Vedanta Resources Plc

Sustainability Governance System

Emergency Response, Fire Prevention and Management

Guidance Notes GN26

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Prepared by:	Roger Belair	Authorized by:	Phillip Turner
Signature		Signature	
Position:	Group Head – Safety	Position:	Group Head – HSE & Sustainability

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1. INTRODUCTION

1.1 Who is this Guidance Note aimed at?

This Guidance Note is aimed at all Vedanta subsidiaries, operations and managed sites with underground mining operations and other business where underground works may be undertaken, including new acquisitions, and to new and existing employees and Business Partner employees. This Guidance Note is applicable to the entire operation lifecycle (including exploration and planning, evaluation, operation and closure).

1.2 What is the aim of this Guidance Note?

Emergencies are one of the major contributors to fatalities within the underground mining industry. The aim of this Guidance Note is to outline the company requirements which Vedanta implements in order to ensure that all risks associated with underground emergencies, including fires are eliminated or minimized within an acceptable level.

1.3 What issues does this Guidance Note address?

This Guidance Note presents the framework for the management of underground emergencies and underground fires. Including procedures required to avoid untoward incidents within Vedanta operations. The focus of the Guidance Note is on the provision of preferred methods and outcomes rather than being prescriptive whilst at the same time representing a practical "how to" guide for all Vedanta operators.

It is however recognised that the different operations are at different levels of "maturity" with regards to the development of systems to manage the risk associated with emergencies underground. The Guidance Note includes two approaches:

- *Prescriptive Approach.* This establishes specific requirements that are deemed mandatory and are indicated by the term '**shall**.'
- *Risk Based Approach.* This is less prescriptive and is driven from the site, acknowledging its specific geology, mining methods, equipment, infrastructure and the competency of its personnel.

In reviewing this Guidance Note, the site needs to decide which approach to adopt using competent advisors. Some sites will already have mature systems in place, and it is recommended that a combination of competent internal and external reviewers determines the level at which the site is currently operating. Where a site is deemed mature with competent resources, a risk-based approach is acceptable.

Those requirements that are associated with '**shall**' statement are mandatory irrespective of site maturity.

1.4 How should this Guidance Note be used?

This Guidance Note is mandatory (as per instructions in Section 1.3 above) and is intended to provide a standard baseline and reflect good practice whilst providing the basis for continual improvement of sustainability issues across the Vedanta business. The need for flexibility at a site is depending upon specific circumstances or regulatory specific requirements is also recognised. This Guidance Note is not designed to be definitive text, nor is it designed to provide prescriptive methods and procedures for undertaking tasks.

In most cases there will also be national and/or local regulatory requirements which address emergency procedural issues and sites must ensure that these requirements are identified and complied with.

The guidance has been designed to be applicable for all Vedanta operations, but is focused on underground mining operations. The successful implementation of this Guidance Note is expected to require several years of dedicated commitment from all the Vedanta mining sites depending on their existing maturity and controls.

The following provides guidance on how this may be achieved. This is not a mandatory approach, but an equivalent implementation programme must be designed where the guidance is not followed:

- Emergency response protocol, including fire prevention and management, is the responsibility of the Mine Manager supported by the Safety Manager and the Ventilation Engineer who will drive the implementation and top line managers with authority to approve new requirements will be accountable for successful implementation.

- The emergency and fire prevention and management planning team, comprising of a diverse group of people from various departments, is responsible for the development and administration of the emergency preparedness plan. Typically, the ventilation engineer takes overall responsibility for developing the plan. However, it cannot be done by one person. In order to create 'buy in' it is important to have many different voices contributing to the design of the plan. At the very least the mine manager, mine production manager, Ventilation Engineer (or Ventilation & Occupational Hygiene Manager), technical services manager, maintenance manager, HR manager, engineering manager, and security manager should be included in the team. Finally, the success of the mining emergency response plan is largely dependent on the support of the chief executive officer and SBU Director of the operation.

- Once the emergency response and fire prevention and management protocol is in place, an audit needs to be conducted with competent resources to determine the current status of the site with regard to the elements of this guidance; ideally this will use resources from across Vedanta sites to enable a peer review to be conducted and create a community of practice amongst champions.

- The results of this audit are to be used as the basis of an action plan to implement those aspects that are currently not in place.

- Once this process has been started, an annual progress review will be required to ensure implementation is on track.

- Each site is encouraged to share experiences and build further competencies and internal capacity within the Vedanta Group.

This document has been developed as a collaborative approach with input provided from within the Vedanta businesses.

The remainder of this Guidance Note is structured as follows:

- Section 2 – Emergency Management
- Section 3 – Stakeholder Roles and Responsibilities
- Section 4 – Analysis Hazards and Risks
- Section 5 – Emergency Management Planning
- Section 6 - Fire Prevention and Management
- Section 7 – Overall Management Approach and Fire Prevention
- Section 8 – Fire Prevention
- Section 9 – Fire Response Preparedness
- Section 10 – Prevention and Recovery measures
- Section 11 – Safety Systems
- Section 12 – Communications
- Section 13 – Training and Competency
- Section 14 – Monitoring and Review
- Section 15 – Emergency resources, personnel and equipment
- Section 16 – Training and competency

- Section 17 – Incident Management

Typical emergency response equipment
Annex A: Developing a Site Emergency Plan, Sample Table of Contents.
Annex B: Example of an Emergency Severity / Level of Response and Emergency Response Flow Sheet from HZL, India.

2. EMERGENCY MANAGEMENT

An emergency that occurs at an underground mine or the surface areas of an underground mine can be defined as any unplanned event that causes serious injuries or loss of life; causes extensive property damage; shuts down or disrupts the mining operations; or threatens the operation's financial standing or public image. Emergency preparedness plans are often referred to as disaster plans. However, the word *disaster* should not be the selected reference. After all, the whole point of the plan is to eliminate the potential disaster. It can, in fact turn a potential disaster into a well-managed situation with the least possible effect on personnel and property of the mining operation.

Therefore, the preferred label would rather be a Emergency and Fire Prevention Plan, a mine operation's guide in the event of a mine emergency that lays out procedures and courses of action in the event of a mine emergency. It identifies those responsible for taking action immediately after the discovery of and during the response to an emergency, as well as their respective duties.

Emergency management involves understanding the likelihood of an emergency and its potential consequences, being prepared to mitigate its effects, responding appropriately, and recovering afterwards. Effective emergency management means that there are plans in place for all foreseeable emergency scenarios, so the response is comprehensive and coordinated. The aims of this guidance note is to:

- Describe the key variables or factors to be considered when emergency response activities are undertaken, including hazard identification and risk management.
- Assist with establishing an EFPP as part of a site's safety management system.

Emergency management involves:

- Risk Assessment – identifying the hazards and analysing the risks associated with potential emergency scenarios and mines emergency response training exercises.
- Prevention – determining appropriate control measures to eliminate or reduce the impact of the identified risks.
- Preparedness – developing a safety management system, which includes preparation and training for emergencies.
- Response – implementing the emergency plan.
- Recovery – returning to normal operations and conducting a post-emergency review of the effectiveness of the emergency plan and emergency response activities so they can be revised as necessary.

Emergency management includes having the appropriate command and control systems, resources, rescue methods, training and competency of emergency response and mine rescue team members, operation and maintenance of

equipment to achieve the desired safety and health outcomes. Most importantly the workforce needs to understand its role in the emergency plan.

3. STAKEHOLDER ROLES AND RESPONSIBILITIES

The general duty of care to take reasonable care for worker safety applies to all stakeholders. There are main groups involved in emergency management:

- SBU Head – this is the owners of the mine who control the allocation of funds and provide direction to the site management team.
- Site Management – those who operate the mine (e.g. managers, operators, other employers, Business Partner, maintainers).
- Emergency Management Team, including incident management and emergency response teams – those who are called to bring an emergency under control, rescue casualties and return the mine to normal operations.
- Suppliers – those who design, manufacture, import and supply equipment
- Employees – they need to evacuate if and when requires and instructed and provide support where needed.
- Mutual Aid Partners – they need to be willing and able to deploy to the emergency when required.

SBU Head

The SBU Head **shall** make such financial and other provisions as are necessary to ensure, so far as is practicable, that the mine is planned, laid out, managed, and works in accordance with local legislation. The mine owner must be able to demonstrate that hazards associated with mining operations and emergency response are controlled so far as reasonably practicable. This is done by considering issues such as:

- Identification of specific risks and provision for regular reviews of controls.
- Any previous events or information including considering of lessons learn from own and other mining disasters (e.g. incident and injury reports, data from similar operations).
- Suitability of established risk controls and work procedures (e.g. separation, inspection and maintenance processes).
- Provision and competency of operational and support personnel (e.g. assessment of knowledge and training needs).
- Emergency response capability that is improved and confirmed by participating in mock drills or mine rescue competitions.

Mine Management

The responsibilities of managers **shall** include:

- Conducting an initial site risk assessment to fire risks.
- Understanding those risks and putting in place appropriate controls.
- Developing safe work procedures for the mine.
- Training all site stakeholders in their specific duties and responsibilities.

In relation to emergency management, mine managers are responsible for:

- Developing a site-specific EFPP.
- Providing emergency response resources.
- Establishing a mine rescue station as well as suitably trained first responders.
- Including emergency response in mine design and change management processes.
- Evaluating and procuring suitable emergency response equipment.

- Training mine personnel about emergency response procedures (e.g. evacuation, fire suppression, first aid).
- Conducting regular mine rescue / emergency response team training, including emergency simulations and post-incident analysis.

Emergency Management Team

The emergency management team needs to plan for all reasonably foreseeable emergencies and respond to emergencies. The responsibilities of the emergency management team **shall** include:

- Develop an SOP outlining required roles and responsibilities, medical fitness, training, drill requirements, composition of team, mutual aid services. Conducting a risk assessment of foreseeable incident scenarios; such as, fire, medical emergency, trapped miners, flooding, seismic events, immediately dangerous to life or health air quality conditions.
- Establishing an emergency response capability including:
  - a fully equipped command and control centre that can be used in emergencies with sufficient tables, chairs, recording system to ensure that an accurate record can be kept of all discussions (telephone and others) as well as the sequence of events as it happened.
  - a fully equipped rescue station for first responders, including:
    - Fire Fighting tools and equipment.
    - HAZMAT Equipment (these items only used in high-risk/low-frequency events can be depleted quickly during an incident).
    - Specialised rescue equipment such as abseiling gear, Water rescue gear, Jaws of life and breathing apparatus for first responders.
  - A medical response station, sufficient in size to handle the potential types and number of casualties associated the reasonably foreseeable emergencies.
  - A fully equipped communications centre that includes a fully operational backup system with a capability to talk to the rescue teams, head office and outside agencies
  - An area should be identified where discussions could be held with family members of injured or missing employees or Business Partner workers, union representatives as well as members from the press.
  - Catering services during emergencies to enable the supply of food and drinks for everybody involved in the emergency.
  - Special logistical and acquisition procedures that can be used during an emergency to streamline processes and approvals.
  - Developing safe work procedures for EFPP (including training exercises).
  - Conducting emergency response competency training.
  - Maintaining emergency tools and equipment to the original equipment manufacturers (OEM's) recommendations.

Suppliers

The responsibilities of suppliers **shall** include:

- Designing and manufacturing emergency response equipment to relevant standards.
- Establishing performance specifications.
- Identifying hazards associated with the equipment and eliminating or reducing risks.

- Sharing residual risk information with the operator for inclusion in the operator's emergency plan.
- Provide information and instructions about the operation, maintenance and servicing of equipment. Trouble-shooting procedures and performance parameters, sharing safety alerts, restrictions and limitations.
- Share product recalls, when required.
- Carry sufficient stock of emergency related consumables.

4. ANALYSIS HAZARDS AND RISKS

Emergency events can introduce hazardous situations not normally encountered on a mine site. The site should conduct a comprehensive site-wide risk assessment to identify all major foreseeable emergency events that could impact on the operation and its personnel. This should be followed by an emergency response risk assessment to identify hazards associated with the response. This may require input and advice from operational groups and subject matter experts. The process followed should be the one outlined in the Guidance note for conducting Risk Assessments.

5. EMERGENCEY MANAGEMENT PLANNING

Emergency management and response planning should be carried out with input and advice from operational groups and subject matter experts using Vedanta's risk management approach.

Emergency Management

The development of plans to adequately manage any given emergency is best completed under distinct category headings:

- Emergency Fire Prevention Plans
- Business Continuity Plan
- Crisis Management Plan

This approach is recommended to avoid duplication and repetition regarding who is responsible for addressing an aspect of an emergency.

The plans should be clearly documented to manage any given emergency and provide instruction to all stakeholders. They should:

- Be written in a language understood by all employees.
- Be compiled and laid out to facilitate quick access to important information.
- Include a site profile (e.g. open cut, underground).
- Include appropriate use of illustrations, such as up-to-date maps and diagrams.
- Provide the location of all relevant emergency response facilities and equipment.
- Identify external resources that are available (e.g. emergency agencies, mutual aid agreements, informal arrangements with neighbours).
- Identify site-specific hazards and risks.
- Be available to all personnel on site.

Emergency and Fire Prevention Plan (EFPP)

An EFPP seeks to safeguard people from further harm, emergency response most often manifests as the procedures and actions that are taken immediately after an incident occurs.

A critical element of emergency preparedness is the development of response plans for identified emergency scenarios. EFPP assign responsibilities and procedures in the event of an emergency. These are determined by the risk assessment process, site-specific circumstances, and size and nature of the operation.

The plan covers the matters to be managed during an emergency at site level, and should reflect size and nature of the operation, nature of the risks, and availability of external resources.

The purpose of the EFPP is to:

- Identify hazards that might cause an emergency at a mine.
- Minimise the level of risk to life, property and the environment as a result of an emergency.
- Identify the resources (e.g. people, equipment, information, knowledge) necessary to minimise the risk.
- Identify roles and responsibilities of all the parties.

- Provide steps to be taken to initiate an emergency, respond to an emergency and recovery of site conditions.
- Provide a basis to develop training material for all employees on what to do in emergencies, including evacuation.
- Provide information for dealing with external authorities and stakeholders (e.g. Department of Mines, Industry Regulation and Safety, Police Force, Environmental Protection Authority, Unions and Media).

The development and implementation of the EFPP should be undertaken in consultation with the workforce, external agencies, emergency services, neighbouring mines and mutual aid parties. The EFPP should include at least the following:

- How to raise the alarm.
- Who will activate the plan?
- Clarity on when and by whom an emergency situation can be initiated.
- Assignment of emergency response duties.
  - o Duties of the person responsible for implementing the emergency response plan.
  - o Duties of site personnel during an emergency.
  - o Duties of site personnel during an emergency.
- Details for persons or agencies that may need to be contacted during an emergency including procedures and protocols for dealing with external authorities and stakeholders.
- Procedures for how to respond to specific scenarios as well as internal and external communication systems to warn of the initiation of an emergency must be established by the mine and documented. Communication systems must cater for all eventualities to ensure that all personnel are kept informed during an emergency, and relevant external agencies are promptly informed and updated as the emergency response unfolds.
- Contact details for rescue response team, personnel trained in first aid, communications systems and other specialist fields (e.g. firefighting, rope rescue).
- Equipment and facilities identified in the risk assessment as being necessary to deal with an emergency (e.g. first aid, firefighting and rescue equipment), including equipment and services from external sources for remote sites.

- Arranging external services such as counselling and notifying next of kin.
- Provision of training in implementing the plan.
- Ensuring that rescue teams are available and ready to deploy at any time, including:
    - o Standby duty rosters.
    - o In date medical evaluation of team members.
    - o The availability of enough team members and backup team members that are trained in the use of rescue and breathing equipment.
    - o Rescue equipment repaired and properly maintained.
- Provision for evacuation of injured personnel.
- Provision for site evacuation (including identification and establishment of refuge chambers).
- The location of potential transfer sites for emergency transport vehicles.
- Provision of training for employees (e.g. first aid training, basic firefighting).
- How we communicate the emergency to families and keep them informed about the situation.
- A full description of appropriate emergency response command and control actions and structures as well as a comprehensive emergency communication strategy to be followed during an emergency.
- The incident command centre should have written directives about how to organize assets to respond to different types of incidents and processes to manage the response through its successive stages.
- An effective method of informing underground workers to evacuate in case of an emergency. This could include radios, telephones and stench gas.
- The minimum safe time for an evacuation to take place of all personnel in the mine shall be determined; (including those personnel engaged in non-routine work such as ventilation engineers in return airways, diamond drillers and geologists in remote locations, etc.) and confirmed by evacuation drills conducted annually to confirm that the communication and evacuation system is effective in evacuating everyone within this minimum time. Detailed records of these drills must be kept for a period of 24 months.
- The location of the emergency command centre where all equipment is kept and where the planning and execution can be undertaking from, for an emergency rescue or response to any foreseeable emergency.

Emergency response plans should be developed for foreseeable scenarios underground applicable to the operation, such as:

- Air blast or wind blast
- Catastrophic failure in a shaft
- Chemical or fuel release (e.g. failure of containment)
- Civil disturbances or criminal activities
- Confined space incident
- Electrical incident
- Engulfment
- Explosives incident
- Falls from height or to depth
- Fires, including for tyres and explosives
- Fixed or mobile plant incident
- Flooding
- Gas release or explosion
- Hazardous material incident
- Inundation or inrush
- Irrespirable or noxious atmospheres
- Loss of radiation sources

- Major power loss
- Mechanical or electrical equipment out of control
- Medical emergencies
- Rockburst
- Personal injury
- Rail accident
- Seismic event
- Significant ventilation failure
- Spontaneous combustion
- Structural failure (plant)
- Unplanned explosion
- Vehicle or machinery incident

This list is not exhaustive and foreseeable scenarios should be identified from a risk assessment of the operation. Further useful information based on real-life emergencies may be obtained from industry safety alerts.

Document review and control procedures should ensure that emergency response plans are maintained and current. Emergency procedures related to the emergency response plan may include, but are not limited to, the following:

- Management structure for emergency command and control
- Response to a fire
- Transport of injured people
- Evacuation or withdrawal procedures, including emergency assembly areas
- Notification of emergency services
- Medical treatment and assistance
- Communication protocols
- Fire near portal procedures
- Vehicle rescue procedures
- Emergency training procedures
- Specific procedures for underground infrastructure collapse

Crisis Management Plan

Crisis management is a strategic approach to issues, focused largely but not exclusively on communication. Crisis management is usually handled at corporate level and has an emphasis on brand and reputation management.

In this respect, a crisis is a situation that poses a threat to the organization's very existence. If the situation is not resolved, the results could be catastrophic to the enterprise. In today's dynamic media space, crises can arise fast, driven by a 24/7 media cycle, the presence of social media, and access to information and opinion that may not be accurate or relevant.

Planning for a crisis means preparing the organization for potential crises and developing the processes that will be used when or if a crisis is declared.

Consider that communication in a response needs to involve traditional print and broadcast media, text and voice, multiple social media channels, and employees themselves, from customer relations to front-line operators and executives.

Drafting of a Crisis Management plan falls outside the scope of this Emergency response guideline, however, common guidelines for a sound Crisis Management Plan are:

Crisis Management Team - it should contain senior managers who have the expertise and experience needed to manage a crisis. The team should also consist of anyone with specialized knowledge useful in managing a crisis.

Organizational responsibilities of the team – each member should be assigned a specific task by defining the his/her functions, duties and responsibilities during a crisis.

Sub-teams – this will function under the overall direction of the main team member. A sub team will have people with different types of expertise, who can handle the tasks associated with the crisis.

Evaluation and corrections – after the conclusion of the crisis, assigned members should evaluate the response and take corrective action to overcome deficiencies.

Contact list – a regularly updated contact list should be compiled to keep internal and external stakeholders in the loop.

Command Centre – a Crisis Management/Emergency Operations Command Centre should be designated as the focal point for handling the crisis.

Logistics – the logistical support for notification, mobilization and Manning of crisis centres should be clearly laid out.

Public relations – in a time of crisis the last thing an organization needs is a 'bad press'. A communincations department team member from the relevant operation Head Office should be specifically assigned to this task. This could be a person on site or person from the relevant operation Head Office.

Business Continuity Plan

A business continuity plan is focused on the actions and preparations to ensure continuity of key business operations. The business continuity team will normally take steps to maintain or restore the organization to its pre-crisis state. This aspect of disaster planning involves the processes and procedures a business should put in place to ensure that mission-critical business functions can keep operating during and after a disaster. The emphasis is on maintaining business operations rather than setting right the damage to infrastructure.

Mines with good continuity plans can survive significant disasters. Drafting of a business continuity plan falls outside the scope of this EFPP, however, common issues that should be considered when a business continuity plan is developed including that:

- plans must be updated and tested annually;
- all types of threats must be considered;
- dependencies and interdependencies should be carefully analysed;
- key personnel may be unavailable;
- telecommunications are essential;
- alternate sites for backups should not be situated close to the primary site;
- employee support (counselling) is important;
- copies of plans should be stored at a secure off-site location;
- sizable security perimeters may surround the scene of incidents involving national security or law enforcement, and can impede personnel from returning to buildings;

- despite shortcomings, Business Continuity Plans in place are indispensable to the continuity effort; and
- Increased uncertainty may lengthen time until operations are normalized.

6. FIRE PREVENTION AND MANAGEMENT

Fire is a serious hazard in mines and outbreaks of fire underground can be particularly dangerous due to the:
- Confined nature of underground excavations
- Potential quantity of smoke and noxious fumes concentrated in the ventilation
- Restricted ability to evacuate quickly from an underground mine.

The prevention of fires is a priority for underground mines as they can lead to entrapment, smoke inhalation, serious or fatal burns, asphyxiation and other serious consequences such as explosions. All underground Vedanta mines shall have a documented underground fire risk assessment that is current and specific to its operations, with appropriate controls in place to manage the risks.

TYPES OF FIRE IN A MINE

Fire has always been a major concern for underground mining operations. A mine fire can occur at any time and can result in a partial or total evacuation of mine personnel with the potential for the loss of lives. Fires can expand rapidly, and time is therefore the critical element in the minimisation of negative consequences. Prompt detection, timely and accurate warnings to those potentially affected, and a proficient response by underground personnel can have a major effect on the containment and elimination of a fire. Fire preparedness and response require a response from both people and technology. If proper systems are in place and properly trained and experienced personnel are employed, fire risk can be greatly reduced.

Underground mine fires can have very serious consequences, due to the difficulties in controlling and eliminating the fire, the potential for the mine being filled with smoke, oxygen depletion and the time required to rescue personnel.

There are several types of fires that can occur in an underground mine. The list below shows the most common sources of fire but is not exhaustive.
- Mobile Equipment
- Fixed Plant Equipment
- Workshops
- Electrical Installations and Transformers
- Explosives
- Fuel & Lubes
- Hoisting Installations
- Earth Moving Machinery
- Storage areas
- Heavily timber supported area
- Pipe cladding
- Waste materials
- Installations such as mobile offices, lunchrooms, etc.

Due to the nature of underground mines, fires can spread very fast and create very difficult and dangerous conditions for people and rescue teams.

Mines use ventilation systems to provide fresh air to people in all parts of a mine. The air is normally supplied via large fans and this means that there is a steady air flow through the mine. The air will provide a steady supply of oxygen which will fuel a fire.

On the fresh air side of a fire, the air will still be clean, and access is possible. On the return air side of a fire the air may be full of smoke, toxins and deficient in oxygen. The air may also contain contaminants such as carbon monoxide and noxious gases, depending on the type of fire.

In the event of a fire, the people who are on the return air side will need to either seek refuge or use an alternate form of oxygen. Refuge can be taken out of the mine via a specified route, if this is possible. However, in some cases personnel will need to use short or long-term self-contained self-rescuers.

Contributory Factors to Fires

Most fires that occur in a mine are the result of poor practices, poor housekeeping, unsafe storage of fuels and explosives, poor maintenance, bad planning or lack of suitable training.

Poor practices include purchasing and installation of unsuitable equipment or equipment without adequate fire safety features. **This can be the result of purchasing decisions being made by people who do not fully understand the consequences, and who focus on cost that results in poor quality equipment**.

Installation of fixed plant equipment in an underground environment requires specific skills and must be managed and maintained by people with specific underground experience.

Mobile plant also requires specific skill levels for deployment, operation and maintenance, as some equipment must be taken apart before being transferred underground, where it is then rebuilt.

Planning and use of new equipment in a mine should always be based on a risk assessment and requires a review of the uses and the environment in which the equipment will be used. Planning considerations require fire prevention, fire control and fire management systems.

Use of both mobile and fixed plant equipment requires proper training of personnel operating and maintaining it. Training shall be carried out by competent persons and be in line with OEM requirements. Training content must be authorised by the mine manager and all equipment must only be operated by trained and authorised personnel. Re-training is required at regular intervals of no more than 12 months and all training must be recorded and records kept for no less than 24 months.

7. OVERALL MANAGEMENT APPROACH AND FIRE PREVENTION PLAN (FPP)

Each site shall establish and implement a Fire Prevention Plan (FPP). The objective of the fire prevention plan is to eliminate the risk of fires that may result in fatalities or serious injuries. The FPP must:

- Be designed by a competent person(s)

- Be designed with the aim of preventing underground fires

- Have suitably qualified people trained in fire control and suppression techniques as per FPP.

- Take the risk assessment into consideration when implementing fire prevention and controls.

- Incorporate lessons learned from other mine fire incidents at the site and other operations.

Be reviewed annually by a competent or external person(s), with a review report signed off by the Safety Head.

The Safety Head have knowladge about the following areas of science:

Fire Safety Science:

- Fire Dynamics
- Heat Transfer
- Fire Chemistry

Human Behaviour & Evacuation:

- Human Behaviour in Fire
- Egress & Life Safety

Fire Protection Systems:

- Passive systems
- Active systems
- Fire Detection & Alarm
- Fire Suppression

Fire Safety Analysis:

- Performance based design
- Smoke Management
- Evacuation Analysis
- Structural Fire Safety
- Risk Management
- Fire Modelling

All employees and business partners working underground shall undergo training in line with the FPP and the training must be delivered by competent persons. Refresher training shall be carried out on an annual basis. Supervisors and mine managers shall receive additional levels of training to include details of the Fire Prevention Plan.

A competent person(s) shall design the following systems:
- Fixed and portable fire detection

- Warning

- Suppression

- Alarms

- Equipment

- Air flows

- Stench gas system

Each operation shall make available suitable and sufficient resources to ensure effective implementation of the emergency response control plan, the FPP as well as the mutual aid plan. Each operation must budget for the resources to ensure effective implementation of the fire control plan.

Fire prevention and management plan shall be aligned with the emergency management and response planning at each operation and this requires alignment with the
- Business Continuity Plan
- Crisis Management Plan

Legislation

All relevant local legislation must be complied with for factors affecting fire prevention and management.

FPP Review

The FPP shall be reviewed annually.

8. FIRE PREVENTION

The safest way to deal with fire is to prevent it. A fire needs three elements - heat, oxygen and fuel. Without heat, oxygen and fuel a fire will not start or spread. A key strategy to prevent fire is to remove one or more of heat, oxygen or fuel.
A fire prevention plan and a fire risk assessment should include detail and a full consideration of all of the issues - including issues arising from heat, oxygen and fuel.

Heat
Heat can be generated by work processes and is an essential part of some processes such as blasting, hot work, friction or short circuits in electricity for example. Heat must be controlled and kept away from fuel unless carefully controlled. Heat generated as a by-product of a process must be dealt with properly by ensuring that the controls are in place and maintained.

Typical controls for Heat
Ensure employees are aware of their responsibility to report dangers associated with heat build-up.
Put a plan in place to control all potential sources of ignition.
Have high risk areas and equipment inspected and maintained regularly.
Install fire fighting equipment at prominent locations.
Irrespective of the controls that are in place the following should be treated as high-risk areas:
- Workshops
- Refuelling bays
- Substation
- Areas where hot work are conducted

The following basic controls should be considered:
- Provide no-smoking/no open flame signs at appropriate locations.
- Ensure hot work area(s) are away from flammable materials.
- Arrange for spark generating material to be disposed of safely and away from combustibles.
- Installation of fire detectors in high-risk areas.
- No smoking is permitted in the mine.

Plant and equipment which is not properly maintained can cause fires. At least the following preventative measure should be implemented:

- Ensure all work equipment brought into the underground work area is designed to be protected against catching fire or overheating
- Ensure proper maintenance of machines, such as ensuring that ventilation points on machinery complies with design criteria and is not blocked - causing overheating
- Have electrical equipment serviced regularly by a competent person to prevent sparks and fires
- Properly clean and maintain heat producing equipment such as burners, heat exchangers, boilers (inspected and tested yearly) and ensure that storage of flammables are not in the vicinity of this equipment.
- Use a planned maintenance programme to properly maintain plant and equipment. Review your programme if you already have one.
- A planned maintenance programme should deal with:
  o frictional heat (caused by loose drive belts, bearings which are not properly lubricated or other moving parts)
  o electrical malfunction
  o flammable materials used in contact with hot surfaces
  o leaking valves or flanges which allow seepage of flammable liquids or gases
  o static sparks (perhaps due to inadequate electrical earthing)

Hot Work

Hot work is an integral part of underground activities. Hot work is work that might generate sufficient heat, sparks or flame to cause a fire. Hot work includes welding, flame cutting, soldering, brazing, grinding and other equipment incorporating a flame, hot work can be very dangerous and stringent controls must be in place.

In respect of hot work, the FPP should include at least the following items:

- The identification process of all hot work.
- Only allow hot work if:
  o No satisfactory alternative is available.
  o In areas where there is not a high fire load.
  o Only where the necessary firefighting equipment is immediately available.
- Ensure that all employees and Business Partners are aware of hot work procedures and permits.
- Use a hot work permit system that includes:
  o Fire-resistant protective clothing requirements.
  o Responsibilities clearly defined.
  o With a logging and audit processes in place.
  o Routine checking and supervision requirement.
  o The item to be worked on removed to safe area.
  o The requirement to remove or protect combustible or flammable materials.
  o The requirement to prevent, suppress and control sparks.
  o The requirement to prevent, suppress and control heat.
  o Ensuring provision of and training on suitable fire-fighting equipment.
  o The provision of a separate person to fire-watch and use fire-fighting equipment – the use of a designated fire watcher.
  o Ensuring particular precautions for special risks, e.g. confined space.
  o Enforcing requirement to leave workplace clean and safe.
  o The condition of a final check of area no sooner than 60 minutes after completed job and certainly prior to premises being vacated.

Electrical

The underground electrical installations span through almost every working area and thus spread the risk of an electric fire throughout the mine.

All electrical equipment and installations must be designed, constructed, installed, maintained, protected, and used to prevent danger.

Only Authorised and qualified electricians must be allowed to conduct installation and repairs to electrical equipment and fittings.

The controls that is associated with electrical fire prevention include:

- Checking of all electrical equipment and removal of defective equipment.
- Ensuring that electrical cords are in good condition.
- Ensuring that equipment is independently protected and powered from separate electrical outlets
- Avoid using extension cords. If you require an outlet in an area where there is none, have one installed by a qualified electrician.
- Ensure that overload and earth leakage equipment is of suitable type and maintained.
- Ensure that all electric cables are installed on cable racks.

Arson

Deliberately started fires pose very significant risks to all types of workplace. The possibility of arson should be considered as a component of your risk assessment and it is one that you can do much to control.

In this respect consider at least:

- Providing adequate security measures
- Preventing access to unauthorised personnel
- Keeping flammables securely stored

Oxygen

The air we breathe contains about 21% oxygen. In the underground environment every area where humans work is ventilated and thus provided with oxygen that can sustain a fire. For this reason, there is little we can do to prevent fires by cutting the oxygen supply, this is normally done when fighting a fire.

Fuel

Workplaces in which large amounts of flammable materials are present, stored or used can present a greater hazard than those where the amount kept is small. In relation to fire, fuel consists of flammable material. Flammable material is material that burns readily in a normal atmosphere. Flammable materials include flammable liquids, flammable gasses and flammable solids. It is important to identify all flammable materials that are in significant quantities in the working places underground so that proper controls can be put in place.

Flammable materials

In the FPP the following requirements in respect of flammable equipment should be addressed:

- Identification of all flammable materials so that proper controls can be put in place
- Identify use of substances with flammable vapours
- Reduce quantities of flammable materials to the smallest amount necessary for safe production and keep it away from escape routes
- Replace highly flammable materials with less flammable ones or treat it with fire retardant chemicals
- Store stocks of highly flammable materials in suitably constructed stores in the return airways
- Provide clearly marked separate storage for flammable chemicals, gas cylinders, and waste materials
- Train employees on safe storage, handling and use of flammable materials
- Keep stocks of explosives in approved magazines or day boxes

Flammable liquids

Flammable liquids can present a significant risk of fire.

- Vapours released are often heavier than air and can travel long distances, so are more likely to reach a source of ignition.
- Liquid leaks and dangerous vapours can arise from faulty storage (bulk and containers), plant and piping.
- Ignition of the vapours from flammable liquids remains a possibility until the concentration of the vapour in the air has reduced to a level which will not support combustion.

The quantity of flammable liquids in the underground workings of a mine should be kept to a minimum and only be stored in officially sanctioned containers or bulk storage metal receptacles.

Flammable liquids, including empty or part-used containers, should be stored safely and empty containers removed from underground daily.

Where large quantities of flammable liquids, such as fuel, are used, they should, where possible, be conveyed by piping through a closed system. These pipes should be run empty after each delivery cycle, where a connection in such a system is frequently uncoupled and remade, a sealed-end coupling device should be used. This shall be inspected weekly for any leaks.

Flammable liquids should not be decanted within a store. Decanting should take place in a well-ventilated area set aside for this purpose, with appropriate facilities to contain and clear up any spillage.

Container lids should always be replaced after use, and no container should ever be opened in such a way that it cannot be safely resealed.

Flammable liquids should be stored and handled in well ventilated conditions. Where necessary, additional properly designed exhaust ventilation should be provided to reduce the level of vapour concentration in the air.

Metal storage containers should be kept covered and proprietary safety containers with self-closing lids should be used for dispensing and applying small quantities of flammable liquids.

There should be no potential ignition sources in areas where flammable liquids are used or stored, flammable concentrations of vapour may be present at any time. Any electrical equipment used in these areas, including fire alarm and emergency lighting systems, needs to be suitable for use in flammable atmospheres.

Fuel storage, refuelling bays and transfer equipment must get specific attention. The following requirements and practices will minimise fire risk when storing and handling fuels:

- All equipment used to store, transfer or distribute fuel underground should meet all the relevant safety standards of the country
- Electrical control systems associated with fuel transfer and storage should also comply with country specific safety standard
- All electrical equipment and wiring systems shall be in accordance with local legislation and standards
- Storage tanks, pipe work and fuel transport vehicles entering refuelling bays should be earthed.
- Permanent storage, supply and refuelling stations should have an automatic fire detection and suppression system that complies with local safety legislation but should include at least a fire alarm and be capable of being manually activated at a safe distance from the refuelling bay.
- Permanent fuel storage locations should have a floor impervious to fuel, capable of being cleaned and with bunding and run-off. Where a storage location is temporary, a risk assessment that deals with fuel spills should be conducted and control measures as identified by the risk assessment implemented.

The following requirements and practices will minimise fire risk in workshops and should therefore be implemented in every underground workshop.

- Workshops should contain a minimum storage of combustible liquids and must not exceed one week's supply.
- Any combustible liquids should be stored in segregated locations and bunded.
- Dangerous goods must be segregated according to the local Dangerous Goods Safety Regulations in respect to labelling of storage and handling.
- The storage and use of compressed and liquefied gases underground should be avoided wherever possible and minimised otherwise.
- Separate locations for hot work like welding, cutting using oxyacetylene, electric welding etc. should be provided to meet the safety requirements.
- Adequate facilities (e.g. absorbent material, fire extinguishers) should be installed to allow the rapid containment or clean-up any fuel spills.
- Suitable physical barriers and designated parking areas shall separate mobile equipment from flammable or combustible liquids.

Cleanliness and housekeeping

The basic principle of cleanliness and housekeeping is to prevent the accumulation of flammable materials. If one avoids the accumulations of combustible rubbish and waste in the underground workings, the chances of a fire is greatly reduced.

Housekeeping includes never storing flammable or combustible rubbish, even temporarily, in escape routes, or where it can contact potential sources of heat.

Position waste containers so that a fire will not put any structure at risk and that fumes and gassed will enter the return airway directly.

Clean surfaces in workshops on a regular basis to prevent oil and grease build-up.

If the intake shaft area has waste or derelict land nearby, keep any undergrowth under control so that a fire cannot spread through dry grass, and allow smoke and gasses to enter the underground workings.

9. FIRE RESPONSE PREPAREDNESS

Fire response preparedness can be separated into three sections, as follows:

1. Fire Prevention and Awareness
2. Fire Detection and Warning Systems
3. Fire Response and Fire Fighting

9.1 Fire Prevention and Awareness

There are general fire safety precautions that should be implemented at every underground mine regardless of the type of mine or the fire load present underground.

To minimise underground fire risk, infrastructure that could pose a high fire risk should only be installed following a formal assessment and consideration of the controls necessary to minimise risk. Infrastructure should be located in, or automatically vented to, the return airway in the event of a fire.

A comprehensive awareness program should be implemented as follows:

General fire prevention awareness

Basic fire prevention awareness training should be provided as part of the mine induction.

Refresher training should then be conducted every 12 months as part of regular safety/tool-box meetings.

All personnel who work at the mine should have a basic understanding of fire prevention measures and be trained and assessed for competency in:

- Basic fire theory;
- Basic fire prevention methods;
- Understanding of fire potential risks;
- Use of the first response of basic fire-fighting equipment, including portable extinguishers, installed on-board vehicle fire suppression systems, etc.;
- Behaviour of fire in enclosed environments, including the role played by ventilation systems;
- Emergency procedures, including use of self-rescuers, refuge chambers and emergency assembly points;
- Reporting procedures during fire emergencies; and
- Distinguishing and identifying audio and visual fire alarms where provided.

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

- The basics of conducting proper inspections;
- Identification of overheating surfaces;
- Requirements for minimising engine and equipment temperatures through correct operating technique;
- Procedures to isolate on-board electrical power sources safely;
- Electrical fire hazards;
- Use of refuelling equipment and refuelling procedures;
- Fire prevention measures of tyre fires; and
- Response to any fire that may occur on a vehicle based on the equipment available.

9.2 Fire Detection and Warning Systems

During the early stages of a fire, smoke, gases and carbon monoxide are produced and released into the mine atmosphere. If these products are not detected in the early stages of combustion, they can result in severe hazards to personnel, especially those in remote areas of the mine.

The primary purpose of a fire detection and warning system is to give an early notice to those who may be affected by fire, so that they can either commence fighting the fire if it is safe to do so, or to evacuate to a place of safety. Early detection and warning systems must be installed in the areas below:

- Mobile plant
- Fixed plant installations
- Electrical installations
- Explosives stores
- Hoist rooms
- Workshops

A fire risk assessment should identify where the highest risks are, and appropriate detection and warning systems must be installed. Training on the management of a fire in any of the above must be provided to people who are required to work with this equipment or who work nearby.

9.3 Fire Response and Fire Fighting

Following the process of fire detection and warning systems, the next stage is fire response, including firefighting. In the event that a person is present when the fire starts, a basic risk assessment must be made. There are limited options available:

- Raise the alarm
- Fight the fire
- Evacuate

For a person to make a decision, they must be trained and knowledgeable. All employees and business partners who are present in a mine must be adequately trained to understand the fire risk and act appropriately.

If no persons are present, then the fire may spread and cause significant damage and become a serious risk to other people in the mine. In areas of high risk, a risk assessment should identify high risk areas where automatic fire systems are required.

Before fighting a fire, some very quick decisions (in order of priority) may need to be made based on the assessment of the fire, such as

1. Raise the alarm.
2. Fight the fire or evacuate?
3. Are firefighting systems in place?
4. Is the fire out of control?

These decisions will often rely on training and require people to have an understanding of the effects of a mine fire, including understanding the hazard and potential elsewhere in the mine. The flowsheet below shows the types of questions and responses required in the event of a fire being observed.
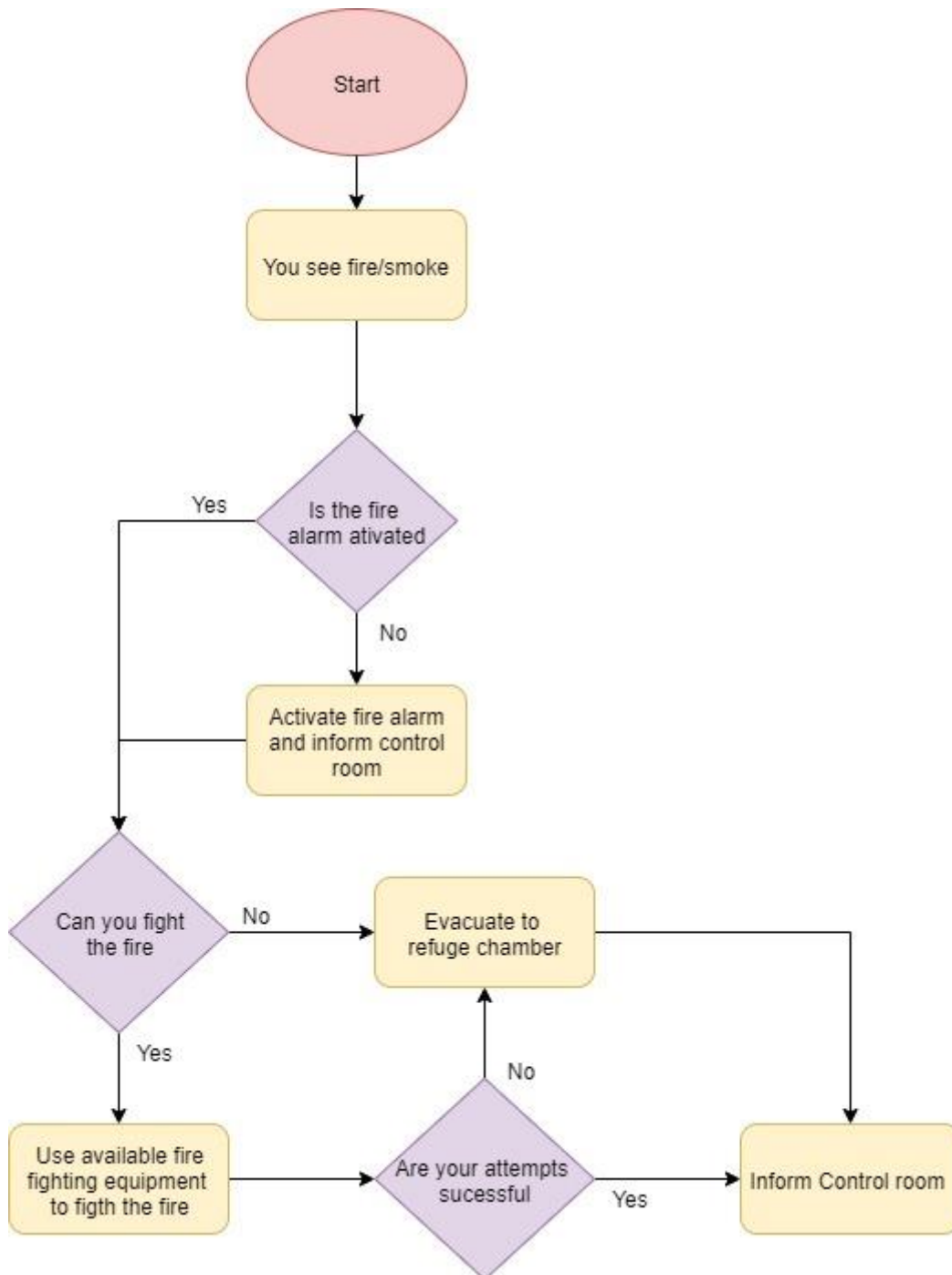
Firefighting equipment and planning must be in place where required and based on an informed and up to date risk assessment.

Basic firefighting equipment must be available at all key areas where there is the possibility of a fire. This includes fire extinguishers, fire suppression systems, water, mains and other appropriate measures, as required by the risk assessment.

Advanced firefighting includes water trucks, fire brigade / fire rescue team and oxygen starvation (ventilation changes, foam, or other).

Sustained firefighting includes the use of mines rescue teams, assistance from nearby mines and oxygen starvation. Planning for sustained action requires a muster room, arrangements for accommodation and food for fire fighters, transportation, etc. Refuge stations must be provided in key areas in underground mines where there may be a requirement for people to take refuge in the event of a fire starting and not being controlled. Evacuation kits are of benefit in key areas.

Escape ways are required both for legislation purposes and as a safe means of alternate egress. During a fire fighting and recovery process in an underground mine, a mining engineer, with knowledge of the mine ventilation and of the specific mine shall be available to provide key information on air flows throughout the mine. Appropriate decisions can then be made regarding turning fans on and off to alter the airflow.

10. PREVENTION AND RECOVERY MEASURES

Fire Prevention

Prevention of fires shall be in line with the Fire Prevention Plan requirements, which is described in Section 3. They shall include but not be limited to the following:
- The fire risks shall be reviewed on a regular basis, at least annually
- All new equipment shall be risk assessed and controls added, where required before being allowed into a mine.
- A formal sign-off procedure that includes the sign off by a Ventilation Engineer who shall be put in place to manage Fire Prevention Plan.
- Inspection and maintenance of equipment shall be on a scheduled regular prescribed basis. Planned maintenance programmes shall be in place for mobile and fixed plant equipment.
- Testing and monitoring of equipment shall be carried out on a regular prescribed basis.
- Training and re-training on fire prevention of all personnel shall be undertaken on a regular prescribed basis.

Fire Recovery

The main objective of recovery work is to return the mine or affected area of the mine back to operation status as soon as conditions permit after a mine fire. This work is normally the responsibility of the mines rescue teams and requires a full assessment of the area including rehabilitation of ventilation and good air quality, if it has been affected. A mine shall have a mines rescue team in place that is fully trained, equipped and in sufficient numbers to ensure that there is always a back-up team available.

Each mine should, where possible, have a mutual aid plan in place with local groups such as the local fire brigade, hospitals and ambulance services to assist during recovery operations.

11. SAFETY SYSTEMS

The mine shall employ approved systems for fire prevention and management. This shall include but not be limited to

- Automatic Fire fighting systems in areas such as underground sub stations.
- Automated sprinkler system for conveyer system.

- Major electrical installations automatic fire prevention system.
- Designated place for fuel, lube & explosive storage.
- Designated refuelling locations.
- Mobile fire tender.
- UG fire & smoke detection system.
- Fire extinguishers in key areas and on mobile and fixed plant equipment.
- Refuge chamber(s).
- Self-contained self-rescuer for all people underground (including visitors), with a capacity as used on the mine.
- Second escape way.
- Emergency route marking.
- Smoking is not permitted in underground mines.
- Mobile phones not permitted underground.
- Stench gas system.

In addition to the approved systems each mine will need to make manufacturers or suppliers aware of the environment in which the equipment is to operate so that they can reduce fire hazards to a minimum. No mine may elect to exclude any fire prevention/extinguisher system that the OEM requires to be fitted when the machines are supplied to other users. Some key factors that should be considered when assessing the likelihood of fire are:

- Selection, installation, inspection and maintenance of fire detection, warning and suppression systems.
- Selection of suitable mobile and fixed plant equipment, including suitable maintenance programmes.
- Electrical equipment and installations fire hazards.
- Definition of mobile equipment that require specific types and sizes of fire extinguishers on board; for example, does LHD have a powder and foam extinguisher on board?
- Types of equipment that require fire suppression systems that are activated from within the cab.
- Machinery and equipment service planning.
- Pre-start checks for all mobile equipment to include fire prevention and containment equipment
- Inspection, testing and monitoring of fire prevention and containment equipment on mobile and fixed installations.
- Not allowing open lights, flames and hot work without a hot work permit.
- Storage and control of flammable materials, preferably in the exhaust air locations.
- Storage of materials considering separation distances from areas of high fire risk.
- Use of fire-resistant materials, such as conveyors, hydraulic fluids, electrical cables, etc.
- Type, storage and use of explosives (Explosives are covered under a separate Guidance Note).
- Provision of alarm systems for carbon monoxide and smoke at key points within the ventilation system.
- Provision of a list of items that are prohibited from being taken or used underground, including a system to prevent these items from being taken into the mine. Petrol is an example of an item that is prohibited in an underground mine.
- Installation of appropriate barricades and signage in place of high fire risk areas.
- Prohibition of materials that have potential for spontaneous combustion. If required from a risk assessment, a Spontaneous Combustion Plan must be required.

Fire Suppression equipment on heavy duty machines

A critical area where fires are prevalent in underground mines is associated with large mobile equipment. The trend is to fit all large equipment with automatic fire suppression systems, which is automatically triggered when temperatures reach a critical level on any of a series of heat sensitive wires positioned throughout the engine compartment. The system can also be triggered manually from inside and outside the cab of the machine. Such a system shall be fitted to all underground mobile machinery and critical stationary equipment.

Fires associated with turbo chargers

A similar issue occurs on underground equipment equipped with turbo chargers, such as LHD machines. These units shall be fitted with two fire extinguishers, one of which shall be a powder extinguisher and the other shall be a foam extinguisher. If a fire is associated with the turbo charger, the powder extinguisher may extinguish the fire, but the fire may restart due to the high temperatures. A foam extinguisher will help to reduce the temperature while also extinguishing the fire.

Turbo fires are often associated with the shutdown of an engine and oil or fuel coming into contact with the turbo charger, particularly when the machine has been working hard and the turbo temperature is very high. Therefore, all machines equipped with turbo chargers shall be run on 'idle' for a minimum of five minutes (or as per OEM guidelines) prior to being shut down.

Turbo chargers (and other heat generating sources) must be protected with a "Heat Shield" to prevent fuels/oils/hydraulic fluids coming into direct contact with these heat sources.

Storage of Flammable materials

Storage of flammable materials should be limited according to the requirements of the mine and isolated from ignition sources.

- Fire resistant fluids should be used, where practicable.
- All pipeline delivering fuels, lubes and oils shall be inspected on a scheduled basis.
- All areas where flammable materials are stored shall be suitably barricaded with signage posted.

12. COMMUNICATION

When a fire occurs, it is of critical importance that there is an alert system so that people can fight the fire, evacuate or raise the alarm. Each operation shall have a system that ensures that all personnel can be alerted in an emergency situation so they can take the appropriate action depending on the site procedures.

Alarm systems shall include the injection of stench gas to the ventilation system, communications via radio or some other system, but it must be adequate to have a reasonable chance of reaching all parts of the mine. In expansive underground mines it is important to have a control room on surface that should be notified of any and every fire that occur. It will then be the responsibility of the control room supervisor to initiate an evacuation of underground employees.

Communication systems may include the following for both underground and open pit operations:

- Direct radio
- Leaky feeder radio
- Through the Earth radio
- Phones – fixed or mobile
- Sirens
- Loudspeaker

- Stench gas

Communication systems shall be based on the risk assessment and be tested on a prescribed basis.

13. TRAINING AND COMPETENCY

The Fire Prevention and Management team shall be responsible for all aspects of fire prevention and management, with the key parts of the plan delegated to various managers and skilled personnel within the organisation or to external experts.

The provision of information, instruction, training and supervision is an essential component of any safe system of work. Training and competency assessment are important to ensure all employees, including emergency responders, can effectively implement the site's safe systems of work and emergency plan. Training may be:

a. Formal, through accredited courses
b. Undertaken on site while being supervised or mentored by trainers and assessors, competent in the subject matter
c. A combination of these approaches

A training needs analysis helps identify the required competencies, training needs and skill gaps for the site and individual workers.

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

14. MONITORING AND REVIEW

To ensure the effectiveness of controls is maintained at the site, a monitoring and review program should be implemented that includes inspections, testing and auditing of the emergency plan and emergency response procedures. This should cover the effectiveness and limitations of on-site emergency response equipment and the availability of additional or specialised equipment (external).

As part of the site's validation process, responsibilities and accountabilities should be clearly defined and assigned and may include independent auditing. The findings of the monitoring and review process should be used to:

- Confirm the recommendations of previous reviews were actioned.

- Confirm responses were appropriate for any incidents or issues that arose.

- Verify compliance with specifications (e.g. inspection, monitoring, and quality control).
- Confirm site practices in order to comply with the emergency plan.

If significant gaps are identified, this should prompt a review of the risk assessment process and SOP. Throughout the risk management process, it is vital to ensure that key stakeholders and subject matter experts are consulted where appropriate. The mine will need to demonstrate that hazards associated with its mining operations and emergency response are controlled so far as is practicable, with the risk assessment and management process formally documented in the operation's hazard and risk register. The documentation of this information forms the basis of the site's emergency plan, training needs analysis and safety management system.

15. EMERGENCY RESOURCES, PERSONNEL AND EQUIPMENT

The person responsible for initially coordinating the response is generally the most senior person on site who has direct control of the area where the emergency incident is located — they assume the role of the incident controller until the response plan is activated.

The response may require the partial or total evacuation of site personnel to designated safe points (e.g. emergency muster points, refuge chambers, fresh air bases).

Based on the risk assessment, sites need to demonstrate their commitment to the emergency plan by obtaining the resources and equipment necessary to carry out the plan. Each site has its own potential hazards and needs. Wherever possible, local professional services should be integrated into the site emergency plan (e.g. fire brigade, ambulance service).

Where sites rely on external agencies, they should consider the minimum resources and capability required to provide immediate response, given the external agencies may have other priorities. Equipment should be appropriately stored in a building that allows for its easy access, storage and maintenance.

Resources

Resources for emergency management should be determined based on the risk assessment, site-specific circumstances, and size and nature of the operation.

Internal Personnel

Personnel should be allocated and their primary responsibly for emergency planning and response. Systems and structures should be developed with key personnel and assistance from subject matter experts where appropriate. This may include:

- Full-time Emergency Services Staff
- Mine Rescue Members.

Competent emergency leaders supported by first aid and emergency response personnel are fundamental to effective emergency management. A site's operations or high-risk activities may need to be adjusted depending on the availability of emergency response personnel. The personnel required is determined by the risk assessment process, site-specific circumstances, and size and nature of the operation. Responsibilities should be clearly documented for all key roles specified by the site's emergency plan. It is essential to establish structures and protocols to implement the emergency plan.

Facilities

Fit-for-purpose facilities should be established near the operations, with appropriate access and egress. Consider the following features:

- A facility to provide first aid to injured persons
- Adequate space to store, clean and maintain emergency response equipment
- Shower and toilet facilities
- Areas for skills-based training
- Parking or garaging for emergency vehicles
- An incident management room

Equipment

Sufficient equipment should be available and kept operationally ready to deliver the objectives of the emergency response plan. The type of equipment required is determined by the risk assessment process, and size and nature of the operation. Equipment should comply with the relevant in country standards.

The mine manager should supply the types of rescue equipment that persons may need to be trained in. These may include, but not be limited to, the following:

- Self-contained breathing apparatus for each rescue team member
- Fire-fighting equipment
- Vehicle rescue and access equipment
- Vertical access equipment
- First aid equipment including resuscitators, defibrillators, pain relief
- Strata fall entrapment equipment
- Water rescue equipment
- Air bags
- Confined space rescue equipment
- Jaws of life
- Lifelines
- Soda Sorb for canisters
- Oxygen cylinders
- Oxygen pump/cascade system
- Self-contained breathing apparatus testing kit
- Multi-gas detectors
- Lightweight, collapsible and/or wheeled stretcher
- First aid bag and supplies
- Portable communication system
- Spray pipes
- Water hose nozzles with pistol grips
- Y-pieces and connectors
- Fire hoses
- Foam delivery fans
- High expansion foam concentrate
- Mine rescue trailer for equipment transport

Vehicles

Suitable vehicles need dedicated at all times for the sole purpose to transport patients, fight fires and respond to emergencies when workers are on site. These vehicles should be ready for use at all times, and may include:

- A vehicle capable of transporting patients (e.g. ambulance)
- Fire-fighting unit(s)
- Dedicated emergency or rescue vehicles
- Specialised vehicles (e.g. watercarts, loaders, dozers, cranes).

Matters to consider include:

- Need for four-wheel drive
- Need for diesel engines (e.g. underground)
- Height clearance
- Visibility
- Storage accessibility
- Scheduled maintenance and inspection processes

External Support

Relationships and links with neighbouring sites and external support agencies should be established, particularly when developing a new site, and regularly reviewed. The following should be considered:

- Availability of external resources, access, equipment compatibility, response time and operator requirements.
- Memoranda of understanding for a mutual aid agreements.
- Contractual arrangements for life support transportation by aircraft / air services.

External support may include:

- Mutual aid with neighbouring sites.
- Local police.
- Local hospitals and nursing posts.
- Medical provider.
- Fire and Emergency Services.
- Government Department of Mines.
- Government Safety Authority.
- Local Government.
- State Emergency Services.
- Government Department of Health.
- Government Environmental Agencies.
- Other external personnel.
- Vendors emergency phone contact details to reach their hotline to get technical support on their products and emergency supplies.

Maintenance

To achieve the desired safety and health outcomes, maintenance activities for emergency response equipment should adequately address matters such as:

- Scheduled maintenance and inspection processes based on OEM recommendations
- Calibration and testing where required
- Cleaning, sterilisation (where required) and storage
- Training to maintain equipment
- Inspections by competent persons (e.g. qualified technicians) to meet OEM's testing and servicing requirements
- Inspection and maintenance checklists, logs, repairs and servicing records
- Access to OEM's manuals and safety data sheets (SDSs) for chemicals

16. TRAINING AND COMPETENCY

The provision of information, instruction, training and supervision is an essential component of any safe system of work. Training and competency assessment are important to ensure all employees, including emergency responders, can effectively implement the site's safe systems of work and emergency plan. Training may be:

- Formal through accredited courses
- Undertaken on site while being supervised or mentored by trainers and assessors, competent in the subject matter
- A combination of these approaches

A training needs analysis helps identify the required competencies, training needs and skill gaps for the site and individual workers.

Training

A training needs analysis should be undertaken to determine training and verification of competency requirements for the incident management team, mine rescue team members and the general workforce by:

- Identifying the required competencies to perform the role, job or task.
- Identify medical fitness for the role.
- Identify training for all equipment and tools.
- Identify the theory and practical components.
- Identifying current competencies of personnel.
- Identifying gaps by comparing personnel competencies against role requirements Planning and implementing a means of filling the gaps.

Conducting a training needs analysis may involve:

- Questionnaires and interviews
- Practical tasks observations and assessment
- Third-party competency requirement reports
- Training records
- HR Records
- Job Descriptions
- Training matrix that identifies the training needs to be addressed and the content of training delivered.

Training records

A formal record must be kept of training conducted, which may be accredited or non-accredited. Records to be kept should include:

- Name of person who received the training
- Dates and times when training was provided (including refresher training)
- Specific details of what was covered
- Duration of the training session or course
- How the training outcomes (competency) were assessed?
- Test and competence assessment results

Emergency response and other relevant training

Based on the site's emergency plan, personnel responding to an emergency must be trained and competent. Emergency response training may include:

- Inductions
- Emergency evacuation
- Training on PPE, self-rescuers, fire extinguishers, refuge chambers, how to activate fans air bays
- Regular training dates (e.g. weekly or monthly)
- Nationally accredited training by qualified trainers and assessors
- Licensing (e.g. heavy-duty vehicles)
- Vocational and professional courses
- Emergency exercises.

Nationally accredited training topics to consider for Emergency Response Team (ERT) personnel include:

- Advanced first aid
- Use of open circuit breathing apparatus
- Handling hazardous materials (HAZMAT)
- Firefighting
- Vertical rescue
- Confined space rescue
- Vehicle extraction
- Search and rescue techniques
- Air ambulance loading of patients

For underground operations, the following topics should be considered for Mine Rescue Team Members:

- Use of closed-circuit breathing apparatus
- Underground search and rescue
- Underground firefighting
- Use of refuge chambers
- Use of self-contained self-rescuers
- Water rescue
- Confined space rescue
- Using Jaws of life
- Use of multi gas detectors
- Installing and operating an underground spray pipe installation
- Using portable communication systems
- Erecting and operating high expansion foam delivery fans
- Conducting rescue operations using vertical access equipment

The risk assessment for each operation determines the need for additional training (e.g. advanced first aid, land search and rescue, suppression of wildfire, emergency vehicle driving, gas testing, working at height, confined space entry).

First aid

The number and competency of workers trained in first aid is determined by the risk assessment process, site-specific circumstances, and size and nature of the operation. The size of the workforce may vary over time, and first aid requirements should be reviewed regularly and as circumstances change.

Medical assistance should be commensurate with the likely medical emergencies. First aid personnel must be trained and competent to use the equipment and resources available.

Emergency training, drills and exercises

Emergency training should be conducted at intervals not exceeding 12 months for each type of emergency identified in the risk assessment, to ensure that emergency response personnel are sufficiently competent to respond to foreseeable incidents, based on standard operating procedures. This is undertaken by:

- Conducting a risk assessment of foreseeable incident scenarios
- Establishing an emergency response capability (e.g. facilities, equipment, personnel) for each scenario
- Developing safe work procedures for emergency response (including training exercises)
- Conducting emergency response training and assessing competency
- Maintaining equipment to the OEM's recommendations

Emergency response plans should be regularly tested to confirm their effectiveness. Desktop tests and emergency response drills involving all on-site personnel should be carried out for the major foreseeable scenarios. The following actions are recommended:

- Conduct at least one physical drill each year for all crews.
- Conduct at least one desktop drill each year for the incident management team.
- Prepare briefing and debriefing notes and reports for drills and exercises.
- Mine rescue team would need to conduct a practice scenario exercise monthly.

Debriefings should be conducted as soon as practicable after each drill or emergency to help identify potential improvements to the emergency plan. The need for counselling should be considered and activated as appropriate using the employee assistance program.

Mine Rescue Competitions

Mine rescue competitions provide an opportunity for ERTs and incident managers to test their skills in scenarios that are as close as possible to real-life. It is recommended that mining operations use these competitions as an opportunity to enhance and evaluate their skills. Feedback generated by the competition can provide direction for future training and an opportunity for improvement.

17. INCIDENT MANAGEMENT

The management of an emergency is determined by the risk assessment process, and size and nature of the operation. During emergency incidents, quick but considered decisions are needed. It is important that sites develop a system of response to aid the available personnel in dealing with the emergency. Typically, this would include establishing a location (e.g. emergency or incident control centre) that contains the resources required to manage the emergency.

Incident and Emergency Management Teams

The roles played by and duties assigned to each of the management teams should be detailed and documented. The most common and essential roles include:

- **Incident controller** – responsible for setting and achieving objectives.
- **Scribe** – also known as a record keeper, is important for accurately documenting the record of events as the emergency develops and unfolds. This is not only essential for managing and reviewing the incident, but the information may also be called upon at a later date for legal purposes.
- **Communications officer** – provides a buffer and filter for the incident controller for incoming and outgoing communications.
- **Logistics officer** – sometimes called the planning officer, is responsible for accessing the resources required to manage the incident.
- **Emergency response controller** – facilitates communication between the incident controller and the ERT.
- **Ventilation officer** – the mine ventilation officer should be used to provide advice and expertise regarding the impact the incident may have upon the mine ventilation system. Reliance on this information is usually more critical in underground emergencies
- **Security** – may be known as the muster warden or tag board coordinator, accounts for all personnel entering and leaving the incident site, as well as those unaccounted for.

The Mine Rescue team will comprise of at least eight member each with the following roles and general duties unless otherwise defined in local legislation:

- Mine Rescue Captain: leads the team, ensures all checks are completed and takes instructions from the briefing officer.
- Mine Rescue 1: monitors the gases and conditions.
- Mine Rescue 2: first aid specialist and leads the team in preforming first aid.
- Mine Rescue 3: the specialty equipment expert and takes care of the extra apparatuses.
- Mine Rescue 4: Vice-Captain and will take control of the team if required.
- Mine Rescue 5: spare man and can be used in any of the positions listed above.
- Mine Rescue 6: technician and can repair any of the mine rescue equipment.

- Mine Rescue 7: briefing officer who remains on surface and advises the captain. He has all necessary resources at his disposal including, engineering, geology, ventilation technician and organizes extra mine rescue teams if required.
- Other duties necessary may include human resources, media, or next of kin, but to relieve pressure on the on-site incident controller, these functions are better performed by personnel at the corporate or crisis management team level.
- Note: On smaller sites, a person may have more than one role.

Communication

Access to reliable communications during an emergency is essential to effectively manage the incident. The availability of modern electronic communications provides this service, but over-reliance upon one type of communication should be avoided. Multiple channels of communication should be established between all parties involved in responding to the emergency. This includes the crisis management team to incident controller, incident controller to ERT, and general across-site communications.

The key factor in any communications network is redundancy and back up. Dead spots in either phone or radio networks should be identified and covered by an alternate method of communication. All communications during an incident should be timely, succinct and, as far as possible, in plain language. It is recommended ERTs have a dedicated secure radio frequency

RELATED DOCUMENTATION

A summary of the references and supporting documents relevant to this document is provided in the following table.

VSS	Underground Electrical Safety Standard
POL 06	HSE policy
VSS	Vehicles and driving
VSS	Ground Control – Underground Mines
VSS13	Emergency Response and fire management
VSS15	Explosives and Blasting
VSS17	Hoisting in Shaft
VSS18	Inflow or Inundation of Liquids
TS 06	Supplier and Business Partner Management
VED/CORP/SUST/MS 1	Leadership, Responsibilities and Resources

VED/CORP/SUST/MS 3	New Projects, Planning Processes and Site Closure
VED/CORP/SUST/POL 5	Supplier and Business Partner Management
VED/CORP/SUST/MS 6	Competency, Training and Awareness
VED/CORP/SUST/MS 9	Documentation and Records Management
VED/CORP/SUST/TS 10	Safety Management
VED/CORP/SUST/MS 11	Incident Reporting and Investigation
VED/CORP/SUST/MS 12	Auditing and Assurance
VED/CORP/SUST/TS 13	Emergency and Crisis Management
VED/CORP/SUST/MS 14	Management Review and Continual Improvement
GN 01	Incident Investigation
GN 07	Risk Assessment
GN 14	Health and Safety Management Systems

Annex A: **Developing a Site Emergency Plan, Sample Table of Contents**

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Appendix 1 – Hazard and risk registers

Appendix 2 – Team duty cards

Annex B: **Example of Emergency Severity / Level of Response and Emergency Response Flow Sheet from HZL, India.**

Level	Emergency	Escalation level
Level-1 Operator Level	• Fire in oil storage area • Fire in surface workshop • Fire in building/headgear • Major fall of rock • Release of noxious gases from ○ diamond drilling hole • Electrical short-circuiting • Failure of heading ventilation fan. • Explosion in apparatus under pressure. • Local power failure affecting less than 3 ventilat districts and/or only local pumping capacity • Minor seismic event	**Up-to Unit Head**

	• Minor air blast due to subsidence • Transformer fire	
Level-2 Level/Site wide emergency	• Fire during transit of Explosive • Fire in HEMM in underground resulting in circula of noxious gases in underground working • Inundation • Major underground subsidence. • Failure of filling barricade • Vehicle collision • Entrapment or falling of person from Equipment • Failure of main mechanical ventilators • Medium air blast due to subsidence • Power failure affecting 1 shaft complex including ventilation and/or pumping capacity • Large seismic event	**Up-to Location Head**
Level-3 Regional / National Level	• Natural calamities such as Earthquake and Cyclones • Inundation due to sudden cloud burst • Major air blast due to subsidence • Major Power failure the mine complex including ventilation and/or pumping capacity • Major seismic event	**Up-to Location Head**

Communication flow diagram from time of discovery
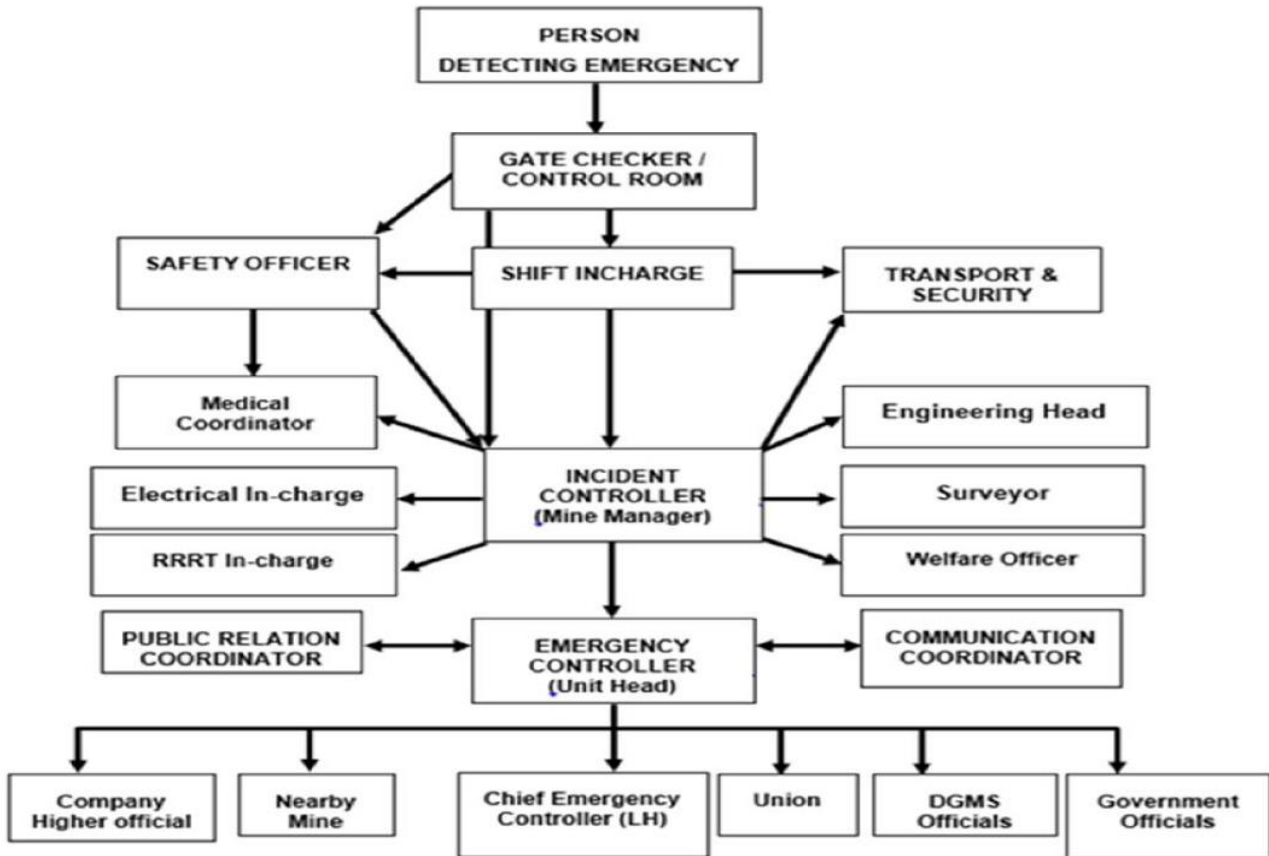
Annex C: *Emergency Preparedness and Response Plan Sample*

Emergency Needs Assessment

The Mine has identified possible emergencies and assessed the risk associated with these events utilising the Integrated Risk Management methodology. Current controls have been recorded and further required actions identified. Responsibilities and target dates for these actions have been assigned. This assessment is reviewed at least each six months and the results of the review forwarded to the SBU Head. Reviews are also driven by organisational, engineering and external changes as well as from the results/findings following from drills and emergency simulations.

Site Emergency Plan

The mine site emergency plan is a controlled document located at strategic points throughout the company enabling easy access by all. Electronic access is also available via the site's Intranet. The Emergency Plan is reviewed on an annual basis. Emergency contact numbers have also been posted in work areas.

The emergency plans are communicated on an annual basis to all employees and business partners via a scheduled Toolbox Talk. The emergency plans are included as a module in the induction process for all employees, business partners and visitors.

Off-site Emergency Plan

Off-site emergencies are included in the Mine Emergency Plan.

Crisis Plan

Crisis's that could result in permanent damage to the company have been identified and the risk associated with these assessed and addressed in the Emergency Plan.

Business Continuity Plan

Business continuity plans are complete for IT and Control Systems at the Mine. The Control Systems DRP can be found as Sect U of the Emergency Plan.

Emergency Communications

The Senior Management representative on call will monitor the emergency situation, lend assistance where required and communicate with third parties e.g. Tara Rescue Teams, Health and Safety Authority, local clergy, etc. They will also communicate with, and call for assistance where required from, other staff and ensure that, through the General Manager corporate staff is kept fully informed. The procedure contact names and telephone numbers for the latter are given in Section M of the Emergency Plan. Any media responses will be formulated after consultation with the General Manager or, in his absence the Mine Manager. Statements should only be issued in accordance with company policy.

Medical Services

A twenty-four hour on call arrangement has been arranged with the local Medical Centre. The doctor on call will assess the medical condition of the injured from the supervisor's description and will determine if the Ambulance Service is required and place the call to the Ambulance Service if necessary. The Doctor will also advise whether to prepare the Site Ambulance ready for his arrival. He shall travel to site and render medical assistance where appropriate.

The Doctor will also liaise with the hospitals and make the necessary arrangements for the transfer of the injured to hospital. The Doctor will keep the HSE Head informed of the status of the emergency medical treatment.

Should for any reason it proves impossible to contact the Doctor, the Mill control room attendant is to notify the Team Leader on shift who will call out the Ambulance Service if he deems it necessary.

NOTE: While at the hospital with the injured, the First Aider is to call the company doctor, via the mobile phone in the ambulance, and inform him if he believes the injured is not getting the required medical attention. The doctor will then liaise with the hospital in order to ensure that the injured receives the best possible care relevant to the nature of the injury.

Ambulance Services

The Ambulance Service will be called when required by the Doctor on call or the Team Leader on shift if the former cannot be contacted. The Ambulance Service should be advised whether to proceed to the Fresh Air Shaft, Main Decline or Process Plant. The Service has been provided with a locality map indicating routes to the Decline, Shaft and Process Plant.

The Site Ambulance is parked underground at the fresh air shaft. The Ambulance keys are in:

1. UG crusher control room
2. Mine rescue room

3. Mine Rescue Manager office

4. Main site Security Office.

Fire Services

The Thurles Fire Service will be called, only in the event of a fire on surface, by the supervisor. They have been provided with a locality map indicating routes to the Decline, Shaft and Process Plant.

Rescue Teams – Mutual Assistance

Arrangements have been made with the management of mine to send rescue teams to if required. The rescue teams will be contacted by the Mining Manager or standby Senior Management Representative after consultation with the Incident Controller.

Health and Safety Authority (HSA)

The HSA Inspector will be contacted in the event of any statutorily reportable incident (or any other significantly serious incident) by the Mine Manager or SHE Manager. The latter will be responsible for submitting the incident report to the HSA Inspector in accordance with the regulations.

Environmental Protection Agency (EPA)

The EPA Inspector will be contacted in the event of any serious incident on site by the SHE Manager or Environmental Co-ordinator. A report to the EPA Inspector will be submitted in accordance with the regulations. (Note that EPA are informed of any IPPCL breaches in any case).

Garda Siochana (Irish Police)

Garda Siochana officers are on 24-hour duty at the Explosives Store on surface. They will be called in the event of a bomb threat or security matter and be responsible for mobilising the necessary Garda services.

The Rapid Reach system is activated via the Concentrator Control Room by the operator when an emergency is reported. Emergency callout numbers are pre-set to the different emergency types and simultaneous calls are made requesting response.

Note: Rapid Reach can be activated at any other telephone point on site should the emergency disable the Concentrator Control Room.

On surface, telephones are available in the Process Plant, main office block and at the workshop/warehouse. Underground, the telephone system will advance with the development and phones are installed at locations shown on the underground fire plan.

There are two emergency telephones located at the sulphuric acid unloading points in the Process Plant. These are directly connected to 5777.

The handheld radio system is also available and in the event of a power failure, channel 6 can be used for communications.

Emergency Protection Systems

A Fire Risk Assessment is conducted at site on an annual basis by corporate consultants. Actions resulting from these assessments are assigned to senior managers with target dates for implementation.

As a result of the above assessments and of legal requirements fixed fire suppression and/or detection systems have been installed in areas of strategic importance to the operation.

These systems are maintained on contract on a quarterly basis.

Standby generators provide emergency power to key installations during periods of power failure.

Emergency and rescue equipment have been identified (and acquired where not available).

The bulk of this is maintained by the Mine Rescue Teams.

Energy Controls (Critical Valves & Switches)

All valves in the process plant have been identified and have been allocated a reference number. These are shown on the DCS control screen and the P&IDs.

Main electrical circuit breakers are also identified and a schematic posted in the main MCC indicating what is being fed and from where.

Relevant employees have been made aware of where to isolate all sources of energy.

Emergency Teams

The Mine Rescue Teams have been established and initial training provided. Ongoing training programmes are in place and a training schedule maintained by the team captain.

The Mine Rescue Teams are involved in emergency simulation drills so as to assess their ability to deal with emergency situations. The Mine Rescue teams also partake in annual mine rescue competitions involving other operations.

An Emergency Response Team has been established in the Concentrator and these teams are involved in emergency simulation drills so as to assess their ability to deal with emergency situations.

Drills and Exercises

Fire evacuation drills

Fire evacuation drills must be conducted in each Foreman/Shift Boss area of responsibility at intervals not exceeding six months. The Foreman/Shift Boss must complete the relevant drill audit documentation and submit it to the Middle Manager and Head of Department who will counter sign the form and highlight any possible areas for improvement. It is recommended that the SO be present when these drills are conducted.

Accident/incident simulations and Emergency Procedures

Each department must conduct an accident/incident simulation at intervals not exceeding six months. These simulations will be arranged by the relevant Head of Department (HOD) in conjunction with the Safety Health and Environmental (SHE) Department. The purpose of these simulations is to test the efficiency of employees in reacting to emergencies. A report describing the simulation, reaction times and actions, compliance with emergency procedures, areas of improvement and areas for recognition will be generated by the HOD and learning points circulated to all concerned, the SHE department and any other HOD whose department was involved.

It is the responsibility of the HOD and his team to identify possible emergencies, document, communicate and test action plans limiting the extent of the impact of the emergency to the department and operation.

The relevant Emergency Procedures are to be briefed (and a record kept) by the Foreman/Shift Boss to all employees working in his area of responsibility on an annual basis. The HOD, Middle Manager and SO will check employee knowledge of these procedures during their periodic audits and VFL tours in the respective sections.

First Aid

Minimum requirements for the number of competent first aiders were determined utilising legislation. Trained first aiders are available for all work areas and shifts.

First Aid Room

The First Aid Room is located in the Administration Building as shown on the surface layout plan. The First Aid Room is equipped with all required equipment to provide a level of care commensurate with the training given.

Ambulance

The Ambulance is parked underground at the fresh air shaft (location of keys is given above).
The vehicle is equipped with medical supplies and will be used when required to transport injured persons to surface and/or hospital. When the ambulance is used to transport an injured person to hospital a First Aider is to travel in the back with the patient.

After arrival at the hospital the ambulance driver and first aider are to remain on standby until the injured is discharged, admitted or sent home. This is to ensure the availability of an ambulance should the injured be required to transfer to another hospital. The site ambulance will facilitate this transfer should a state ambulance not be available.

NOTE: While at the hospital with the injured the First Aider is to call the company doctor, via the mobile phone in the ambulance, and inform him if he believes the injured is not getting the required medical attention. The doctor would then liaise with the hospital in order to ensure that the injured receives the best possible care relevant to the nature of the injury.

First Aid Containers Underground

- ✦ F2 – F3 Pump Station
- ✦ Fresh Air Shaft
- ✦ Workshops
- ✦ FCC No. 1
- ✦ Main Haulage East MCC 04
- ✦ North Access
- ✦ Crusher Station Substation

Medical Support

The Mine has a contract with a local medical company for the provision of services to the Mine. These services include emergency medical assistance on a 24/7 basis.

Copies of the MSDS are to be found with the Fire Brigade, company doctor and at the regional hospital in Kilkenny.

Ambulance

On arrival at the hospital the ambulance driver and first aider are to remain on standby until the injured is discharged, admitted or sent home. This is to ensure the availability of an ambulance should the injured be required to transfer to another hospital. The site ambulance will facilitate this transfer should a state ambulance not be available.

NOTE: While at the hospital with the injured the First Aider is to call the company doctor, via the mobile phone in the ambulance, and inform him if he believes the injured is not getting the required medical attention. The doctor would then liaise with the hospital in order to ensure that the injured receives the best possible care relevant to the nature of the injury.

Organised Outside Help and Mutual Aid

Agreements have been reached with Tara and Galmoy Mines for the provision of mutual assistance.

Local fire brigades have been familiarised with the surface workings of the Mine and are kept informed regarding changes that would affect them during an emergency.