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Mines rescue guidelines : the next generation

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MINES RESCUE GUIDELINES: THE NEXT GENERATION

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ABSTRACT: The procedures under which the coal mining industry based mines rescue organisations for Queensland and New South Wales operate have been developed over many years of challenging training, exercises, rescues, recoveries and, sadly, fatalities. The New South Wales Mines Rescue Service and the Queensland Mines Rescue Service are working together to underpin their operating procedures and guidelines with risk management logic while taking heed of lessons from the past. The initial focus for this undertaking is a crucial aspect of mines rescue operations: the emergency mine entry and re-entry. A three-phase process is being used for the development of new guidelines for emergency mine entry and re-entry to facilitate integration with operations' emergency response systems and day-to-day operations. The first phase is the assessment of risks and determination of appropriate controls for Rescue Services effecting a mine entry or re-entry. The second phase is the conversion of the risk assessment into the practical guidelines ("Emergency Mine Entry and Re-entry Guidelines"), capturing the necessary controls identified in the risk assessment. The third phase is converting the guidelines into systems that mining operations and mines rescue organisations alike, together with other key industry stakeholders (the Inspectorate, Industry Safety and Health Representatives, Industry Check Inspectors etc), can use for effecting mine entry or mine re-entry responses. A particular emphasis in this third phase is the collection and analysis of information in a timely manner and appropriate format to support decision makers, technical support and crews effecting responses. While these efforts focus on the mines rescue organisation provided services and emergency responses, it is clear there are benefits for operations in having systems ready to support the Emergency Mine Entry and Re-entry Guidelines, as there are significant overlaps between information required for most types of emergency responses involving mines rescue organisations and the information operations require in managing their principal hazards.

INTRODUCTION

Mines rescue organisations have been in existence in Australia for 100 years. The development of these organisations, and the protocols under which they respond to incidents, has been driven by experiences in response to a range of incidents and the development of new technologies.

The New South Wales and Queensland coal mining industries have embraced risk management logic into their legislation and safety cultures. This is equally reflected in the training and response to emergencies under the guidelines used by the New South Wales and Queensland mines rescue organisations. Despite this, the guidelines have until recently not been the subject of a comprehensive, formal risk assessment process.

The underground coal mining industry internationally has had many emergency response experiences, ranging from minor incidents through to significant disasters, where investigations of the events indicated significant improvements could have been made in the emergency response. A common theme in many of these investigations is that the emergency response, and ultimately the outcomes, could have been considerably enhanced by the implementation of appropriate systems for: the collection and interpretation of appropriate data and information; and the management of the obtained knowledge for decision making.

The clear link is that for a response to be effective, those making decisions regarding the appropriate response in an emergency must have adequate information, supplied in a timely manner and suitable format.

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MINES RESCUE ORGANISATIONS

Queensland

Mines Rescue in Queensland

2009 marks the centenary of mines rescue organisations in Australia. With coal mining expanding on the West Moreton field (surrounding Ipswich, Queensland), the then Queensland Department of Mines initiated the establishment of a Mines Rescue Brigade in November 1909 (Hanrahan, 2009). The Department suggested that three miners from each mine be trained in first-aid and rescue methods. Three committees appointed soon after considered: appropriate premises for rescue apparatus; appropriate methods for affording instruction to the colliers who may become honorary members of the brigade; and the smoke helmets best adapted for the district.

In 1910, four coal miners (who had been members of the Queensland Ambulance Transport Brigade) and six new volunteers made up a ten man team to undergo a course of instruction in first-aid and the use of rescue apparatus. They became the first formal mines rescue team in Australasia (Strang and Mackenzie-Wood, 1993).

In 1912, a Rescue Station was erected at North Ipswich on the property of the Ambulance Brigade. The first permanent rescue instructor (who had trained in rescue in Britain) was appointed this same year (Hanrahan, 2009). The first fully equipped Mines Rescue Station was subsequently built at Booval (Ipswich, Queensland) in 1923 (Strang and Mackenzie-Wood, 1990).

Queensland Legislation

The Queensland Mining Act Amendment Act of 1920 made a formal, legislated provision for the establishment of a rescue organisation in Queensland (Strang and Mackenzie-Wood, 1990), which carried into the (now repealed) Coal Mining Act 1925. Key in the repealed legislation was not only the need to establish a rescue brigade to afford assistance in the case of emergency in any coal mine, but also to ensure that through the brigade at all times there would be available a sufficient number of suitably qualified and trained persons suitably equipped to allow the brigade to properly discharge its function (Queensland Government, 1996).

In 1997 the Queensland Coal Legislation Amendment Act 1997 amended the Coal Mining Act 1925 and fundamentally changed the relationship between the then Queensland Mines Rescue Brigade and the coal mine operators. This legislation made each coal mine operation responsible for the provision of a mines rescue capability and for being party to an agreement with an accredited corporation (Queensland Government, 1999). The accredited corporation had the function of providing "mines rescue services", including: helping each underground mine operator to provide a mines rescue capability; providing underground mines rescue training programs; and providing adequate and appropriate staff and equipment (Queensland Government, 1999). These legislative provisions continued, with some extensions and minor modification, into the current Coal Mining Safety and Health Act 1999.

The Coal Mining Safety and Health Act 1999 defines a mines rescue capability as "the ability to provide a suitable number of trained persons and maintained equipment to allow continuous rescue operations to take place and to help the escape or safe recovery of anyone from a mine if it has, or may have, an irrespirable atmosphere" (Section 221, Queensland Government, 2009a).

While the legislation clearly places responsibility on operations for their mines rescue capability, Section 174(d) of the Queensland Coal Mining Safety and Health Regulation 2001 places responsibility on the accredited corporation for developing appropriate mines rescue procedures: "A mines rescue agreement for an underground mine must state the operational procedures developed by the accredited corporation to be followed by the corporation in carrying out the mines rescue services at the mine" (Queensland Government, 2009b).

Queensland Mines Rescue Services Limited was formed in 1998 and remains the only corporation accredited under the mines rescue provisions in Coal Mining Safety and Health Act 1999. The head office for Queensland Mines Rescue Services Limited is located at Dysart, Queensland, with stations at Dysart and Blackwater.

New South Wales

Mines Rescue in New South Wales

Strang and Mackenzie-Wood (1990) note no organised rescue facilities were available for disasters at the Bulli Colliery (Illawarra District, NSW, 1887), Mount Kembla (Illawarra District, NSW, 1902), Stanford Merthyr Colliery (South Maitland, NSW, 1902) and Bellbird Colliery (South Maitland, NSW, 1923).

After the Bellbird Colliery disaster, breathing apparatus had been used at several incidents. The continuing public reaction to the Bellbird Disaster, together with confidence gained in the use of breathing apparatus during the re-entry operations, prompted the New South Wales Government to introduce legislation to enable the establishment of a mines rescue station in the four coal mining districts (Strang and Mackenzie-Wood, 1993): South Maitland (Abermain), Newcastle (Boolaroo), Southern (Bellambi) and Western Coalfields (Lithgow) (Mines Rescue Board NSW, 1999). The South Maitland Rescue station has since moved to Singleton and has been renamed the Hunter Valley Mines Rescue Station.

New South Wales Legislation

The New South Wales Mines Rescue Act 1925 was passed subsequent to the Bellbird Colliery disaster and provided for mines rescue stations being established in the four main coal mining districts. The regulations accompanying the 1925 Act and subsequent versions have covered matters such as the duties of rescue station personnel, training standards, rescue procedures, rescue station facilities, equipment and vehicles and rescue facilities at the mines (Mines Rescue Board NSW, 1999).

The current legislation controlling New South Wales mines rescue activities is the Coal Industry Act 2001, through which the Mines Rescue Act 1994 was repealed. The former Mines Rescue Board was dissolved under this legislation, replaced by the provision for one or more companies to provide a range of health and safety services, including mines rescue functions (New South Wales Government, 2009). Coal Services Pty Ltd is the current "approved company" under this legislation, with its subsidiary Mines Rescue Pty Ltd being the current "mines rescue company".

The Coal Industry Act 2001 notes the mines rescue company has the following principal mines rescue functions in connection with underground coal mines in the State: making available rescue services and facilities to deal with emergencies in those mines and, in particular, ensuring that the (Mines Rescue) Brigade has the capacity to deal with any such emergencies; ensuring that adequate rescue equipment (such as breathing apparatus) is available to enable members of the Brigade to deal with emergencies in those mines; training members of the Brigade in mine rescue procedures at those mines and, in particular, in the use of breathing apparatus; establishing appropriate procedures and arrangements for ensuring the mobilisation of members of the Brigade and the supply of rescue equipment in response to emergencies in those mines; ensuring that persons with an adequate knowledge of mine rescue work are available to provide technical advice to the owners of those mines if emergencies should arise in those mines (New South Wales Government, 2009).

Other Australian States and Overseas

It is acknowledged that mines rescue organisations for other states in Australia (Tasmania, Victoria and Western Australia) and overseas have been formed and in many instances continue to service their areas. This paper focuses on New South Wales and Queensland mines rescue organisations servicing their states' underground coal mining industries, as underground coal mining (and associated legislated rescue capability) in Australia outside of these states is limited.

MINES RESCUE GUIDELINES: THE PAST

The term guideline in relation to mines rescue organisations is used to capture the operating procedures, protocols and standards endorsed and used in both training and emergency response by the Queensland and New South Wales mines rescue organisations. While the guidelines encompass some strict boundaries within which mines rescue members, managers, superintendents and associated mines rescue personnel must operate, the term also reflects that there are aspects of operation that must be adapted to suit the particular incident or training exercise.

Emergency responses in the mining industry have been conducted over many centuries, but formal guidelines are a relatively recent development. The first recorded use of breathing apparatus for rescue in a mine was at the Seaham Pit Disaster, North-East England, 1880. An updated version of these Fleuss breathing apparatus was used in the recovery of bodies following the Mount Kembla Disaster in 1902 (Hanrahan, 2009), necessitating training in the use of the apparatus.

Mining disasters, advances in technology and research appear to have been the biggest drivers of guideline development and revision for the New South Wales and Queensland mines rescue organisations, supplemented by learnings from training and emergency exercises and the formal and informal communications between mines rescue organisations.

Some significant drivers of guideline development include:

- Disasters preceding legislation and formal rescue organisations for Queensland and New South Wales: Bulli Colliery (1887), Mount Kembla (1902), Stanford Merthyr Colliery (1902) and Bellbird Colliery (1923);
- The 1972 Box Flat No. 7 Colliery major explosion, near Ipswich, Queensland. 18 men were fatally injured, including mines rescue members, following efforts to fight an underground fire;
- The 1975 Kianga No. 1 Mine underground explosion, southern Bowen Basin, Queensland, following a spontaneous combustion event. 13 men were fatally injured;
- The 1986 Moura No.4 explosion, southern Bowen Basin, Queensland. 12 men were fatally injured in an underground explosion attributed to an ignition caused by a flame safety lamp;
- The 1994 Moura No. 2 Mine explosion, southern Bowen Basin, Queensland,. 11 men were fatally injured due to an underground explosion attributed to spontaneous combustion behind a recently sealed section of the mine;
- The advent and implementation of successive generations of breathing apparatus, including the Fleuss breathing apparatus and Dräger BG174 and BG4 units;
- Updated portable gas monitoring devices for more rapid and accurate analyses of mine environments; and
- The implementation of emergency exercises in the Queensland underground coal mining industry, notably the annual industry-wide "Level 1" exercises since 1998.

Each disaster and emergency exercise has brought about a host of recommendations that have been incorporated into mines rescue guidelines.

MINES RESCUE GUIDELINES: THE PRESENT

The inquiry following the Moura No. 2 Mine explosion of 1994 triggered significant legislative changes for the coal mining industry. One of the most critical changes was the adoption of management plans and procedures, underpinned by risk assessments. Risk management was formally becoming entrenched in the coal mining industry, driven by the need for risk to a person from coal mining operations to be at an acceptable level, defined for Queensland coal mining operations as being within acceptable limits and as low as reasonable achievable (section 29, Queensland Government, 2009a).

Risk Management in Mines Rescue

While the majority of the protocols by which mines rescue operations are undertaken in New South Wales and Queensland remained the same, rescue efforts from the late 1990s began to incorporate risk management, and particularly formal risk assessments, as part of undertaking emergency responses. The guidelines for the New South Wales and Queensland mines rescue services captured the need to risk assess specific emergency responses while the guidelines set the boundaries for rescue operations. The controls in the guidelines however were not subject at this stage to a formal risk assessment.

Given the co-operative spirit between the two states' rescue organisations, similarities in the apparent intent of legislation and the same hazards being present across the underground coal mining industries

for the two states, it is not too surprising that there are many similarities in the mines rescue guidelines from the New South Wales and Queensland mines rescue services.

The intent section of the Queensland Mines Rescue Service guidelines notes: "Mines Rescue guidelines are achieved with the underpinning risk management philosophy in all that is done to minimise and mitigate the challenges, hazards and threats to personnel. However the nature of the underground coal mine environment and situations in which mines rescue teams are called to operate, these guidelines only serve to give direction and guide the decision making process. Decisions are made within risk management practices and therefore are taken by the team leader and team to achieve objectives within the framework of risk based logic. These guidelines serve as a guide to that process" (Queensland Mines Rescue Service Limited, 2007).

The intent section of the New South Wales Mines Rescue guidelines notes: "These guidelines have been developed through detailed risk assessments and consultation with industry and mines rescue experts both within Australian and Overseas. Ongoing annual reviews will be conducted taking into account underground mine emergencies, simulated emergencies and general application of the guidelines to ensure that they remain both functional and practical. Due to the number of variables in an underground coal mine emergency situation the procedures and limits / barriers in the guidelines may not always be appropriate or practical. Should this occur then IMT [Incident Management Team] and MRS [Mines Rescue Service] officers must adopt a documented risk management approach referencing the guidelines to identify likely risks associated with the proposed operation / actions and the barriers to be implemented" (Mines Rescue Pty Ltd, 2009).

The intents in these guidelines clearly point to the use of risk management, and specifically the use of documented risk assessment tools, as part of mines rescue.

Risk Management: Mines Rescue Guidelines

Queensland coal mining legislation can be interpreted as requiring the same application of risk management processes for mines rescue procedures (which would include the guidelines) as is required for the development of procedures for operations. By virtue of the mines rescue agreement stating procedures (such as "the operational procedures developed by the accredited corporation to be followed by the corporation in carrying out the mines rescue services at the mine") and links to each operation's Emergency Response Principal Hazard Management Plan, the Queensland Mines Rescue Service guidelines can be considered a part of each operation's Safety and Health Management System. This is further reinforced by the Queensland Coal Mining Safety and Health Regulation 2001 (refer sections 359, 360, 366) where the use of mines rescue trained personnel, with mines rescue equipment and working under mines rescue procedures, can enter irrespirable atmospheres.

Following this principle, and in the absence of specific regulations or recognised standards, safety and health obligations for mines rescue can only be discharged by taking reasonable precautions and exercising proper diligence (section 38, Queensland Government, 2009a). Underpinning mines rescue guidelines with formal, documented risk assessments is an effective way of demonstrating reasonable precautions have been taken and proper diligence has been exercised.

While the above has focussed on Queensland Mines Rescue Service guidelines satisfying Queensland legislation, the same conclusions can be drawn for New South Wales Mines Rescue guidelines with reference to Duty of Care provisions under the Occupational Health and Safety Act 2001 and the need for "emergency management systems" under the Coal Mine Health and Safety Act 2002 (refer sections 44-47).

MINES RESCUE GUIDELINE REVIEW: EMERGENCY MINE ENTRY/RE-ENTRY

A core mines rescue activity is that of entering or re-entering a mine as part of an emergency response: the emergency mine entry/re-entry. While there are many aspects of the mines rescue guidelines to which risk management philosophy can be applied, the emergency mine entry/re-entry is such a crucial and wide-reaching aspect of mines rescue operations, with significant overlaps with how operations manage their principal hazards and emergency responses, that underpinning emergency mine entry/re-entry processes with risk management will have significant benefits and is a logical starting point for a fundamental review of mines rescue guidelines.

The review of emergency mine entry/re-entry activity was partly in response to the recommendation from the report for the 2007 Queensland Level 1 Exercise (held at Grasstree Mine) that the Queensland Mines Rescue Service "should formalise the guidelines by using a risk based approach to develop a set of mine re-entry TARPS based on explosibility rather than percentage of UEL and LEL of explosive gases" (Alexopoulos et al, 2007).

It is important to note that although there is considerable overlap between information essential for emergency mine entry/re-entry and a "no lives at risk" mine entry/re-entry, risk tolerance and planning processes would differ as recognised in the New South Wales Mines Rescue guidelines: "The re-entry and exploration within a mine for the recovery of bodies or restoration of operations is not normally considered an emergency situation. These activities should be a pre-planned operation, using a risk management approach (with reference to the guidelines to identify the likely risks associated with the proposed operation), and under the direction of mine management" (Mines Rescue Pty Ltd, 2009).

Phase I: Risk Assessment

The first stage of reviewing the emergency mine entry/re-entry process was a thorough and comprehensive risk assessment involving relevant industry stakeholders. The risk assessment team initially undertook a brainstorming process to assist with identifying the potential hazards or barriers which could prevent a mines rescue team entering a mine or part of a mine considered dangerous to coal mine workers. While the brainstorm process identified a number of external barriers which could prevent re-entry, the team consciously focused on the potential hazards and barriers existing at a mine, in what the team regarded as known-unknown information (unquantified hazards) to the rescuers and decision makers (Incident Control Team).

From the brainstorm process, twelve critical hazards were identified for the risk assessment team to analyse, specifically for how they could occur and why they would occur. The risk assessment techniques that were used to assist in the process were a customised semi-quantitative risk assessment tool based on the Minerals Industry Risk Management Guidelines and Queensland Mines and Energy Recognised Standard 02 ("Control of Risk Management Practices"). Due to the risk assessment not being mine specific, the team agreed that no current controls would be applied which therefore ranked all hazards as extreme. Proposed controls and hazard specific barriers where then provided by the group for each hazard to mitigate its risk.

This process was completed through a major industry risk assessment conducted over four days, facilitated by the Queensland Mines Rescue Service (QMRS), with participation from: the NSW Mines Rescue (NSWMR); Queensland Department of Mines and Energy (now Queensland Mines Energy, part of the Department of Employment, Economic Development and Innovation); the Construction, Forestry, Mining and Energy Union (CFMEU) Industrial Safety and Health Representatives; Simtars, mines rescue volunteers and third party industry stake holders. The assessment reviewed key hazards and addressed specific issues in relation to the deployment of mines rescue crews in emergencies. It was highlighted by the risk assessment that mine hazards must be able to be assessed accurately and efficiently, not only to determine and analyse what is known, but to identify what (if any) further information is required for sufficient understanding of mine conditions to the level necessary for sound, risk-management based deployment and management of resources.

This phase of the guideline review was completed November 2008.

Phase II: Guideline Development

The second phase, developing the Mine Entry/Re-Entry Guideline, is in progress. The objective here is to develop the results and controls from the risk assessment into a guideline incorporating checklists and flow charts for emergency mine re-entry. The intention is to establish a tool which can be utilised by both mines rescue services and operations with the aim of efficient and effective management of emergency responses.

A task group, the Mine Re-Entry Task Group, was formed early in 2009 to develop a framework for the implementation of action items from the Mine Entry/Re-entry Risk Assessment. The core members of the task group are: Geoff Nugent (Queensland Mines Rescue Service), Seamus Devlin (New South Wales Mines Rescue), Darren Brady (Simtars), Assoc Prof David Cliff (Minerals Industry Safety and Health Centre, Sustainable Minerals Institute, University of Queensland) and John Grieves (New Hope Corporation Limited).

Under the guidance of the task group, a guideline is being developed, supported by checklists and flowcharts, for knowledge management in the event of an emergency. This guideline will detail what information is required to support an emergency response and how such information can be attained. Part of this guideline development is to scope opportunities for software and hardware solutions suitable for emergency response for the management of information, and to test draft guidelines at emergency exercises.

Specific actions within this second phase are:

1. Classifying the controls from the Risk Assessment:
    - Identify responsibility for collection/interpretation of information (site, mines rescue, external provider);
    - Determine the ability to collect and maintain information prior to a response;
    - Determine the information type eg automatic generation, manual collection; and
    - Determine the information importance to assessment of risk i.e. Rank its level of criticality.
2. Conducting post-mortems of previous emergencies and emergency exercises applying controls from the risk assessment.
3. Developing audit tools from the risk assessment to conduct gap analysis between what information/processes are commonly/typically available at an operation (Qld and NSW) and what is required to comply with developed guidelines.
4. Seek key stakeholder feedback on draft guidelines via: Operators Forums (Qld and NSW); Queensland Safety & Health Conference presentation/workshop; Queensland Mines Rescue Service Technical Advisory Committee; New South Wales Mines Rescue Standards committee; and the Mine Managers Association of Australia.
5. Disseminate guidelines to industry
6. Test guidelines within Level 1 or 2 Emergency Exercise

Release of the draft guideline is planned for first quarter 2010.
The task group has conducted the classification process and developed an audit tool to conduct gap analyses at selected underground operations in Queensland and New South Wales. Gap analyses have been conducted at Anglo Coal Australia's Moranbah North Colliery (Bowen Basin, Queensland), Peabody's Metropolitan Colliery (Southern Coalfields NSW), Caledon's Cook Colliery (Bowen Basin, Queensland), Rio Tinto's Kestrel Mine (Bowen Basin, Queensland), Xstrata's Tahmoor Colliery (Southern Coalfields NSW) and BHP Billiton's Dendrobium Mine (Southern Coalfields NSW). Additionally the Task Group has conducted smaller assessments at Xstrata's Oaky North Colliery (Queensland) and Centennial Coal's Mandalong Colliery (NSW).

Through these gap analyses, the task group has identified some common but important trends in relation to emergency response information management:

- Information requested is captured but not readily available within an acceptable time;
- The supply of critical (and sometimes basic) information is reliant on one or two key people being available;
- Some information monitored is not understood by people monitoring;
- Some required information (particularly for validation) is not monitored or measured at all.

Gap Analyses Results

The gap analyses have provided a wealth of information that assists with the development of the guidelines and provides examples of high quality systems that not only effectively manage principal hazards, but that also provide high levels of support in the event of an emergency response. Equally, the gap analyses have identified areas across a number of the operations where more effective systems would undoubtedly provide better management of principal hazards and superior results in the event of an emergency response. Many of these areas have been identified in previous Queensland Level 1 exercises.

Some examples of high quality systems worthy of consideration at all operations are:

- Up-to-date registers of ventilation control devices, implemented under a regime of routine device inspections;
- The use of a "process checker", a person not directly involved in decision making and action taking, but auditing events against emergency response plan requirements, providing reminders to key personnel on necessary functions that may otherwise be missed;
- Comprehensive mine environment and ventilation monitoring systems with redundancy and due regard for providing information to assist self-escape and aided-escape efforts – consider how a surface controller or control room operator knows where to direct those escaping from underground through the appropriate route; and
- Thorough understanding of seam gas makes and behaviour including the impact on districts and whole of mine environment when change occurs through planned or unplanned ventilation interruptions and barometric influences.

Common shortfalls in emergency response systems, generally also identified in previous Queensland Level 1 exercises, include:

- Inconsistent debriefing processes that fail to capture or pass on information from key eyewitnesses;
- Debriefing process does not utilise targeted questions to determine last known status of localised and general mine conditions such as ventilation and devices, manual atmospheric monitoring, other environmental conditions (eg visibility), roadways and panel layout.
- Control room operators juggling multiple duty cards and under extreme time pressure;
- Heavy reliance on technical people for appropriate responses (eg ventilation officers, electrical engineer) with little or no redundancy;
- Fundamental information for status of the mine environment and systems are not automatically or manual maintained to convey the relevant information to emergency response teams in a clear and concise format.
- Under utilisation, or lack of awareness, of some environmental monitoring software analysis capabilities to provide preset charting with trigger levels for less common ratios and trending rate of change, particularly for potential explosive atmospheres.
- Limited consideration of current location, status and accessibility of other interconnecting airways (including boreholes) for use as alternative means of monitoring, communication and ventilation during an emergency.
- General lack of recognition of specific sensor ranges for handheld, real-time and tube bundle monitoring systems (critically at control room operator and ventilation officer level), coupled with systems failing to indicate or alarm where sensors are returning results that are out of range;
- Automated alarm settings inconsistent with triggers as specified in management plans and associated trigger action response plans (TARP);

Informal feedback has been given to the operations at which the gap analysis has been conducted.

MINES RESCUE GUIDELINES: THE FUTURE

Phase III: Guideline Implementation

The completion of constructing the Mine Entry/Re-Entry Guideline, supported by appropriate control check-sheets and checklists, represents a major step forward for mines rescue operations. Discussion and feedback on the draft guidelines will likely take the guideline development through to mid 2010. The effectiveness of the guidelines and how well the guidelines are incorporated into operations' emergency response systems can be tested through the following: audits through mines rescue organisations; emergency exercises; mines rescue training exercises; and emergency responses.

The logical extension of this process is to continue the review process through the remainder of the mines rescue guidelines.

While the guideline implementation focuses on emergency response, there are clear benefits to operations using guideline systems relevant to everyday operations and day-to-day management of principal hazards. Such opportunities for integrated systems, which promote familiarity for operators and management alike and give the best probability of effective emergency response, are obviously favoured.

Critical Information Management: Implementing the Guidelines

The Moura No. 2 Inquiry Task Group 4 (Mines Rescue Strategy Development) report stated: "Knowledge of conditions in a mine following an incident is essential in planning any rescue effort. Information systems must be provided to support implementation of the most appropriate rescue measures" (Moura No. 2 Inquiry Task Group No. 4, 1994). This same report contained the recommendation that "Industry should develop an effective computer-based emergency decision support system for incident management and training".

In the event of an underground coal mine emergency, the rapid and accurate collection of data relating to mine hazards and the efficient assessment of such data are crucial to the safe deployment and management of resources responding to such an event. Various reports and forums, including the September 2006 Queensland "Fight or Flight" Seminar, have recognised the first five hours of an emergency response as critical for implementing effective strategies for the best outcomes. Analysis of industry emergencies and emergency exercises has repeatedly proven that the site data required to determine an appropriate course of action post-incident and adequately assess the risks in effecting appropriate emergency responses is rarely available in a timely manner and suitable format.

The Queensland Mines Rescue Service and New South Wales Mines Rescue, supported by the task group, have identified a suitable support project for guideline implementation: the "Emergency Response: Mine Entry Data Management" project. The Australian Coal Association Research Program (ACARP) supports this project (reference C19010) and further work will be forthcoming during 2010. ACARP project C19010 will commence in 2010.

The aim of this project is to develop a functionnal specification for data collection and management systems suitable for the efficient, risk-assessed management of mine hazards in the event of an emergency response. The use of risk-management logic provides adequate control of risks in effecting emergency responses while maximising response efficiency. This project is targeting a quantum leap in information management for emergencies by the development of functional specifications for systems that facilitate the "Mine Entry/Re-entry Guideline".

The objectives of this project are to: develop a functional specification for an information collection and management system appropriate for efficient, effective implementation of the Mine Entry/Re-Entry Guidelines; and to raise industry awareness of Mine Entry/Re-Entry Guidelines and information collection and management systems appropriate for emergency responses.

The "Emergency Response: Mine Entry Data Management" project differs from previous research undertaken in the emergency response area by linking risk-management logic underpinning Mines Rescue emergency response procedure development to site emergency response information requirements. The results from this project will be a targeted response to the key recommendation from the forthcoming ACARP C17008 Project ("Optimising the Collection of Information for Effective Use in the Event of an Emergency at an Underground Coal Mine") report: "There is an urgent need to develop a guideline that identifies the scope and quality of information that is needed to effectively manage an emergency. This should [be] consistent industry-wide" (Cliff, 2009).

The major benefits of this research are: industry will have relevant and functional specifications for information management systems that will offer clear directions for current and future mine monitoring and analysis systems so that information relevant to effecting an emergency response is readily available in suitable formats during a mine emergency; information management systems will suit "Mine Entry/Re-entry Guidelines"; and a key priority for underground research from ACARP, "reviewing the adequacy and effectiveness of emergency response measures leading to practical solutions for industry implementation" will be researched.

Key components of this project to manage emergency response information management issues are: researching and developing software and hardware specifications (with paper based equivalents for sites where electronic systems are not justified); targeting information appropriate to specific incident types; and building on research completed to date (including systems such as ACARP funded integrated data management system NEXSYS – refer Rowan et al, 2007 – and the NERDDC funded expert computer software system ECAS – refer Nemes-Nemeth and Aubrey, 1991).

The key risk areas for the project are: ensuring developed systems are appropriate for "Mine Entry/Re-entry Guidelines"; and ensuring the development of useful, appropriate specifications that integrate with the variety of information management systems (paper and computer-based) already in utilised by operations. The experienced project leaders representing the key Queensland and New South Wales mines rescue organisations, combined with other key task group members, and the level of support offered from key industry stakeholders and operations minimise exposure of this project to these risks.

Adoption of Guidelines by Industry

Updating the guidelines is of little value if the results and key learnings are not disseminated to industry, or if the guidelines are not absorbed into the fabric of emergency response strategies within the coal mining industry.

Efforts to achieve widespread adoption include:

- The Mine Entry/Re-Entry guidelines will be incorporated into Queensland Mines Rescue Service and New South Wales Mines Rescue procedures, promoting standardisation;
- Integrating the processes documented under the guideline and information management tools into existing industry emergency management training programs, such as the Queensland Mines Rescue Service's Mine Emergency Management System (MEMS) and Coal Mines Qualifications Board Emergency Management Course;
- Reviewing competency standards for emergency management and ventilation officers to identify opportunities for improvement based on the guideline and developed technology; and
- Promoting guideline and information management tools through industry forums via presentations and workshops.

CONCLUSIONS

The Emergency Mine Entry/Re-entry Task Group believes that the development of the Emergency Mine Entry/Re-entry Guideline, appropriately implemented and coupled with a knowledge management tool (founded on risk management logic), would significantly assist emergency responses and decision makers in real and simulated emergency situations through:

- Taking reasonable precautions and demonstrating proper diligence in the decision making process;
- Determining and understanding existing risk within a constrained time, promoting effective planning and strategies;
- Developing and implementing plans and strategies that do not place rescuers at an unacceptable level of risk.
- Minimising delay to rescue operations during information collection and assessment;
- Reducing the likelihood of abandonment of any attempt of rescuing affected coal mine workers.

The process of establishing the updated guidelines, underpinned by risk assessment, also facilitates the review process for future refinement. The information management systems have obvious benefits for day-to-day and routine operations in the management of any operation's principal hazards.

Completion of the processes outlined in this paper will mark a quantum leap forward in industry emergency response, emergency preparedness and information management.

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