrial, medical and domestic type pressure receptacles, this standard also covers cylinders for self-contained underwater breathing apparatus (SCUBA) for recreational diving, self-contained surface breathing apparatus (SCBA), **fire**-fighting extinguishers and fixed **fire**-fighting extinguishing systems.

12.3. The standard covers the design requirements for CO2 and High-Pressure Inert gas mixtures used in portable and fixed **fire**-fighting systems but excludes the operational performance requirements of portable and fixed **fire**-fighting extinguishing systems (see **SANS** 1572 and **SANS** 1567).

12.4. It does not cover special pressure receptacles used in aircraft or air-brake reservoirs and SCUBA cylinders for professional use.

13. **SANS** 1015-1:

13.1. This part of **SANS** 10105 gives the requirements for the selection, installation, inspection and use of portable and mobile **fire** extinguishers.

14. **SANS** 10105-2:

14.1. This part of **SANS** 10105 covers the requirements for the installation and inspection of **fire** hose reels and above-ground hydrants.

15. **SANS** 10287:

15.1. This standard establishes general principles for the design, installation and maintenance of automatic sprinkler installations for **fire**-fighting purposes in buildings and industrial plants.

15.2. It covers the classification of **fire hazards**, the provision of water supplies, components to be used, the installation of automatic sprinkler systems, the testing of installations, maintenance, and the extension of existing systems.

15.3. With regard to buildings, it identifies construction details that are necessary for the satisfactory performance of sprinkler installations in terms of this standard.

16. **SANS** 10400-T:

16.1. This part of **SANS** 10400 provides deemed-to-satisfy requirements for compliance with part T (**Fire** Protection) of the National Building Regulations.

17. **SANS** 10400-W:

17.1. This part of **SANS** 10400 provides deemed-to-satisfy requirements for compliance with part W (**Fire** Installation) of the National Building Regulations.

18. **SANS** 7240 consists of the following parts, under the general title **Fire** detection and alarm systems:

18.1. Part 1: General and definitions.
18.2. Part 2: Control and indicating equipment.
18.3. Part 4: Power supply equipment.
18.4. Part 5: Point-type heat detectors.
18.5. Part 6: Carbon monoxide **fire** detectors using electro-chemical cells.
18.6. Part 7: Point-type **smoke detectors** using scattered light, transmitted light or ionization.
18.7. Part 8: Carbon monoxide **fire** detectors using an electro-chemical cell in combination with a heat sensor.
18.8. Part 9: Test **fires** for **fire** detectors (Technical Specification).
18.9. Part 10: Point-type flame detectors.
18.10. Part 11: Manual call points.
18.11. Part 12: Line type **smoke detectors** using a transmitted optical beam.
18.12. Part 13: Compatibility assessment of system components.
18.13. Part 14: Guidelines for drafting codes of practice for design, installation and use of **fire** detection and **fire** alarm systems in and around buildings (Technical Report).

19. **SANS** 14113

19.1. Gas welding equipment - Rubber and plastic hoses assembled for compressed or liquefied gases up to a maximum design pressure of 450 bar.

20. **SANS** 9244

20.1. Earth-moving machinery — Machine safety labels — General principles

21. **SANS** 12100

21.1. Safety of machinery — General principles for design — Risk assessment and risk reduction

22. **SANS** 10087-1,

22.1. The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation.

23. **SANS** 10119:

23.1. Reduction of explosion **fire hazards** presented by electrical equipment —Segregation, ventilation and pressurization.

24. **SANS** 10087-2 (**SABS** 087-2),

24.1. The handling, storage and distribution of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 2: Installations in mobile units and small non-permanent buildings.

25. **SANS** 10087-3,

25.1. The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L.

26. **SANS** 10087-4 (**SABS** 087-4),

26.1. The handling, storage and distribution of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 4: Transportation of LPG in bulk by road.

27. **SANS** 10087-6,

27.1. The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 6: The application of liquefied petroleum and compressed natural gases as engine fuels for internal combustion engines.

28. **SANS** 10087-7

28.1. The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations – Part 7: Storage and filling premises for refillable liquefied petroleum gas (LPG) containers of gas capacity not exceeding 9 kg and the storage of individual gas containers not exceeding 48 kg.

29. **SANS** 10087-10

29.1. The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations – Part 10: Mobile filling stations for refillable liquefied petroleum gas (LPG) containers of capacity not exceeding 9 kg.

30. **SANS** 10089-1

31. The petroleum industry – Part 1: Storage and distribution of petroleum products in above-ground bulk installations.

32. **SANS** 10089-2

32.1. The petroleum industry – Part 2: Electrical and other installations in the distribution and marketing sector.

33. **SANS** 10089-3 (**SABS** 089-3)

33.1. The petroleum industry – Part 3: The installation of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations. Amendment 2 **SANS** 10108: The classification of **fire** hazardous locations and the selection of apparatus for use in such locations.

34. **SANS** 60079-0/IEC 60079-0

34.1. Explosive atmospheres – Part 0: Requirements – General requirements.

35. **SANS** 60079-2/IEC 60079-2

35.1. Explosive atmospheres – Part 2: Equipment protection by pressurized enclosures “p”.

36. **SANS** 60079-13/IEC 60079-13

36.1. Electrical apparatus for explosive gas atmospheres – Part 13: Construction and use of rooms or buildings protected by pressurization.

37. **SANS** 60079-16/IEC 60079-16

38. Electrical apparatus for explosive gas atmospheres – Part 16: Artificial ventilation for the protection of analyser(s) houses.

39. **SANS** 1234

39.1. This standard specifies requirements for six classes of **fire**-door and **fire**-shutter assemblies that are intended to close permanent openings in walls or partitions, to provide a **fire** resistance of at least 30 min in order to stop the spread of **fire** and to limit the spread of smoke.

40. **SANS** 193

40.1. This standard specifies requirements for **fire** dampers and test methods for the determination of the resistance of **fire** dampers to **fires** and to the passage of gases at high temperatures.

41. National Veld and Forest **Fire** Act, 1998 (Act No 101 of 1998) as amended.

42. **MHSA** regulation 5.1(3) as amended.