

ESTABLISHING A FORMAT FOR EMERGENCY PREPAREDNESS

GA Gibson MBA FAusIMM

Chief Executive Officer, Mines Rescue Board of New South Wales

ABSTRACT

The paper proposes an emergency preparedness system incorporating risk management, emergency planning and organisation, the provision of appropriate facilities and equipment, all integrated by a multi-faceted training strategy, as a framework for preventing and managing emergencies.

INTRODUCTION

Mine emergencies often occur as the result of a lack of systems, or failures in existing systems, to limit, control or prevent circumstances that trigger incidents which, when ineffectively managed, lead to disasters. An emergency may then be defined as "...an unplanned event that impacts upon the safety or welfare of personnel, or the continuity of operations, which requires an effective and timely response in order to contain, control or mitigate the situation...."

All forms of mining operations have particular hazards and risks that may lead to an emergency situation, for example:

- **Underground Coal Mining**
Methane liberation and coal dust generation, high energy mining systems, coal's propensity to spontaneous combustion, roof and rib strata failure, outbursts;
- **Surface Mining Operations**
Large scale high speed mobile equipment, unplanned initiation of explosives, slope stability, and;
- **Coal Processing**
Hazardous chemical exposure, spill or leak, tailing dam or stockpile failure, large scale mobile equipment.

Good mining and operational practices have generally evolved that incorporate relevant measures to control or mitigate these risks. However, mine disasters continue to regularly occur throughout the world and accident investigations and inquiries continue to identify failures to apply the lessons of the past, and failures to apply effective barriers and control measures to known hazards and risks. These failures are often compounded by a lack of adequate measures to intervene, control, and manage the emergency situation.

The paper outlines an approach to emergency preparedness that can be utilised as a framework to both control and mitigate mining hazards and risks, and to develop effective measures to ensure control of the emergency and the continuity of mine operations, measures that meet the outcomes identified in the recently established International Labour Organisation Convention (176) and Recommendation (183) for improving safety and health in mines.

EMERGENCY PREPAREDNESS MANAGEMENT SYSTEM

The emergency preparedness management system proposed comprises an integrated systems approach to the prevention and management of emergencies. It includes:

- Organisational intent and commitment - corporate policy, management commitment and leadership;
- Risk Management - identification, assessment and control of hazards and risks;
- Definition of measures to manage an unplanned event, incident or emergency;
- Definition of emergency organisation - strategies, structure, staffing, skills, systems and procedures;
- Provision of facilities, equipment, supplies and materials;
- Training of personnel in the identification, containment and notification of incidents, and their roles in the mobilisation, deployment and post-incident activities;
- Evaluation and enhancement of the overall system through regular auditing procedures and trials;
- Periodic risk and capability reassessment, and;
- In the event of an emergency, critique and evaluation of the response coupled with necessary system enhancement.

Incorporation of emergency preparedness within the ISO 9000 quality management system framework provides a structured approach to contain and control emergency situations in a timely, effective and safe manner.

ORGANISATIONAL INTENT AND COMMITMENT

Few people will be convinced of the need for emergency preparedness unless a potential danger is recognised and it is seen as directly threatening, highly possible if not probable, and likely to occur in a relatively short time span. However, the nature of emergencies is that this recognition generally does not occur prior to the event, or is rationalised as non-threatening. The lack of adequate systems, or failures in existing systems, results in an incident or emergency situation.

Commitment to and investment in effective emergency preparedness planning provides an organisation with the capability, expertise and systems to provide a safe work environment, meet moral and legal obligations, and enhance prospects for business continuity in an emergency. In coal mine fires and explosions, including non-fatal incidents, business continuity losses are often significant due to the extent of damage, or the type and nature of control measures employed. Failure to have effective measures in place to manage and control an incident will compound overall losses whilst investigative processes will further impact on operational and business continuity.

Development and implementation of an effective emergency preparedness system requires continuing management leadership, commitment and support. This commitment and support will be a prerequisite to:

- Establishing long term goals and purpose;
- Guaranteeing financial support;
- Guaranteeing the availability of personnel, and their access to, and involvement in training, and;
- Providing appropriate organisational resources to develop, implement and maintain the system.

The necessary leadership and commitment can be further demonstrated by the appointment of an experienced, capable and highly respected officer as Emergency Preparedness Co-ordinator, with the authority to ensure participation and co-operation at all levels and within all units of the organisation. Formation of an Emergency Preparedness Planning Committee, under the Co-ordinator's leadership, will provide the necessary resources to plan, organise and implement an integrated and effective emergency preparedness capability throughout the organisation.

RISK ASSESSMENT

The risk management process enables the type of risks facing the organisation to be identified and analysed to determine the likelihood and the consequence of their occurrence. This framework then enables the risks to be assessed against established criteria to determine if the risks are acceptable, or what form of treatment must be applied to reduce those risks (eg; reducing likelihood of occurrence, reducing consequence of occurrence, transferring all or part of the risks, or avoiding the risks). Targeted implementation plans are then developed, implemented and managed to control the identified risks.

This framework can be similarly applied to develop emergency plans that enable effective controls to be implemented, should a contingent situation arise. Identification and analysis of risks enables likely scenarios to be predicted with a frightening degree of accuracy. Control measures can then be identified to address each of the recognised emergency scenarios, which then form the basis of emergency preparedness strategies.

Scenarios that are likely to be identified may include some or all of those listed in Figure 1. Alternatively Australian Standard AS/NZS 4360: 1995 - Risk Management provides a listing of generic sources of risk, other classifications of risk, and the areas of impact of risk that provides a comprehensive structure for hazard analysis in emergency preparedness.

EMERGENCY CONTROL MEASURES AND STRATEGIES

Three levels of response measures should be identified, evaluated and developed within the emergency preparedness system:

- **Individual or Primary Response**

- Comprises the actions of individuals upon the identification of hazardous situations or an incident, including:
- ⇒ notifying details of the situation, circumstances or incident to appropriate supervisors, controllers or management personnel;
 - ⇒ containment (basic fire fighting, life support or extrication), and;
 - ⇒ evacuation, escape or refuge.

Fires <ul style="list-style-type: none"> • Underground • Plant And Surface • Bushfires • Community • Vehicle (LHD) 	Explosions/Implosions <ul style="list-style-type: none"> • Dust • Chemicals • Blasting Agents • Petroleum • LPG/LNG • Gas Line Explosion 	Exposures <ul style="list-style-type: none"> • Heat/Cold • Noise • Vibration • Radiation • Chemical • Biological
Chemical Spills/Leaks <ul style="list-style-type: none"> • Oil Spills • Ruptured Gas Main • Containment Of Spill • Off-Site/On -Site • Storage Capabilities 	Civil Disturbance <ul style="list-style-type: none"> • Strike • Protest • Bomb Threat • Kidnap/Extortion • Sabotage • Other Threats 	Environmental <ul style="list-style-type: none"> • Air Pollution • Water Pollution • Soil Pollution • Waste Material (Disposal Problem)
Injuries <ul style="list-style-type: none"> • On-Site • Multiple • Fatality • Critical 	Power Failure <ul style="list-style-type: none"> • Long Term Electrical Blackout • Short Term Electrical Blackout • Gas Shortage • Water Shortage • Communication Systems Failure 	Cave In <ul style="list-style-type: none"> • Underground • Surface Subsidence • Highwall Failure/Slip • Surface Excavation Failure • Structural (Building)
Natural Disasters <ul style="list-style-type: none"> • Flooding • Cyclone • Earthquake • Severe Storm • Ruptured Dam • Mud Or Land Slide 	Water Inrush <ul style="list-style-type: none"> • Exploration Drill Hole • Bulkheads • Pillar Failure • Unplanned Holing Of Old Workings • Tailings • Ruptured Dam • Fractured Ground • Water Main Failure 	Transportation <ul style="list-style-type: none"> • Automobile Accident • Train Accident • Boat/Shipping Accident • Aeroplane Accident • Hazardous Materials In Transport Accident
Community Evacuation <ul style="list-style-type: none"> • Planned • Unplanned 		Extrication <ul style="list-style-type: none"> • System/Resources • Unplanned

Source: *Emergency Preparedness Guidelines*, Mines Accident Prevention Association Ontario

- **Secondary Response**
Comprises the actions of trained responders upon notification of the incident, including fire teams, search and rescue teams, and special casualty access teams (SCAT), all utilising advanced skills, competencies and equipment.
- **Tertiary Response**
Comprises the deployment of specialised systems, equipment and technologies in situations where primary and secondary response cannot be safely or effectively utilised, including:
 - ⇒ large diameter borehole rescue;
 - ⇒ inertisation, remote sealing or flooding, and;
 - ⇒ surveillance/exploration vehicles and systems (borehole cameras, atmospheric sampling).

DEFINING THE EMERGENCY ORGANISATION

History shows that emergency conditions grow more serious the longer the situation is allowed to proceed. It must be recognised that the early moments of an emergency situation require that on-site personnel know what to do and how to do it. A multitude of activities must be co-ordinated and managed to ensure the situation is rapidly and effectively controlled.

Emergency organisation provides a structured framework that defines and integrates the emergency strategies, management structure (or chain of command), personnel resources, roles and responsibilities, equipment and

facilities, systems and procedures. It embraces all phases of an emergency, from the initial identification and containment activities, to notification, mobilisation, deployment and recovery (re-establishment of normal operations).

The emergency organisation should address a number of key elements, including:

- The organisation's overall capability for primary and secondary response to an emergency, including; major fire or explosion, unplanned movement or discharge (vehicle, strata, facility), major process failure, hazardous material/substance spill, natural or environmental disaster, security breach or bomb threat.
- Overall organisational capability to manage and control an emergency including; co-ordination and communications, gathering, assessing and evaluating data, decision making and implementation, controlling emergency operations.
- The breadth of procedures necessary for effective control including; identification and containment, notification and early reporting, declaration of an emergency, specific operational procedures, firefighting, evacuation, extrication and life support, monitoring and review.
- Identification and assignment of key functional responsibilities; control, advisory, technical, administration and support services.
- Transitionary arrangements from normal to emergency operations in terms of lines of communication, authority levels, accountability, compliance, liaison and policy.
- Capability and capacity to maintain emergency operations for an extended period, and include provision for "changes of shift".
- Impact of organisational changes in an emergency situation, including; supervision and control of personnel, re-allocation or re-assignment of personnel, motivation, commitment and discipline, role of experts and specialists, external agencies and corporate officers/ executives.
- Contingency provisions to address situations such as those arising out of hours, or where key organisational members are unavailable or affected by the emergency.
- Integration and deployment of tertiary response systems, equipment and technologies.

EMERGENCY FACILITIES, EQUIPMENT AND MATERIALS

The nature, extent and scope of facilities, equipment and materials required to control and mitigate emergencies will be identified through application and extension of the risk management process and determination of the emergency control strategies. For example, a high level risk of fire will necessitate the provision of adequate firefighting facilities and equipment. These would be deployed at the three response levels (viz; primary, secondary and tertiary response) consistent with the risk profile. Similarly, the facilities, equipment and materials necessary to effectively address life support and first aid, or evacuation, escape and rescue can be identified as illustrated in Figure 2.

Response/Level	Primary	Secondary	Tertiary
Fire	Fire extinguishers, hydrants and hoses installed adjacent to high risk areas such as conveyors, fuelling stations, electrical transformers and sub-stations, and on mobile equipment.	Breathing apparatus and protective clothing provided in central areas to enable a "fire team" response with advanced apparatus such as foam generators and multiple hoses.	Provision for remote sealing or inertisation.
Life Support and First Aid	Life support; respiration and circulation.	First aid, triage, stabilisation and extrication.	Paramedical, forensic, legal.
Evacuation, Escape and Rescue	Provision of warning or notification systems, secure escapeways, oxygen based self rescuers, lifelines and communication systems, availability of transport.	Provision of suitably equipped refuge chambers, trained and equipped mines rescue teams, personnel locating devices.	Large diameter borehole rescue systems, inertisation, purpose-designed rescue vehicles.

Other facilities and equipment that may be necessary in an emergency include; incident management and control facilities, employee and rescue muster areas, site security and access controls, facilities for next of kin and the

media, materials and consumables, transport and logistics. These facilities and equipment are best pre-planned and established prior to an incident. Recent mine emergencies have reinforced the necessity to focus on three specific infrastructure issues, viz; refuge chambers, communications, and atmospheric monitoring.

Refuge Chambers

Refuge chambers are being increasingly utilised as a means of enhancing escape and rescue of underground personnel. Some are designed to permit persons to change self rescuers and communicate with the surface in safety, others have been designed to effect refuge for an extended period so as to permit assisted rescue.

The decision to install refuge chambers is dependant upon the overall escape/rescue system for the mine. The following factors need to be evaluated when considering the need for and design of refuges:

- The likelihood of entrapment, eg; winders and other mechanical means to remove people from shaft and steep drift mines may not always be available after an incident, water inundation may close off vital roadways;
- The time taken for people underground to evacuate through the normal means of egress may be excessive in mines with extensive workings or difficult conditions such as low heights or steep grades;
- The capability of persons underground to self escape due to pre-existing medical conditions or fitness levels, or as a result of injuries sustained in the incident;
- The discipline required to maintain and utilise refuge chambers;
- The means to assist personnel to locate the refuge chambers in conditions of extremely low visibility and duress;
- The design of refuge chambers (explosion resistant, fire proof, airtight, size and capacity) and the services provided (ventilation/air purification, cooling, communications, sanitation, and sustenance) should be consistent with the overall escape/rescue strategy;
- The potential application of inertisation as a control strategy;
- The options for final recovery of personnel (mine rescue teams, large diameter boreholes)

Communications

Communications infrastructure is generally in place in all mines to facilitate management and control of operations as well as contribute to the safety of the mine through fast calls for support. Unfortunately, the infrastructure is usually not robust enough to survive a significant fire or explosion, disrupting communications when it would be most beneficial. Furthermore conventional systems incorporate handsets which cannot be safely used with most self rescuers and breathing apparatus, and are usually deployed in main intake airways adjacent to fixed plant, rather than in escapeways.

The need for post-incident communications should be closely evaluated. Whilst it is preferable that a post-incident communications system is part of the pre-incident system, to enhance maintainability, cost and reliability, a stand-alone emergency communications system may be warranted. Regardless, the communications system should be integrated within the mines overall escape/rescue and emergency management strategies.

Atmospheric Monitoring

Knowledge of conditions in a mine following an incident is essential to enable the most appropriate measures to control a situation to be identified and implemented, or to assist escape/rescue and protect rescuers. The need for post-incident atmospheric monitoring should be closely evaluated and systems provided that meet mine specific needs, possibly incorporating:

- The location and design of fixed station atmospheric and ventilation sampling points for normal and potentially abnormal atmospheric conditions;
- The maintenance of capabilities to analyse, trend and interpret the mine atmosphere, particularly where explosive mixtures may be present post-incident;
- Modularisation of tube bundle systems around boreholes to minimise sampling delays and improve the systems robustness;
- Provision of systems to verify integrity of tube bundle systems post-incident;

Utilisation of gas chromatography where explosive mixtures are possible post-incident and rescuers may be required to enter the mine.

EMERGENCY PREPAREDNESS SKILLS, COMPETENCIES AND TRAINING

The skills and competencies required to effectively manage, control and resource an emergency can be readily determined following the identification of core risks, the development of emergency control measures, organisation and procedures, and determination of necessary facilities and equipment.

Emergency preparedness skills and competencies include not only planning and management of an emergency, but a diverse range of basic skills associated with the primary and secondary response initiatives, skills that should be incorporated in a comprehensive training strategy, including:

- The identification and containment of the incident (eg; firefighting, life support, evacuation, extrication);
- Notification (eg; radio and telephone procedures);
- Mobilisation and deployment activities (eg; search and rescue, firefighting, casualty management, recovering bodies).

Emergency preparedness training can be structured into a number of categories as illustrated in the training matrix shown in Figure 3.

Figure 3: TRAINING MATRIX

Education And Induction	Procedural/Secondary	Functional/Tertiary
<p>Primarily educational, designed to ensure employees understand the nature of mine emergencies and how specific aspects of the overall emergency plan may involve or affect the individual, including primary response measures.</p> <p>Knowledge and competence elements include:</p> <ul style="list-style-type: none"> • Key indicators of mine incidents; • Environmental conditions following an incident, eg temperature, visibility and gasses; • Ability to respond to adverse changes in environmental conditions, eg smoke, ventilation disruption; • Notification and communications required post-incident; • Appropriate emergency response options to environmental conditions; • Use and limitations of escape apparatus, routes and systems; • Roles and responsibilities of all mine personnel under emergency response plans including their own specific roles and responsibilities; • Primary response skills and competencies associated with specific emergency scenarios, eg basic fire fighting, life support escape and refuge ; • Mines rescue and other emergency services; • Participation in simulated emergencies. 	<p>Skills and competencies to successfully complete specific procedures defined under the emergency response plans and the secondary response measures associated with specific emergency scenarios.</p> <p>Knowledge and competence elements include:</p> <ul style="list-style-type: none"> • Key indicators of mine incidents; • Detect, monitor and evaluate environmental conditions following an incident, eg mine gasses, ventilation, smoke; • Assess and interpret changes to mine ventilation systems, eg destruction of stoppings, seals and air crossings, damage to main fans; • Response measures that can be used to manage and mitigate an emergency, eg fire fighting, search and rescue, restoration of ventilation, first aid, triage and extrication; • Roles and responsibilities of all mine personnel under the emergency response plans and the capability to perform their nominated role; • Implementation of internal emergency communications and protocols; • Use and limitations of escape and rescue apparatus and systems, eg self rescuers, refuge chambers, breathing apparatus; • Capability of mines rescue and other emergency services; • Initiation of call out and mutual assistance schemes; • Participating in simulated exercises and emergencies. 	<p>Development of skills and competencies necessary for the management and control of emergencies.</p> <p>Knowledge and competence elements include:</p> <ul style="list-style-type: none"> • Key indicators of mine emergencies and detailed knowledge of trigger events to initiate emergency response; • Detailed knowledge of mine design, mine ventilation and monitoring systems; • Assess and interpret current information systems at the mine, eg ventilation and environmental monitoring data; • Control measures that can be used to manage and mitigate an emergency; • Operation and management of emergency response plans and procedures, conducting simulated emergencies; • Implementation of emergency communications and protocols, both internally and externally; • Capability of mines rescue and other emergency services, and access support from these services; • Establish and support critical incident team; • Capability and deployment of tertiary response systems, eg locating systems, inertisation, remote sealing, large diameter borehole rescue, mobile laboratories; • Utilisation of specialist resources, eg paramedical, forensic, legal, critical incident stress debriefing, technologists; • Crisis management and leadership;

Having identified the necessary skills and competencies these can be incorporated into a competency-based training and assessment structure, such as that provided by the National Competency Standards, to provide a comprehensive training system. A training specification comprising a detailed training strategy and plan can then be readily developed, enabling a detailed curriculum to be developed and accredited by ANTA if required. The Training Specification for a recently developed *Coal Mine Emergency Preparedness And Mines Rescue* program is provided separately as an example.

AUDIT, REVIEW AND EVALUATION

Audit and review processes need to be adopted to assess and evaluate the effectiveness of the overall emergency systems, procedures, facilities, equipment, training, and individual competencies. The conduct of an audit or simulation provides, without exception, opportunities for improvement, constructive criticism, and verification of satisfactory performance levels of key activities such as:

- Adequacy of training and personnel capabilities;
- Adequacy, suitability and capability of equipment;
- Recognition of unrealistic expectations or assumptions;
- Evaluation of the written emergency procedure/s, and;
- Adequacy of inspection and preventative maintenance programs.

Every organisation should test its overall emergency plan at least once per annum for each operating shift. Critical elements of the plan, such as emergency power or remote alarm systems should be tested separately and more frequently.

Two basic forms of auditing are available, horizontal and vertical, as detailed below:

- **Horizontal Auditing**

Horizontal auditing involves the testing of small specific elements of the overall plan to identify deficiencies that may seem trivial, but could become critical in the event of a real emergency. Examples include:

Element	Deficiency
Indicators of incipient incident or event	Failure to recognise, notify, record and action
Alert/evacuation procedures	Employees unfamiliar with evacuation procedures
Donning of emergency respirators	Employees unfamiliar with respirators
Fire fighting equipment	Fire extinguishers discharged, missing or damaged hoses, fire hydrants concealed or buried
Emergency alarms	Ignored, unauthorised acknowledgment
Gas testing instruments	Not regularly maintained, serviced or calibrated

The audit process can incorporate routine equipment and apparatus testing coupled with drills to evaluate specific elements. Figure 4 provides an indicative schedule for equipment tests that could be conducted under a horizontal audit process.

- **Vertical Auditing**

Vertical auditing tests multiple elements of an emergency plan simultaneously through desk top, floor or full simulation of an emergency event including activities such as:

- ⇒ Activating the emergency plan;
- ⇒ Search and rescue;
- ⇒ Fire fighting;
- ⇒ Extrication of personnel, life support;
- ⇒ The logistics associated with an emergency response at a remote mine or facility.

Simulations may involve personnel from more than one department and perhaps personnel from other companies, mutual aid organisations, or even emergency services such as Police, Fire Brigade, Ambulance and Rescue. Involvement of external emergency service organisations provides all parties with an invaluable opportunity to enhance and integrate emergency preparedness operations, procedures, and equipment, and tailor response capabilities to major risks and hazards at specific sites.

Figure 4: SCHEDULE FOR EQUIPMENT TESTS			
Equipment Tests	Monthly	Quarterly	Annually
Emergency Lighting			
Smoke/ Heat Detectors			
Remote Alarms: Contact Fire/Security Services			
Emergency Alarms			
Self Contained Breathing Apparatus			
Communication Systems			
Emergency Power			
Emergency Telephone System			
First Aid Rescue Equipment			
Ambulance/Emergency Response Vehicle			
Fire Hydrants			
Fire Pumps			
Fire Fighting Equipment			
Respirators			
Hazardous Materials Detection Systems			
Combustible/Flammable Gas Detector			
Personal Protective Equipment			
Uninterrupted Power Supplies			
Extrication Equipment			

Source: *Emergency Preparedness Guidelines*, Mines Accident Prevention Association Ontario

A formal critique should be conducted as soon as possible, preferably immediately following the audit or simulation. Recognition should be extended to those individuals or teams that performed well. Non-conformance's must be described as specifically as possible and procedures reviewed to incorporate systemic improvements where necessary. Responsibilities and accountabilities for implementing necessary changes must be determined and performance against improvement plans monitored.

A sustained program emphasising planning, practice, discipline and teamwork are necessary elements of well balanced simulations and training drills. Experience has proven repeatedly that every drill is a good drill; every drill is beneficial and presents opportunities to demonstrate strengths and expose areas that require improvement. Figure 5 provides an indicative schedule for simulation and training drills that could be conducted under a vertical auditing process.

PERIODIC RISK AND CAPABILITY REASSESSMENT

Few risks remain static. Consequently risks and the capability of control and emergency preparedness measures needs to be monitored and evaluated to ensure that changing circumstances (eg; people, systems, processes, facilities, equipment, etc) do not alter risk priorities and impact on system capabilities.

Figure 5: SCHEDULE FOR TRAINING DRILLS

Training Drills And Simulations	Monthly	Quarterly	Annually
Evacuation And Head Count			
Search And Rescue			
Fire Fighting Drills			
Equipment And Process Shutdown Procedures			
Chemical Spill Procedures			
Environmental Discharge Procedures			
Mutual Aid Response			
Regulatory Agency Response			
Off-Site Notification Of Key Personnel			
On-Site Notification Of Key Personnel			
Loss Of Critical Services; Power, Water, Communications			
Treatment Of Casualties			
Liaison With External Emergency Services			
Training With External Emergency Services			
Special Problems; Egress From Multi-Level Operations, Number Of Personnel Involved			

Source: *Emergency Preparedness Guidelines*, Mines Accident Prevention Association Ontario

SUMMARY AND CONCLUSIONS

An emergency has been described as “...an unplanned event that impacts upon the safety or welfare of personnel, or the continuity of operations, which requires an effective and timely response in order to contain, control or mitigate the situation....” Whilst they are often considered as unforeseen, in reality, in this day and age of advanced communication and technology, there are few events that can be truly called unforeseen and few misfortunes that haven’t been already experienced. Newspaper clippings, hazard alerts, accident statistics and technical reports all provide sound historical data and a “crystal ball” image of what the future may hold for the ill prepared.

Although history will often appear to repeat itself when we fail to learn the lessons of the past, the nature of emergencies also changes as industry changes. Relying on techniques and emergency measures adopted from past experience will not always provide the same degree of security for future events.

Risk management provides a comprehensive and structured approach to the understanding of mine hazards and risks, and the development of effective emergency response capabilities and systems. The process of risk management must be understood and continuously applied, particularly when deploying mine rescue personnel into a potentially hazardous or explosive environment.

Underpinning emergency preparedness is the training of all mine personnel in basic hazard awareness, the early recognition and notification of incipient incidents and trigger events, and primary response and escape skills. Eyewitness accounts of survivors of the Moura No2 and Endeavour Colliery explosions graphically demonstrate the circumstances faced in such circumstances. Expectations training under conditions of heat, humidity, smoke and low visibility is essential. Failure to adequately train personnel in these basic skills has often been the difference between an incident and a disaster.

Training provides the mechanism for operationalising emergency preparedness organisation and planning. Integration of emergency preparedness within a quality systems framework coupled with routine auditing and simulation provides the mechanism to improve and enhance emergency preparedness in a non-threatening manner and within a “learning” approach. A number of the recommendations of the Mining Warden (Moura No2 Mine Accident) reinforce this conclusion:

- The development of mine specific safety management plans that address key risk areas;
- The training of all mine personnel in the recognition of key risks;
- The retraining of mine officials in mine gases, fires and explosions, emergency procedures and communication;
- The development of industry guidelines for emergency escape systems, facilities and life support apparatus;
- The development of industry guidelines and mine protocols for the withdrawal of persons, and;
- The design of new mines to take into account how surface facilities and infrastructure impact on the conduct of emergency procedures following a disaster and, the development of plans at all mines detailing the location of all surface facilities and infrastructure.

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REFERENCES

- AS/NZS 4360:1995-Risk Management*, Australian/New Zealand Standard ®, Standards Australia, 1995.
- AS/NZS ISO 9001-9004:1994-Quality Systems*, Australian/New Zealand Standard ®, Standards Australia, 1994.
- Convention 176; Convention Concerning Safety And Health In Mines*, International Labour Conference, International Labour Organisation, 1995
- Emergency Preparedness And Mines Rescue Guidelines (Draft)*, Mines Rescue Board Of New South Wales, 1996.
- Emergency Preparedness Guidelines*, Technical Standing Committee Report, Mines Accident Prevention Association Ontario, Canada, undated.
- Explosion at Endeavour Colliery 28 June 1995, Summary of Investigation, MDG NO 1007*. Coal Mining Inspectorate and Engineering Branch, Department of Mineral Resources NSW, May 1996
- Mines Emergency Preparedness Program*, West Virginia University Mining Extension Service On Behalf Bureau Of Mines, Department Of Interior, USA, Undated.
- Moura No2 Mine Accident*, Mining Warden's Inquiry Recommendations and Task Group IV Report on Mines Rescue Strategy Development, personal communications, 1996.
- Recommendation 183; Recommendation Concerning Safety And Health In Mines*, International Labour Conference, International Labour Organisation, 1995
- Train The Officials Seminar (Proceedings)*, SIMTARS and Sedgman-BMC Pty Ltd, Redbank, Queensland, 1989.