1 TITLE PAGE

COP : Code of Practice

BLACK MOUNTAIN MINE

MANDATORY CODE OF PRACTICE FOR PREVENTION OF FIRES AT MINES

This Code of Practice was drawn up in accordance with Guideline DMR 16/3/2/4-B3 issued by the Chief Inspector of Mines promulgated in the Government Gazette on 30 September 2016

DMR Mine Code number: 0195

Operation Reference Number: BMM-HSE-VOH-COP-010

Effective Date: 28 February 2017

DMR Date First Issued: First Edition

Revision Dates: (Include all revision dates)

Revision 1: 10 JUNE 2020

Revision 2: 10 JUNE 2023

Next Revision Date: 10 JUNE 2026

The Contents of this Document state the minimum requirements.
These requirements may be enhanced in the interest of Safety and Health.

PREVENTION OF FIRES AT MINES

Code of Practice Approval Page

Compiled By: 603542 L Mageman VOH Manager Date: 2023.07.24	Approved By: 31/10/2023 NUM Health & Safety Representative Date:	Approved By: R Kotze Safety Manager Date: 08/11/23
Approved By: AM Cloete Snr. Environmental Supervisor Date: 2023.08.28	Approved By: J Behr Survey Manager Date:	Approved By: M Hanekom Engineering Manager Date: 3/11/2023
Approved By: K Nel Plant Production Manager Date: 28/08/23	Approved By: D Mathebula Mining Manager Date: 13 Nov 2023	Approved By: R Matodzi General Manager Date: 29/11/2023

Table of Contents

1. PURPOSE

To have in place a Code of Practice that will improve prevention of fires, thereby minimizing the risks to persons affected by fires.

2. SCOPE

This Code of Practice applies to all Black Mountain Mining licenced areas

3. STATUS OF CODE OF PRACTICE

3.1 This COP was drawn up in accordance with Guideline Reference Number DME 16/3/2/4-B3 issued by the Chief Inspector of Mines

3.2 This is a mandatory COP in terms of section 9(2) and (3) of the MHSA

3.3 The COP may be used in an accident investigation/inquiry to ascertain compliance and also to establish whether the COP is effective and fit for purpose

3.4 The COP supersedes all previous relevant COP’s

3.5 All managerial instructions, recommended procedures (voluntary COP’s) and standards on the relevant topics must comply with the COP and must be reviewed to ensure compliance

4. MEMBERS OF THE DRAFTING COMMITTEE

4.1 In terms of section 9(4) of the MHSA, the Health and Safety Committee was consulted on the preparation, implementation or revision of this COP.

4.2 I, **Rembu Matodzi (4.1 Appointee)**, hereby appointed the members as listed below on the drafting/reviewing committee for this COP.

4.3 Members of the Drafting:

NAME	DESIGNATION	QUALIFICATION	AFFILIATION	EXPERIENCE	SIGNATURE
Charles Klopper	VOH Manager	Cert in Mine Environmental Control	Mine Ventilation Society (MVS)	23 years	
Marius Magerman	Sectional VOH Officer	Cert in Mine Environmental Control	Mine Ventilation Society (MVS)	16 years	
Lance Williamson	Engineering Manager	GCC	AMRE	30 years	
Colin Masobeni	NUM Representative	COMSOC 1 & 2 Blasting Certificate	NUM	21 years	
Wendell Freeman	Full Time Health & Safety Rep	COMSOC 1 & 2 SAMTRAC		17 years	
Llewellyn Barry	Full Time H&S Rep	COMSOC 1 & 2		9 years	
Werner Carsten	Assistant to Manager: Deeps	Mine Overseer Certificate		23 years	
KAINGO NKOANA ~~Jaco Venter~~	Section Manager: Swartberg			years	
Edwin Matlapeng	Safety Manager	B-Tech Safety Management	IOSM	30 years	
Theo van Landeghem	TMM Engineer	GCC (MECH)		30 years	
Wessel Sauer	Act Plant Engineer	BEng. E&E		3 years	
Kotishi Mamosebo	Mining Manager	MMC	SANIRE	32 years	
Shane Links	Shaft Engineer	B-TECH MECH ENG		13years	
Kenric Barbery	HRD MANAGER ~~Act HR Manager~~	B-Tech HRM		20 years	
Weston van Wyk	Act Training Manager			years	
Gary Ephraim	Commercial Manager	CIPS		29 years	
Adrian Landsberg	Plant Manager			years	

4.4 Members of the Review Committee:

NAME	DESIGNATION	QUALIFICATION	AFFILIATION	EXPERIENCE	SIGNATURE
Leonard Magerman	VOH Manager	Cert in Mine Environmental Control	Mine Ventilation Society (MVS)	26 years	
Marius Magerman	Sectional VOH Officer	Cert in Mine Environmental Control	Mine Ventilation Society (MVS)	20 years	
Mbongani Mkheto	NUM Health & safety	Operator	NUM	16 years	
Wendell Freeman	Full Time Health & Safety Rep	COMSOC 1 & 2 SAMTRAC		18 years	
Llewellyn Barry	Full Time H&S Rep	COMSOC 1 & 2 SAMTRAC NEBOSH INTERNATIONAL		13 years	
Mapheu Mawasha	Section Manager: Mining	Mine Managers Certificate B-Tech Mining		10 years	
William Titus	TMM Engineer	B-Eng Mech		3 years	
Freddie Haefele	Compliance Officer	COMSOC 1&2 OHSAS 18001		20 years	
Shane Links	Shaft Engineer	B-Tech Mechanical Engineering GCC		13 years	
Reagon Links	Plant Engineer	GCC, Mechanical Engineer N.National diploma		16 years	
Weston van Wyk	Training Manager	B-Tech HRM		17 years	

Signed for on behalf of the Joint Health and Safety Committee:

Name	Signature	Date
W Freeman		27/07/2023
L Barry		21/08/2023

Approved: Rembu Matodzi - General Manager (4.1 Appointee)

Signature: _______________ Date: ______________

5. GENERAL INFORMATION

5.1 MINE DESCRIPTION & LOCATION

Black Mountain, coordinates -29.252929/18.817737, is an underground Base Metal mine situated near the town of Aggeneys, 70 km west of Pofadder and 110 km east of Springbok, consisting of the following major areas:

- Deeps section (situated 8 km west of Aggeneys)
- Swartberg section (situated 15 km west of Aggeneys)
- Concentration Plant (situated 10 km west of Aggeneys)

5.2 COMMODITIES PRODUCED

Black Mountain produces lead, zinc and silver from the underground sources at Deeps Swartberg orebodies. Monthly ore production is set at 160 000 tons, of which between 45 % originates from Swartberg,

5.3 MINING METHODS

Black Mountain Mining

- Deeps & Swartberg: mechanized mining utilizing Cut & Fill and Blast-hole mining methods

5.4 FIRE PREVENTION MEASURES

At Black Mountain Mining, the emphasis remains one of prevention embodied in the design of structures and ventilation systems in order to prevent the occurrence of fires and to limit the impact of such occurrences. In line with the mine's risk assessment approach, the implementation of the hierarchy of controls are followed during the design of processes, equipment and machinery. The use of flammable materials and substances must be limited. Where this is not possible, risk assessments are utilized to select adequate and viable protective measures as per BMM Fire Standards, Reference number VOH-SOP-010A.

Fire prevention measures are discussed in more detail under section 8.2 Fire Prevention Controls. A brief summary is given below:

a) Induction/refresher training – Fire & Emergency preparedness modules and assessments

b) Maintenance of equipment

c) Hot work permit systems

d) Explosive controls

5.5 UNIQUE FEATURES TO BLACK MOUNTAIN MINING

The mine's remoteness/location:

- This has an influence on traveling times for additional emergency services

Deeps - Decline & shaft system:

- Deeps shaft consists of a decline (surface to shaft bottom) and a shaft system for means of escape should it be necessary

Swartberg - Decline & second escape system:

- Swartberg consists of a decline system, with the ventilation shaft provided with the necessary equipment to easily install escape equipment by the proto teams as a means of second escape.

5.6 OTHER RELEVANT COP'S, SOP'S, STANDARDS & PROCEDURES

The following documentation has relevance:

a) COP 001: Lamp rooms

b) COP 002: Emergency Preparedness & Response

c) VOH-SOP-010A Fire Standards

d) VOH-SOP-002A Emergency Management Plan

e) VOH-BMF-002A Emergency Management Flow Chart

f) BMM-VOH Baseline Risk Assessment for Fire Prevention & Control

g) BMF 034 Emergency Call-out Procedure

h) SS0078 Fire Emergency Reporting

i) COP 010: Airborne Pollutants

j) COP 011: Prevention of Flammable Gas Explosions in Mines other than Coal Mines

k) COP - GEN-ENG- Safe use of Conveyor Belt Installations for the transportation of mineral

l) COP 008 - Operation of Trackless Mobile Machinery

m) MIN-PRD-EXP-003 - Explosives Management.

n) VOH-COP 012 Management of working in confined spaces at mines

o) SOP: Housekeeping and Waste Removal System

p) SOP 014: Smoking Policy

q) TMM Risk assessments (copies kept with the TMM Engineer / document control)

r) Explosives: Various documents as referred to under section:

s) Hot Work: Various documents as referred to under section*: 8.2.4 Workshops* and *8.2.6.2 Combustible Substances, c) Flammable Gases*

6. TERMS & DEFINITIONS

As & When Required	This COP will be reviewed and updated after every serious incident relating to the topic covered in the COP or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material
BMM	Black Mountain Mining
COP	Code of Practice
DMR	Department of Mineral Resource
Fire	A rapid oxidation process in which a chemical reaction results in the evolution of light, gases, and heat energy varying in intensity
Fire Detection System	The combination of Fire Alarm Systems and Fire detectors
Fire Alarm System	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 in order to initiate the appropriate response to those signals
Fire Detector	An automatic device designed to detect the presence of a fire and initiate action
Flammability	The ease with which a substance is capable of catching fire
Flash Point	The lowest temperature at which a substance produces enough vapour to ignite and burn when an ignition source is applied but will stop when the source is removed
Ignitability	The ease with which a substance or material is able or likely to catch fire or burn
Flammable Range	The range of concentrations, expressed as a percent by volume, over which a gas or vapour is flammable
Smoke Detector	An automatic device designed to detect the presence of smoke and initiate action
Fire Protection Measures	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
Fire Suppression System	A system designed to enable total flooding by or for the localized application of extinguishing agents

Fire Specialist	A person with specific training in fire related science and technology with suitable experience in the field of application and operation
Flame	The visible portion of the fire
Flame Retardant	A self-extinguishing substance or material that will inhibit the formation or the spread of a flame on a surface to which it is applied
Fire Hazard	A condition that presents the potential for harm to people and damage to property, or the environment as a result of fire
Hierarchy of Controls	A structured sequence of options for the application of controls and barriers to eliminate or reduce risk
Hot Work	Work involving burning, heating, welding, grinding or a similar operation that is capable of initiating fires or explosions
MHSA	Mine Health and Safety Act, 1996 (Act No. 29 of 1996) as amended
MINE	As defined in the Mine Health and Safety Act, 1996 (Act No. 29 of 1996) as amended
NFPA	National Fire Protection Association
OEM	Original Equipment Manufacturer
OEHS	Occupational, Environmental, Health and Safety
RISK	A measure of the probability and severity of adverse effects that result from exposure to a fire hazard
SABS	South African Bureau of Standards
SANS	South African National Standard
SDS	(Material) Safety Data Sheet (solids, liquids and gases)
VOH	Ventilation & Occupational Hygiene

7. RISK MANAGEMENT

7.1 RISK ASSESSMENT

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 and to record the significant hazards identified and risk assessed. The employer must determine how the significant risks identified in the risk assessment process must be dealt with. This COP, together will related documents, will address how the significant risks identified in the risk assessment process will be dealt with, having regard to the requirements of Section 11(2) and (3) that, as far as reasonable practicable, attempts are made to, in order of priority:

a) Eliminate the risk at source

b) Control the risk at source

c) Minimize the risk

d) Provide PPE insofar as the risk remains

e) Monitor the risk via a formal programme

A Baseline Risk Assessment was conducted, reference BMM-VOH Baseline Risk Assessment for Fire Prevention & Control, to systematically identify, assess and prioritize the most significant fire related hazards and risks on the mine. The main purpose of the Baseline Risk Assessment was to;

f) Comply with the requirements of Section 11(2) of the Act, to identify hazards, assess the health and safety risks to which employees and non-employees may be exposed while they are at work

g) Evaluate existing fire prevention and protection measures and where controls are insufficient or inadequate provide recommendations for further risk elimination or loss reduction measures

h) Obtain and provide detailed information in order to review and update the mine's existing fire standards and fire risk management program

The Baseline Risk Assessment included shaft surface areas and infrastructure, underground workings, installations, workshops and mining sections at both Deeps shaft and Swartberg section, as well as surface areas such as the plant, main workshops and stores. Significant risks identified and assessed during the baseline risk assessment are listed under item 8.1.1.3 Fire hazard identification process and section 8.1.2: 'Assessment of fire risks'. In addition to the above, TMM specific risk assessments were conducted for the various type of TMM in use at BMM.

7.2 RELEVANT INFORMATION

In order to assist with the hazard identification and risk assessment process relevant information pertaining to fires was utilised, such as mine procedures, COP's, fire standards, industry wide Incident/accident statistics, research reports /case studies, national and international fire standards, OEM's specifications, approvals and design criteria. Refer to annexure 'A' for a detailed reference list in this regard.

The risk assessment is conducted, systematically identifying the risk of all the processes and contributing factors and these risks is then prioritized. BMM Fire Baseline Risk Assessment is updated based on the information to have an integrated approach to health and safety risks.

7.3 PERIODIC REVIEW

In addition to the periodic review required by Section 11(4) of the MHSA, this COP will be reviewed and updated after every serious incident relating to fires, altered circumstance, or if significant changes are introduced to procedures, mining and ventilation layouts, mining methods, plant or equipment and material. The periodic review will not exceed a period of three (3) years.

8. ASPECTS ADDRESSED IN THE COP

In order to manage the risks associated with fires at BMM, the Fire Risk Management structure as depicted below is followed:

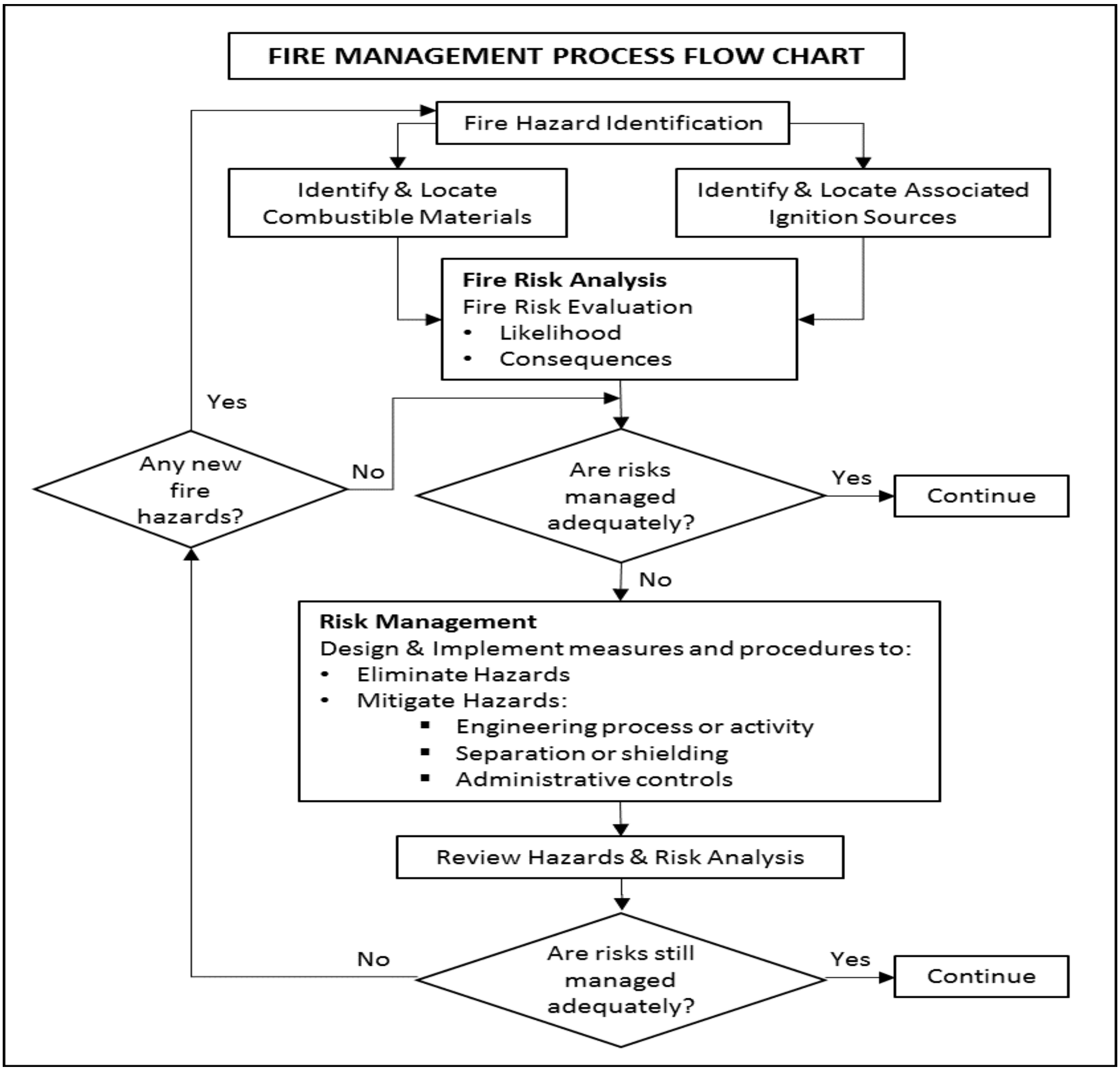

Figure 1: Fire Risk Management Diagram

8.1 FIRE & RISK MANAGEMENT

The main aim of the mine's fire risk management program is to enhance and maintain the health & safety of people and the operation. To this end the fire management program is based on a risk management approach to safety and is an integral part of the mine's OESH and emergency Management system. In relation to fire risk management, each of the following must be addressed:

a) Fire hazard identification (fuel sources, ignition (heat) sources)

b) Fire risk assessment and risk control (Preventative measures, Fire Standards, Standard Operating Procedures, Codes of Practice)

c) Consultation with all stakeholders (Provision of adequate information, instruction, training and supervision on fire hazards and fire risk controls).

d) Monitoring, review, revision, audit and reporting on the fire risk management process.

The fire risk management process shall be carried out in all BMM locations in accordance with *Figure 1: Fire Risk Management Diagram (above)*

8.1.1 IDENTIFICATION OF FIRE HAZARDS

All fire hazards must be identified and dealt with so that they are effectively eliminated or otherwise controls established to minimise the risk to Occupational, Environment, Safety, & Health (OESH) to the lowest level reasonably practicable. Identification of fire hazards shall take place continually as an integral part of operations management. The various types of fire hazard identification and risk assessment processes utilised by BMM are described in section 8.1.1.3.

In order to identify and evaluate fire hazards and risks, it is necessary to have some understanding how fires start. The three requirements for a fire are: *fuel, heat (ignition source) and oxygen*. When combined, they result in a rapid chemical chain reaction that releases heat and light and is accompanied by a flame. *An effective fire prevention strategy emphasises the elimination or control of fuel and ignition sources,* while the strategy in case of a fire outbreak focuses on removing the heat, fuel or oxygen, or suppressing the underlying chemical reaction.

The identification of scenarios that could lead to fires shall focus on eliminating or controlling the first two requirements (for example by physical means), as oxygen will always be present in air in the mine environment and cannot be excluded. Fire hazards shall be identified in accordance with the process depicted in Figure *2* below.

Identification of fire hazard locations

The first step in the process is to systematically identify and list potential fire hazard locations and fire hazardous areas throughout the mine. A baseline fire risk assessment as described in section 7.1.2 was conducted to identify the Fire hazard locations and potentially hazardous areas, and included: Refer to Fire Prevention Risk Assessment (Mobi Lift, Crane, telehandler, VDM trucks)

a) Fuel Storage areas

b) Main Substations

c) Hoist Room

d) Shaft access points

e) Trackless Mobile Equipment (TMM) – mobile fire risk

f) Workshops

g) Hot work areas

h) Gas cylinder stores

i) Crushers

j) Pump stations

k) Conveyor belts

l) Hazardous materials storage

m) Waste disposal

n) Flammable liquid stores

o) Explosives storage areas

p) Office buildings & control room

q) Lamp room

r) MCC

s) Compressor Houses

t) HT Yard

Fire hazards associated with each of the above locations as well as a fire impact description and a risk analysis to determine the inherent risk, have been completed during the baseline risk assessment (see comprehensive details). A summary of information is shown in Annexure B.

8.1.1.1 FIRE HAZARDS: FUEL SOURCES

Fuel sources have been identified in terms of the fire classes defined by the combustion process associated with them, using table 1 below, a hazard classification shall be assigned to the identified hazards.

Fuel source classification	Description
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.
Class B: Materials (flammable liquids and gases)	Non-solid fuels consisting of flammable or combustible liquids or gases such as diesel, petrol, acetylene gas, etc.
Class C: Energized electrical equipment	Electrical fires involve potentially energized electrical equipment. This sort of fire may be caused by short-circuiting or overloaded electrical networks.
Class D: Combustible metals	Combustible metals mostly encountered are magnesium, potassium, titanium, and zirconium. With the exception of 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 they have the ability to 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.
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 subclass of the flammable liquid/gas category, the special characteristics of these types of fires, namely the lower flash point, are considered important enough to re-classify these separately.

Table 1: Fuel Source Classification

8.1.1.2 FIRE HAZARDS: IGNITION SOURCES

Following the identification and classification of fuel sources, the next step in the process, is to identify potential sources of ignition including but not limited to the following energy sources:

Ignition Source	Description
Heat energy	The presence of heat energy is often characterized 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, contraband (cigarette butts, matches or cigarette lighters). Hot work naked flames from use of welding flame cutting or grinding equipment
Electrical energy	Switch gear, motors, retarders, transformers, lights and cables; short-circuit arcs, earth-faults, static electricity discharge, induction heating, thyrist or drives.
Mechanical energy	Friction (conveyor belts drives, winch ropes), mechanical impact (coal picks) or grinding.
Chemical energy	Self-heating, auto-ignition, exothermic reactions, spontaneous combustion of coal and induced pyrolysis of vehicle tyres (lightning).

Table 2: Ignition Sources

Fire Hazard Register

The outcomes of the fire hazard identification process is recorded in a Fire Hazard Register that identifies the location of the hazard, together with its classification of fuel and ignition sources – included as part of the Baseline risk assessment document.

8.1.1.3 FIRE HAZARD IDENTIFICATION PROCESS

To facilitate a structured approach to risk assessment, BMM utilises a three-tier risk assessment process as follows:

i) **Baseline Risk Assessment:** are conducted to systematically identify and prioritize fire risks associated with the geographical areas, facilities/installations, equipment and activities in order to determine the current status of fire risks and associated hazards that may impact the Health and Safety of people and the Environment. The results of the baseline risk assessment shall be used as a basis for the assessment and control of fire risk at the mine and shall be maintained and kept current by utilising the outputs of issue based and continuous risk assessments. Additionally, a review of the baseline risk assessment shall be conducted on an annual basis, or immediately with the occurrence of changes in conditions and/or processes or resulting from an incident as outlined below.

ii) **Issue Based Risk Assessments:** are used to conduct a risk assessment in greater detail, due to the significance of the risk involved and the need for an improved understanding of the causal factors. Issue Based Risk Assessments can therefore be done in great variance/degree of detail and complexity, *depending on the degree of risk involved.* As circumstances and needs arise, issue-based risk assessment studies will need to be conducted, and are normally associated with a system for the management of change, for example:

- When a new machine, equipment or material is introduced into the mine, or a system of work is changed, or operations alter
- After an incident/accident has occurred, and/or
- As new knowledge comes to light and information is received which may influence the level of risk to employees at the mine
- Information from employee fire hazard identification and reporting procedures
- Results from workplace inspections and observations, and
- Equipment and plant inspections

a) Scoping the Risk Assessment

Before any risk assessment (baseline or issue based) is undertaken, the geographical scope/ definition of parameters of the assessment must be determined as follows:

- The name of the person responsible for the respective assessment(s)
- Date and location of assessment
- Activities, processes, area(s) to be assessed
- Internal and external stakeholders
- Relevant policies and processes
- Relevant legislative requirements, SOP's, Fire standards, COP's, and
- Individual roles and responsibilities

b) Selecting a Risk Assessment Team

- The risk assessment team shall comprise appropriate internal and (if necessary) external expertise, relevant to the type and scope of the assessment. The team shall, at a minimum, consist of a representative cross-section of personnel involved in the project/activity/working area being assessed, from management level through to employee level
- 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. VOH Manager or VOH Officer) be involved in the assessment of fire risks

c) Operational Procedures & Standards

- A list of operational procedures and standards that were affected (added, amended or deleted) as the result of risk assessment shall be included – Refer to section 5.6 “Other Relevant COP’s, SOP’s, Standards & Procedures”, as well as details of where the official risk assessment documentation is kept at the mine. Records shall be documented and managed in accordance with BMM’s Document Management system/Document Control procedure.

d) Documentation & Records Management

- The risk assessment process and results shall be appropriately documented. Details of where the official risk assessment documentation is kept at the mine shall be managed in accordance with BMM’s **Document** Management system/Document Control procedure.

iii) **Continuous Risk Assessments:** are used to identify hazards of a restricted and specific work area, machinery or equipment, prompting immediate action – to the point of conclusion, by the person who identified the hazard, due to significance of the risk involved. The following forms part of continuous risk assessments:

a) Pre-task risk assessments: are conducted before a task is performed and recorded in a pocket sized booklet. The objective of this risk assessment is to identify hazards related to specific tasks before they are undertaken, identify unwanted events that could occur and to review the controls that are in place to eliminate or minimise the risk

b) Inspections (including pre-use/ pre-start, workplace, plant &/or equipment)

c) Observations and over inspections

d) Planned Maintenance systems

e) Fire surveys and audit

8.1.2 ASSESSMENT OF THE FIRE RISKS

8.1.2.1 FIRE RISKS ASSESSMENT METHOD

The fire hazards and threats as identified during the Baseline Risk Assessment (and listed in 8.1.1) are analysed to assess their contribution to the overall fire risk in order to determine their relative importance, based on the likelihood of occurrence and the potential impact it may have on People, Local Communities, the Environment, and the future viability of operations. The BMM risk matrix (reference SS 0014) was used to assess the risk and included:

a) The identification of 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; and
c) The input from a number of specialist areas, including Ventilation Occupational Hygiene (VOH) and emergency response as part of the risk mitigation process. A team-based approach is followed when conducting a risk assessment as outlined 8.1.1.3 “Selecting a risk assessment team”

Where appropriate, similar fire hazards or classes of fire hazards will be/was analysed in logical groupings as may be determined by the mine’s infrastructure, process or design.

The table below depicts the areas covered during the risk assessment, with a brief description below:

Location	Fuel Source	Fire Load	Ignition Source(s)	Impact Description	Risk Analysis			Existing Controls		Existing Controls	Residual Risk			Risk Mitigation Recommendations
					Likelihood	Consequence	Risk Rating	Preventative Measures	Protective Measures	Gap Analysis	Likelihood	Consequence	Risk Rating	

Table 3: Baseline Risk Assessment Table

i) Likelihood of exposure/impact

In order to determine the likelihood of exposure/impact, the hazards/risks are assessed considering the harm that could be caused, with a numerical factor that best describes the likelihood of exposure or impact assigned to it as per table below:

Almost Certain	5	The unwanted event has occurred one or more times per year at the site and is likely to happen again within 1 year

Likely	4	The unwanted event has occurred less than once per year at the site but is likely to happen again within 5 years
Possible	3	The unwanted event/has occurred in the business at some time: or could happen within 10 years.
Unlikely	2	The unwanted event has occurred in the industry at some time: or could happen within 20 years
Rare	1	The unwanted event has never been known to occur in the industry: or it is highly unlikely to occur within 20 years

Table 4: Determining likelihood (example)

ii) Consequences (Impact)

To determine the consequences/impact for each of the fire hazards/risks identified, a judgement is made about severity. Identifying the probable consequences requires determining the nature and type of consequence which could potentially occur as a result of an incident or impact. When establishing probable consequences it is important to take into consideration any existing control measures and the likely effect that they would have on the outcome. It is also important to consider both immediate consequences and any potential secondary consequences that may occur at a later stage. Assign a numerical factor that describes the potential severity/consequences of the incident as follows:

Insignificant	1	First aid cases Minimal harm/damage: no operation disruption, No operational disruption/changes
Minor	2	Medical treatment injuries Impact limited to within the operational area. External impact minor and reversible requiring minor remediation Minor operational disruption/changes
Moderate	3	Restricted work injuries Moderate reversible impact with short-term effect and moderate remediation. Temporary operational area shut-downs.
Major	4	Major injuries, harm/damage from uncontrolled releases, with short-term effect and significant remediation. Prolonged operational shut-downs. Major national media coverage and stakeholder concerns.
Catastrophic	5	Fatality (or fatalities) Serious environmental harm/damage from uncontrolled releases, with medium-term effect, requiring significant remediation; Extensive operational shut-downs. Sustained national adverse media coverage;

Table 5: Determining consequences/impact (example)

iii) Risk Factor (Ranking)

Once the analysis of risk has been completed, the two factors *'likelihood of occurrence'* and *'probable severity of consequence'* is be used to derive an overall risk factor. For evaluation purposes the resultant overall risk factor will be compared to predetermined control strategies.

		Severity				
		1	**2**	**3**	**4**	**5**
Likelihood		Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	**5**	**11(M)**	**16(H)**	**20(H)**	**23(Ex)**	**25(Ex)**
Likely	**4**	**7(M)**	**12(M)**	**17(H)**	**21(Ex)**	**24Ex)**

Possible	**3**	**4(L)**	**8(M)**	**13(H)**	**18(H)**	**22(Ex)**
Unlikely	**2**	**2(L)**	**5(L)**	**9(M)**	**14(H)**	**19(H)**
Rare	**1**	**1(L)**	**3(L)**	**6(M)**	**10(M)**	**15 (H)**

Table 6: Matrix for determining overall risk factor

Risk Factor Interpretation:

a) *Risk Factor 21 to 25 - Very High* – A risk factor in this range would indicate an "unacceptable" level of risk. It would be appropriate to prohibit the activity until suitable improvements have been implemented to reduce the level of risk to an acceptable level;
b) *Risk Factor 13 to 20 - High* –. Hazards within this range will be proactively managed to reduce the risk to a level as low as reasonably practicable;
c) *Risk Factor 7 to 12 - Medium* – Risk factors within this range may be regarded as "tolerable" and identified hazards within this range will be actively managed; and
d) *Risk Factor 1 to 5 - Low* - Risk factors within this range would indicate that the level of risk is "acceptable" and therefore no further action would be necessary. However it would still be important to ensure that any existing controls are maintained.

8.1.2.2 FIRE RISK ASSESSMENT TOOLS

The fire risk management process, figure 1, shows how the fire prevention program fits into the mine's risk management framework. It enables the mine, through the risk assessment process to identify fire hazards/risks and objectively verify existing control measures and where necessary, to introduce additional control measures designed to eliminate, reduce or control residual risks to a tolerable level:

a) Give an indication that the actual risk is understood
b) Fire Risk Treatment - Upon completion of the assessment of fire risks, consider the precautions already in place for the prevention and mitigation of each fire hazard, determine its adequacy by measuring it against legal and the mine's fire standard (VOH-SOP-010A) requirements.
c) Where shortfalls are identified, risk treatment recommendations to close the gaps must be provided but the effect of these must also be considered during this process.
d) Residual Risk - Following the selection of additional risk treatment measures, re-assess the risk.
e) Any areas where a residual level of risk has been determined above a "Low" rating will be reviewed in order to further reduce the risk, so far as is reasonably practicable.
f) Monitoring Criteria - The monitoring regime necessary to ensure the ongoing effectiveness of the control measures must be assessed. The monitoring and review requirements, including frequencies for the various types of monitoring and measurement systems (e.g., inspections, observations, tests, maintenance, audit, over-inspection,) are to be determined and accountabilities assigned to competent persons. Where it is found that existing controls are not sufficiently managing the risk, reviews will be conducted, and alternate control measures implemented in line with BMM's objective of continual improvement in HSE matters.

During the above process the impacts and consequences of any fire incident on the health & safety of employees, neighbouring communities, the environment and the future viability of operations (e.g. material and reputational damage) will be considered. In this process, the Hierarchy of Controls will be considered to control and minimise fire risks to the lowest level reasonably practicable and in the following order:

a) Avoid the risk by deciding not to start or continue with the activity that gives rise to the risk
b) Eliminate the fuel and/or ignition sources, if practicable.

c) Substitute the fuel and/or ignition source to one of a lesser hazard.
d) Segregate the fuel and ignition source, (isolating the hazard)
e) Use engineering means to: (a) minimise the risk of initiating a fire; (b) provide systems for the early detection of fires; and (c) provide systems to suppress and extinguish a fire.
f) Develop emergency procedures for early warning, fire suppression and the safe egress of people, the application of appropriate administrative control measures may be required (e.g. improved procedures and provision of relevant training); and
g) Use of personal protective equipment (PPE)

Risk Mitigation Action Plans

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

Communication and consultation at work is integral to achieving a safe and responsible work environment, by giving and receiving information about hazards and risk controls, influencing attitudes and behaviours and building commitment and ownership. Risk assessment results must be available and open for inspection by employees and where relevant, external stakeholders; Communicate sufficient information to employees and contractors to enable them to fulfil their duties with respect to HSE, such information shall be determined by risk assessment and include:

a) Fire risk controls to prevent a fire initiating;
b) Fire detection methods and communication of fire detection;
c) Fire suppression methods;
d) Emergency procedures, withdrawal conditions
e) Evacuation, assembly points, places of safety, refuge chambers
f) Isolation points for fuel / energy sources;
g) Fire-fighting plans

8.1.2.3 RISK ANALYSIS

The analysis of fire risk is covered in the Baseline Risk Assessment for Fire in order to facilitate a systematic flow of information and a consistent approach to risk assessment as outlined in Figure 2: Fire risk assessment process

i) Potential for Fires (Fire Impact Description)

Following the identification of fuel and ignition sources, the fire risk and potential consequences/impact must be determined and described for each area/location. In addition to the risk considerations provided below, reference must also be made to the BMM Fire Standards - VOH-SOP-010A, section 9 “Survey determining fire risk”. Identified risks shall be expressed in terminology that can be understood by the intended audience.

ii) Characterizing Potential Fires

The following shall be considered during this phase, including Impacts and consequences of any fire incident on the health and safety of employees, local communities, on the environment and the future viability of operations:

a) The quantity of fuel available for combustion

b) “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)
c) The chemical composition and intensity of smoke and fumes or gases likely to be generated by a fire (this information will be used for the selection of a suitable emergency evacuation procedures)
d) The location of fuel and combustible material storage areas, relative to other areas
e) The route that will be followed by any smoke generated by a fire (to define possible escape routes)
f) The fire spread potential - the presence of further fuel sources that might participate in an extended fire scenario

iii) Fire Hazard Location

a) Fires located in a main intake airway (e.g. vertical and decline shafts) are likely to pose a higher risk than if located in a return airway
b) Fires located close to the main working areas are likely to provide less time for affected personnel to respond timely and adequately, meaning there could be limited time for employees to evacuate to a place of safety such as fresh air bases and refuge bays
c) Fires on surface close to fresh air or compressed air intakes to underground workings or to offices on surface can pose a significant risk
d) Fires located close to or within, hazardous material and combustible liquids storage enclosures have the potential to pose a risk to other neighbouring areas

iv) Ventilation

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 will be considered when deciding how to manage ventilation systems during a Fire include: the prevailing air flow, oxygen feed to the Fire, rate of contamination downstream and fire spread beyond the source particularly in situations where employees may still be trapped by the fire.

The impact of ventilation system operation on the behavior of fires is likely to differ for each location and for each application. Due to this, persons competent (e.g. VOH Manager or Sectional VOH Officer) in the design and operation of the ventilation systems will be involved in the assessment of fire risks at Black Mountain.

8.1.2.4 RISKS ASSESSMENT OUTPUT

The fire risk assessments shall yield the following information but 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 (based on the BMM 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 programs and 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 risk. The impact of heat generated by an incipient fire will also be considered as a small fire in a “critical” location may provide sufficient heat to initiate a much larger conflagration

Based on the Fire Risk assessments, the Fire Hazard Register will be updated.

8.2 FIRE PREVENTION CONTROLS

The risks identified in the baseline risk assessment and in the risk management section of this COP have been listed under Annexure B of this COP and provides a description of existing control measures and planned controls as well as the monitoring criteria for each hazard/hazardous area. Taking into account current systems, processes and equipment employed at the mine, the main aim of such controls is aimed primarily to prevent the occurrence of a fire incident, or an intervention intended to limit the impact of any incipient fire. These can take the form of a process or equipment re-design, implementation of different material selection criteria or of adequate operational standards.
In the baseline documentation controls are assigned to each fire hazard and corresponding risks identified, aligned with the level of anticipated risk.

The fire prevention controls (in place or planned) forms part of the baseline risk assessment and are listed under Annexure B in the COP. Critical controls are actions or interventions whose integrity will ensure that the hazard will not cause harm and will be recognised as such in the controls register. Monitoring criteria for the effectiveness of critical controls will be employed and listed as part of the baseline risk assessment.

Regular monitoring and recording of the performance of defined critical controls will take place.
The section below provides broad parameters and objectives of each major control applicable to relevant fire prevention controls, taking cognizance of the support notes provided the Guideline for a Mandatory COP for the Prevention of Fires at Mines.

8.2.1 DESIGN, CONSTRUCTION & OPERATION

At BMM, the emphasis remains one of prevention of fires and to avoid contributing to the occurrence of fires. The design, construction and operation of any process or system will be measured against regulated standards and design codes (such as SANS, NFPA, etc.), taking cognizance of section 21 of the MHSA. In line with the mine's risk assessment approach, the implementation of the hierarchy of controls are followed during the design of processes, equipment and machinery.
The use of flammable materials and substances must be limited. Where this is not possible, risk assessments are utilized to select adequate and viable protective measures as per BMM's Fire Standards reference number VOH-SOP-010A. During the design of ventilation systems, due consideration is given to fire risk exposures and mitigation strategies includes fire-zoning of different parts of the working environment to limit fire spread and subsequent damage.

The information contained in the *Guideline for a Mandatory COP for the Prevention of Fires at Mines*, with special reference to Annexure 4 General Design Requirements Mobile Equipment and Annexure 5 General Design Requirements for Fuel Storage Areas, Fuel Transfer Equipment and Refuelling Bays will be consulted as part of design, construction and operational parameters to assess fire hazards.

Change management procedures are in place to cater for modifications in the process or layout of the environment during the life of the project. Systems shall be maintained and repaired in accordance with specifications to ensure maximum protection at all times. All work shall be carried-out and inspected by suitably competent individuals and external auditing of design systems and procedures shall be included in the process.

8.2.2 MINE INFRASTRUCTURE

Fire hazards identified during risk assessment processes will be recorded in the fire hazard register for all infrastructure and installations that could pose a significant fire risk, including (if applicable, but not limited to):

a) Fuel storage and associated transfer equipment
b) Refuelling bays
c) Main substations and switchgear installations
d) Underground hoisting stations – not applicable to BMM (no underground hoisting stations)
e) Workshops (surface and underground)
f) Densely timbered areas in intake airways – not applicable to BMM (no densely timbered areas)
g) Diesel fuel lines in main shafts and declines – where these are used for transport
h) Any fire hazardous areas as classifiable by SANS 10108: Fire hazardous area classification
i) High density surface storage area, e.g. fire hazardous material and combustible liquid storage areas, fuel storage tanks, tyre storage areas, etc; and
j) Waste disposal containers.

To minimise fire risk at critical installations and infrastructures, the following requirements will be considered at the design stage:

a) The installation of infrastructure that could pose a heightened high fire risk will only be undertaken following a formal assessment and consideration of the controls necessary to minimise risk; and
b) Wherever possible, such high-risk infrastructures will be located in the return airways or near these, 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
c) As part of the above, a formal Change Management process will also form part process

8.2.3 FIXED PLANTS

The following is a list of fixed plant components that are assessed as part of fire hazard identification audits. This list provides the overview of fixed plant components and firefighting equipment / systems installed – for more detail and additional controls please refer to the BMM Fire Risk Assessment/Register:

No	Type / Location	Type: Fire-fighting Equipment / Systems	
		Portable	Fixed
1	**Air, gas or refrigerant compressors**		
a	Broken Hill	• 9kg DCP	•
b	Deeps	• 9kg DCP	•
c	Process Plant	• 9kg DCP	•
d	Swartberg	• 9kg DCP	•
2	**Major electrical installations**		
a	Process Plant – MCC	• 5kg CO2	• Auto detect & suppress

b	Process Plant – Main sub-station 1	• 5kg CO_2	• Auto detect & suppress
c	Process Plant – Main sub-station 2	• 5kg CO_2	• Auto detect & suppress
d	Process Plant – Main sub-station 3	• 5kg CO_2	• Auto detect & suppress
e	Process Plant – Main sub-station 4	• 5kg CO_2	• Auto detect
f	Process Plant – Main sub-station 5	• 5kg CO_2	• Auto detect
g	Broken Hill surface – Main sub-station	• 5kg CO_2	• Auto detect & suppress
h	Deeps surface - Main sub-station: Winder house	• 5kg CO_2	• Auto detect & suppress
i	Deeps surface - Main sub-stations: Main fans	• 5kg CO_2	• Auto detect & suppress
j	Deeps underground - Main sub-station 34 level	• 5kg CO_2	• Auto detect
k	Deeps underground - Main sub-station 40 level	• 5kg CO_2	• Auto detect
l	Deeps underground - Main sub-station 45 level	• 5kg CO_2	• Auto Detect
m	Deeps underground - Main sub-station 50 level	• 5kg CO_2	• Auto Detect
n	Swartberg – Main sub-station	• 5kg CO_2	•
o	Deeps underground – mini-substations	• 5kg CO_2	•
p	Swartberg underground – mini-substation	• 5kg CO_2	•
3	**Crushers (surface and underground)**		
a	Process Plant crusher	• 9kg DCP	• 25mm x 30m hoses • Fire Hydrant & hoses
b	Swartberg surface crusher	• 9kg DCP	•
c	Deeps - 45 level crusher	• 9kg DCP	•
4	**Mineral processing plants (inclusive of smelting and refinement processes)**		
a	BM Process Plant	• 9kg DCP	• 25mm x 30m hoses • Fire Hydrant & hoses (with fire pump station)
5	**Conveyor belt installation (underground and surface)**		
a	Swartberg to plant, included elevated section	• 9kg DCP	• 25mm x 30m hoses • Auto detect & suppress (first part of elevated section)
b	Deeps surface	• 9kg DCP	• 25mm x 30m hoses • Auto detect & suppress (first 50 meters)
c	51 level Note: only SANS 971-2013 compliant conveyor belts are used at 51 level	• 9kg DCP	• 25mm x 30m hoses • Fire Hydrant & hoses • Auto detect & suppress (various sections along belts)
6	**Hoist rooms and winding plant installations (surface only)**		

a	Deeps surface	• 9kg DCP • Foam trolley	• Auto detect & suppress (with fire pump station)
7	**Pump stations**		
a	Deeps underground – 34 level	• 9kg DCP	•
b	Deeps underground – 45 level	• 9kg DCP	•
c	Deeps underground – 51 level	• 9kg DCP	•
8	**Materials handling equipment**		
a	Various lifting equipment	• 9kg DCP	•
b	Various hoisting equipment	• 9kg DCP	•
9	**Fire hazardous material and combustible liquid storage areas**		
a	Diesel storage - surface: Commercial	• 9kg DCP • 25kg DCP • 50kg DCP	•
b	Diesel storage - surface: Swartberg	• 9kg DCP	• Auto detection & suppression
c	Diesel storage - surface: SPH	• 9kg DCP	•
d	Diesel storage - underground: Deeps 45 telecon	• 9kg DCP	• Auto detect & suppression (Foam system)
e	Deeps underground: Telecon bay (grease, oil, etc.)	• 9kg DCP	•
f	Process Plant: Chemical stores	• 9kg DCP	• Fire Hydrant & hoses
g	Process Plant: Cyanide Plant	• 9kg DCP	• Auto detection & suppression
h	Commercial – various storage of chemicals, oils & grease, etc.	• 9kg DCP	• Auto detection
i	Salvage yard	• 9kg DCP	• Fire Hydrant & hoses

Guideline for a Mandatory COP for the Prevention of Fires at Mines, Annexure 3: Mine infrastructure and fixed plant provides examples of preventative controls that will be considered underground and on surface for fixed plant components as classified in SANS 10108: Fire hazardous area classification.

The location of fixed plant equipment in underground and confined spaces will consider the normal flow of fresh air so as to guide the type, size and location of any fire detection and fire-fighting equipment.
All fixed electrical and related equipment such as sub-stations, switch-rooms and main distribution boards will be in accordance with applicable SANS standards (such as, but not limited to, SANS 60076 (2011): Power transformers, SANS 1029 (2008): Mini substations, SANS 62135 (2013): Resistance welding equipment and SANS 10280 (2013) - Overhead power lines 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 oil leaking from transformers and switchgear installations is contained; and
d) Consider the use of “dry”, “inert gas” or emulsified (low flammability) coolant options for transformer and switchgear equipment.

Fire prevention measures and protection equipment considered for these installations shall be designed to address adequately and reasonably the level of fire risk.
Where flammable oil is used, fixed electrical equipment should:
a) Be provided with automatic fire suppression systems;
b) Be located so that the air current that flows over them passes direct to return; and
c) Have aggregate bund walls capable of containing the total oil volume with a plus 10% excess to capture any oil spillage.

The details of fire detection systems installed is based on the respective fire risk assessment and recommendation made by competent fire engineering experts, included in an action plan as well as of any fire-fighting equipment provided as a further protective measure. This specialised equipment are/will be designed, installed and maintained in association with competent fire engineering experts.

8.2.4 WORKSHOPS

The design and operation of workshops both on surface and underground is of utmost importance to minimise the risk of fires. The following aspects are included in workshop standards and operating procedures:
a) Workshops to contain a minimum storage of combustible liquids (oils, lubricants, fuel, etc.). Storage quantities shall not exceed consumption for one week’s work;
b) Any combustible liquids will be stored in segregated locations and be bunded as required
c) Appropriate signs as per SANS1186-1 (2011): Symbolic safety signs - Part 1: standard signs and general requirement, and notification will be installed at all entrances to workshops indicating:
   - Type and volume of combustible liquids stored
   - No smoking or naked lights near flammables
   - Hot work in designated areas only
   - Housekeeping requirements
   - Emergency procedure in case of fire
d) The maximum mass of combustible materials stored or in use in a workshop in different subdivisions shall not exceed one week consumption (e.g. fuel, lubricants, grease, rubber or poly-urethane filled tyres, paints, welding gas cylinders, etc.). This information will be used to determine the appropriate type and quantity of fire-fighting equipment as well as the location of any fire detection sensors.
e) The design of the ventilation system serving workshops must follow a risk-based approach that caters for:
   - 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;
   - 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; and
   - Contingency arrangements may be required in the event of power failures.

f) Where part of a workshop is earmarked for hot work (welding, grinding, cutting or heating or burning using oxy-acetylene or electric welding), separate locations (cutting bays or welding bays or grinding bays) are provided and supplied with adequate flow of fresh air to dilute any smoke or fumes generated by such work. Standard operating procedures includes a blanket permission to allow hot work whenever this is performed in these locations.
g) A Hot work permit systems is implemented for hot work in any other area of the mine
h) Chemicals in stores that can generate heat or release fumes will be appropriately separated from workshops working areas and be stored in “bunded” areas
i) Sealed waste oil disposal system and suitable containers for the disposal of other flammable waste is used to minimise spillage.
j) Space heaters will not be used in workshops unless they have a surface temperature less than 300°C and are kept clear of rags, paper and other flammable material.
k) Welding gases such as acetylene and oxygen will be stored and used in accordance with OEM requirements.
l) Workshops are provided with adequate spillage containment facilities (e.g. water hose, absorbent material) to contain or clean-up any fuel spills quickly and effectively.
m) Any waste (e.g. soiled absorbent material) will be placed immediately in clearly marked receptacles and be kept well away from any potential ignition source. These receptacles will be emptied at least weekly.
n) Fire extinguishers and fire-fighting equipment are installed/provided as required.
o) Suitable barriers or designated parking areas will be installed to provide for adequate separation of mobile equipment from flammable materials.
p) The following SANS standards will be considered during workshop design: SANS 10400(2009): National building regulations, SANS 10263(2009): The warehousing of dangerous goods and SANS 10232(2007): The transport of dangerous goods.

8.2.5 MOBILE EQUIPMENT

The operation of self-propelled mobile equipment poses a mobile risk at Black Mountain Mine, including confined environments and is determined by a number of factors:

a) The mass of flammable material on vehicles – Refer to Annexure C. This may include, but is not limited to:
   - Fuel
   - Hydraulic and engine oil
   - Tyres
   - The nature of the payload (fuel, oil, timber, etc.).
b) The routing (mobility) of the vehicles particularly in main intake airways poses risk as a vehicle fire is likely to contaminate the air downstream of the event.
   - On-board fire extinguishing systems are installed and maintained on the larger TMM equipment
   - LDVs are equipped with hand-held fire extinguishers
c) Propensity of a vehicle fire to involve other parts of the mine is mainly limited to
   - HDPE/plastic piping in certain underground roadways
d) The location of refuelling bays or places where (temporary) maintenance is done
   Deeps:
   - 45 Level: Diesel storage and refuelling – bunded storage area provided with automated fire detection and suppression and ventilated directly to a return airway. Portable fire extinguishers also available in the area
   - 45 Level: Mobile unit servicing vehicles in the mine

   Swartberg:

- Bunded diesel storage area and refuelling bay located on surface, bunded storage area provided with automated fire detection and suppression. Portable fire extinguishers also available in the area

General Surface:

- Commercial: Bunded main depot and refuelling stationed on surface with, portable fire extinguishers available

e) The air quantity flowing past a potential fire site and sites through which is coursed downstream will have a direct impact on the fire. The air quantity will vary throughout the underground sections, depending on mining requirements. Ventilation surveys and air distribution surveys are conducted and depicted on a plan showing quantities and direction of airflow

The general design of vehicles will 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 manufacturer's specification. The routing of electrical (power) cables, fuel and hydraulic lines, particularly in engine bays, near brakes and pinch-points will be such that incidental damage and contact with hot surfaces is avoided. Pipes and hoses will be manufactured from high quality; durable materials and the piping layout will consider abrasive action and allow for adequate mobility.

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

Guideline for a Mandatory COP for the Prevention of Fires at Mines, Annexure 4 General Design Requirements Mobile Equipment provides series technical solutions risks posed by the operation of self-propelled mobile equipment.

Guideline for a Mandatory COP for the Prevention of Fires at Mines, Annexure 6 Safe Use, Transport and Handling of Explosives provides examples of preventative controls that are considered underground and on surface for the transport of explosives (Referencing to the explosive procedure in terms of MHSA regulation 4.2(b).

8.2.6 MANAGING FIRE POTENTIAL

The use and presence of flammable substances at a mine is inevitable and therefore the risk posed by these must be managed adequately. Measures to address the storage and use of such substances or materials that have a flash point below 60°C (including compressed gases such as acetylene and propane) are as follows:

- Relevant MSDSs in accordance with SANS 10234 are kept readily available: List of global harmonised classification and labelling of chemicals are consulted to determine the type of any precautionary measures that require implementation
- Only trained and authorized personnel are allowed to conduct hot work
- A "Hot Work Permit System" are in place for any hot work to be conducted

8.2.6.1 General Requirements

Measures are put in place to minimise fire risk associated with the storage or use of flammable substances at the design or selection stage – Refer to VOH-SOP-010A Fire Standards for additional information. The following are considered:

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

b) All combustible materials will be stored in dedicated (and if required, bunded), clearly marked storage areas
c) The use and location of flammable substance storage areas will 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 will 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 will be constructed of non-flammable materials
e) 'No Smoking' and 'No Naked Flame' signs are/will be displayed at all flammable materials storage locations
f) Flammable materials will not be stored on or near heat or ignition sources
g) The routing of electrical cable clusters, particularly high-tension lines, will 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 will not be placed in flammable material stores
i) Wherever possible and reasonable, light fittings will be mounted clear of flammable materials
j) All electrical equipment must meet relevant electrical standards for design and installation and must 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 are/will be installed on electrical equipment that is left to operate unattended
l) The quantity of flammable materials stored in any location, will be kept to a minimum as per mine risk assessment
m) Flammable material storage equipment will be located away from high traffic or collision-prone areas or be otherwise protected against vehicle collisions
n) Wherever possible and reasonable, hot work will 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) are in place for any such work outside workshops
o) Wherever possible and reasonable, vehicle access to combustible stores will only be for the purpose of loading and unloading. Vehicles will not be parked in tyre stores.

8.2.6.2 Combustible Substances

Measures for the storage and use of combustible substances or materials at BMM that generally have a flash point below 60°C, including Class 3 flammable liquids:

a) Paints / lacquers / varnishes
b) Diesel fuel
c) Resins

Foams and resins may be particularly volatile in their component form (i.e. prior to mixing). Where foams are used they must comply with SANS 1867 (2003): Sprayed plastic foams for use in mines

a) Flammable solids
   Minimum requirements for the use and storage of flammable solid materials:
   i) Large-scale use of timber support – not utilized at Black Mountain Mining.
   ii) The outline fire prevention measures in waste storage facilities. These includes, 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

The use, transport and handling of explosives in mines may be considered to be an additional fire hazard. Below is the relevant standards, procedures and precautionary measures intended for the safe use, transport and handling of explosives used at BMM:

i) MIN-PRD-EXP-001 Destruction of Old Explosives and Treating Misfires Underground
ii) MIN-PRD-EXP-002 Explosive Spillage
iii) MIN-PRD-EXP-003 Transportation and Delivering Explosives Underground
iv) MIN-PRD-EXP-008 Secondary Blasting
v) MIN-PRD-EXP-009 Gas Testing
vi) MIN-PRD-EXP-010 Secondary Blasting
vii) HIRA Destruction of Old Explosives and Treating Misfires Underground
viii) HIRA Explosive Spillage
ix) HIRA Transportation and Delivering Explosives Underground
x) HIRA Secondary Blasting
xi) HIRA Gas Testing
xii) HIRA Sleep-over Blast

b) Flammable liquids

The following requirements related to the use and storage of flammable liquids will be enforced:

i) All vessels containing flammable liquids must be provided with clear and easily understood labels and respective MSDSs
ii) Only purpose-built containers, designed to prevent spillage, will be used to transport flammable liquids. Diesel fuel will only be transported in purpose-designed bowers 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 justified by risk-based considerations, storage vessels will be enclosed in a containment area (bund wall) where any spillage following the rupture of the containment vessel. The containment area must be large enough to accommodate 110% of the maximum flammable liquid volume in storage at any time. In addition, if these areas are filled with inert material such as gravel, consideration must be given for the volume of flammable liquid in the storage vessel. Where drainage system(s) is used it will be fitted with a device that is normally closed
iv) The vehicles used for the transport of flammable liquids will be appropriately designed for the task

Guideline for a Mandatory COP for the Prevention of Fires at Mines, Annexure 5: General design requirements fuel storage areas, fuel transfer equipment and refuelling bays below 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.

Guideline for a Mandatory COP for the Prevention of Fires at Mines, Annexure 6: Safe use, transport and handling of explosives below 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.

c) Flammable gases

The management of risks associated with the natural occurrence of flammable gases in underground operations will not be covered in this COP as it is covered in the following:

- COP 011: Prevention of Flammable Gas Explosions in Mines other than Coal Mines
- COP 001: Lamp rooms

This minimum requirements for the use of industrially manufactured flammable gases that is used in various processes at a mine, for example welding and cutting, are set out below. The following documents are also in place for the safe use and storage of flammable gases and "hot work":

- Pre-use inspection on oxy/acetylene equipment
- Monthly inspection on oxy/acetylene equipment
- Standard Procedure: Oxy-acetylene equipment
- Hot Work Permit Procedure / system

Following is the minimum requirements related to the use and storage of flammable gases used in "hot work":

i) Flammable gas cylinders must be stored in a well-ventilated area
ii) Flammable gas cylinders will be transported and stored in accordance with the relevant manufacturer's specification
iii) Gas cylinders will be secured so that they cannot fall over. In particular, cylinders containing acetylene will always be stored in an upright position
iv) When transporting cylinders, care will be taken to ensure it does not protrude over the vehicle's loading bed extremities
v) Flash-back arresters are installed and used on all oxy-acetylene equipment
vi) The contents of flammable gas cylinders will not be decanted
vii) Oxy-acetylene equipment will only be used in accordance with accepted operational standards and only in designated "hot work areas" or when approved through the use of the BMM "hot work permit" system

8.2.6.3 Operating & Maintenance Procedures

The following Operating & Maintenance Procedures are in place to assist in fire prevention and detection:

a) Operating procedures will be developed from the action plans drawn from the various fire risk assessments.
b) Maintenance systems (controlled by the Engineering department) are 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
c) Oversight procedures are in place to ensure that:
    - Regular maintenance of equipment for the prevention of fires, that is used for fire detection and fire-fighting will be reviewed as part of the implementation of the various protection measures identified during risk assessments
    - All repair and maintenance activities for machinery, systems and equipment associated with fire risks and employed for fire prevention and protective measures will be carried out at specified intervals, by suitably qualified individuals and in accordance with original equipment manufacturer specification
    - Repair and maintenance activities must restore equipment to the intended design and operational functionality

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

Guideline for a Mandatory COP for the Prevention of Fires at Mines, Annexure 7**:** Generic operational and maintenance procedures below 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.

8.3 PURCHASING PROCEDURES

The requirements as set out below will be included in BMM's purchasing procedures and implemented to ensure that any machinery, equipment or materials purchased for use at the mine comply with site standards – also reference VOH-SOP 010: Fire Standards. This procedure will:

a) Require manufacturers or suppliers to provide evidence that fire risks associated with such machinery, equipment or materials have been considered and addressed (refer Section 21 of the MHSA) and in compliance with applicable at least national standards
b) Require manufacturers or suppliers to make mine management 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 mine management of any fire-fighting equipment or additional fire protection requirements associated with the use of such machinery at a mine
d) Require commercial department to ensure that MSDS's are provided for any combustible or flammable materials supplied to the mine; BMM will not except delivery of such materials without the required MSDS
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

8.4 INSPECTIONS

Regulation 5.1 of the MHSA requires that:
"The employer must ensure that a competent person reports to the employer, at appropriate intervals determined in accordance with the mine's risk assessment, on –

(a) The effectiveness of the precautionary measures taken to prevent or suppress explosions of coal dust or flammable gas; and
(b) The adequacy of measures in place to prevent, detect and combat the start and spread of mine fires."
    - VOH surveys are conducted at set intervals of working places and reported to responsible persons, reported to 3.1 & 4.1 Appointees

In order to fulfil the requirement of this Code of Practice that a series of inspections relating directly to fire hazards be performed, the following will be put in place:

a) Fire hazard audits: Intervals will be determined and stipulated in accordance with section 8.1.1 of this guideline
b) Regular inspections of working areas to monitor compliance with fire controls, including preventative procedures and fire protection equipment – these are currently conducted as per the VOH Annual Planning Schedule. Improvements are planned to have specific inspections for fire prevention measures
c) Inspections will be aimed at identifying either substandard acts or work practices (behaviour) and substandard conditions (fire hazards). It is envisaged that two types of inspections will be conducted:
    - Formal inspections of all workplaces that are undertaken on a regular (i.e. weekly, monthly, quarterly) basis, depending on the level of risk. These include (but are not limited too) VOH surveys and explosives magazine inspections. Formal inspections are recorded with the use of area-specific or task specific checklists to record any defects
    - Informal inspections that are undertaken by employees, supervisors and managers on a daily basis

Formal inspections must be recorded in adequately structured, fit-for-purpose reports. 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.

Guideline for a Mandatory COP for the Prevention of Fires at Mines, Annexure 8: Inspections provides guidance for consideration during inspections

8.5 AWARENESS TRAINING FOR FIRE PREVENTION

Employees will receive formal Training during initial and annual refresher training (General Induction - Prevention of Fires at Mines), including an assessment, conducted at the BMM Training Centre. Focussed information and awareness fire awareness, prevention and control are conducted through the Toolbox talks, notice boards, pamphlets, etc.

During training in elementary fire-fighting procedures, all employees will be cautioned to ensure their own and fellow employees' health and safety so as to prevent these 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 are warned of the dangers of going beyond their level of knowledge and proficiency in using fire-fighting equipment. The measures to address awareness training are set out below.

8.5.1 GENERAL FIRE PREVENTION AWARENESS

Basic fire prevention awareness training (General Induction - Prevention of Fires at Mines) is provided as part of the mine induction programme, with annual refresher training conducted every 12 months. Regular safety/tool-box meetings are also used to raise awareness concerning fire prevention, response and incidents that have occurred.
All personnel who work at BMM will have a basic understanding of fire prevention measures and be trained and assessed for competency in (as applicable for their particular occupation/work location):
a) Basic fire theory
b) Basic fire prevention methods
c) Understanding of fire potential risks
d) Use of the first response of basic fire-fighting equipment, including portable extinguishers, installed on-board vehicle fire suppression systems, etc.

e) Behaviour of fire in enclosed environments, including the role played by ventilation systems
f) Emergency procedures, including use of self-rescuers, refuge chambers and emergency assembly points
g) Reporting procedures during fire emergencies; and
h) Distinguishing and identifying audio and visual fire alarms where provided

8.5.2 MOBILE EQUIPMENT OPERATORS TRAINING

In addition to the general fire awareness training (General Induction - Prevention of Fires at Mines), all operators of mobile equipment at the mine are 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 of overheating surfaces
c) Requirements for minimising engine and equipment temperatures through correct operating technique
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

Modules for training include:

- Induction – TMM and Prevention of Fires at Mines
- TMM and Practical assessment and Checklist of relevant TMM
- Induction – TMM refuelling (Refer to SOP 0127)

8.5.3 FIXED PLANT OPERATORS TRAINING

All personnel who operate fixed plant at the mine will be trained and assessed for competency (General Induction - Prevention of Fires at Mines), 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; and
e) Where appropriate, safe emergency stopping of machinery using brakes in terms of regulatory provisions.

8.5.4 MOBILE EQUIPMENT MAINTENANCE AWARENESS

All personnel involved in the maintenance of mobile equipment at the mine will be trained and assessed for competency (General Induction - Prevention of Fires at Mines), with the assistance of equipment manufacturers 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; this will include the correct use of hose crimping, where required
f) Use of hot work permits and welding equipment, where required
g) Maintenance of fire suppression systems, where provided and necessary
h) Importance of completing pre-use checklist items pertaining to fire prevention measures

8.5.5 ELECTRICAL MAINTENANCE PERSONNEL

Personnel involved in the maintenance of electrical equipment or installations at the mine will be trained and assessed for competency with the assistance of equipment manufacturers 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

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

8.5.6 FUEL STORAGE OPERATION PERSONNEL

Personnel involved in the transport, storage or handling of fuel (Induction – TMM refuelling: Refer to SOP 0127), combustible materials and explosives at the mine will 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 area; and
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.

8.6 FIRE PROTECTION & EMERGENCY RESPONSE

Below is a summary of the fire-protection and emergency response tactics for major fire hazards at BMM. In particular, this COP describes the principles used in the selection of each tactic, the alignment of this with the respective fire risk assessment and any specialist input made in devising the protective measures and responses (e.g. fire engineering criteria to determine fire-fighting equipment specifications where deemed necessary, etc.).

- This Code of Practice must be used in conjunction with the Code of Practice for Emergency Preparedness and Response as it provides a comprehensive and coordinated approach in addressing the fire prevention measures and control of fires

- VOH-SOP-002A Emergency Management Plan also has relevance as it outlines the overarching management plan during emergencies
- Fire prevention measures is a proactive endeavour aimed at eliminating the hazard of fire and is therefore considered as the primary form of control
- Fire protection is considered as a secondary control aimed at reducing the consequences of a fire by limiting the severity and impact of a fire.

Note: The use of fire braziers (mbaulas), i.e. any fixed or portable solid fuel or gas fired equipment or appliance designed for heating and used outdoors, are not permitted under any circumstances at Black Mountain Mine and are important for any personnel that could work at remote locations, for example security and remote exploration drill sites. Training are provided in this regard and air-conditioners (heating and cooling) are supplied at these facilities where possible.

8.7 MONITORING & COMMUNICATING

8.7.1 DETECTION METHODS

Below is a brief description of the method(s) employed to detect the occurrence of a fire, presence of noxious gasses or flammable gasses underground:

a) Hand-held gas detection instruments issued to various personnel
b) Persons observing occurrence fire
c) Cameras at various locations
d) Fixed detection systems
e) Environmental Monitoring system

8.7.2 APPROACH FOR THE POSITIONING OF SENSORS

Below is a brief description of the approach used during the planning 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:

a) Sensors are positioned mainly in the main return airways, with smoke sensors being installed in strategic locations in the intake
b) Additional sensors in high-risk areas, for example 45 level Workshops
c) Automatic fire detection and/or suppression systems, for example Main Sub-stations

8.7.3 CHANNELS OF COMMUNICATION

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/escape routes are shared

Underground

Types & Location:

- Two-way radios: Two-way radios are utilized as a means of communication and will be utilized as a means of warning to persons. These are installed in mobile machinery and are issued to certain personnel.
- Telephones are installed at the following locations:
    - All shaft stations
    - All refuge bays

  - Sub-stations
  - Pump stations
  - Crushers
  - Tips
  - Conveyor Belts
  - Workshops
  - 45 level office complex
- Stench gas systems:
  - Deeps - installed at the Deeps sub-bank area on surface and in the Broken Hill Decline just below surface. Both installations can be operated manually or automatically from the Deeps Control Room
  - Swartberg - installed at the Swartberg Decline just below surface and can be operated manually or automatically from the Deeps Control Room

Back-up systems:

- In the event of a total power failure.
  - UPS at Shaft for telephone system.
  - Portable generators: in case the UPS fail / battery life run out.
  - Generator for the Main Offices and the Clinic.
- Barking dog telephones and telephone wire (lifeline) are kept in the Proto room as part of the emergency equipment.
- 2 x 3-Megawatt Diesel driven generators are installed on surface which will be used in the event of an extended total power failure to power the Man Winder, which will be utilized to extract personnel from the underground workings.

Plant.

Types & Location:

- Localized Alarm system and shouting are utilized as warning method(s) in case of emergencies.
- Two-way radios are utilized as a means of communication and will be utilized as a means of warning to persons. Operators, artisans and supervisors are issued with two-way radios.
- Telephones are also utilized as a means of communication and will be utilized as a means of warning to persons in the Plant. Telephones are installed at the following locations:
  - Control room.
  - Offices.

Surface:

Types & Location:

- Localized Alarm systems, handheld alarms and shouting are utilized as warning method(s) in case of emergencies.
- Two-way radios are utilized as a means of communication and will be utilized as a means of warning to persons. Certain mine personnel are issued with radios.
- Warning to persons. Telephones are installed in most offices across the mine.

Communications from the Mine to Outside Parties

- Fixed line telephones and cell phones will be utilized to communicate with outside parties in the event of an emergency.

Note: No other mines are directly/indirectly connected to BMM due to its location.

8.7.4 UNDERGROUND ENVIRONMENTAL MONITORING DURING A FIRE

a) Fixed Detectors / Early Warning Systems:
- Deeps Section:
  - The current environmental monitoring system is in the process of being upgraded, and will include smoke sensors in strategic positions in the intake airway
- Swartberg Section:
  - An environmental monitoring system is in the process of being installed

8.7.5 EVACUATION PLANS

The Mine Ventilation & Rescue Plans evacuation plans are available in the Emergency control room with the following information depicted on these plans:

a) Location of sensors
b) Location of refuge bays (inclusive of refuge bay number, capacity & telephone numbers)
c) Identification of escape routes (marked with “running person”)

PART D: IMPLEMENTATION.

1. IMPLEMENTATION PLAN.

1.1 The implementation plan will follow a 5 phase approach, which includes Risk Assessment, Planning, Implementation, Monitoring and Review. Note that overlap will occur between phases as the ensure effective continuation of fire prevention and control strategies

1.1.1 STRATEGY ON FIRE PREVENTION

The overall programme on fire prevention & control is an integrated approach that requires planning, co-ordination and co-operation between various departments

The main focus of fire prevention is placed on the prevention of fires in the work place and provide the necessary assurance on the success of the control programme. Emphasis is therefore placed on the maintenance of standards and design specifications on equipment and processes used in the mining and concentrating processes.

Parallel to the above process a fire risk profile is established and updated for all the operational areas by the implementation of a continuous fire risk assessment programme.

a) Fire Risk Profile

The risk profiles are established through analysis of relevant fire report information available to the mine. Those fire profiles so established are:

- Used to update the fire risk assessment and risk profile
- Reviewed annually

b) Continuous Fire Risk Assessment

The fire risk profiles mentioned above will be reviewed on the basis of information gathered through the programme for continuous risk assessment

c) Functions & Responsibilities

The functions and responsibilities of departments, committees and disciplines are depicted below:

➢ **Mine Management**

The owners of the mine must take responsibility for health and safety in terms of the Act. However, the management of that responsibility is delegated to Mine Management. The Act also requires that a health and safety committee, represented by Management and Employees, be established for consultation on health and safety issues, including protection against fires.

Other responsibilities relating to the prevention of fires include:

- The compilation and implementation of the mine's health and safety policy.
- Approval of specific fire limitation procedures and the issuing of instructions relating to the implementation of the fire prevention.
- The delegation of responsibilities.

➢ **VOH Department**

The main function of this department with regards to fire prevention & control is the planning, co-ordination and control. In that respect it is important that all departments involved in fire prevention & control be represented on the health and safety committee. Specific duties include:

- Assessment of standards for compliance. Those standards include international benchmarks, local regulatory standards or mine standards (procurement, monitoring, etc.).
- Review of the fire standards and, on that basis, recommend to management the actions that may be taken.
- Ensuring compliance with policy decisions.

➢ **Occupational Hygienist**

The main function of the Occupational Hygienist is the anticipation and recognition of fire risks coupled with the assessment of design, control and protection strategies. Specific responsibilities include:

- The design of the monitoring.
- The selection of suitable monitoring methods and procedures for measurement.
- The selection of suitable instrumentation for measurement.
- The analysis and validation of results collated by the VOH department.
- The interpretation of findings emanating from the analysis of the results.
- Compilation and maintenance of the fire risk profiles.
- Defining the required competencies and training needs in respect of the hygiene and monitoring functions.
- Compilation of procurement standards
- Evaluation of equipment and design specifications of various operations.
- Define the requirements for fire protection equipment
- Prepare records and reports for the purpose of routine reporting, review and formal reporting (legal) on health and safety.

➢ **Safety Department**

From a safety perspective the responsibilities include:

- Audits and reporting of non-conformances.

➢ **Line Management**

The main function of Line Management is to create a culture of prevention of fires by:

- Inclusion of fire prevention control and protection in their normal competency training programme.
- The implementation and maintenance of control engineering procedures and systems.
- Competencies on the implementation of the training in the workplace must be audited/verified by the Training Department.

➢ **Training**

The Training Department is responsible for:

- The induction and refresher training of employees in the first instance and also to report, for review purposes, on training statistics.

➢ **Supply Chain**

The contribution of the Supply Chain is to:

- Implement the mine specifications on fire prevention & control (developed in consultation with the hygiene discipline) in the tendering and purchasing process.
- Ensure the necessary documentation with regards to the risk assessments are obtained from the OEM, Supplier or Importer of equipment.

- Administer the fire prevention & control specifications and standards information and the purchasing of equipment and protection.
- Report, for review purposes, on procurement statistics.

➢ **Original Equipment Manufacturers (OEM's), Suppliers & Importers**
Local legislation imposes "duty of care" responsibilities on the manufacturers of machinery and equipment. Accordingly, it is incumbent upon manufacturers to assess the potential risks imposed on users of their products:

- It should be noted that, if a fire hazard is associated with equipment supplied to mines, the supplier can only relinquish his responsibility with regard to risks of fire exposures if the fire characteristics of the equipment are specified, the necessary precautions are stipulated and the mine management has accepted, in writing, the responsibility of implementing those precautionary measures.
- Therefore, equipment can only be accepted after the relevant documentation of acceptance has been duly completed.

1.2 Graphical representations are / will be utilized to facilitate easy interpretation of data and to highlight trends.

2. COMPLIANCE WITH THE COP.

Measures to ensure compliance is instituted through auditing from first, second and third party auditors.

3. ACCESS TO THE COP & RELATED DOCUMENTS.

3.1 A complete electronic COP, with related documents, is kept readily available at the mine for examination by any affected person. Hard copies, when printed, are treated as uncontrolled copies. Line supervisors and management have direct access to these electronic copies and can distribute it to affected employees when required. On written request to the Manager, any other affected person will be supplied with copies. A register will be kept of such persons or institutions to facilitate updating.

3.2 The registered Trade Unions and Full Time Health and Safety Representative will be supplied with copies of this COP on written request to the Manager. A register will be kept of such persons or institutions to facilitate updating.

3.3 The employer will ensure that all employees are fully conversant with those sections of this COP relevant to their respective areas of responsibility.

4. Distribution and Access

- The latest revision of this document is available as a read only on the document on the Intranet. The Compliance Officer shall maintain an authorised hard copy of this policy/procedure in the relevant location.
- Line Managers, who have staff reporting to them that do not have access to the Intranet, shall ensure that these personnel are adequately guided and informed.

Annexure A – List of Reference Documents

The following documents, standards and specifications were cross-referenced during the Baseline Risk Assessment:

a) The Mine Health and Safety Act 29 of 1996
b) Guideline for the compilation of a mandatory code of practice for the prevention of fires at mines (DMR 16/3/2/4-B10)
c) Vedanta Resources Plc. Guidance Document – Risk Assessment VED/CORP/SUST/GN 07
d) Industry & Investment NSW Issued: January 2010 MDG 1032 Guideline for the prevention, early detection and suppression of fires in coal mines
e) BMM - Mandatory Code of Practice for the Operation of Trackless Mobile Machinery (COP- 008)
f) BMM - Mandatory Code of Practice for the Prevention of Flammable Gas Explosions in mines other than coal mines (COP- 011)
g) BMM Mandatory Code of Practice on Emergency Preparedness and Response (COP- 002.)
h) BMM Mandatory Code of Practice for the safe use of Conveyor Belt Installations for the transportation of mineral (COP)
i) BMM - Fire Standards (VOH-SOP-010A)
j) BMM - Explosives Management (MIN-PRD-EXP-003)
k) BMM - Explosives Management - Issue Based Risk Assessment
l) BMM - Issue Based Risk Assessment on Explosives Control.
m) BMM - Risk Assessment Report: Plant, Reagents Dosing Area (July 2008)
n) SANS Hydraulic hoses parts 10a and 10b and SANS 347 (2009): Categorization and conformity of pressure equipment;
o) SANS 246 Code of practice for fire protection for electronic equipment installations
p) SANS 369 - 1 Code of practice for the operation of fire protection measures. Part 1: Electrical actuation of gaseous total flooding extinguishing systems
q) SANS 369 - 2 Code of practice for the operation of fire protection measures. Part 1: Electrical actuation of gaseous total flooding extinguishing systems. Part 2: Mechanical actuation of gaseous total flooding and local application extinguishing systems.
r) SANS 10139 - 2 Fire detection and alarm systems for buildings — System design, installation & servicing
s) SANS14520-1 Gaseous fire-extinguishing systems Physical properties and system design Part 1 General requirements for the inert gas suppression systems in the substations room areas and in the cable voids.
t) SANS 50054-3/EN 54-3 Fire detection and fire alarm systems-Part 3: Fire alarm devices-Sounders
u) SANS 50054-4/EN 54-4 Fire detection and fire alarm systems-Part 4: Power supply equipment.
v) SANS 50054-5/EN 54- Fire detection and fire alarm systems-Part 5: Heat detectors - Point detectors
w) SANS 50054-7/EN54-7 Fire detection and fire alarm systems-Part 7: Smoke detectors - Point detectors using scattered light, transmitted light or ionization
x) SANS 50054-11/EN 54-11(SANS EN 54-11) Fire detection and fire alarm systems-Part 11: Manual Call points
y) SANS 1186 - Signage for fire protection equipment
z) SANS 971:2013 Conveyor belting - Methods of testing fire retardant properties of all conveyor belt constructions

Annexure B – Fire Hazards, Prevention & Control

The following is the Fire Hazards, Prevention & Controls identified during the risk assessment – Refer to the Baseline Risk Assessment for comprehensive list:

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
DEEPS # SURFACE							
Control Room	Class A - C	Fixed	Electrical, cables/ wiring. plastics/ PVC.'s computers and monitors	Electrical wiring/ cables, Db boards/ switch boxes, overloading, short circuits computer equipment air conditioner units, smoking/ contraband	Earth leakage relays are installed, tested and maintained; smoking is prohibited in the control room Formal system in place for checking all electrical equipment on 3 monthly bases	Some installations are protected by fire detectors and CCTV surveillance Portable fire extinguishers are provided Emergency assembly points and procedures are available Employees are trained in the use of portable fire extinguishers Fire drills are held Control room is occupied 24/7 all year round Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Coordinator be appointed to oversee the mine's overall emergency preparedness and response programme.

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Office Complex - Isandleni	Class A - C	Fixed	Ordinary Combustibles, paper office furniture and fittings, plastic/ PVC's appliances, computers, monitors, printers, electrical cables/ wiring	Electrical wiring/ cables, Db boards/ switch boxes/ appliances, air conditioner units, overheating, overloading, short circuits smoking/ contraband	Earth leakage protection provided, tested and maintained; smoking is prohibited in all offices Formal system in place for checking all electrical equipment on 3 monthly bases Waste is controlled	A fire hydrant is situated more than 30m from buildings Fire detection, portable fire extinguishers are provided Emergency assembly points and procedures are available Employees are trained in the use of portable fire extinguishers Fire drills are held Security staff 24/7 presence Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Office Complex - Mining, & Surface Area's	Class A - C	Fixed	Ordinary Combustibles, paper office furniture and fittings, plastic/ PVC's appliances, computers, monitors, printers, electrical cables/ wiring	Electrical wiring/ cables, Db boards/ switch boxes/ appliances, air conditioner units, overloading, short circuits smoking/ contraband	Earth leakage protection provided, tested and maintained; smoking is prohibited in all offices Formal system in place for checking all electrical equipment on 3 monthly basis Waste is controlled	Regular emergency exercises/drills and refresher training programs are in place to ensure emergency team's readiness Inspections and maintenance of fire and emergency equipment are carried out Emergency response plans, evacuation and assembly points are provided Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Surface Lamp Room	Class A & C	Fixed	Cap lamp battery casing/plastic/ PVC's (734 cap lamps including spare units)	Electrical fault - overcharging / overload - short circuits, smoking/ contraband	The lamp room is not interlinked with the shaft access way Earth leakage protection is provided and tested Cap lamp racks/ shelving are of steel construction Lamp room staff are formally trained, lamps man's appointment, SANS 1737 test certificates and MSD's are posted A voltage regulator is installed to prevent overcharging of batteries Formal system in place for checking all electrical equipment on 3 monthly basis Waste is controlled	Housekeeping is of a high standard and lamp repair work is carried out in the lamp room Portable fire extinguishers are provided Smoking/contraband is strictly controlled, and the facility is manned at all times Emergency response plans, evacuation and assembly points are provided Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place CCTV surveillance report to Deeps Control Room	
Fire Pump House	Class A & B	Fixed	Diesel, engine oil, rubber pipelines, battery	Electrical wiring, electrical switch box, oil/ diesel leaks, overheating, hot surfaces	The pump house construction is of non-combustible materials, well separated from other buildings and access controlled Regular pump inspections, maintenance and testing by	Portable DCP fire extinguishers are provided Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					Engineering team	SOP-010A Prevention of Fires is in place	
Surface Engineering Workshops	Class A, B & C	Fixed	Oil, grease, cleaning solvents, adhesives, gas cylinders, electrical cables, PVC's, rubber (tyres, pipelines)	Open flame, hot work, gas leaks, flash back, hot surfaces, molten metals, electrical equipment, cables, switch boxes, overload, arching/ short-circuits	Earth leakage relays are installed and tested; smoking is prohibited Dedicated approved hot work area is available Oils/grease are kept in separate bunded storage facilities Cutting torches are fitted with flash back arrestors Gas cylinders are stored outside the workshops in well ventilated approved gas cylinder stores	DCP portable fire extinguishers are provided A fire hydrant is available within 30 m of the workshops Emergency response plans and assembly points are in place Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Hoist Room Transformer Installation	Class A, B & C	Fixed	Total combined stored oil 9,920 Lt, i.e., man winder, 2 transformers - 2075 Lt each plus an aux-transformer/ 810 Lt - Same for Rock winder	Electrical fault/ short circuits, low oil level overheating, loose/ hot connections Moisture or high carbon content in oil tank	Preventative measures/devices installed, i.e., Buchlotz device, overload, oil level & temperature protection, infra-red scanning, oil analysis, silica gel breathing units Inspections and planned maintenance programs are in place	Portable fire extinguishers are provided The installation is properly fenced in, and access is controlled Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Hoist Room Transformer Installation	Class A, B & C	Fixed	Total combined stored oil 9,920 Lt, i.e., man winder, 2 transformers - 2075 Lt each plus an aux-transformer/ 810 Lt - Same for Rock winder	Electrical fault/ short circuits, low oil level overheating, loose/ hot connections Moisture or high carbon content in oil tank	Preventative measures/ devices installed, i.e., Buchlotz device, overload, oil level & temperature protection, infra-red scanning, oil analysis silica gel breathing units Inspections and planned maintenance programs are in place	Passive fire protection measures to prevent fire spread are installed i.e., fire and bund walls, cable penetrations in walls and trenches are sealed Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Hoist Room Transformer Installation	Class A, B & C	Fixed	Total combined stored oil 9,920 Lt, i.e., man winder, 2 transformers - 2075 Lt each plus an aux-transformer/ 810 Lt - Same for Rock winder	Electrical fault/ short circuits, low oil level overheating, loose/ hot connections Moisture or high carbon content in oil tank	Preventative measures/ devices installed, i.e., Buchlotz device, overload, oil level & temperature protection, infra-red scanning, oil analysis silica gel breathing units Inspections and planned maintenance programs are in place	All hoist room transformers are protected by means of high velocity water spray systems which allows for automatic fire detection and suppression Dry powder portable fire extinguishers are provided Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Hoist Room	Class A, B & C	Fixed	Electrical cables, switch boxes, grease, oil-hydraulic system in basement	Electrical fault/ short circuits, winder hydraulic oil leaks/ vapours, hot work	Earth leakage, protection relay, arc flash protection, inspections, servicing, planned maintenance and tests are conducted as per legal requirements Infra-red scanning programme is in place Access to the hoist room is controlled Housekeeping servicing and maintenance standards are of a high order	The winder room is manned at all times Portable fire extinguishers is available. The brake system hydraulic oil lubricating system is bunded CCTV camera monitored by the control room is installed Hot work is controlled - permit system available Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Hoist Room Sub Station	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical overload, fault/ short circuits, arching, sparking, flash	Earth leakage, protection relay, arc flash protection, (definite time & IDMT protection) interlocking of panels, infra-red scanning programme is in place Housekeeping (no dust accumulation on electrical panels) servicing and maintenance standards are of a high order	Fixed fire protection consists of four CleanSol aerosol fire suppression canisters positioned at ceiling level in each corner of the room Portable CO2 fire extinguishers are provided Electrical cable penetrations in walls & floors are sealed CCTV camera monitored by the control room is installed Access to the substation is controlled Two trained fire teams, equipped	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Surface Main Fans - Transformer Installation	Class A, B & C	Fixed	Transformer oil 2000lt, electrical cables/ PVC's	Electrical fault/ short circuits, low oil level overheating, loose/ hot connections Moisture or high carbon content in oil tank	Preventative measures/ devices installed, i.e., Buchlotz device, overload, oil level & temperature protection, infra-red scanning, oil analysis silica gel breathing units Inspections and planned maintenance programs are in place	The transformer is protected by means of a high velocity water spray system which allows for automatic fire detection and suppression Dry powder portable fire extinguishers are provided A fire hydrant point is available more than 30m from the installation Fan operation is monitored by the Control Room A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Sub Bank (between the cable trench and downcast shaft)	Class C	Fixed	Multiple/ grouped electrical cables, combustible materials i.e.. plastic/ PVC cable sheath	Electrical Energy - fault overload/ heat, substandard cable joints (temporary joints), damaged cable short circuit	Earth leakage, protection relay installed and tested Temporary cable joints are prohibited No temporary joints was observed during the site inspection Housekeeping practices maintained	Inspections and maintenance programs are in place 5 m fire breaks by means on intumescent paint at the shaft entry point and in the cable way Portable dry powder fire extinguishers are available Employees trained in basic firefighting and use of fire extinguishers Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place Should smoke enter shaft/underground - Refuge bays available underground. SCSR provided to all underground personnel.	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Shaft Headgear: loading bin ore transfer point-overland conveyor belt.	Class A, B & C	Fixed	Rubber/ conveyor belt. Lubricating oils and grease Electrical cables/ PVC's	Heat energy - friction, pulleys, gearbox bearings and/ or hot work/ repair or maintenance work Electrical fault/ short circuits	Maintenance of belt and related equipment. Pulley bearing temperature detection and belt nonslip, belt alignment devices are installed Metallic sections of the belt construction are earthed Earth leakage units are installed on the system COP - Safe use of conveyor installations	An automatic fire detection and fire suppression system installed over last 50 meters of conveyor at shaft position Portable dry powder fire extinguishers are available at the pulley fire hose reels are positioned along the entire length of the belt Fire hose reels installed along length of belt at 30-meter intervals A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place Should smoke enter shaft/underground - Refuge bays available underground. SCSR provided to all underground personnel.	
DEEPS # UNDERGROUND							

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Shaft Barrel	Class A & C	Fixed	Electrical cables/ PVC's	Heat energy - hot work/ repair or maintenance work	Shaft examination takes place on a weekly basis Major repair work are planned for and performed during off periods SOP' s are available for shaft work Enforce strict control over hot work operations in downcast shaft	Procedures for work in shaft, including a hot work permit system are in place Fire precautionary measures pre & post hot work are catered for Fire extinguishers are provided Employees trained in basic firefighting and use of fire extinguishers A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place All employees issued with SCSR's Emergency plans are in place Refuge chamber is available at various positions underground A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site	
40 Level Station area	Class A & C	Fixed	Electrical cables/ PVC's	Heat energy - hot work/ repair or maintenance work Electrical fault overloading, short circuits wiring/ cables, switch boxes	Earth leakage, protection relays are installed, inspected and tested Hot work permit system is in place Smoking is prohibited underground Material cars/ diesel telecons are collected upon delivery Housekeeping standards in	DCP Portable fire extinguishers are provided Employees trained in basic firefighting and use of fire extinguishers A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place All employees issued with SCSR's Emergency plans are in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					place and maintained	Refuge chamber is available at various positions underground A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site	
45 Level Station area	Class A & C	Fixed	Electrical cables/ PVC's	Heat energy - hot work/ repair or maintenance work Electrical fault overloading, short circuits wiring/ cables, switch boxes	Earth leakage, protection relays are installed, inspected and tested Hot work permit system is in place. Smoking is prohibited underground Material cars/ diesel telecons are collected upon delivery. Housekeeping standards in place and maintained	DCP Portable fire extinguishers are provided Employees trained in basic firefighting and use of fire extinguishers A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place All employees issued with SCSR's Emergency plans are in place Refuge chamber is available at various positions underground A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site	Smoke sensors installation is in progress
51 Level Station area	Class A & C	Fixed	Electrical cables/ PVC's	Heat energy - hot work/ repair or maintenance work Electrical fault overloading, short circuits wiring/cables, switch boxes	Earth leakage, protection relays are installed, inspected and tested Hot work permit system is in place Smoking is prohibited underground Material cars/ diesel telecons are collected upon delivery	DCP Portable fire extinguishers are provided Employees trained in basic firefighting and use of fire extinguishers A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained	Smoke sensors installation is in progress

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					Housekeeping standards in place and maintained	on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
45 Level Pump station	Class A & C	Fixed	Electrical cables/ PVC's, pump motor v-belts	Heat energy - friction, overheating, pulleys, v-belts, bearings Electrical overloading, short circuits wiring/ cables, Db boards/ switch boxes	Earth leakage, protection relays are installed, inspected and tested Inspections and planned maintenance programs are in place Housekeeping standards in place and maintained	DCP Portable fire extinguishers are provided CCTV system in place Emergency plans are in place A refuge chamber is available in the area Employees trained in basic firefighting and use of fire extinguishers A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Provide 2m long intumescent painted fire breaks at regular intervals Electrical equipment/ distribution boards, coat cables at entry and exit points
51 Level Pump station	Class A & C	Fixed	Electrical cables/ PVC's, pump motor v-belts	Heat energy - friction, overheating, pulleys, v-belts, bearings Electrical overloading, short circuits wiring/ cables, Db boards/ switch boxes	Earth leakage, protection relays are installed, inspected and tested. Inspections and planned maintenance programs are in place. Housekeeping standards in place and maintained	DCP Portable fire extinguishers are provided The facility is manned at all times Emergency response plans and arrangements are in place A refuge chamber is available in the area Employees trained in basic firefighting and use of fire extinguishers All underground staff are issued with self-contained breathing sets A mutual aid	Provide 2m long intumescent painted fire breaks at regular intervals Electrical equipment/ distribution boards, coat cables at entry and exit points

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
45 level underground workshops TMM service area	Class A, B & C	Fixed	Electrical equipment, cables / PVC's, oil, grease, diesel, cleaning solvents, adhesives, gas cylinders, rubber(tyres) TMM equipment being serviced	Heat energy - hot work/ repair or maintenance work Electrical fault overloading, short circuits wiring/ cables, switch boxes, battery charging, smoking/ contraband.	Earth leakage, protection relays are installed, inspected and tested. Inspections and planned maintenance programs are in place Dedicated approved hot work area is provided Oils/ grease are kept in separate bunded storage facilities Cutting torches are fitted with flash back arrestors Battery storage is in a well-ventilated approved storage bay. Housekeeping standards in place and maintained	DCP portable fire extinguishers are provided Fire hose reels are available Emergency response plans and 2 x refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
45 Level Workshops-Oil Distribution Pump Facility	Class B	Fixed	Oil (under pressure) stored oil 7,500 lt	Heat energy - electrical pumps (oil vapour) hot work	Purpose designed pumps and piping arrangements, earth leakage protection, inspections and planned maintenance programs are in place Symbolic signage " no open flame" are posted Emergency stop switches are provided & demarcated	Bund walls are constructed around the facility and 4 DCP fire extinguishers are provided. Emergency response plans and a refuge chamber is available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Review installation of an automatic fire detection and fire suppression system in addition to current controls Install intrinsically safe lighting
45 level underground workshops vehicle refuelling bay	Class B	Fixed	Diesel fuel (telecon) 2800 lt TMM equipment being refuelled	Heat energy - electrical pump, cables/ switch box, contraband smoking/ hot work/ fuel spillages, vehicle impact, static electricity	High current electrical equipment pump and its associated switchgear are well separated away from the diesel storage/ telecon Pipes and pumps are earthed to prevent the build-up of static charge	DCP and foam trollies fire extinguishers are provided at the refuelling point A foam deluge system connected to a heat detector is installed covering the refuelling point, telecon and vehicle area All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires	Install intrinsically safe lighting. Smoke sensors installation is in progress

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						ref: VOH-SOP-010A Prevention of Fires is in place	
45 level underground workshops tyre storage bay	Class A	Fixed	Vehicle tyres (10 tyres Max) in tyre bay)	Hot work cutting & welding	Approved Hot work area is not in close proximity to the tyre store. New tyres are stored in purpose designed tyre racks	Portable fire extinguishers and water hoses are provided in the immediate area. Emergency response plans and 2 x refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Water deluge system to be installed
Underground Vehicles Trackless Mobile Machinery (TMM) Roadways/ramps (Mobile fire risk)	Class A & B	Mobile	Oil, grease, diesel fuel, hydraulic oil, rubber hoses, tyres	Leaks, friction/ brake system overheating, electrical wiring, arching, short circuits, hose leak/ fuel vapour/ hot surfaces. engine and exhaust system	Vehicle maintenance, inspection and service programs are in place. Reinforced hydraulic hoses/ fuel lines are used All vehicles inspected during the underground visit were found in a good condition, no oil or fuel leaks were observed A code of practice Ref: 008 is in place for the operation of trackless mobile machinery	TMM are equipped with Ansul on board fire detection and suppression systems and portable DCP fire extinguishers. Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					Maintenance of TMM	dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Underground Vehicles LDV Roadways/ramps (Mobile fire risk)	Class A & B	Mobile	Oil, grease, diesel fuel, hydraulic oil, rubber hoses, tyres	Leaks, friction/ brake system overheating, electrical wiring, arching, short circuits, hose leak/ fuel vapour/ hot surfaces. engine and exhaust system	Vehicle maintenance, inspection and service programs are in place. Reinforced hydraulic hoses/ fuel lines are used All vehicles inspected during the underground visit were found in a good condition, no oil or fuel leaks were observed A code of practice Ref: 008 is in place for the operation of trackless mobile machinery Maintenance of TMM	All LDV vehicles are equipped with a portable DCP fire extinguisher. Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
45 level underground stores	Class A	Fixed	Combustible materials	Heat energy - contraband, smoking, hot work, electrical switch box & cables	Flammable and combustible materials are well separated, housekeeping inside the store is of a high standard Electrical DB boards and earth leakage units are inspected and maintained	Portable DCP fire extinguishers are provided Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Smoke sensors installation is in progress

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
45 Level Office & tearoom area	Class A - C	Fixed	Ordinary combustibles, paper office furniture and fittings, plastic/ PVC's appliances, computers, monitors, electrical cables/ wiring	Electrical wiring/ cables, Db boards/ switch boxes/ appliances, overheating, overloading, short circuits smoking/ contraband	Earth leakage protection provided, tested and maintained; smoking is prohibited underground Electrical inspected on quarterly basis by electrical team Waste is controlled/ steel telecons available	Fire detection, portable fire extinguishers, hose reels are provided Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Main Sub-station: 31 level (shaft station)	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels, inspection and planned maintenance including infra-red scanning programs are in place	Portable fire extinguishers are provided Fire detector head installed Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Main Sub-station: 34 level (shaft station)	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels, inspection and planned maintenance including infra-red scanning programs are in place	Portable fire extinguishers are provided Fire detector head installed Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Smoke sensors installation is in progress
Main Sub-station: 40 level (shaft station)	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels, inspection and planned maintenance including infra-red scanning programs are in place	Portable fire extinguishers are provided Fire detector head installed Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Smoke sensors installation is in progress

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Main Sub-station: 45 level (shaft station)	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels, inspection and planned maintenance including infra-red scanning programs are in place	Portable fire extinguishers are provided Fire detector head installed Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Smoke sensors installation is in progress
Machinery Control Centre (MCC): 45 level Crusher	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels, inspection and planned maintenance including infra-red scanning programs are in place	Portable fire extinguishers are provided Fire detector head installed Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Main Sub-station: 50 level	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels, inspection and planned maintenance including infra-red scanning programs are in place	Portable fire extinguishers are provided Fire detector head installed Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Machinery Control Centre (MCC): 51 level Pump Station	Class A & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels, inspection and planned maintenance including infra-red scanning programs are in place	Portable fire extinguishers are provided Fire detector head installed Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Underground mini substation (Transformers)	Class C	Fixed	Electrical cables/PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	Dry type mini subs are used underground reducing the severity/fire load Earth leakage, protection relay Inspections and planned maintenance including infra-red scanning programme is in place	Portable DCP fire extinguishers are provided on the air intake side of the installation. Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Treat cables at mini sub entry and exit points (2m) with an intumescent paint
12 level pump station MCC – 1 x oil cooled transformer 12 level consumer sub – 3 x oil cooled transformers	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath-transformer oil	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels in consumer sub stations, inspection and planned maintenance programs are in place	Portable DCP fire extinguishers are provided on the air intake side of the installations Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Due to the isolated location of the installations, high fire loading, lack of protection measures and associated risk of intake air contamination serious consideration should be given to replacing the existing oil cooled equipment with air cooled equipment or alternatively protect all installations by installing automatic fire detection and fire suppression systems

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Underground mini substation (Transformers) Broken Hill: Surface to 34 & 47 West substations – oil cooled mini-substations 19 level consumer sub – 1 x oil cooled transformer 19 level pump station MCC – 1 x oil cooled transformer	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath-transformer oil	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection relay, arc flash protection, interlocking of panels in consumer sub stations, inspection and planned maintenance programs are in place	Portable DCP fire extinguishers are provided on the air intake side of the installations Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Due to the isolated location of the installations, high fire loading, lack of protection measures and associated risk of intake air contamination serious consideration should be given to replacing the existing oil cooled equipment with air cooled equipment or alternatively protect all installations by installing automatic fire detection and fire suppression systems
Underground mini substation (Transformers) 47 level west – 1 x oil cooled mini sub	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath-transformer oil	Electrical fault/ short circuits, arching flash/ sparking	Earth leakage, protection installed, inspection and planned maintenance programs are in place	Portable DCP fire extinguishers are provided on the air intake side of the installations Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Due to the isolated location of the installations, high fire loading, lack of protection measures and associated risk of intake air contamination serious consideration should be given to replacing the existing oil cooled equipment with air cooled equipment or alternatively protect all installations by installing automatic fire detection and fire suppression systems

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
45 Level Crusher area	Class A & B	Fixed	Electrical cables/PVC, cable outer sheath/oil, grease	Electrical fault/ short circuits, arching/ sparking Heat energy, overheating bearings, oil leaks. open flame/ hot work	Earth leakage, protection relays are installed, inspected and tested. Inspections and planned maintenance programs are in place	DCP portable fire extinguishers are provided The crusher is manned when in operation Emergency response plans and refuge chambers are available All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
51 level underground conveyor belt installation	Class A, B & C	Fixed	Rubber/ conveyor belt length 168m Gear box oil/ grease. Electrical cables, switches Belt 1: 139m Belt2: 29m	Heat energy-friction, pulleys, over heating bearings and/or hot work/repair or maintenance work. Electrical fault/short circuits	Conveyor belts comply to SANS 971-2013 F-Type specification Pulley bearing temperature detection and belt non slip devices are installed Metallic sections of the belt construction are earthed Earth leakage units are installed on the system	Automatic fire detection & suppression systems installed Flame retardant type belt is installed DCP fire extinguishers are provided at head and tail pulleys Fire hose reels are installed along the belt route Hot work permit system is in place The belt is manned when in operation Emergency response plans and a refuge chamber is available All underground staff are issued with self-contained breathing sets	Smoke sensors installation is in progress

PREVENTION OF FIRES AT MINES

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Underground mining activities	Intersection of flammable gas	Mobile	TMM in operation in mining areas Electrical installations	Electrical short circuits open flame, smoking, sparks, arching	Monitoring and tests for flammable gas are done on a daily basis VOH-COP-007 Prevention of Flammable Gas Explosions in Mines other than Coal Mines is in place	Monitoring programs are in place Emergency response plans and a refuge chamber is available All underground staff are issued with self-contained breathing sets A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Continue existing monitoring programs and ensure compliance with VOH-COP-007 Prevention of Flammable Gas Explosions in Mines other than Coal Mines requirements.
MINE STORES							
Tyre Store	Class A	Fixed	Tyres	External fire source veld fire, hot work	Tyre store is detached from the main stores Vegetation is controlled to reduce fire spread risk Housekeeping standards maintained	Portable fire extinguishers are provided A fire hydrant is available outside the storage facility Employees trained in basic firefighting and use of fire extinguishers Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Gas Cylinder store	Class B	Fixed	Oxygen & Acetylene cylinders	Gas cylinder leaks/ open flame/ smoking	A properly designed storage facility is provided and is adequately ventilated Various types of gasses are separated by means of brick walls Cylinders are secured with brackets Portable fire extinguishers are provided	Portable fire extinguishers are provided A fire hydrant is available in the stores area Employees trained in basic firefighting and use of fire extinguishers Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Continuous monitoring of cylinder handling and storage practices to ensure compliance with mine standards
Flammable Liquids store	Class B	Fixed	Oil based paints, turpentine, cleaning solvent	Electrical cables switches/ short circuits, light fittings open flame, smoking	Small storage facility situated away from other buildings	DCP fire extinguisher provided	
Main Stores building	Class A	Fixed	Combustible materials	Electrical cables switches/ short circuits open flame, smoking	Flammable and combustible materials are properly separated Housekeeping in the store is of a high standard Electrical DB boards and earth leakage units are inspected and maintained. Good housekeeping standards are maintained in the main stores building	DCP fire extinguishers are provided throughout the stores complex Security staff present on a 24/7 basis	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Bulk Diesel Storage Tanks	Class B	Fixed	3 x horizontal steel tanks with a combined storage capacity of 33,000lt	Electrical cables switches/ pump/ short circuits open flame, smoking, lightning, spillages.	Tanks are surrounded by bund walls Pumps; electrical switches are located outside the bund area The tanks are earthed, and earth leakage protection is provided and tested on all electrical systems	Portable fire extinguishers are provided A fire hydrant is available in the stores area Issuing of fuel is controlled	
MAIN WORKSHOPS							
Offices	Class A - C	Fixed	Ordinary combustibles, paper office furniture and fittings, plastic/ PVC's appliances, computers, monitors, printers, electrical cables/ wiring	Electrical wiring/ cables, Db boards/ switch boxes/ appliances, air conditioner units, overheating, overloading, short circuits smoking/ contraband	Earth leakage protection provided, tested and maintained; smoking is prohibited in all offices Waste is controlled with regular removal systems	The area is protected with a fire hydrant and is situated within 30m of buildings Portable fire extinguishers are provided Emergency assembly points and procedures are available Staff are trained in the use of portable fire extinguishers Fire drills are held Security staff 24/7 presence A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Tyre shop (fitment & storage)	Class A	Fixed	Tyres	Open flame, hot work cutting & welding	Earth leakage protection provided, tested and maintained; smoking is prohibited No hot work is carried out not in the area	Portable fire extinguishers and water hoses are provided in the immediate area Emergency plans and drills are held Security staff present on a 24/7 basis A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Garage (LDV service area)	Class A, B & C	Fixed	Oil, grease, cleaning solvents, diesel adhesives, gas cylinders, electrical cables, PVC's, rubber (tyres)	Open flame, hot work gas leaks, flash back, oil fuel leaks, hot surfaces, engine, exhaust, electrical equipment, cables, switch boxes, overload, arching/ short-circuits	Earth leakage relays are installed and tested Smoking is prohibited Dedicated approved hot work area is available Oils/ grease are kept in separate bunded storage facilities Cutting torches are fitted with flash back arrestors Gas cylinders are stored outside the workshops in well ventilated approved gas cylinder stores	DCP portable fire extinguishers are provided A fire hydrant is available Emergency response plans and assembly points are in place A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Boilermaker shop	Class A & B	Fixed	Cleaning solvents, gas cylinders, electrical cables, PVC's,	Open flame, hot work gas leaks, flash back, hot surfaces, molten metals, electrical equipment, cables, switch boxes, overload, arching/ short-circuits	Earth Leakage relays are installed and tested Smoking is prohibited Dedicated approved hot work area is available Oils/ grease are kept in separate bunded storage facilities Cutting torches are fitted with flash back arrestors Gas cylinders are stored outside the workshops in well ventilated approved gas cylinder stores.	DCP portable fire extinguishers are provided. A fire hydrant is available in the workshop area. Emergency response plans and assembly points are in place. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Review and amend existing emergency response plans to provide for site and threat specific action orientated plans.

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
TMM service shop	Class A, B & C	Fixed	Oil, grease, cleaning solvents, adhesives, gas cylinders, electrical cables, PVC's, rubber (tyres, pipelines) TMM equipment	Open flame, hot work gas leaks, flash back, oil, fuel leaks - hot surfaces, engine, exhaust, electrical equipment, cables, switch boxes, overload, arching/ short-circuits	Earth Leakage relays are installed and tested Smoking is prohibited Dedicated approved hot work area is available Oils/ grease are kept in separate bunded storage facilities Cutting torches are fitted with flash back arrestors Gas cylinders are stored outside the workshops in well ventilated approved gas cylinder stores.	DCP portable fire extinguishers are provided A fire hydrant is available in the workshop area Emergency response plans and assembly points are in place A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
PLANT							
Laboratory	Combustible chemicals	Fixed	Dry chemicals	Incompatibility of chemicals to spontaneously combustion Storage	Access control to lab Minimal chemicals stored in lab area Segregation between non-compatible chemicals	Fire extinguishers Hose reels Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Dosing area	Combustible chemicals	Fixed	Flammable liquids	Chemical energy- manual handling, friction, compatibility of stored chemicals	Inspection and maintenance of dosing systems and equipment Partial automated dosing During manual plant operational personnel available	Fire extinguishers Hose reels Automatic fire detection and suppression system installed Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Laboratory Flammable liquid store	Class A & B	Fixed	Flammable liquids	Electrical cables switches/ short circuits, light fittings open flame, smoking, fumes, vapours	Small storage facility situated away from other buildings Bund walls constructed around the store Ventilated by means of air bricks/ through ventilation No ignition sources, electrical fittings or switches are installed inside store	Portable fire extinguishers are provided No smoking signs are displayed MSD's are available for stored items Fire hydrant point is available in the immediate area Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Main Sub-Station Incomer	Class B	Fixed	Electrical cables Plastic/PVC, cable outer sheath Oil cooled switch gear	Electrical overload, fault/ short circuits, arching, sparking, flash	Access controlled area Air cooled equipment installed, planned maintenance & inspections earth leakage, protection relay, arc flash protection, (definite time & IDMT protection) interlocking of panels, infra-red scanning programme Inspections and planned maintenance programs are in place	Automatic fire detection and suppression systems are installed CO2 portable fire extinguishers are provided CCTV cameras installed Passive fire measures are catered for to prevent fire spread cables/ openings in walls are sealed Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Main Sub-station 1	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath, oil cooled switch gear	Electrical overload, fault/ short circuits, arching, sparking, flash	Access controlled area Air cooled equipment installed, planned maintenance & inspections earth leakage, protection relay, arc flash protection, (definite time & IDMT protection) interlocking of panels, infra-red scanning programme Inspections and planned	Automatic fire detection and suppression systems are installed CO2 portable fire extinguishers are provided CCTV cameras installed Passive fire measures are catered for to prevent fire spread cables/ openings in walls are sealed Selected plant personnel training in firefighting (same as surface	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					maintenance programs are in place	fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Main Sub-station 2	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath, oil cooled switch gear	Electrical overload, fault/ short circuits, arching, sparking, flash	Access controlled area Air cooled equipment installed, planned maintenance & inspections earth leakage, protection relay, arc flash protection, (definite time & IDMT protection) interlocking of panels, infra-red scanning programme Inspections and planned maintenance programs are in place	Automatic fire detection and suppression systems are installed CO2 portable fire extinguishers are provided CCTV cameras installed Passive fire measures are catered for to prevent fire spread cables/ openings in walls are sealed Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Substation 1 & 2 transformer installations	Class B & C	Fixed	Transformer oil, electrical cables	Electrical fault/ short circuits, overload/ heat, low oil level, loose/hot connections, moisture or high carbon content or moisture in oil tank	Access controlled area Preventative measures/ devices installed, Buchlotz device, overload, oil level & temperature protection, infra-red scanning, oil analysis silica gel breathing units	Transformers are protected by automatic fire detection and suppression systems (High velocity water spray systems) Fire walls are constructed between transformers Bund walls filled with aggregate are in place Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Main Sub-station 3	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath, oil cooled switch gear	Electrical overload, fault/ short circuits, arching, sparking, flash	Access controlled area Oil cooled equipment installed, planned maintenance & inspections, earth leakage, protection relay, arc flash protection, (definite time & IDMT protection) interlocking of panels, infra-red scanning programme. Inspections and planned maintenance	Portable fire extinguishers are provided Automatic fire detection & suppression installed in sub-3 Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	Install automatic fire detection and suppression systems in sub 4 in addition to detection system

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					programs are in place.	A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Main Sub-station 5	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath, oil cooled switch gear	Electrical overload, fault/ short circuits, arching, sparking, flash	Access controlled area Oil cooled equipment installed Planned maintenance & inspections, earth leakage, protection relay, arc flash protection, (definite time & IDMT protection) interlocking of panels, infra-red scanning programme. Inspections and planned maintenance programs are in place	Detection systems installed Portable fire extinguishers are provided Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Install automatic fire detection and suppression systems in sub 5 in addition to detection system
Crusher Lube room	Class B & C	Fixed	Hydraulic oil, electrical cables	Leaks/ vapours, electrical pump, switch box/ short circuit, arching, over heating	Purpose designed pump and piping arrangements, earth leakage protection, inspections and planned maintenance programs are in place.	Passive fire protection measures cable sealing and bund walls are catered for Portable fire extinguishers are provided A High velocity water spray system is installed Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Workshops-Fitter oil store	Class B	Fixed	Oil, paint, thinners, grease	Open flame, smoking, ventilation/ fumes, electrical light fittings	Standards are in place for safe storage practices of flammable liquids Oil quantity maintained at set levels Compatibility chart maintained Housekeeping standards maintained	Storage area is bunded Portable fire extinguishers are provided A fire hydrant is located within 30 m Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Workshops-gas cylinder store	Class B	Fixed	Oxygen & Acetylene cylinders	Gas cylinder leaks/ open flame/ smoking	Access controlled A properly designed storage facility is provided. adequately ventilated. Various types of gasses are separated by means of brick walls cylinders are secured with brackets, portable fire extinguishers are provided	Portable fire extinguishers are provided A fire hydrant is located within 30 m of the store Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						010A Prevention of Fires is in place	
Fire pump house & pipe reticulation	Class A, B & C	Fixed	Diesel, engine oil & grease, rubber pipelines, battery, electrical cables.	Electrical fault/ short circuit, oil/ diesel leaks, hot surfaces, over heating	The pump house construction is of non-combustible materials, well separated from other buildings Earth leakage protection provided, tested and maintained,	Portable DCP fire extinguishers are provided Pump operating instructions and procedures are posted inside the pump house Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Replace all HDPE pipes in the hydrant water supply line with steel pipes comply with SANS 1128 parts I and II requirements
Overland Conveyor	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, mis-alignment switches, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor installations is in place.	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Automatic fire detection and suppression systems at the drive head section (and over last 50m of conveyor). Sprinkler system installed at gravity take-up which is accessible from ground level. Self-lubricating units to ensure adequate lubrication to bearings. Selected plant personnel training in firefighting	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						(same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Screen feed Conveyor	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, mis-alignment switches, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor installations is in place.	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Sprinkler system installed at gravity take-up which is accessible from ground level. Dedicated operators per section 24/7. Camera monitoring from the 24hr manned control room. Self-lubricating units to ensure adequate lubrication to bearings. A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Fine ore Feed Conveyor	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, mis-alignment switches, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor installations is in place.	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Sprinkler system installed at gravity take-up which is accessible from ground level. Dedicated operators per section 24/7. Camera monitoring from the 24hr manned control room. Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Discharge Conveyor	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Dedicated operators per section 24/7. Camera monitoring from the 24hr manned control room. Selected plant personnel training in firefighting	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					installations is in place.	(same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Conveyor belt (silos)	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor installations is in place.	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Dedicated operators per section 24/7. Camera monitoring from the 24hr manned control room. Self-lubricating units to ensure adequate lubrication to bearings. Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Ring feed sprinkler system to be installed alongside length of conveyor which is controllable from ground level. BA sets to be used when access of silos is required in case of a fire.

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Secondary Feed Conveyor belt	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor installations is in place.	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Dedicated operators per section 24/7. Camera monitoring from the 24hr manned control room. Self-lubricating units to ensure adequate lubrication to bearings. Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Cross over Conveyor	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Dedicated operators per section 24/7. Camera monitoring from the 24hr manned control room. Self-lubricating units to ensure adequate lubrication to bearings.	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
					installations is in place.	Selected plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	
Rod mill Feed Conveyor	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor installations is in place.	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Dedicated operators per section 24/7. Camera monitoring from the 24hr manned control room. Self-lubricating units to ensure adequate lubrication to bearings.	
Load-out Conveyors	Class A, B & C	Fixed	Rubber belt, electrical cables, idlers, pulleys, oil & grease Electrical cables	Heat energy - friction, pulleys, gearbox bearings and/or hot work/ repair or maintenance work Electrical fault/ short circuits	Pulley bearing temperature measurement. Belt slip detection, anti-roll back device, are installed Metallic sections of the belt construction are earthed. Earth leakage units are installed on the system A. COP - Safe use of conveyor installations is in place.	DCP fire extinguishers installed at drive head, fire hose reels are installed along the conveyor belt route. Dedicated operators per section 24/7. Self-lubricating units to ensure adequate lubrication to bearings. Conveyors running at slow speed.	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Cyanide plant	Substance is non-combustible	Fixed	Flash point - not applicable	NFPA Rating Health - 4 Flammability - 1 Instability- 1	The installation is situated away from other buildings, completely fenced off Access is strictly controlled - specific hot and other work permit system in place Well ventilated area, with wind direction indicators in place Electrical installations, monitoring devices and requirements for a safe installation is in line with legal requirements and codes	A water spray system installed which can be activated (push button) outside the entrance gate Breathing apparatus available (BA sets) at two dedicated First aid/emergency rooms Plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	
Dry chemical store	Combustible chemicals	Fixed	Combustible chemicals	Incompatibility of chemicals spontaneous combustion Storage	Storage facility is well separated from other buildings. Openings in walls provides for through ventilation Access is controlled Material Safety Data Sheets are displayed inside the store The store is bunded and incompatible chemicals are well separated	Portable fire extinguishers are provided with a fire hydrant point situated within 30m of the store Plant personnel training in firefighting (same as surface fire teams) Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Backfill plant -office area	Class A - C	Fixed	Ordinary Combustibles, paper office furniture and fittings, plastic/ PVC's appliances, computers, monitors, printers, electrical cables/ wiring.	Electrical wiring/ cables, Db boards/ switch boxes/ appliances, air conditioner units, overloading, short circuits smoking/ contraband	Earth leakage protection is provided, tested and maintained; smoking is prohibited in all offices No accumulation of waste observed during site inspection	A Fire Hydrant is situated within 30m of buildings Fire detection, portable fire extinguishers are provided. Emergency assembly points and procedures are available Staff are trained in the use of portable fire extinguishers Fire drills are held Security staff 24/7 present Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	
Backfill plant - sub-station	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical overload, fault/ short circuits, arching, sparking, flash	Access controlled area Inspection and planned maintenance including infra-red scanning programs are in place Earth Leakage relays are installed and tested	Automatic fire detection & suppression system installed Portable CO2 fire extinguishers are provided Access to the substation is controlled Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	
Backfill plant - conveyor belt	Class A, B & C	Fixed	Rubber/ conveyor belt length 10m) Gear box oil/grease Electrical cables, switches	Heat energy-friction, pulleys, over heating bearings and/or hot work/ repair or maintenance work	The belt is well maintained (alignment, idlers and pulley's, no oil leaks observed) Metallic sections of the belt construction are earthed	DCP fire extinguishers are provided at head and tail pulleys Hot work permit system is in place The belt is manned when in operation Two trained fire teams, equipped	Maintain existing preventative standards

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
				Electrical fault/ short circuits	Earth leakage units are installed on the system	with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies	
SWARTBERG #							
Surface diesel storage tank (23800 lt tank)	Class B	Fixed	Diesel fuel	Electrical cables switches/ pump/ short circuits open flame, smoking, lightning, spillages	Purpose designed pump and piping arrangements; earth leakage protection is in place Symbolic signage " no open flame" are posted Emergency stop switch is provided	Automatic detection & suppression system installed DCP fire extinguishers are provided Storage tank is bunded Emergency response plans and assembly points are in place Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Surface crusher sub station	Class C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath, oil cooled switch gear	Electrical overload, fault/ short circuits, arching, sparking, flash	Preventative measures/ devices installed, i.e., Buchlotz device, overload, oil level & temperature protection, infra-red scanning, oil analysis silica gel breathing units. Inspections and planned maintenance programs are in place	Portable fire extinguishers provided Bund walls filled with aggregate is in place Emergency response plans and assembly points are in place Two trained fire teams, equipped with firefighting equipment, BA sets, PPE, and a fire tender is available to deal with all surface	

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
						emergencies A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Decline entrance	Class C	Fixed	Multiple cables, plastic/ PVC, cable outer sheath	Electrical Energy- fault. Overload/ heat, substandard cable joints (temporary joints), damaged cable Short circuit	Earth leakage, protection relay installed and tested Temporary cable joints are prohibited No temporary joints was observed during the site inspection	Portable DCP fire extinguishers are provided Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	
Decline entrance	Class A	Fixed	Overgrown vegetation, accumulation of waste/ combustibles	Smoking/ contraband, lightning, malicious damage, sabotage	All vegetation has been cleared around the decline entrance point No other combustible materials are stored in and around the entrance	Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Maintain existing standards

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
850 Level workshop	Class B	Fixed	210 Lt Oil drums and open 5 Lt plastic oil containers	Open flame, smoking, hot work	A bunded oil storage facility is provided Housekeeping standards maintained	DCP fire extinguishers are provided Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Environmental Monitoring System to be installed
Underground	Class B	Mobile	Diesel storage and refuelling	Heat energy - electrical pump, cables/ switch box, contraband smoking/ hot work/ fuel spillages	No diesel storage tanks, or vehicle refuelling done underground	DCP fire extinguishers are provided Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Environmental Monitoring System to be installed

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
850 Level workshop	Class A & B	Fixed	Gas cylinders, rubber hoses, combustible materials	Open flame, gas leak, faulty equipment, smoking, hot work, combustible materials in hot work area	Approved hot work/ cutting bays are provided in the workshop A hot work permit system is in place Cutting sets are fitted with flash back arrestors and cylinders are mounted on specially designed trolleys to prevent them from falling over	Portable fire extinguishers and fire hose reels are provided Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Maintain existing standards. Environmental Monitoring System to be installed
Underground mini subs 825 & 850 levels	Class B & C	Fixed	Electrical cables/ plastic/ PVC, cable outer sheath	Electrical fault/ short circuits, arching flash/ sparking	No oil cooled mini subs in use underground Housekeeping at the installation is of a high order	Portable DCP fire extinguishers are provided on the air intake side of the installation Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Environmental Monitoring System to be installed

Location	Fuel Source	Fixed / Mobile Risk	Fire Load	Ignition Source(s)	Existing Controls		Risk Mitigation Improvement Recommendations
					Preventative Measures	Protective Measures	
Underground Vehicles - LDV's	Class A & B	Mobile	Oil, diesel fuel, rubber hydraulic hoses, tyres	Leaks, friction/ brake system, overheating, electrical wiring, arching, short circuits, hose leak/ fuel vapour/ hot surfaces	Vehicle maintenance, inspection and service programs are in place A code of practice for the operation of trackless mobile machinery Ref: 008 is in place	All LDV vehicles are equipped with a portable DCP fire extinguisher Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Maintain existing standards. Environmental Monitoring System to be installed
Underground Vehicles Trackless Mobile Machinery (TMM) Roadway's/ramps (Mobile fire risk)	Class A & B	Mobile	Oil, diesel fuel, rubber hydraulic hoses, tyres	Leaks, friction/ brake system, overheating, electrical wiring, arching, short circuits, hose leak/ fuel vapour/ hot surfaces	Vehicle maintenance, inspection and service programs are in place A code of practice for the operation of trackless mobile machinery Ref: 008 is in place	All vehicles are equipped with Ansul on board fire detection and suppression systems and portable DCP fire extinguishers Refuge bays in place All underground staff are issued with self-contained breathing sets A mutual aid agreement to provide assistance is in place with MRS - Trained and equipment Proto teams maintained on site A formal procedure dealing with fires ref: VOH-SOP-010A Prevention of Fires is in place	Maintain existing standards. Environmental Monitoring System to be installed

Annexure C – Mass of Flammable Materials on Vehicles

The following is a summary of the mass of flammable materials on vehicles:

Note:

a) Fuel / Combined Oil and Coolant capacities are per Vehicle

b) Oil / Coolant capacity includes oils such as: engine, hydraulic, brake, etc.

Type		Amount	Fuel Capacity		Oil / Coolant Capacity (lt)	Tyres Size	Nature of Payload	Remarks
			Type	Capacity (lt)		(Each)	(normal operation)	
LHD	Loader LH517	5	Diesel	485	703	29.5 x 29 L5S 34ply	Ore/Waste	
LHD	Loader LH517	3/5	Diesel	485	703	29.5 x 29 L5S 34ply	Ore/Waste	
LHD	Loader LH 410	2D	Diesel	280	240	1800 X25 L5S 28ply	Waste	
LHD	Loader LH 203	1D	Diesel	130	120	12,00 x 20 L5S, 20 ply	Waste	
LHD	Toro 1400	1	Diesel	300	682	26.5x25 L5S	Ore/Waste	n/a
Truck	Toro 50D	2	Diesel	700	737	29.5R25	Ore/Waste	n/a
Truck	TH550	5S/2D	Diesel	700	692	29.5R26	Ore/Waste	
Truck	TH551	4D	Diesel	840	1022	35/65 R33	Ore/Waste	
Truck	TH320	1D	Diesel	350	400	18.0 R 25	Waste	
Truck	MT436	1D	Diesel	439	240	26.5R25	Waste	
Face Drill Rig	DD321	1D	Diesel	150	353.7	12.00-20/PR20	N/A	
Face Drill Rig	282 Rocket Boomer	2S/1D	Diesel	60	195	12.00-20/PR20	N/A	
Face Drill Rig	DD422i	1S	Diesel	100	270	14.00–24 PR28	N/A	
Roof bolter	DS311-C	3D	Diesel	80	275.6	14.00-24/24PR	Resin	
Roof bolter	DS411	1D	Diesel	140	378	14.00-24/24PR	Resin	
Roof bolter	335H/235H	3S	Diesel	60	195	12.00 x R20	Resin	
Long hole Drill Rig	DL 421-7C	1D	Diesel	140	378.8	14.00-24 / 24PR	N/A	
Long hole Drill Rig	DL430-7S	2S	Diesel	150	360.4	12.00-20 PR20	N/A	
Long Hole Drill Rig	ME7C	1D	Diesel	110	250	12.00xR24	N/A	
Long Hole Drill Rig	Cabletec	1D	Diesel	110	250	14.00R24	N/A	
Grader	Barlows	1S/1D	Diesel	378	243	17.5X25	N/A	
Grader	Aard	1S	Diesel	120	120	17.5 x 25	N/A	
LDV	Toyota, Nissan	124	Diesel	75	10	265/70R16	People	
LDV (C&BP)	Various makes	28	Diesel	75	10	265/70R16	People	C&BP
Bus	Merc Benz	5	Diesel				People	
Mini bus	Various	6	Diesel	75	10	265/70R16	People	
Forklift	Various makes	5	Diesel				Various	
Scaler	Bell 220	7	Diesel	100	150	17.5/ 25 L5	N/A	
Scissor Lift	Uv80	2S/3D	Diesel	85	170	35 x 15 - 15	Various	
Tractor	Various makes	8	Diesel				Various	Trailer

Truck	MAN	7	Diesel	400	270	315/80/22.5	Ore/Waste	SPH
Truck	NISSAN UD	2	Diesel	600	270	315/80/22.5	Ore/Waste	SPH
Truck	ISUZU FVZ	1	Diesel	400	60	315/80/22.5	Water	SPH
Truck	BELL ADT	1	Diesel	500	280	23.5 R25	Water	SPH
Truck	ISUZU FVZ	1	Diesel	600	120	315/80/22.5	Crane	SPH
Excavator	CAT 329D	3	Diesel	520	350	N/A	Ore/Waste	SPH
Excavator	CAT 349D	1	Diesel	520	400	N/A	Ore/Waste	SPH
Screen	TEREX 683 Finlay	1	Diesel	500	370	N/A	Ore/Waste	SPH
Crusher	LT105 LOKOTRACK	1	Diesel	550	300	N/A	Ore	SPH
LDV (C&BP)	TOYOTA/ ISUZU	6	Diesel	75	10	245/70R16	Various	SPH
LDV (C&BP)	KIA	1	Diesel	1000	10	195/70R14	Diesel	SPH
Mini bus	TOYOTA	2	Diesel	75	10	195/70R15	People	SPH
Forklift	Fortevens	1	Diesel	50	65	700x12.5	Various	SPH