Level 1 Emergency Exercise Report

2012

Oaky North Mine

This publication has been compiled by John Sleigh of Mine Safety and Health, Department of Natural Resources and Mines

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Summary

The 2012 Level 1 Mine Emergency Exercise was conducted at Oaky North Mine at 11 am Sunday 7 October 2012.

A simulated frictional ignition on Longwall 306 led to a gas explosion, which opened and damaged the doors in the tailgate and blew out the pressure release panels at the upcast shaft.

The ignition injured three coalmine workers on a longwall face. Two coalmine workers in the main gate were knocked over, but remained conscious. They walked 12 km to the surface. One wore compressed air breathing apparatus (CABA) all the way out and the other wore opaque goggles to simulate walking through smoke.

During their escape they went through emotional turmoil questioning whether they had done the right thing in escaping themselves or should have attempted to rescue their work mates. There is no right answer to that question. They had every reason to believe that their colleagues were behind them. They even left the section vehicle behind for their mates to use, reasoning that they would be picked up when the others caught up.

One technique they used well was leaving notes for those following with details of their escape. One worker was unable to keep hydrated because he was wearing CABA, and the lack of drinking water available during the trek resulted in two very tired and thirsty survivors.

These exercises raise questions like this and many other questions so industry can benefit from discussion.

The explosion stopped ventilation in each of the production districts and in the East Mains where outbye crews were working. Power dropped off the underground workings, and communications and real time gas monitoring were disrupted inbye 13 cutthrough East Mains. A gas monitoring tube sampling the recently sealed LW305 goaf had been cut by the exercise organisers so that it reported almost fresh air. Disruption of the new seals was one possibility considered by the Incident Control Team (ICT).

One crew made a decision to wear self-rescuers or to take CABA with them when evacuating. A member of that crew received a trainer self-rescuer to put on and then transferred to CABA and topped up at each refresh station until a place of safety was reached.

Future issues to be addressed included surface issues. There was no effective signalling system on the surface to make people arriving at the mine aware that an emergency was in progress. The available siren was turned off after a short period because the sound was obtrusive. People continued working in the workshop and offices even when additional resources were needed.

Recommendations

- Activities such as contacting off-site mine officials and emergency response teams should be given to another person through the duty card system and carried out in another location.

- Devise an unobtrusive alert system that tells people at the mine and those arriving after the start of the emergency that an emergency is in progress.

- Emergency planning must recognise administration staff members are needed to take and receive phone calls on behalf of ICT members.
- Establish a means of rehydrating while wearing CABA as an industry research priority.
- Mines should review any jargon or shorthand messages to check if they might cause confusion.
- Nominate an alternate for each of the senior team members and plan for that person to rest in preparation for a handover in about eight hours.
- The teams carry out a handover and the primary team disengage, but monitor the performance of their delegates.
- Evaluate methods to reduce the lag with tube bundle readings so that the information can be obtained while it is still meaningful.
- Arrange emergency mutual assistance between mines to address the analysis of the large volume of technical data by appropriately qualified people.
- Develop improved debriefing techniques. This has application in incident investigations as well operational activities.
- Evaluate the distances that people will be required to travel to evacuate on foot.

Background to the exercise

Each year an emergency exercise at an underground coalmine tests the systems that are in place to handle an emergency that could potentially result in multiple fatalities.

The annual Level 1 Emergency Exercise was one of the recommendations of the Warden's inquiry into an explosion at Moura No. 2 Underground Mine on 7 August 1994 in which 11 miners died. Fifteen of these exercises have been conducted since 1998. The protocols are set out in the *Coal Mining Safety and Health Act 1999* (the Act).

The scope of the mining exercise is set out in the Act's Recognised Standard 8 and the four most recent exercise reports available on the department website show the breadth.

The Recognised Standard 8 is available at:

http://mines.industry.qld.gov.au/assets/mines-safety-health/recognised_standard08.pdf

Reports of recent exercises are available at:

http://mines.industry.qld.gov.au/safety-and-health/emergency-excercise-reports.htm

The three cases below illustrate the nature and magnitude of mining disasters:

- Pike River, New Zealand, November 2010: 29 died, two escaped after explosion. Rescue resources were on standby for five days. Community expectations of a rescue were high for that period.
- Upper Big Branch, United States of America, April 2010: 29 died, no survivors. For five days after the explosion it was believed that four may have survived so rescue efforts continued.

- Beaconsfield, Tasmania, April 2006: A roof fall killed one miner and trapped two. For five days, it was not known that the two trapped miners were alive, while search operations continued. The survivors were located after five days, but their rescue took a further nine days.

The 2013 exercise will be conducted at the Ensham mine in the Bowen Basin near Emerald. The precise date is not determined until closer to the event and not generally publicised.

The Exercise

A Level 1 Emergency Exercise conducted at Oaky North Mine at 11 am–10 pm Sunday 7 October 2012 was based on the scenario of a gas explosion after a longwall ignition.

Oaky North Mine

Oaky North Mine is near Tieri, a central highlands town with 468 houses and a camp for around 2000 mine workers.

In 2012, it was the highest producing underground coalmine in Australia, with two operating longwall faces. The mine, operated by Xstrata Coal, employs 585 people to produce around 9 million tonnes and 30 km of development roadways each year.

Rationale

The mine has had a series of frictional ignitions, the most recent on 18 July 2011 in MG 402 development and in Longwall 400 on 11 July 2011. There was also an ignition on the longwall face at Oaky Number 1 on 25 March 2012.

Recommendations from recent Level 1 exercises have included the need to improve debriefing of people who have escaped from the mine.

An inspector expressed concern about a downcast shaft's location near a projected goaf and the possibility of spontaneous combustion with full mine ventilating pressure across the shaft pillar. This scenario was not incorporated in the exercise, but did distract the ICT in its early deliberations.

Local factors

Several factors were considered when developing the exercise.

- The mine has been operating since 1989. Workings now extend for 12 km from the surface facilities.
- An upcast and a downcast shaft close to the current face workings would enable a ventilation circuit to be maintained if there was a major obstruction in the main roadways. There is also a possibility of a short circuit if ventilation control devices were destroyed in the inby workings.
- Most of the senior management team had been at the mine for less than a year at the time of the exercise.
- There are two surface infrastructure locations. The transport drift and the mine offices are located about 4 km away from the coal-handling portal.

Activation

An emergency response commences when a person becomes aware that the normal systems in place are not adequate to control the current situation. The exercise tested the effectiveness of activation in the following ways:

- identification of out-of-the-ordinary situations

- calling for assistance.

In this exercise, the explosion destroyed ventilation structures, telephone communications and gas monitoring from the working sections of the mine. The loss of ventilation, together with the inability to call control to find out the reason or the likely duration was a trigger for people to evacuate from the mine. The loss of communications and gas monitoring failure raised alarms in the surface control room.

Loss of ventilation and communications underground

All work crews identified the need to evacuate when the assessors told them that the ventilation was not working and that the telephone and DAC systems were not working.

Crews were expected to evacuate using the primary escapeway in any available transport vehicles. All of those underground did so, except for two mineworkers in the longwall panel.

These two decided to start walking, rather than take the vehicle that they shared with the rest of their work group. They believed that the others would bring the vehicle behind them and pick them up. This was a logical and safe decision.

However, unknown to them, because their section was the site of the frictional ignition, their colleagues were injured or killed in the explosion. As a result, the two had to walk 12 km to the surface.

The control room

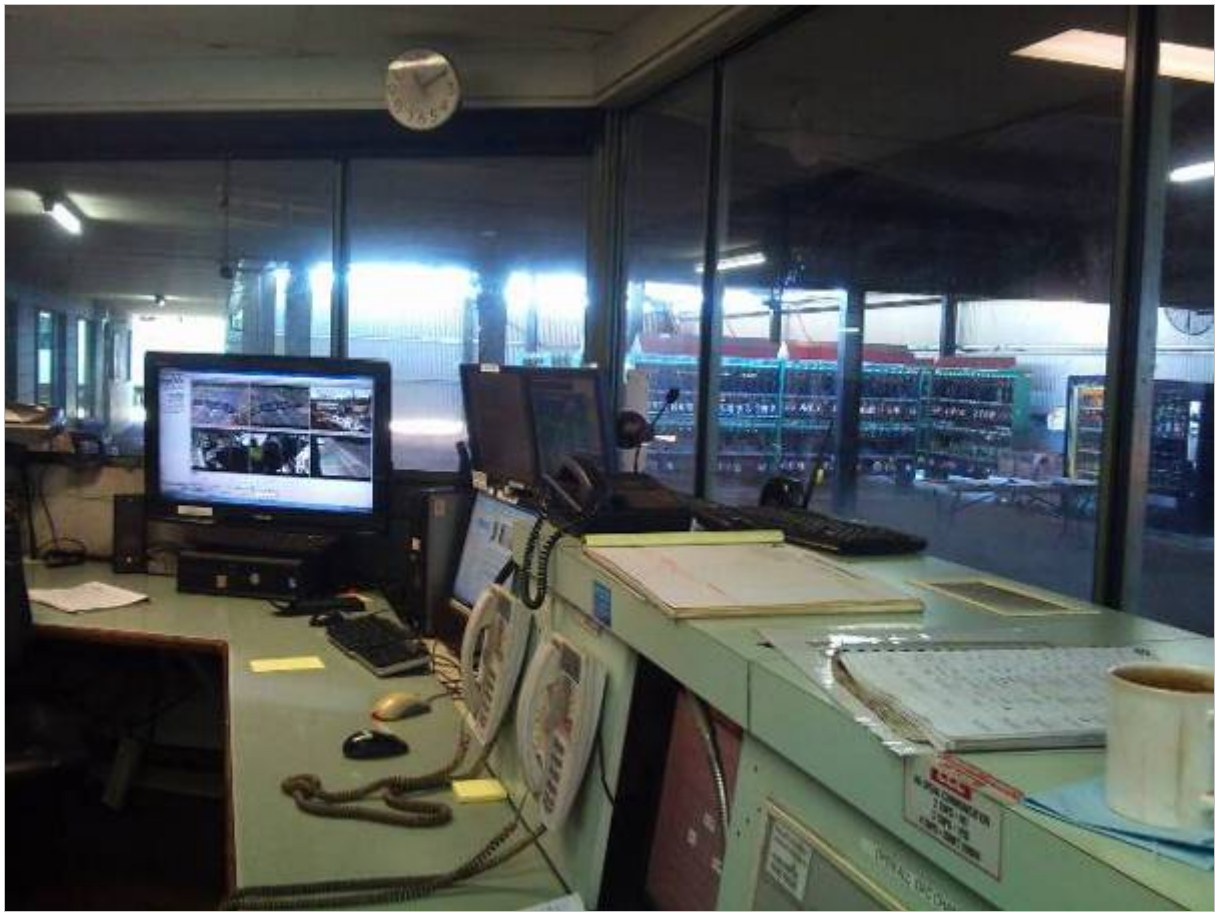


Image 1: **Control room**

The control room has two staff members who monitor mine operations and record reports from underground. They observe the gas monitoring system, which measures concentrations and calculates trends at critical underground points.

Initial indicators identified in the control room included loss of fan ventilation pressure and a sudden increase in gas concentrations. Attempts to contact the areas of the mine that appeared to be affected were unsuccessful because the explosion destroyed the telephone lines.

The control room operated effectively, considering the large volume of information that had to be processed.

The staff called the management team, mines rescue, Simtars and the inspectorate at appropriate times.

Interpretation of the gas monitoring values in the control room was accurate.

Control room staffing (2 persons)

One person normally staffs the control room. Shortly before the exercise, management identified that two people were required to maintain control room operations in busy periods. A second person, trained in control room activities, works on the surface and can be available if needed. Some mine procedures specify that a second person is required in the control room during particular activities.

In the exercise, having the second person in the control room helped, but the workload was still high.

Recommendation

> Activities such as contacting off-site mine officials and emergency response teams should be given to another person through the duty card system and carried out in another location.

This delegation reduces the amount of activity in the control room and frees up available phone lines.

Duty cards use

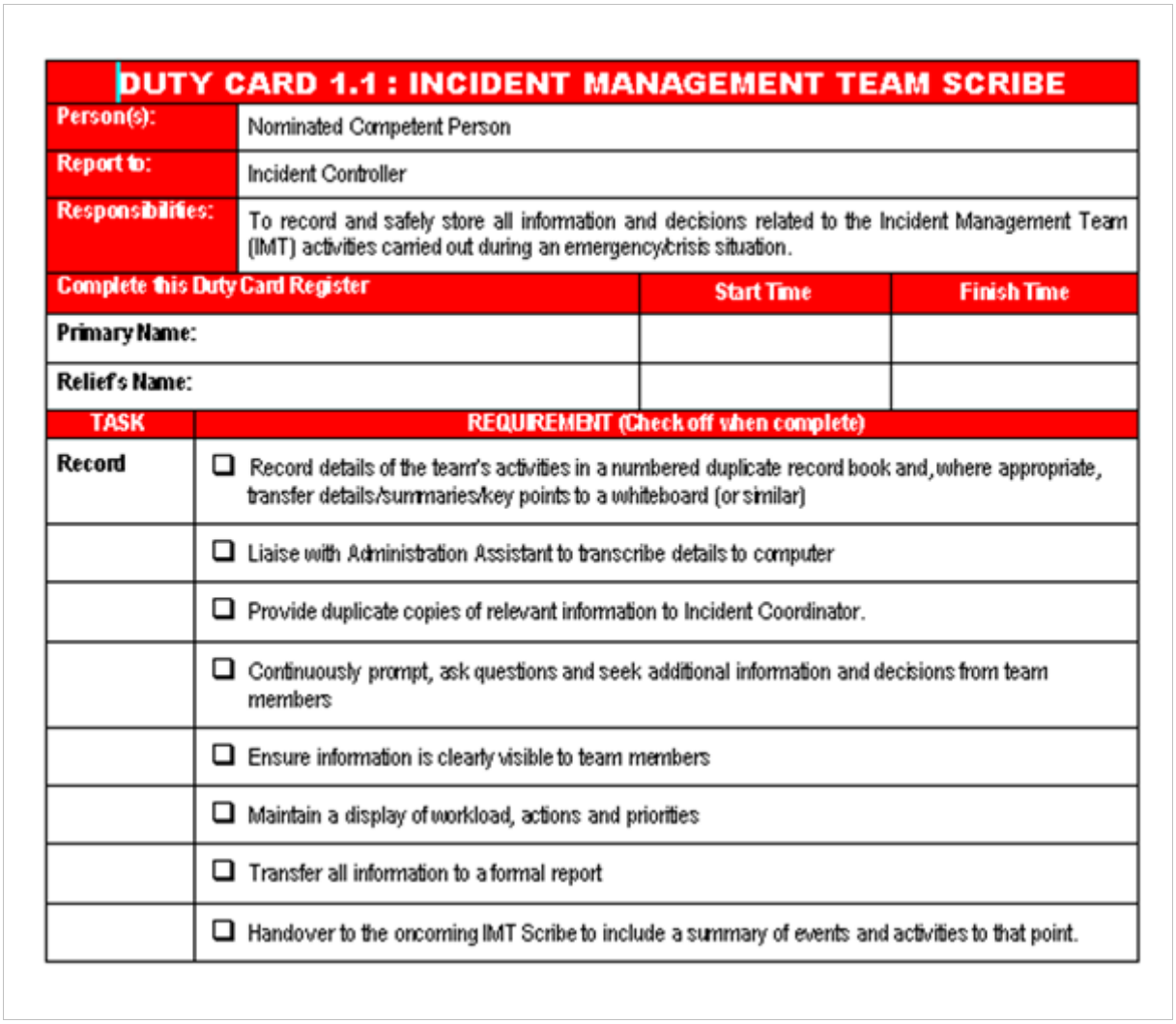
Image 2: **Duty card cases**

A series of duty cards have been developed to allow available, but inexperienced, people to carry out necessary activities. These cards set out critical steps and contact details. They are stored in hard cases in the main conference room. The cases also contain other appropriate items, such as tabards and clip boards.

People started to gather in the main conference room at 1.15 pm. A number of activities started before the duty cards were used. The site security duty cards were distributed at 1.35 pm.

Activities such as advising senior management, sounding the surface siren and sending evacuate personal emergency devices (PEDs) occurred as initiatives of individuals rather than as steps in a planned process.

An example of the effective use of duty cards was an operator taking a sample from the tube bundle system for further analysis by gas chromatography. He was able to do this by following the procedure, even though he had never done it before.



DUTY CARD 1.1 : INCIDENT MANAGEMENT TEAM SCRIBE			
Person(s):	Nominated Competent Person		
Report to:	Incident Controller		
Responsibilities:	To record and safely store all information and decisions related to the Incident Management Team (IMT) activities carried out during an emergency/crisis situation.		
Complete this Duty Card Register		Start Time	Finish Time
Primary Name:			
Relief's Name:			
TASK	REQUIREMENT (Check off when complete)		
Record	☐ Record details of the team's activities in a numbered duplicate record book and, where appropriate, transfer details/summaries/key points to a whiteboard (or similar)		
	☐ Liaise with Administration Assistant to transcribe details to computer		
	☐ Provide duplicate copies of relevant information to Incident Coordinator.		
	☐ Continuously prompt, ask questions and seek additional information and decisions from team members		
	☐ Ensure information is clearly visible to team members		
	☐ Maintain a display of workload, actions and priorities		
	☐ Transfer all information to a formal report		
	☐ Handover to the oncoming IMT Scribe to include a summary of events and activities to that point.		

Image 3: Sample duty card

The cards tell people with limited familiarity how to do tasks so that all necessary steps are taken. Unfortunately, many of the duty card cases were not opened until the senior managers arrived because those on duty did not recognise their value at the time of the incident.

At 2.25 pm the Media and Corporate, Family Liaison Office and Ventilation cases were still in the meeting room unopened.

Surface siren

The emergency surface siren can be activated from the control room to bring an emergency to the attention of everyone on site. In this exercise, the sounding of the siren was intermittent which caused problems of awareness and shortage of emergency help.

A record shows the surface siren sounded at 1.53 pm. Another record at 3.12 pm shows the ICT discussing why the siren was not activated. A later record shows the siren sounding at 3.52 pm. In response to this sounding a group of tradesmen, who had been at work on the site all day, came to the control room at about 4 pm to ask what was going on.

The siren had been activated from time to time, but switched off to reduce disturbing noise. As a result, people who arrived after the emergency was declared went to work in the offices

and the workshop, unaware of the situation and without being alerted to the need to assist with the many necessary emergency tasks.

There was such a shortage of people available in the early stages that the occupational first aider was sent to the portal as a security guard, rather than to the first aid room to prepare for the potential large demand.

Recommendation

> Devise an unobtrusive alert system that tells people at the mine and those arriving after the emergency starts that an emergency is in progress.

Contact with off-site management, expertise and responders

The exercise was conducted at 1 pm on a Sunday, a time when many of the senior members of the management team and technical experts are not at the mine. Out-of-date contact details made it difficult to contact several people; some numbers even had to be obtained through third parties or the White Pages phone directory.

Telephones

The control room handled most of the telephone calls. This is the normal operational communication centre, but during the emergency there was so much other activity there that outgoing and incoming phone calls would have been better handled at a separate office nearby.

Portable phones with dedicated numbers were available for the key positions in the ICT, but calls were generally made and received on the ICT members' personal mobiles. The dedicated phones that rang during ICT meetings were not answered.

Recommendation

> Emergency planning must recognise administration staff members need to take and receive phone calls.

The main gate and several other areas on-site were mobile phone black spots. Critical people, such as gate security, assigned to those locations required effective forms of communication.

Three phones on the surface in the East Mains downcast shaft and main fan facility were not working.

Evacuation

The evacuation from the mine went well, although most crews evacuated to the conveyor portal because a PED was received with the message 'T3.' The person who sent it meant that the target action response plan (TARP) was now at level 3 whereas in the Oaky North evacuation plan TARP T3 means evacuate to the conveyor portal, which most underground crews did. There is a need to ensure that any shorthand PED messages are sent accurately and understood by all involved.

CABA system

Image 4: Mineworker wearing CABA

Everyone underground wears a self-contained oxygen self-rescuer, which provides breathable air in a toxic atmosphere for about 40 minutes. This is long enough to reach CABA units which can be refilled at recharge stations set up along the escape route.

In the exercise, one person from each production district wore a training self-rescuer and then changed to a CABA unit. In previous level 1 exercises concerns have been expressed about the way that this was done. In 2012, the standard was high.

Escapeways

The regulation requires two escapeways from most parts of the mine. When an incident prevents safe travel through one escapeway, the second escapeway must not be affected.

Combustion products polluted the primary escapeway because there was no effective separation of the airways at 403 panel drivehead (21 cutthrough East Mains). The machine doors at 20 cutthrough, which do provide escapeway separation, were closed when the assessment team entered the mine.

Walking out of the mine

Of the two mineworkers from the longwall section who walked 12 km from the face to the surface, one wore CABA all of the way and the other wore opaque glasses to simulate walking through smoke.

Recommendation

Evaluate the distances that people will be required to travel to evacuate on foot.

They left the vehicle that was available in the panel for their colleagues to use and started out on their their own in the expectation of being picked up by the remainder of the crew when they came past. They were not aware the remainder of the crew in that section were either killed or severely injured in the explosion.

After walking a few hundred metres, they began to debate whether they should continue walking out or go back to see if they could assist their crew. They reasoned that all of their training had been to look after 'yourself'. They decided that as this was a training exercise they should continue walking, but recognised that in the real thing they would probably go back. Having discussions like this is one of the benefits of emergency exercises.

Sensibly, as they walked out they left notes at key points to tell those following that they were ahead. However, because the crews from other sections had evacuated in vehicles, there was no one behind them.

There is no way of rehydrating while wearing CABA. As a result, the worker who walked out wearing this apparatus was dehydrated by the time the two reached the surface.

Recommendation

Establish a means of rehydrating while wearing CABA as an industry research priority.

Evacuate from the mine through the belt drift

There are two separate locations for people to leave the mine. The main portal is near the office complex and the bath house. A conveyor portal is about 4 km away.

Although there was no operational requirement to evacuate to the remote conveyor portal, most crews did so, probably because:

- it was the closest portal for people installing secondary support on the outbye conveyor roadways
- the traffic signals had been turned to red which indicated to people evacuating that traffic was not permitted to come out the main drift. (The sentry at the main portal entry had changed the lights to prevent anyone entering the mine.)
- the local shorthand for PED messaging meant different things to different people so there was confusion.

PED messages

Each person who goes underground carries a cap lamp. This also has a digital screen Personal Emergency Device (PED), which allows messages of up to 32 characters to be sent to individuals, work groups or the whole of the mine. Messages can be sent from most computers on site. Most of the PED messages were sent from the control room. This added to the workload there, with people coming in to send a PED.

The TARPs set out steps to take when specific alarm levels are reached, including when specified levels or gas concentrations are encountered, or after the ventilation has failed for a certain period. There are usually four or five trigger levels; at some mines these are referred to as T1, T2, T3 and so on.

At Oaky North the expressions T1, T2 and T3 have a different meaning during an evacuation. T1 sends workers to a nearby place of safety', such as a crib room. T2 means evacuate to the surface through the transport drift. T3 means evacuate through the conveyor portal.

The PED message T3 sent in this instance was supposed to communicate that the third level of the evacuation TARP had been reached. However, most people interpreted it as 'evacuate to the conveyor portal'.

Recommendation

> Mines should review any jargon or shorthand messages to check if they might cause confusion

Response

Mines have comprehensive fire fighting and first aid facilities as well as an industry-specific mines rescue service. Available resources include paramedic staff, transport vehicles, water tankers, and self-contained breathing apparatus.

In addition to the objectives set out in the introductory pages, the objectives of level 1 exercises are further defined in Recognised Standard 8 as:

- to test the mine's emergency response system
- to test the ability of external services to administer assistance
- to provide a focal point for emergency preparedness in the State.

To this end, the scope of the exercise will include the following:

- Mine response to the scenario presented testing self-escape, aided escape and in-seam response as required.
- Mobilisation of Queensland Mines Rescue Service and other external services, including Mines Inspectorate, industry safety and health representative(s), Simtars, police, and ambulance to the extent required by the exercise scenario.

Queensland Mines Rescue Service will be expected to:

- provide the rescue team response as defined in the mines rescue agreement with the mine
- deploy rescue teams underground including the establishment of a fresh air base (if required) in response to the scenario.

Queensland Mines Rescue Service

Queensland Mines Rescue Service (QMRS) is the only organisation approved by the Minister as an accredited corporation, under Part 13 of the Act. The Minister approves an organisation to provide appropriate mines rescue training programs, equipment and resources to establish mines rescue agreements with coal mine operators. These agreements also cover the maintenance and testing of mines rescue equipment, audits, and other exercises to show the corporation's ability to respond to an emergency.

QMRS have established a mutual assistance scheme for coal mine operators to help each other in an emergency. The main service that rescue teams provide is the capacity to

conduct a rescue exercise in an unbreathable atmosphere, wearing self-contained breathing apparatus.

Volunteers from each underground coal mine train at least six times each year and many compete in competitions conducted at State, national and international level each year. Each mine has at least 5 per cent of its workforce trained and available to respond to an emergency.

Image 5: Mines recue team

Critical events in this exercise

2.08 pm	The incident controller requested that QMRS be contacted
2.38 pm	QMRS advised that two teams had been activated from Grasstree and Crinum mines.
3.35 pm	Enough rescue-trained people had arrived at the mine to mobilise two teams
4.10 pm	Teams briefed by incident controller and they completed the mines rescue risk assessment to determine whether it was safe to proceed underground. (This decision is based on information sources such as the gas monitoring system.)
6.15 pm	Two teams proceeded underground
7.00 pm	The teams had established a fresh air base at 13 cut-through in longwall 306 gate road. The active team walked inbye without coupling up their breathing apparatus suits.
7.11 pm	They reached 21 cut-through, where gas levels made it necessary to couple up their suits. The second team stayed at the fresh air base FAB as a standby team to provide

	back up to the active team.
7.36 pm	They moved the FAB inbye to 20 cut-through
8.17 pm	The active team reached and treated the first casualty
8.30 pm	A second casualty was located and treated
8.42 pm	They found two deceased casualties.
9.00 pm	The standby team left the FAB at to assist the active team with the recovery of the live casualties.
9.11 pm	The first casualty was brought by stretcher to the FAB
10 pm	They arrived on the surface

Queensland Mines Rescue Service brigade response

There were unconfirmed reports that some mines were unwilling to release mine rescue team members for the exercise. This is inconsistent with the spirit of the mutual assistance scheme and may breach obligations under the legislation.

Mine response

All of the people underground at the time of the explosion were located within three hours. The (simulated) lack of phones inbye 17 cut-through East Mains contributed to the delay.

The evacuation through the belt portal meant that the tag board system at the pit top could not be relied on to indicate that a person had reached the surface. It took almost two hours for someone to arrange a roll call of the people who were waiting at the belt portal.

Debriefing

As in previous years, the standard of debriefing was poor. Crew members were debriefed in in groups; potentially resulting in people not disclosing what they had seen if it contradicted what others had confidently reported.

Incident management

Incident management is carried out under mine emergency management system (MEMS), a series of protocols developed by the QMRS. It has been adapted from the Emergency Management Australia system used by military, fire and ambulance for effective management of emergencies. At Oaky North 26 people have completed the MEMS training program.

The role of the incident control team

The ICT is made up of the senior functional managers and technical experts present at the mine. The team consists of an incident controller, and planning, operations and logistics controllers.

Each of the controllers manages a small team of up to seven that meets in dedicated location. The controllers report back to the ICT at appropriate intervals.

The process applies these principles:

- one controller (usually the UMM, SSE or initially the senior mine official)
- management by objectives (setting objectives to focus on controlling the incident)
- functional delegation (the incident controller delegates the roles but retains overall accountability)
- span of control (no more than seven people should report to a team leader).

Image 6: The incident control team in action

Phones

The use of phones during the exercise could be improved. Most of the communication into the incident control room came by telephone. A suite of portable phones were set up and numbers allocated to key position holders. This was not used to its full potential; instead people took and made calls on their personal mobile phones. This is not a good practice.

In the likely event that the response was to continue beyond a single shift, the dedicated phone numbers ensure contact with the current position holders, regardless of fills the role. On the other hand, reliance on personal mobile phones results in off-duty team members being disturbed during their recovery period and could lead to decisions being made that were not passed back to the team in control.

Frequently calls came in or were made during ICT meetings. A better practice would bar from meetings and a dedicated person taking messages.

Fatigue management for the ICT members

The exercise commenced at about midday on a Sunday afternoon, when most of the ICT members would have been awake for several hours: this could result in fatigue before the event was concluded. Best practice would be to set in place a process to manage fatigue.

Recommendation

> Nominate an alternate for each of the senior team members and plan for that person to rest in preparation for a handover in about eight hours.

Most coalmine emergencies extend over several days and need top quality decision making 24 hours a day, even if those decisions are to defer a decision or not to disturb the key players. This need was identified and implemented early in the exercise, but the reserve team did not leave the mine. This would be advantageous in future exercises.

Recommendation

> The teams carry out a handover and the primary team disengage, but monitor the performance of their delegates.

Decision making

Decision making in this exercise did not always happen in the optimum situation: often data was analysed in the ICT, rather than in the functional areas.

The planning group comprised the technical services manager, ventilation officer and gas drainage engineer who found it difficult to collect the data/information required as well as do any planning. Planning appeared to be happening in the ICT meetings with the Planning Group going away and collecting information and bringing it back to ICT meeting.

After attending several ICT meetings the planning coordinator and ventilation officer identified that they were not getting enough time for gas interpretation and requested more time between meetings.

Data analysis

A large amount of data is available at a modern mining operation but in this exercise the data was not always used appropriately or made available.

The planning group used the CITEC machine monitoring system to identify the likely location of the shearer at the time of the explosion. Some information, such as the vacuum pressure for each tube bundle line was not readily available, although it was known to the ventilation officer. If this information was available in the tube bundle shed, the status of tube integrity could be assessed more readily.

On many occasions, available data was not considered in the ICT's decision-making process. There was little input to the ICT process from the debriefing of evacuated mine workers. Ratios such as Tricket's ratio or the ratio of hydrogen to carbon were not computed to evaluate the nature of the explosion. Because of the likelihood of a second explosion, the ICT declared a no-go zone around the shafts on the surface, but this was not followed at the main fan site.

These shortcomings might have been due to:

- the frequency of the ICT meetings that left little time for detailed analysis and interpretation

- a lack of understanding of the practical application of the theory
- assumption of assumed cause: an inspector had drawn attention to the potential issues around placement of an upcast shaft in proximity to a future goaf. In early deliberations by the ICT this appeared to be the only explosion source considered, even though the goaf was not yet in the region of the shaft pillar.

Logging activity

Decisions by the ICT were logged on white boards and transferred to computer file as the exercise progressed.

This practice is essential when an event carries on through a shift transfer. Typically a coal mine incident will last for several days, perhaps weeks. Records of the grounds for decisions will provide invaluable reference material as the incident progresses, and hopefully as normal operations resume.

There was only one briefing from the ICT to the workforce.

Gas monitoring

The gas monitoring systems required by legislation in Queensland mines have been a major contributor to the State's reputation as a world leader in coal mining safety. Control room operators have immediate access to current and historical information about the presence of explosive and toxic gases, which may be naturally occurring or products of combustion. Every underground mine in Queensland has a system that provides immediate readings from each working section, where natural gases are more likely to be liberated and locations which have a high risk of fire, such as conveyor belts. There is also a tube bundle system, where a continuous stream is drawn from these locations and sampled at frequent intervals on the surface. The advantage of this system is that analysis can continue when power is lost underground.

The disadvantage is the time it takes to bring the sample to the surface. At Oaky North, there is a set of surface analysers in a hut at the top of the 35 cut-through shaft 8–10 km from the working faces. This lag between sampling and analysis averaged up to 3 hours for the working panels. Relocating the hut to the 17 cut-through shaft location, or to a purpose-built borehole closer to the faces, could reduce the delay to 30 minutes.

Recommendation

> Evaluate methods to reduce the lag with tube bundle readings so that the information can be obtained while it is still meaningful.

Locating the analysers, and the associated pumps and telemetry equipment, close to the shafts puts them at risk if an explosion reaches the surface, as was the premise for this exercise. Explosions at Pike River in New Zealand and Raspadskaya in Eastern Europe in 2010 demonstrated the vulnerability of surface installations if the explosive wave reaches the surface.

Simtars prepared a set of simulated data representing a frictional ignition and explosion and fed this data into the control room computers. Control room operators, incident controllers and responders were given realistic indicators to respond to.

At times the ICT appeared to be looking for information to confirm a view that they already held, rather than objectively analysing the data.

Gas sampling

No suitable pump was available for taking a sample from a surface to seam borehole.

The sampling points at the tube bundle shed were not leak tight when a technician first tried to take a bag sample. The filter catch pots on a number of sampling locations on the tube bundle system were full of water. This compromised the integrity of gas analysis from those sampling locations because insufficient sample was able to reach the analyser

The vacuum pressure for each tube bundle line was not readily available, although it was available in the ventilation officer's files. Displaying this information in the tube bundle shed would assist assessment of tube integrity. Although the mine had no gas chromatograph operators available on shift, assistance came from the nearby Oaky Creek Number 1 Mine.

Ventilation modelling

The mine uses Ventsim, a computer model, to represent the ventilation circuit. The model is updated each month, and scenarios can be proposed to evaluate the effects of changes to the ventilation circuit. The model was used during the exercise and the output contributed to the ICT discussions.

The planning group used the model to assess scenarios, however this placed great strain on the small number of available users. The ventilation officer, the most knowledgeable user, was often needed for other activities, so had to leave the modelling.

A mutual assistance arrangement, facilitated through a similar structure to that used by electrical and mechanical engineers, could contribute to the need for continuing professional development and refresher training for people in positions such as technical services manager and ventilation officer.

Recommendation

> Arrange emergency mutual assistance between mines to address the analysis of the large volume of technical data by appropriately qualified people.

Potential information sources

The exercise identified that some information was available, but was not used. There was poor use of reports from people who have come out of the mine. At one stage a stack of debrief reports had been left in the debriefing room for over three hours.

Recommendation

> Develop improved debriefing techniques. This has application in incident investigations as well operational activities.

There is a large volume of automatic data collection in all personal gas monitors. This could have been downloaded to provide a picture of the atmosphere that people had travelled through when evacuating.

There area number of CCTV cameras located at critical points around the mine that can be monitored in the control room. Fans and portals should be monitored and recorded so that after an incident, video can be replayed to observe any emissions.

Appendix 1: Level 1 exercises

As set out in Recognised Standard 8, the objectives of the level 1 emergency exercises are:

- •safely test the facilities and strategies in place at a mine to manage emergency events in all circumstances
- • test the competency of mineworkers in using those facilities and implementing the strategies
- • enhance the confidence and ability of mineworkers to respond in an emergency
- • identify opportunities for improvement
- • share the learning outcomes with industry.

The objectives are further defined in the standard as:

- • to test the mine's emergency response system
- • to test the ability of external services to administer assistance
- • to provide a focal point for emergency preparedness in the State.

To this end, the scope of the exercise will include testing these aspects:

- • Mine response to the scenario presented, testing self-escape/aided escape and in-seam response as required.
- • Mobilisation of Queensland Mines Rescue Service and other external services, including Mines Inspectorate, industry safety and health representatives, Simtars, Queensland Police Service, and Queensland Ambulance Service to the extent required by the exercise scenario.

Queensland Mines Rescue Service will be expected to:

- • provide the rescue team response as defined in the MRA (Mines Rescue Agreement) with the mine
- • deploy rescue teams underground including the establishment of a fresh-air base (if required) in response to the scenario.

Considerations for future exercises

Waiting time for rescue teams

The people in the longwall face were to be rescued by QMRS teams. Identification of the need, activation and response would take several hours. To avoid having a number of people sitting around waiting for an extended period, inspectors from New Zealand and New South Wales and a rescue station manager from New South Wales were assigned as assessors to the longwall. They provided the waiting employees with details of the Pike River explosion and other major incidents. This worked well.

Production in the longwall continued after the start of the exercise for other sections. This allowed the shearer to be parked up in the ideal location, as well as giving the visitors from interstate and overseas an opportunity to see the longwall operating.

The gap also allowed casualties' wounds to be simulated.

Alternate team take over ICT

As most coal mine emergencies extend over several days and need top quality decision making available 24 hours a day, it would be advantageous to have a handover after about four hours and the primary team disengage, but monitor the performance of their delegates.

This will also allow the handover process to be monitored. This could be adopted for mine site level 2 exercises, although in many cases the ‘reserve team’ manage the incident.

Assessors should be briefed not to show people the charts with gas values but to verbally just tell people—possibly show on the plans what can or cannot be shown to the crews taking part in the exercise.

Data simulation

In future exercises, consider machine monitoring systems as an indicator of event causes. This year we provided collar pressure at the fans, but the technical services manager went straight to CITEC to determine the location of the two longwall shearers at the time of the event. This had not been allowed for in the planning.

Other data sources that may be considered include the downloadable information held in every portable gas detector.

Involvement of community organisations

In 2013, emergency services will be invited to test the interface between mining and community systems in a desktop exercise. As the level 1 exercises are designed to stretch the mine’s resources to the limit, it is not practical to host visitors or observers while the exercise is taking place but we have offered to provide a briefing in advance and a report after the event to stakeholders and emergency resources.

Mines have comprehensive fire fighting and first aid facilities as well as an industry-specific mines rescue service. This includes paramedic staff, transport vehicles, water tankers, and self-contained breathing apparatus.

In an emergency, it may be necessary to call on community resources such as morgues, hospitals, doctors and ambulances. There are also emergency management requirements. Media interest is likely to be high. Although the mines have security staff, crowd control may be an issue. The mines have access to counselling services, but the need for community reassurance is also high.

To enable the state services to conduct an emergency desktop exercise in parallel with this event there is an offer to feed progress reports by either phone or on line to provide realistic input into the activity.

Appendix 2: Extract from Coal Mining Safety and Health Regulation 2001 (General)

Section 35 of the Coal Mining Safety and Health Regulation 2001 (General) states:

(1) A coal mine's safety and health management system must provide for managing emergencies at the mine.

(2) The system must include provision for the following —

(a) identifying, by risk assessment, potential emergency situations;

(b) minimising risks associated with potential emergency situations;

(c) carrying out aided rescue and self-escape of persons from the mine in an emergency;

(d) carrying out emergency exercises, including testing the effectiveness of emergency management procedures and the readiness and fitness of equipment for use in an emergency;

(e) auditing and reviewing the emergency exercises;

(f) if the mine is a surface mine—involving an open-cut examiner for the mine in—

(i) developing and testing the emergency management procedures for activities, including mining activities, in and around the surface excavation; and

(ii) auditing the documentation for the procedures;

(g) if the mine is an underground mine—involving an ERZ controller for the mine in—

(i) developing and testing the emergency management procedures for explosion risk zones; and

(ii) auditing the documentation for the exercise

Appendix 3: Information given to mineworkers

Several weeks before the exercise

These short announcements were included in daily briefings so that the workforce was prepared for the exercise:

Short sharp reminders (a different one each day) such as these would be suitable:

- The level 1 exercise is a chance to find out what we don't know about how to act in an emergency. By treating it seriously we can become that much better if we are ever unfortunate enough to be underground when a real emergency happens.
- Let your friends and family know that the exercise is planned in the next couple of weeks. That way if they hear a news report about emergency teams being called to Oaky North they will not be unduly worried.
- The assessors are not trying to trap you or trick you. They are looking to see what everyday coal miners would do and what the whole industry can learn from our experience. Your mistake may save many other people's lives in a real emergency. Don't cover it up. Be proud of it so we can all learn from it.
- Remember to put a signed information tag on your crib bag, marked ‘OK to take out in exercise’ so that it can be brought to the surface if the exercise is today. We won't move any bag that is not tagged, so you may not get your crib.
- Do not use your belt-worn or cache self-rescuers during the level 1 exercise. A few people will be asked to wear a self-rescuer, but these will be supplied by the assessors. Keep your own rescuer ready for use in case of a real emergency, just as you do every other day.
- Do not take any extra risks during the level 1 exercise. Do not travel in a vehicle unless you have a seat. Do not do anything that you would not do under normal working conditions.
- During the exercise, all PED messages and telephone or DAC communications that are about the exercise should start with the words, ‘Exercise Only’. If there is a real emergency, start your message with, ‘Emergency, Emergency, Emergency.’ The exercise will stop if a real emergency occurs.

Exercise initiation

Assessors were provided with instruction sheets that were appropriate for the part of the mine. The text below is the guide that was given to assessors in the development sections.

Assessor guide—evacuation from underground

As an assessor

Keep a record of the activities that you observe on the assessor record sheets.

Provide information that you have from this guide, but otherwise allow the people involved to make assumptions and decisions based on the information they have. For example, you will provide gas and ventilation quantities that are different to what they see in front of them, but otherwise a road is accessible, unless this guide says it is not.

Once you have given them the information, do not interfere with their decision making process.

Self rescuers and CABA

If the crew chose to wear self-rescuers, provide one person with a training self-rescuer. Ask him to put it on. Then change from self-rescuer to CABA at the first CABA station. That one person tops up as required on the way out to mains. When you get to the mains, only the person from the shotfiring crew continues to top up.

Check the steps against the assessor guide.

After the decision has been made to wear self-rescuers, talk to the crew about when to don a self-rescuer, as mentioned in the briefing note.

Debriefing

When the people you are accompanying reach a place of safety, they will be debriefed. Would you please stay with them and ensure comment on the information from the debriefing is the debrief record? Even if you disagree with the information or think other important information has been missed, please avoid contributing to the debrief. We are checking how they act, not how they should have acted.

20 minutes to time zero

Tell the ERZ controller:

Set the panel up as you would if you were leaving it for a full shift: machines in a safe place, power off equipment. Consider ventilation and services such as pumping and water. You know your panel. Leave it safe.

At time zero

The power has dropped off any electrical equipment that you are near. If they choose to check any other equipment, then any equipment that they physically check also has the power off

The air current has stopped.

There are no other indicators that can be felt where you are.

If they try to make a phone or DAC call

The phones and DAC are not working inbye 13 cut-through East Mains.

When you reach the East Mains

Until the fan ventilation is restored, from 24 cut-through through to 17 cut-through, all gas detectors go into high level alarm for CO and read 200 ppm. Visibility is restricted.

Observe whether this leads to wearing self-rescuers / CABA if not already worn.

People evacuating on foot are to be given smoke goggles.

The driver of any vehicle is to follow the directions of the front seat passenger. They are not to wear smoke goggles. If the driver makes a turn without being told to by the passenger, then make him reverse and go straight ahead past the turn. Getting back on track is to be

done through instructions from the front seat passenger. Experience from Avon and Moura is that one person walked in front of the vehicle to give directions to the driver.

The smoke clears at 17 cut-through. Record any decision about taking off self-rescuers / CABA.

When you reach 13 cut-through, East Mains

All telephones and DACS are working.

When you reach the surface

Record the team actions on Assessor record—Reaching the surface.

When to put on a self-rescuer

The guide below was developed by the organising committee and used by the assessors as a discussion prompt for the evacuating mineworkers.

Good practice says to put on a self-rescuer when you see or smell smoke or when you are told to by an experienced miner or a deputy or a mine official.

But if you are the experienced miner or the deputy or mine official, and you have a CO detector with you, at what concentration would you put on your rescuer?

The *Mines Rescue Handbook* (McKenzie-Wood & Strang) gives the following effects of carbon monoxide:

PPM	Blood saturation	Time at rest	Time working	Effect
<30	<5%	8 hours	8 hours	No apparent effect
50	5%	8 hours	4 hours	Blood flow to organs increases. Risk for people with cardiovascular disease
100	10%	4 hours	2 hours	Impairment of visual threshold, judgment or vigilance
200	20%	4 hours	2 hours	Tightness in forehead, headache
400	33%	2 hours	45 minutes	Dizziness, general weakness in the legs, nausea
1200	60%	3 hours	1 hour	Possible collapse, even at rest, disturbed judgement and speech
2000	60%	1 hour	10 minutes	Convulsions, coma, depressed pulse, possible death
3000	70%	30 minutes	1 minute	Death possible

(From the table on page 147 of 1998 edition)

If you are walking towards a fire in underground workings, it would not take much for the concentration to increase suddenly.

It makes good sense to put on a self-rescuer at any sign or smell of smoke, any known fire or when the CO reading is known to be 30 ppm or more.

There is a big reduction in ‘safe’ exposure time when working compared to rest. If you are under stress, such as trying to escape, this would reduce again.

The reason for this is simple; CO accumulates unless it is purged from your bloodstream. Exposure is affected by the concentration of the gas and the volume of gas inhaled. The heavier you breathe the more you take in.

The table values are based on an average fit adult male. We need to allow for the not so fit, overweight or those who suffer from breathing disorders.

The other advantage of wearing the SCSR is to remove any irritation by smoke which can also be increased psychological reaction—again increasing your breathing rate.

So, with all of these considerations together, exposure to 50 ppm CO for less than 4 hours could affect some people significantly.

CO is just one of the gases that come from a fire. Plastics, oils and other chemicals that are found underground also give off very toxic fumes and gases. A higher concentrations of CO than normal is an indicator that a fire is likely.

To give an indication of the other sources of CO at a modern coal mine—a spike of 25 to 30 ppm occurs when a shot is fired in a panel roadway. Figures of 5 to 7 ppm are recorded when a number of diesels pass some of the CO monitors in a convoy, such as at change of shift.

CO is taken up by the blood at about 300 times the rate of oxygen. When blood saturation reaches 15% it becomes very difficult to work hard or run. Normal blood saturation is about 1.5% for non smokers and 4 to 6% for smokers. Once you have a dose of CO it takes 4 to 5 hours for half of it to clear from your blood if you breathe normal air.

First aid treatment is to breathe pure oxygen. Any case of carbon monoxide exposure should be treated by a doctor.

Appendix 4: Level 2 reports

Each mine is required to conduct a level 2 exercise each year. Some of the scenarios are provided here to assist organisers to plan their own activities.

Underground mines

Evacuation through smoke

An escalating fire on a conveyor drive head required the underground workforce to determine the best means of egress. During the egress pedestrians were struck by a vehicle, causing serious injuries to three mineworkers.

Evacuating mineworker threw up into self-rescuer face piece

When thick black smoke entered the panel, the crew escaped on foot, initially wearing self-rescuers. During the escape, a crew member vomited into his face mask. He was unconscious but breathing. The crew had to make a decision on how to manage the situation.

Bomb threat

An administration staff member took a phone call from a disgruntled/agitated caller. He loudly indicated repeatedly, ’I will show you people, I will show you people.” He then indicated a bomb would explode underground at 9.30 am.

Surface mines

Missing person

A search and rescue mission was established to find a missing person who performs some work tasks alone in isolated locations. This scenario was based on real incidents, to show the possible consequences and the necessary controls for working alone. The missing person had suffered a snake bite and was found unconscious in a remote work area.

Treat and recover casualty in dump truck

A rear dump truck operator suffered a heart attack while operating in a production circuit.

Acknowledgements

The activities during the exercise were observed by 28 observers who came from almost every underground mine in Queensland, the Queensland and New South Wales mine rescue services, the University of Queensland, Simtars and mines inspectors from New Zealand, New South Wales and Queensland. We thank them for their contribution and commend the mine workforce for the serious approach to the exercise.

The organising committee would like to thank Oaky North mine management and mineworkers for their assistance, commitment and cooperation during the exercise.

The organising committee would also like to thank all assessors for their input and acknowledge the cooperation and assistance of all of those involved in the Level 1 Emergency Exercise 2012.

The exercise was managed by a committee consisting of:

- John Sleigh, District Inspector of Mines, Rockhampton, Chair
- Russell Albury, Senior Inspector of Mines, Brisbane
- Kevin Poynter, Inspector of Mines, Rockhampton
- David Cliff, Associate Professor, Minerals Industry Safety and Health Centre (MISHC), University of Queensland
- Darren Brady, Manager, Occupational Hygiene Environment and Chemistry Centre, Simtars
- Paul Harrison, Executive director, Simtars.
- Clive Hanrahan, Operations Manager, QMRS
- Les Marlborough, Underground Mine Manager, Grasstree Mine.
- Martin Tsai, Computer Systems Engineer, Simtars, who modelled the effect of the scenario on the mine's gas monitoring system and prepared a model to provide information as the scenario progressed.

A number of mines allowed senior staff to take on the role of assessor, which required several days away from the mine. We thank the companies for their support and recognise the contribution of the assessors. In addition to the committee members and the specialists, the assessors were:

- Bruce Gorham, Oaky Creek Number 1
- Damien Cavanagh, Aquilla
- Damien Wynn, Oaky Number 1
- David Caley, Kestrel
- Jason Kachel, Kestrel
- Larry Hoffmann, North Goonyella
- Lindsay Creighton, Eagle Downs
- Luke Mahony, Broadmeadow
- Mike Walker, Crinum
- Richard Eagleton, North Goonyella

- Wade Kathage, Moranbah North
- Ron McKenna
- Dave Holt
- Clive Hanrahan, Queensland Mines Rescue Service
- Steve Tonegato and Brian Kelly from Mines Rescue in New South Wales,
- Matthew Ubrien and Bob Myatt, NSW Inspectors of Mines
- Michael Firmin and Bryan Harrington from the mines inspectorate, New Zealand Department of Labour
- Ruth Fuller and Tania Xiao, postgraduate students at the University of Queensland
- Matt Jurak, a mining engineer from Oaky North, answered the committee's many questions without raising suspicion.

Glossary and abbreviations

CABA	compressed air breathing apparatus
DAC	A commercial public address system, with a response mechanism, used throughout the mine
FAB	fresh air base
ICT	Incident control team, made up of the senior functional managers and technical experts who are present at the mine.
MEMS	Mine emergency management system, a series of protocols developed by the QMRS. These have been adapted from the system used by Australian military, fire and ambulance services for effective management of emergencies.
PED	Personal emergency device, a commercial digital messaging system with a screen attached to each mineworker's cap lamp. Messages can be sent to individuals, members of a work group or the whole of the mine from most computers on site.
QMRS	Queensland Mines Rescue Service is the only organisation that has been approved by the Minister as an accredited corporation, under Part 13 of the *Coal Mining Safety and Health Act,1999*.
SSE	The site senior executive is the most senior officer employed or otherwise engaged by the coal mine operator for the coal mine who is located at or near the coal mine; and has responsibility for the coal mine.
TARP	trigger action response plan
UMM	Underground mine manager , the site senior executive must appoint a qualified underground mine manager to manage and control the mine.

Call: 13 QGOV (13 74 68)

Visit: www.dnrm.qld.gov.au

Queensland Government