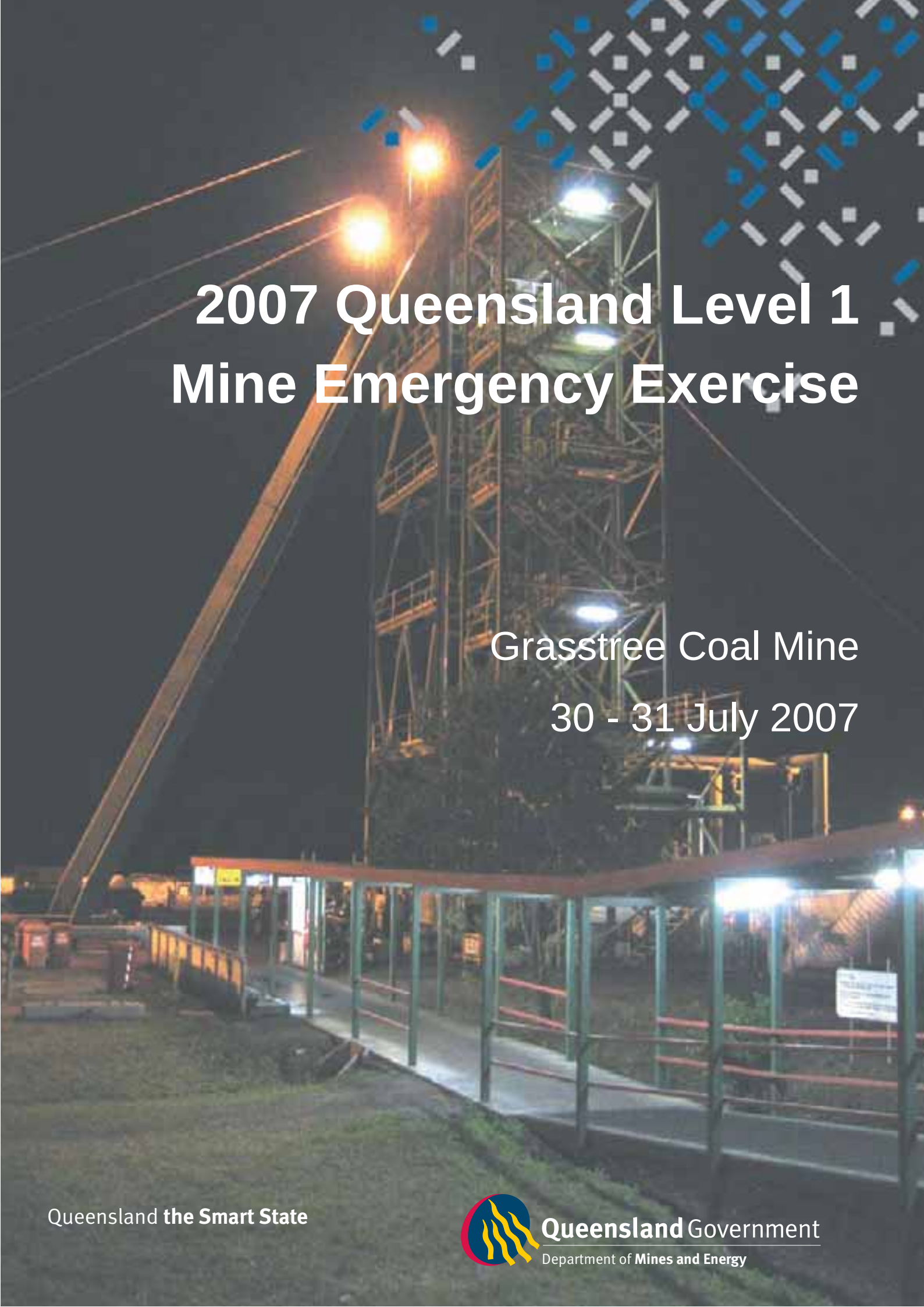

2007 Queensland Level 1 Mine Emergency Exercise

Grasstree Coal Mine

30 - 31 July 2007

Queensland **the Smart State**

Queensland Government
Department of **Mines and Energy**

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Front cover image: Grasstree Mine
Inside front cover: Mineworker wears SCSR – "That's Gold" & Safegas simulation computers

Preface

This report has been compiled by the Level 1 Organising Committee from input provided by each of the assessors involved in the exercise. Each assessor has written their own account of the aspect of the exercise for which they were responsible. This results in the report containing a variation of writing styles.

The Organising Committee would like to thank the assessors for their input and acknowledge the co-operation and assistance of all of those involved in the Level 1 Mine Emergency Exercise.

Executive summary

Background

The Queensland Mining Warden's inquiry into the explosion at the Moura No. 2 Mine in August 1994 recommended - **"Emergency procedures should be exercised at each mine on a systematic basis, the minimum requirement being on an annual basis for each mine."** (**Windridge et al. 1996).**

In December 1996 the "Approved Standard for the Conduct of Emergency Procedures Exercises" was published and has been subsequently revised (Queensland Department of Mines and Energy Safety and Health Division 1999). This document provided guidelines for conducting mine site emergency exercises as well as the requirement for a test of statewide emergency response by holding a Level 1 Mine Emergency Exercise at one mine on an annual basis.

From 1998 to date (July 2007) ten Level 1 Mine Emergency Exercises have been held in Queensland, Australia. This is the report of the 2007 Level 1 Mine Emergency Exercise held at Grasstree Mine between 22:00 on Monday, 30 July and 06:00 on Tuesday, 31 July 2007.

Grasstree Mine is an underground longwall coal mine located approximately 26 km east of the Tieri township, 250 km south-west of Mackay, Central Queensland *(see Figure 1)*.

Objectives

The objectives set for the exercise were to test:

- Self escape, including the changeover process for self contained self rescuers.
- Use of changeover bays.
- The incident management team process.
- Queensland Mines Rescue Services response and underground deployment.
- Mine site and Department of Mines and Energy emergency call-out procedures.

The 2006 Level 1 Mine Emergency Exercise conducted at Broadmeadow Mine had similar objectives as well as an additional one of providing practical input into the development of a recognised standard for the conduct of emergency exercises under Section 72 of the *Coal Mining Safety and Health Act 1999*. Previously an approved standard (Queensland Department of Mines and Energy Safety and Health Division 1999) made by regulation under the *Coal Mining Act 1925* had existed, but was repealed when that Act was replaced by the *Coal Mining Safety and Health Act 1999*. Release of the draft recognised standard is awaiting the outcome of and input from the three committees formed as a result of the Fight or Flight Seminar convened by the Queensland Chief Inspector of Coal Mines in Emerald in October 2006.

Scenario

Grasstree Mine has a high methane gas make on the longwall, is practicing methane drainage and utilises ventilation methods to keep the gas fringe away from the tailgate motor area of the working longwall. Nearby mines have all had frictional ignitions on both longwall and development panels. Consequently, it was decided to base the scenario for the 2007 Level 1 Mine Emergency Exercise on a frictional ignition on the longwall face as this was considered to be appropriate for the current underground situation at Grasstree Mine.

For the purposes of the scenario it was deemed that the shearer drivers and another operator on the longwall would be seriously injured, however they would be able to make contact with the surface using non-verbal communication later in the exercise. The reason for this was to assist the decision process making for the deployment of mines rescue teams.

In all likelihood, a frictional ignition at the tailgate end of the face igniting a gas plume, in addition to damaging ventilation appliances and stopping the fans would result in several immediate fatalities on the longwall face. A coal dust explosion is also a distinct possibility following such an incident. This would have an even more devastating effect on the mine infrastructure increasing the likelihood of even more fatalities.

In 2004 a frictional ignition in a development panel, was used as the scenario for the Oaky No 1 Mine Level 1 Mine Emergency Exercise. All personnel in the panel were "deemed to have been killed". The final phase of that exercise was the mine staff finding 10 dead work colleagues which left them with a feeling of failure at the end of the exercise even though they had successfully formed an incident management team, resolved all information required to deploy mines rescue and completed the full exercise. The Organising Committee was cognisant not to deliberately create a similar negative outcome when developing the scenario for the 2007 exercise.

Ventilation modelling was undertaken to predict the anticipated spread of pollutants through the mine. The mine's Safegas (mine gas monitoring system) was replicated and interfaces to the mine supervisory control and data acquisition system created. This was done to enable the delivery of simulated mine condition information through systems familiar to the mine staff and which they would use in a real emergency situation. Gas data is based on real information from the mine and uses Safesim – a Simtars software package which inputs predetermined gas concentrations into the mine gas monitoring system interface.

Gas concentrations used in the scenario reflected levels which permitted the deployment of rescue teams as indicated in the *Guidelines of the Queensland Mines Rescue Service*. (Queensland Mines Rescue Service 2006).

A total of 20 assessors were on site with representatives from Simtars, the Queensland Mines Inspectorate, mines rescue (Queensland and New South Wales), an industry safety and health representative from the Construction, Forestry, Mining and Energy Union, the Minerals Industry Safety and Health Centre, mine staff from Newlands, Moranbah North, Crinum, Broadmeadow and Aquila mines, a mining engineer from Solid Energy (New

Zealand), a mining engineer from South Africa and a mine site representative (mole) (see Appendix C for details of the assessors).

Major conclusions

1. All aspects of the mines response were professionally conducted and demonstrated the mine's commitment to the Mine Emergency Management System process.

2. The mine is to be commended for its implementation of the Mine Emergency Management System and for training a significant number of personnel.

3. Mines rescue response from the available trainees was excellent.

4. There were again delays in the deployment of mines rescue.

5. Non-verbal communication enabled the control room operator to obtain a great deal of information from the underground personnel.

6. The call out of the on-call mines inspector and the industry safety and health representative was not successful.

7. No site safety and health representative was notified of the exercise.

8. In some cases the Level 1 Mine Emergency Exercise is being regarded as a pass or fail test by mines whereas, in fact, it is a test of the statewide response with an opportunity for an individual mine to test, trial and learn about its own emergency response plan[1].

9. The use of vehicles to escape speeded the evacuation process.

10. There are still issues within the industry with the donning and changing of self contained self rescuers.

11. Some of the self contained self rescuers opened were faulty.

Major industry recommendations

These recommendations apply to all underground coal mines and the industry in general.

1. Emergency response plans

All mines should assess their emergency response plans and other associated hazard management plans and conduct a gap analysis against the recommendations contained within this report and in Appendix B. This will enable any gaps to be identified and any required modifications and improvements to be made.

All organisations should review the Incident Control Team/Mine Emergency Management System for application in emergency incident control. Key areas of

[1] The term emergency response plan is used interchangeably with the term emergency management plan throughout this document.

learning are: discipline in adhering to the system, utilising but limiting the span of control (i.e. no greater than five particular resources per person), clear authority in authorising plans and actions and managing the communication flow.

2. Recognised standard for the conduct of simulated exercises

The draft recognised standard developed as part of the objectives of the 2006 Level 1 Mine Emergency Exercise should be circulated for comment and adoption as this will provide mechanisms for the follow up from Level 1 Mine Emergency Exercises and information not currently available from Level 2 mine site exercises. This should also help alleviate the 'apparent fear' associated with the running of an exercise at some mines.

3. Changeover protocols and training in the use of self contained self rescuers

Training in donning and use of self contained self rescuers needs to be addressed as indicated by previous Level 1 Mine Emergency Exercises, and highlighted in recent forums in the United States of America. It is recommended to industry that a similar competency based training regime to that proposed by the United States mining industry (at refresher intervals of 3 months) is implemented as well as ensuring that all mineworkers have used a real self contained self rescuer or a training rescuer that has simulated heat and resistance capabilities. **(This is the same recommendation as 2006).**

Not only should training in the use of self contained self rescuers be reviewed, but also the option of installing "changeover" stations, or equivalent, where escaping mineworkers can changeover the self contained self rescuer in a less hazardous atmosphere, communicate with surface and also have the option of remaining in the station for a period of time. Grasstree Mine had implemented a system of changeover stations as part of their emergency response plan.

4. Mines Inspectorate and Industry Safety and Health Representative

A mines inspector and industry safety and health representative should respond to and attend all Level 1 Mine Emergency Exercises. The Mines Inspectorate and the industry safety and health representatives should have fatigue policies in place to ensure that attendance can be undertaken without compromising personnel safety.

All mines should modify their emergency response plans to contact the Queensland Mines Inspectorate via the emergency number 07 3237 1696. This means that the Queensland Mines Inspectorate emergency response can start immediately.

The 2008 Queensland Level 1 Mine Emergency Exercise will be held at Newlands North Underground Coal Mine.

Martin Watkinson
Chairman - 2007 Level 1 Mine Emergency Exercise Executive Management Committee

Introduction

Background

The Queensland Mining Warden's inquiry into the explosion at the Moura No. 2 Mine in August 1994 recommended - **"Emergency procedures should be exercised at each mine on a systematic basis, the minimum requirement being on an annual basis for each mine."** (**Windridge et al. 1996).** In December 1996 the "Approved Standard for the Conduct of Emergency Procedures Exercises" was published and has been subsequently revised. (Queensland Department of Mines and Energy Safety and Health Division 1999) This provides guidelines for conducting mine site emergency exercises as well as the requirement for a test of statewide emergency response by holding a Level 1 Mine Emergency Exercise at one mine on an annual basis.

From 1998 to date (July 2007) ten Level 1 Mine Emergency Exercises have been held in Queensland, Australia. This is the report of the 2007 Level 1 Mine Emergency Exercise held at Grasstree Mine between 22:00 on Monday, 30 July and 06:00 on Tuesday, 31 July 2007.

Grasstree Mine is an underground longwall coal mine located approximately 26 km east of the Tieri township, 250 km south-west of Mackay, Central Queensland (*see Figure 1*).

Figure 1: Location of Grasstree Mine

Scoping the exercise

The first scoping meeting for the exercise was held on the 2 February 2007 to define the objectives for the 2007 Level 1 Mine Emergency Exercise. The membership of the Executive Management Committee consisted of Martin Watkinson and Darren Brady of the Safety in Mines Testing and Research Station (Simtars), Greg Dalliston of the Construction, Forestry, Mining and Energy Union (CFMEU), Mick Farrag of the Queensland Mines Rescue Service (QMRS), Tim Watson of the Department of Mines and Energy (Inspector) and David Cliff of the Mining Industry Safety and Health Centre (MISHC).

The initial site visit for scoping the exercise was conducted on 14 to 16 of February 2007 by Greg Dalliston and Martin Watkinson. The purpose of this visit was to ascertain the underground conditions and decide on possible scenarios to achieve the objectives set by the first scoping meeting. A number of meetings were held to refine the scenarios and to determine the optimum one to test the objectives of the exercise. A briefing meeting was held on 29 and 30 May 2007 with two mine managers and a representative from the Mines Inspectorate to test industry perception of the scenario and the objectives for the exercise.

Full details were then prepared on the exercise scenario including ventilation simulation and preparation of input data for the Simtars' Safesim program. A full team briefing of all 21 assessors was held on 16 and 17 July 2007 to brief the team on the exercise objectives, the scenario, the reporting requirements, and site visit/inductions and to conduct a risk assessment of the exercise to ensure that no additional risks were introduced by the running of the exercise.

Replication of the mine monitoring system was completed and installed on the morning of 30 July 2007. The exercise was commenced at 22:00 on 30 July 2007.

Objectives

The objectives set for the exercise were to test:

- Self escape, including the changeover process for self contained self rescuers (SCSRs).
- Use of changeover bays.
- The incident management team (IMT) process.
- Queensland Mines Rescue Services response and underground deployment.
- Mine site and Department of Mines and Energy emergency call-out procedures.

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awaiting the outcome of and input from the three committees formed as a result of the Fight or Flight Seminar convened by the Queensland Chief Inspector of Coal Mines in Emerald in October 2006.

Scenario

Grasstree Mine has a high methane gas make on the longwall, is practicing methane drainage and utilises ventilation methods to keep the gas fringe away from the working longwall. Nearby mines have all had frictional ignitions on both longwall and development panels. Consequently, it was decided to base the scenario for the 2007 Level 1 Mine Emergency Exercise on a frictional ignition on the longwall face (*see Figure 2*) as this was considered to be appropriate for the current underground situation at Grasstree Mine.

For the purposes of the scenario it was deemed that the shearer drivers and another operator on the longwall would be seriously injured, however they would be able to make contact with the surface using non-verbal communication later in the exercise. The reason for this was to assist the decision making for the deployment of mines rescue teams.

In all likelihood, a frictional ignition at the tailgate end of the face igniting a gas plume, in addition to damaging ventilation appliances and stopping the fans would result in several immediate fatalities on the longwall face. A coal dust explosion is also a distinct possibility following such an incident. This would have an even more devastating effect on the mine infrastructure increasing the likelihood of even more fatalities. Considerable discussion was held on this during the full team briefing meeting on 16 and 17 July 2007.

In 2004 a frictional ignition in a development panel, was used as the scenario for the Oaky No 1 Mine Level 1 Mine Emergency Exercise. All personnel in the panel were "deemed to have been killed". The final phase of that exercise was the mine staff finding 10 dead work colleagues which left them with a feeling of failure at the end of the exercise even though they had successfully formed an IMT, resolved all information required to deploy mines rescue and completed the full exercise. The Organising Committee was cognisant not to deliberately create a similar negative outcome when developing the scenario for the 2007 exercise.

Ventilation modelling was undertaken to predict the anticipated spread of pollutants through the mine. The mine's Safegas (mine gas monitoring system) was replicated and interfaces to the mine supervisory control and data acquisition (SCADA) system created. This was done to enable the delivery of simulated mine condition information through systems familiar to the mine staff and which they would use in a real emergency situation. Gas data is based on real information from the mine and uses Safesim – a Simtars software package which inputs predetermined gas concentrations into the mine gas monitoring system interface.

Gas concentrations used in the scenario reflected levels which permitted the deployment of rescue teams as indicated in the *Guidelines of Queensland Mines Rescue Service* (Queensland Mines Rescue Service 2006).

A total of 20 assessors were on site with representatives from Simtars, the Queensland Mines Inspectorate, mines rescue (Queensland and New South Wales), an industry safety and health representative (ISHRs) from the CFMEU, MISHC, mine staff from Newlands, Moranbah North, Crinum, Broadmeadow and Aquila mines, a mining engineer from Solid Energy (New Zealand), a mining engineer from South Africa and a mine site representative (mole). One assessor phoned the mine acting as the Press. Making a total of 21 assessors used for the exercise (see Appendix C for details of the assessors).

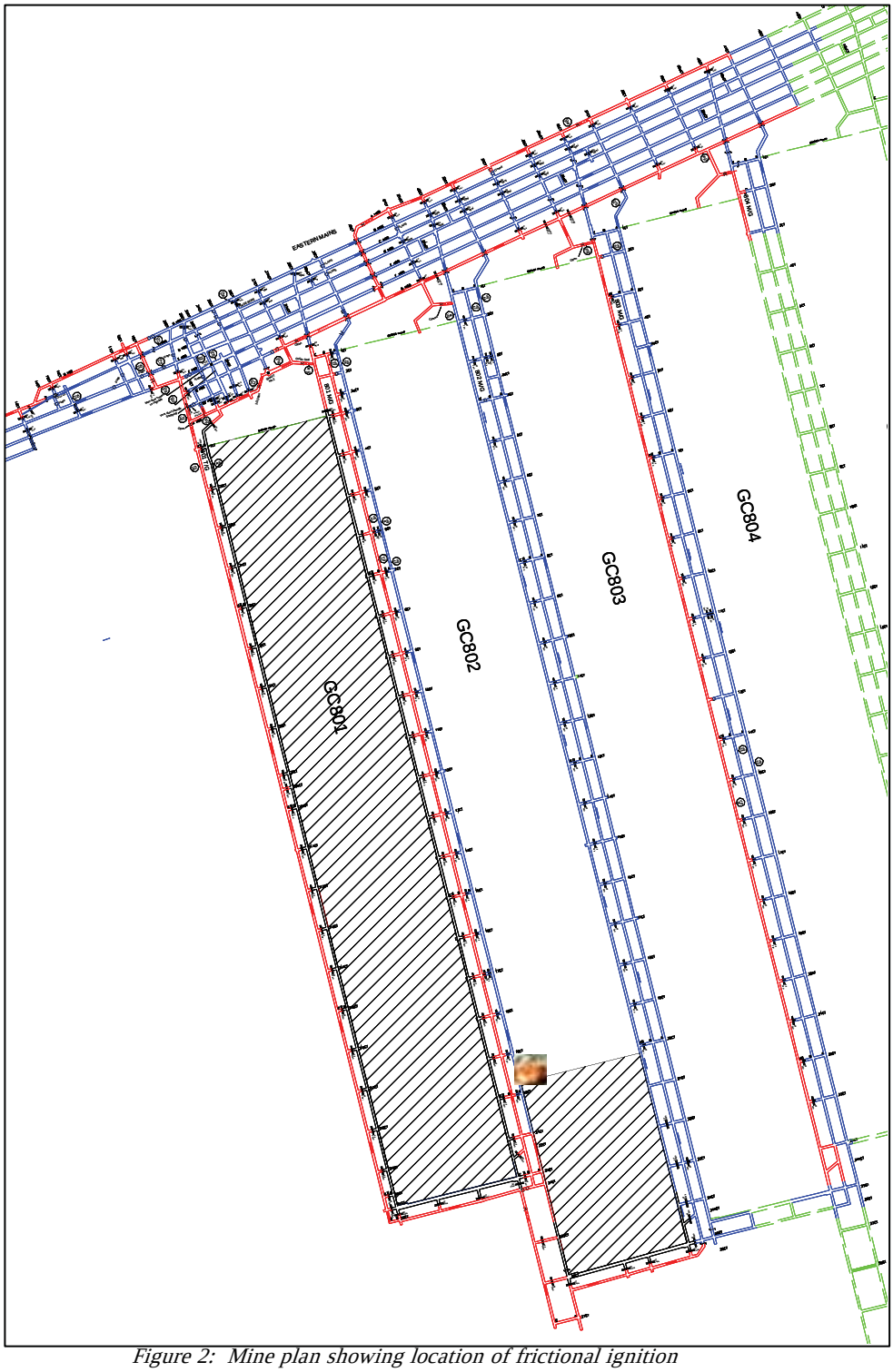

Figure 2: Mine plan showing location of frictional ignition

Assessor briefing

The briefing notes given to the assessor teams were as follows:

- Level 1 Mine Emergency Exercise to be held at Grasstree Mine at 22.00 hours Monday, 30 July 2007.
- A frictional ignition occurs on the longwall face which propagates a gas explosion from the mixing chamber. Ventilation control devices are damaged in the tailgate short circuiting the air and allowing the gas fringe to come forward creating an irrespirable atmosphere.
- The fans at Grasstree will stop/become damaged.
- Man-riding at the No 1 shaft will be inoperable (temporarily). Available for mines rescue deployment as will be the fans if required.
- Communications with the longwall crew will be lost initially but maintained in the development panels. The two survivors will be able to undertake non-verbal communications from 01:00.
- The longwall crew has a varying degree of injuries, those operating in and around the shearer suffering the worst of the injuries. Other crew members on the face and outbye of the face will be able to self escape. Two injured crew members plus one fatality will be unable to self escape and will require external assistance (i.e. QMRS).
- These three can wear a self rescuer to see what the duration is at "rest".
- Some of the crews may evacuate through the Southern/Grasstree West entrances. How will this be controlled/monitored by the mine? (*See Figure 4 for details of the mine plan*).
- Mines rescue will be deployed around 03:00. If IMT has not got the information by then it will be provided so that mines rescue can be deployed and conduct search and rescue.
- IMT will be asked to prepare for possible injuries/fatality when this occurs and also prepare a mine recovery plan.
- The development crews will be unaffected although the panels will lose ventilation; visibility will be reduced from dust in suspension. Use the lightly scratched goggles. Crew to be provided with SCSRs if they would have worn them. Dust cloud/irrespirable cloud outbye as per plan.
- Need to pick up the contractors building seals, etc.
- Any activities the incident control team (ICT)[2] wants to put in place will have to be actioned, e.g. use of gas chromatograph (GC) samples from bore holes.
- Longwall crew to be briefed that there is zero visibility on the longwall face.

[2] Incident Control Team (ICT) and Incident Management Team (IMT) are interchangeable terms.

Figure 3: Assessors preparing to go underground

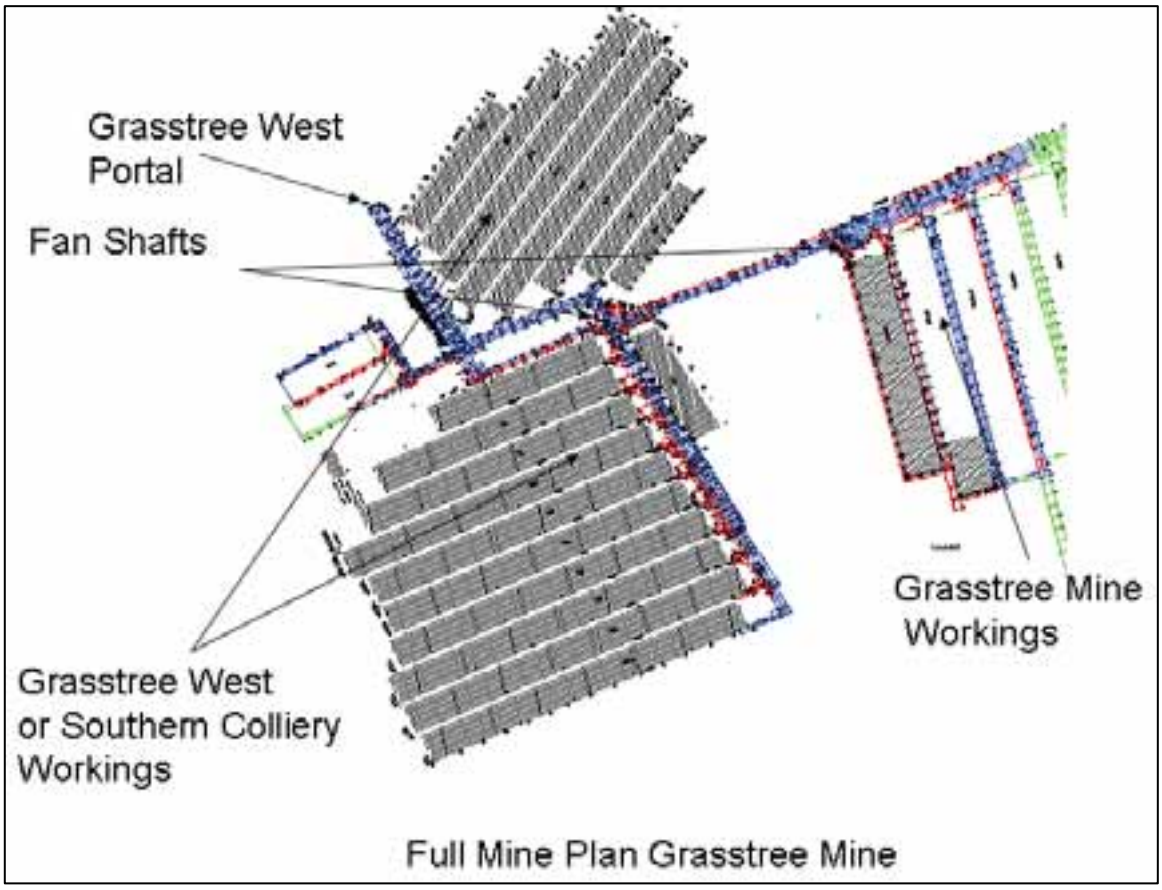

Figure 4: Grasstree Mine Plan

The exercise

Recommendations are identified throughout this section of the report by representation in blue text.

Exercise timeline

Table 1: Summary of timeline for the exercise

Location	Surface observation	Time	Underground observation	Location
	Exercise commenced	22:00	Longwall team SCSRs donned by team	Longwall face
Control room	DAC call to control room from longwall - non-verbal	22:10	Contact made with control through non-verbal communication. Longwall	Maingate 802 C-heading
Control room	Control Room Operator (CRO) advised Undermanager that three people were missing	22:38		
Grasstree West control	Commenced key personnel call-out	22:49		
		22:57	Mains development crew reached Grasstree West go-line.	
Grasstree West control	Completed call-out key personnel	23:16		
Control room	Undermanager requested that key people be brought back from Grasstree West first	23:39		
	QMRS onsite (Operations Manager)	23:47	Longwall team and convoy cleared portal at Grasstree West	Grasstree West portal
ICT (Incident control team)	First ICT meeting - Undermanager briefed ICT from memory	23:50		
EMT	Advise ISHR and mines inspector	23:53		
Grasstree West control	Longwall ERZ controller briefed Grasstree West CRO on events underground.	00:00		
EMT room	Site Senior Executive (SSE) debriefs ERZ (Explosion Risk Zone) Controller from longwall and emailed to Grasstree ICT	00:12		
Debrief room	Debriefer and Undermanager debriefed longwall ERZ Controller	00:50		

Location	Surface observation	Time	Underground observation	Location
ICT	ICT meeting operations controller stressed need to act quickly	01:00	Non-verbal communication from longwall face initiated	Longwall face
Rescue sub station	Three rescue teams ready to deploy underground	01:03		
Grasstree	All QMRS members briefed	02:20		
Planning	Planning doing risk assessment for re-entry by mines rescue	02:30		
QMRS	First teams underground	04:10		
Longwall panel		04:28	Encountered abandoned PJB at 14c/t - spent 19 minutes trying to move it	
		04:55	Fresh air base established efficiently - all checks completed	
		05:04	First team deployed to search for missing men	
		05:37	Reached casualties and commenced treating the injured	
Control room	Exercise deemed to be over	06:05		

Underground section

Longwall evacuation

Assessors: Brett Capper, Tim Watson and Anthony Alexopoulos

At 22:00 the longwall crew was working in two separated groups. Three operators were at the shearer (located at the tailgate end of the face) preparing to start mining with the remainder of the crew situated at the maingate. The crew at the maingate was shown a card explaining that they had felt a major concussion and thick dust (low visibility) was now present in the air. Gas readings were also shown to the ERZ Controller (Explosion Risk Zone Controller). These readings portrayed the following gas levels: Carbon monoxide (CO): off scale, methane (CH_4): 0.6%, carbon dioxide (CO_2): 1.5% and oxygen (O_2): 18.99%. At this time the ERZ Controller instructed all persons present to don their SCSRs.

With smoke glasses in place the men at the maingate commenced fitting the SCSRs. Fitting of the SCSRs was completed with varying degrees of effectiveness, however overall all the men were able to successfully don and use the SCSRs. The ERZ Controller then communicated with the crews by writing instructions on a pad and passing it around the mineworkers. (In reality this would not have worked as it was deemed to be zero visibility). The crew linked together by holding the person in front and proceeded to evacuate to the crib room. This can be viewed in detail on the movie file included on the report CD.

Upon reaching the outbye end of the longwall beam stage loader the crew turned off the longwall belt and continued outbye. As the crew were moving towards the DAC at 17c/t, control came over the DAC looking for communication from the longwall crew. The crew reached the DAC and called exchange. When no verbal contact was made, the CRO asked if the crew was attempting non-verbal communication. Upon confirmation of this from the ERZ Controller a series of questions were asked and a volume of information sourced from the team. The questions asked and answers given included:

"Can you see the hazard?" No

"Can you see smoke?" Yes

"Can you see a fire?" No

"What cut-through are you at? Beep for the number." 17 beeps sent.

"Are you at 18 cut-through?" No

"Are you at 19 cut-through?" No

"How many people do you have?" Seven

"Do you have seven people?" Yes

"Are you missing persons?" Yes

"How many people are missing?" Three

A massive volume of information was passed at this time. However care needs to be taken to ensure easy questions are asked. Asking the ERZ Controller to identify the c/t he was at was difficult and caused frustration to both ends of the communications.

Upon arriving at 17c/t B-Heading, the ERZ Controller instructed his crew to wait and he proceeded, inbye in search of a seal construction crew thought to be working behind the longwall. At this time a number of the crew's SCSR bags looked deflated and a member of the crew indicated for the crews to sit down. Once the crews sat down most of the bags expanded back to full volume.

The ERZ Controller returned and the crew moved off to the crib room. Here three of the crew undertook an SCSR changeover. The changeover looked complex as the men struggled to control all the straps, etc. The ERZ Controller's new SCSR failed to start when the unit was pulled from the casing. However, the unit was already inserted in his mouth and he was struggling to start it. Assistance to activate the self starter was supplied by another crew member. Given his old unit was still delivering air, he should have ensured the new unit was creating air before he inserted it in his mouth.

After changeover at 22:23 the crew moved out towards the changeover bay at 14c/t. In the 14c/t changeover bay the crew was instructed by the assessors to remove the SCSRs as some of the units were approaching 30 minutes of use and this avoided the carbon dioxide spike associated with these units at about 45 minutes of use. The crew was asked to give their account of wearing the rescuer to the camera for the benefit of others. This debrief is part of the video file on the CD included with hard copies of the report and is also included on the CD where copies of the report have been circulated on CD.

The crew were told to continue to assume they were in an irrespirable atmosphere. The ERZ Controller contacted the control room via the phone and used non-verbal communication as he still had his SCSR in place. None of the crew recognised that the compressed air feed into the changeover bay meant that fresh air was possibly available and therefore normal communication was possible.

Movement from 14c/t outbye was effected through the use of man transports at that location. The driver was told to remove his smoke glasses and drive to what conditions would exist. The driver decided to replace his goggles to see how hard it was drive. When asked how hard it was he replied "bloody hard". Good use was made by the crew of the reflective droppers marking the escape way as they waved their lights to identify the droppers and therefore the rib location for the driver.

The man transport reached the next outbye changeover bay at 22:50 and the crew entered to undertake another changeover. Again the ERZ Controller contacted the Incident Controller and effected non-verbal communication. Once more there was no recognition by the crew that fresh air was available in changeover bay to assist communication. Two compressed air breathing apparatus (CABA) units were available in the changeover bay, however none of the crew was trained in their use so they were left unused.

After passing 2c/t the crew were told they now had fresh air but no ventilation was present. At this time the ERZ Controller told his men they could remove their SCSRs, and the crew proceeded to the tag board.

At the tag board the first verbal communication with the control room was conducted via the DAC. Here the crew was told to egress from the mine through Grasstree West. Again the crew passed on information relating to who was present and who was missing from the crew and the present ventilation situation at their location. Some confusion occurred as the driver was communicating with the CRO but the ERZ Controller in the vehicle was yelling instructions to him from within the vehicle.

Back in the vehicle the crew travelled out to the mains and to the shaft. An outbye crew was sitting in a vehicle at the shaft bottom, they were unsure of what they needed to do or where they should be going. The longwall ERZ Controller instructed him to follow them out of the mine via Grasstree West.

Egress continued and the crew were required to stop again to open a brattice roller door, which acted as the ventilation split separator between the Grasstree and the Grasstree West ventilation systems. This roller door proved very cumbersome to open. The steel bar along the base snagged on the pipe work on the left hand side rib and in the end it required two men to hold up the brattice as the machines drove under.

The crew continued to the 5c/t changeover bay where they met up with one of the development crews. The phone in the changeover bay was unserviceable so no communication to the surface was possible. In this changeover bay the two ERZ Controllers present conferred and exchanged known information. At this time the 15 men in the changeover bay were told three men were missing in the longwall.

Evacuation continued from the mine with one more communication to the surface made at the corner of the eastern mains in Grasstree West.

The crews cleared the portal at Grasstree West and arrived at the ramp top sentry at 23:50. Here a complete list of those persons exiting the mine was taken and the vehicle proceeded to the main administration building at Grasstree West. Upon arrival at the "Go Line" the structure that had been apparent in the underground evacuation broke down. The longwall crew moved off in several directions including into the workshop in search of tea and coffee. A duty card holder arranged to have the longwall ERZ Controller's gas monitor identified with an information tag.

A few attempts were made to centralise the crew outside the control room but this had little effect or increased control of the men. The ERZ Controller gave his debrief to the Grasstree West CRO and then prompted the CRO that he should be debriefed as he had critical information. The CRO recorded his debrief and then contacted the Executive Management Team (EMT) at Grasstree West who requested the longwall ERZ Controller attend the EMT to be debriefed. The scribe at the EMT was able to take the ERZ Controller's statement and email it to Incident Control Team (ICT). The Site Senior Executive (SSE) arranged transport for the longwall ERZ Controller to Grasstree to be debriefed by the Mine Manager. **However the critical piece of information about the PJB being stranded in the maingate at 14c/t was not identified and passed on to mines rescue.**

During this time the remainder of the men were left outside the Grasstree West control room. Slowly some movement to transport the men back to Grasstree was made. No

debrief was conducted at Grasstree West and significant opportunity was given to the crews to share stories and conclusions which likely tainted the later debrief.

After the transport of the crews back to Grasstree all the men were mustered into the training room for debrief but the process seemed to take an excessive amount of time and only selected persons were debriefed. From this time the men were left unattended and with little feedback from the ICT. The Undermanager gave two updates to the men during the event. Given that these persons knew that three people were missing, in a real event they would have been demanding a significantly greater volume of information and would have caused major disruption to the process.

What worked well

- Donning of the SCSRs with limited visibility was completed well with few difficulties.
- Non-verbal communication with the control room over both the DACs and phones worked very well and conveyed an extensive amount of information. Some confusion occurred when more complex questions were asked, e.g. "What c/t are you at?" but overall it was excellent.
- The egress markers down the roadway provided a good visual reference for the crews.
- Evacuation completed with the assistance of vehicles made the evacuation more effective and less stressful on the crews.
- The ERZ Controller made a number of effective decisions and stuck to them providing good leadership to his crew.
- Consistent updates with control kept the surface updated on the crew's movements underground.

Areas for improvement

- The location and construction of the changeover bays was good but the crews failed to utilise the respirable atmosphere to communicate and comfort themselves.
- Control of men after exiting the mine at Grasstree West was not effective and too long was taken between this and when any sort of debrief occurred. There was a high potential for some critical information to be lost. **In particular, the information that a vehicle was left in the roadway at 14c/t 801A, which affected the later rescue response.**
- Transport of the men from Grasstree West to Grasstree occurred more by necessity than by design.
- The underground crews were left in an information void and with the knowledge of three missing men (and a probably fatality) this could have become a volatile situation that required more direct management.

Recommendations

Mine

- Provide training in the donning, wearing and changeover of SCSRs to all underground mine workers.
- Provide training and familiarisation in the use of the changeover bay.
- CABA training should be provided for a minimum of four persons on every crew.
- A more structured and better resourced people control mechanism needs to be implemented for the crews when they exit the mine.
- Debriefing of mineworkers should be improved. A facility should exist for them to talk through the trauma of any incident
- Grasstree should ensure that it is possible to travel all evacuation routes without complication
- All changeover bays should be checked to a schedule as part of ERZ Controller's inspections.
- A system for effective transport of persons from Grasstree West to Grasstree needs to be provided.

Industry

- Continued focus is required on donning and changeover of SCSR which is critical in ensuring personnel are able to effect self escape.
- Establishment of standard cross industry non-verbal communication practices, e.g. two beeps for no and three beeps for yes, in similar fashion to cap lamp signals would supply a common knowledge necessary due to the transient nature of many mine workers in Queensland.
- Where mines have CABA deployed and available for use underground personnel should be trained in its use for evacuation purposes
- Industry should review first response capability and define what actions can be taken in first response. First response activities should be subject to risk assessment and competencies of the responding personnel.

Exercise team

- Continued use of real SCSRs gives the persons involved an excellent experience.
- All mine site personnel crews need to be briefed to start all communications with "this is an exercise".
- All underground crews should also be briefed to ensure that they do not do anything which is unsafe and if necessary should make their place of work safe before commencement of the exercise

Longwall face

Assessor: Alex Mackay

Three mine workers were working at the longwall face tailgate when there was a frictional ignition at 22:00. One was killed instantly, the other two were severely injured and knocked unconscious. The remainder of personnel in the mine were evacuated and an ICT was formed to manage the incident.

Three hours after the ignition the injured personnel regained consciousness. Due to the extent of their injuries they were unable to self escape, however while using SCSRs were able to communicate with the CRO via non-verbal code using the longwall face DACs.

Whilst waiting for the deployment of mines rescue the three mineworkers wore a SCSR at rest. It was noticed that one mineworker was very competent at donning an Oxybok SCSR and he successfully donned his SCSR in 40 seconds. However the second worker eventually donned his SCSR after four minutes and the third mine worker failed to successfully don an SCSR. He was unfamiliar with the procedure and while under duress was unable to problem solve issues inherent with that type of SCSR.

Three hours into the exercise non-verbal communication was initiated by the mineworkers. This was planned to give impetus to deployment of mines rescue.

"Are you injured?" "Yes"

"How many people are with you? "Two"

"Do you require assistance?" "Yes"

"Can you Move?" "No"

"Is the other person injured?" "Yes" (note that at this point how many people are with you answer 2 total 3 had now become 2 persons)

"Only 2 injured are you in the tailgate"? "Yes"

"Have you got a rescuer on?" "Yes"

"Do you have access to the 10 rescuers at the tailgate?" "Yes"

"Can you see smoke?" "No"

"Can you see fire?" "No"

"Has the roof fallen?" "No"

"Can you be accessed from the maingate?' "Yes"

"Is Scott there?" "No"

"Is Scott with you?" "Yes"

"Is Joe with you?" "Yes"

"Am I speaking to John?" "Yes"

"Are there three personnel with you?" "Yes"

"Do you want me to ask you any more questions?" "Yes" (Note this reply brought a silence as there were no more pre-prepared questions. Some of the next questions did not help clarify the situation)

"Is everyone conscious?" "No"

"Is everyone alive?" "No" (note from this point on the indication that there had been a fatality reported by non-verbal communication became a fact)

"How many are alive?" "Two"

'Do you need medical assistance?" "Yes"

"Is the other bloke injured? "Yes"

"Are his legs injured as well?" "Yes"

"Are you trapped?" "Yes"

"Are you trapped by rocks?" No

Further questions were asked relating to how the men were trapped to identify what equipment would be required to free them.

When this questioning was underway most of the questions were not written down nor the answers recorded in the control room

Seven hours after the ignition a mines rescue team arrived at the maingate end of the longwall to rescue the injured personnel.

What worked well

- Non-verbal communication was known well and worked reasonably well at conveying critical information. More complex information was difficult to convey.

Areas for improvement

- Training in SCSRs – two different units were in use at Grasstree.
- There was an issue with an SCSR where the hose (soft black rubber) had self-glued due to the tight packaging and long length of tubing, causing a major blockage and restricting the ability of the person to breathe adequately and due to unfamiliarity the mineworker was reticent to pull on it to free it (*see Figure 5*).

Figure 5: Collapsed SCSR hose

- Longwall face DACs appeared not to work at times, mainly from mid-face to tailgate. CRO was unable to communicate to longwall face tailgate 6 hours after the "ignition". Also if this were a real event, if underground power had been off how long would communications last?

Recommendations

Mine/industry

- There should be continued focus on training in the donning and changeover of SCSRs. This is critical in ensuring personnel are able to effect self escape/survive in an irrespirable atmosphere.
- Non-verbal communication – suggest to add four beeps for "Do not know/cannot answer".
- The photo showing the collapsed hose on the SCSR should be distributed to all mine sites and added to the training package for the unit.

Exercise team

- The industry should develop a communication strategy to reduce fear of the exercise by mine-site personnel (to reduce avoidance by mine operations personnel).
- The exercise committee should develop alternative methods to communicate/review exercise to industry.
- Injured personnel could have simulated injuries to increase realism for responding QMRS personnel.

Development 803 panel

Assessors: Jon Balcomb and John Coughlan

Upon arrival at the panel the ERZ Controller informed the assessors that work involving blocking off a number of methane drainage boreholes had to be done prior to the exercise beginning.

The crew were briefed, immediately before the exercise commenced, that a Level 1 Mine Emergency Exercise was being conducted and that they should follow the information and/or directions given to them by the assessors and their site safety and health management plans.

The evacuation was conducted in an expeditious manner with all crew members safely on the surface at Grasstree West and accounted for within one and a half hours. There was enthusiastic participation by the personnel involved throughout the evacuation.

The incident

The exercise commenced at 22:24 with the majority of the development crew at the back of the continuous miner in the bleeder heading behind 803 face-road. They were informed that they had experienced a "pulse" and it had become very dusty. The ventilation had stopped.

The ERZ Controller assumed control of the situation and directed the crew to go and get into the vehicles, located at the start of the bleeder heading, with the objective of retreating to the changeover bay at 22c/t.

The ERZ Controller called the CRO on the DAC, but no response was received from the CRO. Realising that a secondary support crew (contract team) were operating in the adjacent 803 face-road the ERZ Controller travelled via the nearest cut-through to where they were operating and informed them of the Level 1 Mine Emergency Exercise and that they were required to retreat to the changeover bay via the vehicles.

Prior to getting in vehicles the ERZ Controller instructed the crew to put dust masks on. All members of both crews were in two vehicles (start of bleeder heading) at 22:30 and retreating to the changeover bay.

No head count of persons was conducted prior to the vehicles leaving for the changeover bay.

The vehicles arrived at the changeover bay at 22:33 with persons exiting the vehicles promptly and entering the changeover bay. Once in the changeover bay the ERZ Controller phoned the CRO and gave their location along with details of what had happened. The ERZ Controller confirmed through control that there had been an explosion in the longwall and that the winder (shaft access) was unserviceable so that evacuation would have to be via Grasstree West and that they were in currently (803 panel) in fresh air. The ERZ Controller briefed this information to crews and told them their objective was to evacuate the mine via Grasstree West. The crew was instructed by the ERZ Controller to each take a SCSR, water and blindman stick from the changeover bay.

Upon exiting the changeover bay each person scribed their name on the chalk board in the changeover bay. At this stage the phone rang (the CRO) to confirm information with the ERZ Controller whilst two crew members exited the changeover bay and walked off to the vehicles by themselves.

By 22:44 all persons were in the vehicles and exiting the panel via A-heading (primary escapeway).

No head count of persons was conducted prior to the vehicles leaving the changeover bay.

The vehicles reached the panel MG803 tag board.

The vehicles exited the panel, passed through a set of brattice flaps and made a left turn into B-heading. This decision to travel via B-heading was made by the ERZ Controller because it was segregated by ventilation control devices from the other roadways.

At 22:59 the ERZ Controller was informed that they have now encountered an atmosphere with higher levels of CO, namely 200-300 parts per million (ppm) CO, 19.8% O_2 and 0.4% CH_4. The vehicles were stopped and the persons told by the ERZ Controller to don their SCSRs. It was observed in the second vehicle that the training units did not work and were unable to be worn. Two real self rescuers were worn in the first vehicle and 3 real self rescuers were worn in the second vehicle. These SCSRs were donned with varying degrees of competence with one person having theirs fully donned before another had pulled his from the casing. At least one person was a little hesitant as to what he had to do to put his rescuer on.

The vehicles travelled toward pit bottom passing 32c/t B-heading at 23:02. The driver of the second vehicle was noting the integrity of the stoppings on either side of the roadway as they were evacuating. The vehicles reached 20c/t and noted stowage ahead, then turned left into 20c/t, proceeded through a set of flaps and then through two brattice stoppings into F-heading (noted reflective markers along the roadway). The vehicles passed 13c/t F-heading at 23:12.

Written notes were passed between the crew and the ERZ Controller stating that they should stop at the next changeover bay. The vehicles arrived at the next changeover bay (5c/t F-heading) at 23:17 with all persons exiting the vehicles and entering the changeover bay.

No head count of persons was conducted once in the changeover bay to check that everyone was accounted for.

Once in the changeover bay the air supply was activated. A person not wearing an SCSR then told persons who were to take off their SCSRs because they were in fresh air. They were hesitant and the person told them again that they were in fresh air and to take off their SCSRs. As they proceeded to do so the ERZ Controller gave instructions to take off their SCSRs.

It wasn't noticed whether the ERZ Controller checked the air to determine whether or not it was respirable before giving instructions. The person who gave instructions in the first instance would have been wearing an SCSR in a real scenario thus would not have been

able to give instructions, however, he may have been inclined to remove his SCSR upon entering the changeover bay, assuming fresh air.

The ERZ Controller proceeded to call the CRO however the phone was unserviceable. An electrician on the crew was asked to try and fix the phone.

Whilst in the changeover bay, with persons not wearing SCSRs, the door to the changeover bay was opened by two people entering from outside. These people were from the longwall and were not wearing SCSRs. They informed the ERZ Controller that there were people missing from the longwall, that the air outside of the changeover bay was respirable because the Grasstree West fans were working and to continue evacuating to the surface via Grasstree West.

Had the air outside the changeover bay been irrespirable when the two longwall persons entered it may have contaminated the atmosphere within the changeover bay. Given the persons within the changeover bay were not wearing SCSRs at that time they may have been overcome by the contaminants.

All persons then went back to the vehicles, with the vehicles leaving the changeover bay at 23:25.

There were now four vehicles exiting, two from development 803 and two from the longwall. The convoy stopped at the first available phone (1c/t) to call the CRO. Details of the location and persons were confirmed with the CRO and that they were continuing to exit via Grasstree West. The vehicles continued to evacuate and passed a changeover bay at 23:39 en route to the surface, arriving at the surface at 23:45.

The travel road had some sections in particularly bad condition. Large holes and rough areas in the road made riding in the vehicles hazardous.

The first vehicle stopped at the portal entry, with the ERZ Controller checking that the other vehicles exited the portals. He directed them to continue to the surface facilities. At the top of the surface ramp the vehicles were stopped by Portal Security and each person checked off by taking their tags. The vehicles proceeded to the surface facilities where the persons were checked off by the surface controller and told to wait around the building (time 23:50). At a later time vehicle/s would be arranged to transport mineworkers to Grasstree.

No briefing was given at Grasstree West surface facilities and no information was asked for from Development personnel.

What worked well

- ERZ Controller assumed leadership role and delivered good clear and concise instructions.
- Decision made to use vehicles to allow more efficient evacuation.
- The ERZ Controller made every effort to update the CRO on the progress of the team and their evacuation and briefed the crew well once he had information.

- All people, including those performing tasks additional to the crew, were located at the time of the incident.
- The team took the exercise seriously and genuinely looked to implement emergency procedures.
- The primary escapeway and the changeover bays were all well signposted and easy to identify.

Areas for improvement

- Headcounts were not taken when getting in and out of vehicles. It may have been possible to leave a person behind particularly if people were mixing vehicles.
- The application of the SCSRs was variable and underscores the need for regular training and practice of this skill.
- The knowledge of the role of the changeover bay is not well understood. **It must be clear that the changeover bay is not a "place of safety" and should not be assumed to be fresh air.**
- Condition of road in the escape-way was of poor standard overall with many holes and wet areas.
- The layout of the changeover bay led to the build-up of people near the door.
- There was no immediate debrief for either the ERZ Controller or the crew once at surface facilities. There was also no updated information passed on to the crew members at Grasstree West while waiting for transfer to Grasstree.

Recommendations

Mine

- The layout of the changeover bays should be reviewed to ensure that congestion at the entrance is eliminated and the availability of floor space is maximised.
- Program a schedule of works to ensure the main escape-way between Grasstree and Grasstree West is kept in a trafficable condition.

Industry

- There should be confirmation of the standard practice for evacuees in a changeover bay. There is a risk that changeover bays are assumed to be mandatory fresh air and that it is okay to take off an SCSR once inside.
- Increase the frequency of training in the application of SCSRs to ensure that this skill is available when required under adverse conditions.

Exercise team

- When training SCSRs are to be used, assessors must be instructed in their use. The training SCSRs should also be opened and assembled immediately prior to use - not set up in advance.

Mains development

Assessors: Alan Wardle and Bryan Harrington

At 22:00, 30 July 2007, mains development face area, the crew were shown cards saying that they had felt a percussion wave, light dust in air and the mine ventilation had stopped.

Generally, the evacuation process worked well. Evacuation routes and changeover bays were clearly identified. The crew was familiar with the escape route and used vehicles to enable an effective evacuation.

Note pads were used for communication whilst wearing SCSRs. Where persons were having difficulty in donning SCSRs, one of the crew members took an excellent leadership role and used a note pad to help others in the crew correctly don their SCSRs.

All of the men took the exercise seriously and acted in a professional manner throughout.

The ERZ Controller and one mineworker directed the crew effectively. The ERZ Controller left to his role to make the decisions, was assisted well by the mineworker who acted upon his instructions and guide crew.

The mains development crew suffered the same issues with navigating the escape route, surface debrief and transport to Grasstree from Grasstree West as the other evacuating crews, i.e.:

- Little or no information about the incident given to crews.
- Crews were left in muster area with no instruction regarding where to be. Persons were wandering around workshops, etc.
- Mineworkers had no updates or communication from the management team regarding what had happened and the status of the situation.
- There was no support for crews in the way of basic food or water. Many were left for 4 hours.
- Brattice roller door at entry to Grasstree West in man travel route could do with improvement. Requiring four men and four minutes to open this is unacceptable and could be improved with ease.

What worked well

- The escape route was clearly defined and changeover bays clearly defined and identified.
- Leadership role of the ERZ Controller and one of the mineworkers.
- The use of vehicles for self escape.

Areas for improvement

- Improvement is required in SCSR training and familiarisation. There was hesitation in donning SCSRs, with the limited information given to crews by assessors. Donning could have been activated after contact with CRO at mobile changeover bay as a

minimum as the ERZ Controller was not present at the start of exercise and no other gas monitoring was available.

- Mineworkers not familiar with use of training SCSRs took a long time to don the actual unit.
- Some attempts were made by mineworkers to verbally communicate with SCSRs in place and took SCSRs off without instruction of verification of known fresh air.
- Crews drove past all changeover bays without stopping to get another SCSR.
- Communication to surface of detail about what is happening and who is escaping (names, number of personnel). Grasstree would benefit from some form of tracking of persons underground, e.g.; location, who they are. CRO was given information of "Mains Crew evacuating via Grasstree West" but not number or names of persons.
- Emergency notification underground requires improvement. DAC system not as effective as other systems available. Contract persons working around pit bottom area on Eimcos did not hear emergency siren and had to be told by others.
- Familiarisation with duty cards to avoid confusion. Mine workers allocated duty cards did not understand the requirements of the task. Duty cards could more clearly describe what the person has to do.
- Possibly too many duty cards, duties appeared to double up on tasks. There were two persons checking mineworkers off a list. The names did not match who was underground. After 10 minutes, this process was given up and names were then written on a sheet.

Recommendations

Industry

- All mine sites should implement a personal tracking and recording system or a process to identify who is where at what time. Systems are under development but industry and testing/approval processes should be improved to encourage private investment in further development and cost reductions.
- Mine sites should develop their own first response teams as mines rescue deployment take a minimum of 5 hours in the Level 1 Mine Emergency Exercises
- Mines rescue risk assessment process needs to be streamlined to mitigate risk but also be able to provide a prompt response to mineworkers in need.
- Continued focus is required on donning and changeover of SCSRs which is critical in ensuring personnel are able to affect self escape.
- Mineworkers require training and need to demonstrate competency in the evacuation protocols of their mine.

Surface section

Grasstree control room

Assessors: Larry Ryan and Darren Brady

The usual CRO had phoned in sick and a relief CRO from the crew was assigned to act as CRO for the shift of the exercise.

The incident was initiated at 22:00 and a real time alarm was noted by the CRO of 50 ppm CO. The CRO immediately contacted the Undermanager who reported directly to the control room. The Undermanager was viewing the real time gas monitoring data and assessing which trigger action response plan (TARP) had been activated. The initial assessment was that it was an "orange level"[3] but this was based on 50 ppm CO (the maximum value that the underground sensor in use can measure).

The CRO and Undermanager were initially unaware of off scale outputs of real time sensors – 50 ppm reading could have been much higher which would have changed TARP interpretation.

The gas and other alarms on the mine SCADA system should be able to identify which TARP has been activated.

The CRO and Undermanager found it difficult to fill out the required forms during initial phase of operation due to pressure of activities and instead used post-it notes and pocket notepads. Initial briefing by the Undermanager to ICT was done from memory, assisted by various notes and partially filled out forms. The briefing did cover the essential details of the incident to that time, succinctly and accurately.

The CRO identified that the fans had stopped and told the Undermanager. With 5% methane being measured at the fan the Undermanager called for the evacuation of the mine. **However, this indication of 5% CH_4 at the fan was a mis-interpretation of the data presented.**

The CRO tried to make contact with the longwall but got no response.

The crew in 803 were advised by the CRO that the primary escape way should be satisfactory.

Contacting of external agencies and offsite Grasstree personnel was assigned to the Grasstree West CRO. From communications between the two control rooms it appeared that initially this contacting was done without following a procedure or list. This has been confirmed by the review of actions undertaken at Grasstree West control.

Non-verbal communication was established with the evacuating longwall crew. Although some problems were experienced, on the whole this form of communication was effective and gave some valuable information. Details of the communication are given in the underground section of this report.

[3] Orange level is a pre-defined level in a TARP - enables mineworkers to refer to the correct responses by being colour coded

While looking at the gas monitoring data it didn't take long for the Undermanager to work out the scenario. After 14 minutes he had determined the incident to be a frictional ignition at the longwall.

When possible the CRO and Undermanager questioned those communicating as to what had happened and the conditions underground. Those escaping were advised on the route to take and encouraged to drive out.

The CRO/Undermanager "phoned" emergency services (000) at 22:22. The police from Tieri arrived at site with in 10 minutes and the police officer in Middlemount was contacted and reported some 20 minutes later. Both of them communicated to the district disaster coordinators in Mackay and Rockhampton and advised them of the situation.

The police were on site for approximately one hour, however they did not take part in the Mine Emergency Management System (MEMS)/Incident Control System (ICS) process.

There were no facilities for the police and they had to use the mine site telephones as their mobile phones did not work on site.

The identities of those missing was initially gained using non-verbal communication and this list given to the police already onsite by the CRO. A short time later it was established that the initial list given was incorrect. The police overheard this conversation and came back for an update on the list otherwise it is unknown what would have happened with different lists of who was missing.

Although identified as being advantageous, the CRO did not have access to nor was he able to modify the tube bundle sampling sequence to hold the most relevant tubes, resulting in longer than necessary delays in updating data.

Both the CRO and Undermanager realised that the maximum CO concentration measurable on the tube bundle system was 1000 ppm and after this a GC would need to be used to measure the CO.

The number of Grasstree personnel entering the control room unnecessarily was limited as were unnecessary communications.

Having an experienced CRO come in as an assistant to the CRO was a very good idea and the two worked well together.

What worked well

- Even though a relief CRO, the CRO did a very good job.
- The Undermanager, although only acting, did a good job in assessing the situation and working out what had happened.
- The Undermanager and CRO both tried to utilise and encourage transport out of the mine and advised the underground personnel which route to take.
- There were minimal unnecessary communications coming through (and out of) the control room.

- The number of Grasstree personnel entering the control room unnecessarily during the incident was minimal.
- Non-verbal communication was effective although there were some minor problems throughout.
- Having an experienced CRO as an assistant to the CRO worked well.
- Both the Undermanager and the CRO knew the limitations of the tube bundle gas monitoring systems (maximum CO reading is 1000 ppm and hence needed a GC).
- There was good communication with the injured personnel underground.

Areas for improvement

- The off-scale value of 50 ppm for CO was initially used to determine that an "orange level" TARP was activated. This assessment was made without consideration that CO may, in fact, be higher.
- Due to the volume of information coming into and going out of the control room in the first couple of hours it was difficult for the CRO to log everything as required by the mine's emergency response plan[4].
- Notification of external agencies and offsite Grasstree personnel was not effective.
- The police were originally given an incorrect name for one of the people missing. No controls were evident on when and to whom such information should be given.
- The CROs had trouble obtaining the list of people to contact.
- The Grasstree controller couldn't set holds on the Safegas tube bundle system.
- DAC communication from one location underground was very difficult to understand.
- The listing of people about to evacuate the mine was rushed and hence in reality slowed down the process.
- Sharing of information between the tube bundle room and ICT, i.e. faxing of gas data.
- The CRO duty card and CRO procedures require the CRO to issue a number of duty cards, the majority of which were actually issued by the Logistics Group[5], as is defined in the Logistics Duty Card DC L1. The only log used was the communications log used as part of normal CRO operation.

[4] The term emergency response plan is used interchangeably with the term emergency management plan throughout this document.
[5] Refer to page 45 for explanation of Logistics Group

Recommendations

Mine

- CROs should be given capability to modify tube bundle sample sequence and put tubes on hold.
- The alarm protocols on the mine SCADA system should be improved to flag the TARP involved and what level of the TARP has been triggered. It should be possible to link the alarm to the TARP electronically and thus provide a quick prompt of required actions by CRO and senior mine officials.
- Review non-verbal question list with those underground and CRO to eliminate questions that can't be acted on and add those that would give more information, questions such as how many people are with you should be reworded to including yourself how many people are there.
- Review the use of non-verbal communication for larger numbers, e.g. maybe use "Are you between cut-through15 to 20?"
- Make the list of people to contact in an emergency readily accessible.
- Make sure the emergency response plan identifies where the police will be accommodated when on site.

Industry

- Investigate easy and readily available methods to transfer data in an emergency.
- Review the use of personnel locating equipment.
- Care should be taken when releasing the names of injured/deceased personnel to the police. Mines should have a protocol in place for this.
- All mines should ensure that they have adequate emergency phone coverage on the mine site and should install a mobile phone repeater dish on site where necessary
- Look at "text messaging" possibilities for underground phones.

Exercise team

- If mine site personnel are to be injured in the scenario they should be given food/extra clothing, etc. so they are looked after.
- The computer system for the scenario should be set up on site days prior to the actual exercise.

Surface marshal, portal guard/tag board Grasstree

Assessor: Maree Tanner

At 23:15 a surface marshal was appointed and supplied with the surface marshal duty card. The surface marshal then obtained briefing from the control room and also another duty card for the portal guard.

There was confusion when the mineworkers came to the muster area as to whether they should be reporting to the training room first for debriefing or be removing self rescuers and lamps and tagging off. There was also confusion regarding the recording separately of Grasstree mineworkers and contractors. The surface marshal recorded these as "mineworkers" and "contractors". The whereabouts of a contract crew also caused confusion.

The assistant CRO was constantly inspecting the tag board and updating. If information was not clear he would go away to clarify. Communication between the assistant CRO and the surface marshal and portal guard was excellent.

Mines rescue teams gathered in the muster area at around 01:00. The duty card stated that 'written authority' needed to be obtained for anyone proceeding underground after evacuation. This 'written authority' had not been explained to the surface marshal and, caused much confusion. It took some time to clarify; whether the mines rescue teams could have just one 'authority' or had to have one for each individual. There was also an issue as to whether the Grasstree employee/cage driver (travelling onsetter experienced operator who knows how the cage is operated for travelling into and out of the mine) needed authority. The outcome was that one written authority was required for all mines rescue teams and none was required for the cage driver as long as he came straight back from pit bottom after dropping the rescue teams off.

Whilst the issue of 'written authority to go underground' was eventually clarified, it wasted time and resources.

At 02:00 a third person was assigned the portal guard duty and reported to the surface tag board waiting for mines rescue teams to be deployed. At around 03:55 the mines rescue teams reported to the portal guard to deploy underground. The portal guard then recorded each separate tag and placed them on the board (22 in total). Whilst this is necessary, it could have been done while waiting to go underground, and wasted time when they had to go ahead while each member of the team tagged on.

What worked well

- The assistant CROs communication was excellent - constantly checking the surface tag board and communicated discrepancies with the portal guard. If there were any discrepancies, he promptly initiated action to ascertain the whereabouts of the mineworkers/contractors.
- The assistant CRO was very helpful with anything that was not clear, e.g. the issue regarding written permission for going underground after evacuation.

- Grasstree staff did a great job and took the exercise seriously, despite being unfamiliar with responsibilities on their duty cards.
- Good communication was observed between mine staff, especially the assistant CRO, checking with the portal guard that he was coping with duties.

Areas for improvement

- There was confusion with duties and responsibilities with one person doing two duty cards for an hour. It was very intense when evacuated mineworkers/contractors were coming into the Grasstree main muster area there was no clear direction as to where they should be reporting.
- The area where cap lamps and rescuers were housed was completely roped off. A comment was made that it would have been better roping off each housing individually as the surface marshal had to constantly step over the roping to return the lamps and rescuers.
- Clarification on the duty card about 'written permission' for person/s going underground after evacuation.
- Delay in deployment of mines rescue teams due to tagging on and individually stating 22 names to portal guard – perhaps this could be done before or in a more time efficient manner.

Recommendations

Mine

- One staff member for each duty card – or cut down on number of duty cards.
- Staff to be familiar with responsibilities on duty cards which could be assisted by making them simpler to understand.
- After evacuation from Grasstree West mineworkers/contractors to be given clear instructions regarding arrival at Grasstree main muster area.
- Clarify the situation regarding written authority for personnel reporting underground in an emergency situation. Given that this will probably be QMRS, this should be an industry standard.

Control room – Grasstree West

Assessor: Dave Carter

The Grasstree West control room was notified of the event at 22:26. The CRO performed most of his tasks as required by the CRO Duty Card. Sentries were in place within 15 minutes and the first escaping workers were at the portal at 23:00. This group and other groups following were asked to remain at the muster area, but gradually drifted away if they were not given a task. All underground workers, minus three trapped at the face, arrived on the surface by 23:50. All relevant information appeared to be relayed to Grasstree CRO in an accurate timely manner.

Transportation of workers to Grasstree for debriefs/redeployment took over four hours to complete.

The CRO reacted professionally handling the multi-tasking well under pressure. The CRO group had obviously had in-depth discussions regarding their roles in an emergency and were prepared for the intricacies of the task. The CRO on duty was clear and concise, fielded questions from persons nominated to hold duty cards and knew the roles they were supposed to perform.

The call out system was not very efficient and took over an hour to call all relevant personnel. The Mines Inspectorate was not called directly by Grasstree West CRO, Grasstree West CRO asked QMRS to do this and this is not their responsibility. Tasks could have been delegated to Bundoora and Aquila mines. May also find benefit from key personnel numbers on speed dial.

What worked well

- The CRO was familiar with procedures.
- Alarms were initiated in the prescribed manner.
- Communicated well with Grasstree CRO.
- Took control and allocated duty cards efficiently.
- Recorded main information in log.
- Maintained efficient communications with multiple media – telephone, radio, DAC and in-person with mineworkers.
- There were more than adequate personnel available to take on the many duty cards.
- As soon as names began to be reported over two-way radio, the person calling was asked to stop and provide information in person.
- The need for relief persons for duty cards recognised.
- The need for re-hydration of escaping workers recognised.

Recommendations

Mine

- Reduce the number of duty cards.
- Have duty card holders' record their own names on a board near the duty card box in the muster area as the CRO did not have an opportunity to compile this for 75 minutes. The list provided was also confusing as it listed all available duty cards not just the ones under the CRO duty card.
- The surface marshal should coordinate the sentries, lamp room attendant and diesel attendant then report relevant information to the CRO (single point of contact avoids confusion) Rather than have an assistant CRO Duty Card this person could be the surface marshal (experience with coordinating people).
- A camera or perhaps a manual control should be installed at the gates. The gates were of left open for 10 to 15 minutes due to CRO not knowing the remote actuator didn't work or being busy with other tasks. (The gates were also reported as not being good enough to stop a vehicle if required.)
- All the duty cards should have a description of what the duty is supposed to achieve as well as the specific items to check.
- A single system of physical data transfer should be used preferably email, managed by assistant CRO (this would provide an assurance the information is received as well as accurate timeline information post event).
- At Grasstree West some or all of the duty cards should be amended to report to the assistant CRO if ICT member is unavailable.
- A system to transport and debrief personnel escaping to Grasstree West should be developed to rapidly take control of this resource. This would also avoid the confusion created within workers group as to their movements after escaping. It took over four hours to move these workers to Grasstree East.
- EMT should rely on updates from ICT not Grasstree West CRO.
- Care of the workers should be improved as it was slow and sporadic during the exercise.

Industry

- Test CROs' workload in Level 2 and 3 Mine Emergency Exercises to ensure their workload in an incident is not too high.
- Check the number of duty cards to ensure that critical tasks can be managed on a back shift.
- Test call-out systems for effectiveness - time taken to call out as well as time taken for response.
- Implement the use of speed dial for contacting mine site personnel.
- Use the emergency number for notifying the Mines Inspectorate rather than phone their mobile phones.

Gas chromatograph analysis

Assessor: Darren Brady

At 00:10 the first GC operator arrived at the tube bundle room to start running samples through the GC. It was at this time that the tubes deemed as relevant were put on hold.

A further two GC operators arrived at the tube bundle room at 00:40 to replace the original operator who went back to Grasstree to assist the Ventilation Officer.

The GC was calibrated and the first sample run at 01:10am. Running of the samples as requested by the Ventilation Officer proceeded with minimal problems.

The results generated by the GC were not reviewed for any indicating ratios and were only considered for explosibility after completion of all of the samples.

What worked well

- Having dedicated GC operators works well, however in this instance because the incident occurred out of hours, GC results were not available until operators arrived from Middlemount.
- Being able to divert the bag out from the tube bundle directly to the GC made the running of samples from the tube bundle sample points through the GC efficient and easy.

Areas for improvement

- When diverting flow from the tube bundle analysers to the gas chromatograph Safegas was left in system maintenance mode, this effectively puts the tube bundle gas monitoring off line. Once sample flow has been stopped to the GC, the Safegas should be taken out of system maintenance mode.
- The CRO although identifying the advantage in modifying the routine sampling regime to limit it to the points of interest was unable to do so through the mine SCADA system. The Grasstree West CRO was also unable to modify the sampling sequence or put certain tubes on hold.
- Briefing of GC operators on the nature of the incident could be improved.
- GC operators, depending on training and skill level, could be utilised for gas interpretation of both the GC and tube bundle data.
- GC operators were running a room air between each sample to purge the previous sample. Although a small amount of carryover does occur between samples, the need to run room air between each sample in this case was not necessary. The reason for running room air after span gases is to eliminate the carryover of ethylene which was not present in the samples.
- No one checked the flows through the tube bundle analysers to see if there were any problems with flow rates. No mention was made of whether the tubes were still intact,

whether integrity tests had been conducted in the last month or what the draw times for each tube were.

Recommendations

Mine

- Improve communications in tube bundle room. No modem connection exists for communication with Simtars for assistance during any incident.

Industry

- Provide training and awareness for mine staff of the maximum concentrations that can be measured on a mine's gas monitoring systems.
- Have other experienced CRO(s) that can assist the CRO(s) throughout any incident.
- Implement monitoring and logging of vacuum pressures for each sample tube.
- Implement monthly tube bundle integrity testing and determination of draw times.
- Install vacuum gauges to monitor and log vacuum pressures for each tube.

Exercise team

- The exercise team must ensure there is greater emphasis on the need to start all communications with "this is an exercise" is needed. One of the GC operators arrived onsite and took up duty thinking that it was a real incident.
- Include printers with the equipment brought to site.
- Minimise the number of assessors in the control room during the incident.

Mines rescue response

Assessors: Seamus Devlin and Steven Bullough

Surface observations

Seamus Devlin

There was a good response by mines rescue trainees and QMRS managers with three complete teams ready for deployment by 01:03. There was good communication among all people. Of the initial 19 trainees that arrived, five had worked the day shift, six were rostered off and nine had commenced work that night at various mines. The two QMRS station managers had also worked day shift. With fatigue related issues industry needs to decide if people who had worked the day shift should be used in an emergency response situation.

Figure 6: Briefing of mines rescue personnel

What worked well

- The mines rescue brigadesmen response was very good. The number of responders was so large that it required action to stop any more personnel reporting to site.
- Three teams were ready to go active at 01:03. The first call to QMRS was at 22:40.
- Response of mines rescue brigadesmen was direct to the substation. This kept the pit top/muster area clear of unnecessary personnel.

- The operations manager was very much in control and made himself available to the ICT through involvement in the Planning Group[6] of the MEMS structure.

Areas for improvement

- The rescue substation is remote from the operation building and there is no signage indicating where the substation is located. QMRS trainees not familiar with the surface layout had trouble locating the substation.
- Transporting rescue equipment from the substation to the lamp room area proved difficult as the teams had trouble sourcing a suitable vehicle.
- The phone in the rescue substation had no telephone number listing and is placed on a wall with no provision for writing down messages. The phone would be better if placed above the bench on the opposite side to its' current position.
- No ice machine was available for ice packs for BG4 units so the teams had to source party ice from the operations building.
- There were no goggles in the MARS units.
- There were issues sourcing the QMRS captains' cards as they were not in the substation.
- QMRS operations managers may need to consider not becoming too involved with the functional area to which they are assigned, and direct their energy to the challenges involved with the deployment of mines rescue brigadesmen.
- An essential area for focus should have been on the survivability of the missing persons and the techniques and equipment that would be required to effect their rescue.
- The use and involvement of mines rescue brigadesmen in the entry risk assessment seemed to dramatically slow the procedure. This was caused by the mines rescue brigadesmen asking for information which had already been discussed in other meetings where they were not present. This led to the risk assessment heading down a long and repetitive track when the crucial factor was the limited ability of the trapped personnel to survive.
- Trust needs to be developed and accepted in certain areas, i.e.:
    - QMRS to trust the mine personnel in their solving of mining issues.
    - Mining personnel to allow QMRS to develop intervention plans.
    - Mines rescue brigadesmen to trust the validity of direction from QMRS staff.
- The main impediment to QMRS entry into the colliery was establishing if there was an active source of ignition. This could have been confirmed by the evidence given by the escaping personnel (22:57 "may have been a frictional ignition"), the survivors (2:36 "frictional ignition – no residual source") and could have been verified by atmospheric analysis trends after the event.

[6] Refer to page 445 for explanation of Planning Group

Underground QMRS observations

Stephen Bullough

A fresh air base was established efficiently with all checks being completed and relayed to team captains. Control was advised that the fresh air base operational. Both captains performed radio checks prior to going operational. Captains instructed their respective teams to don suits in readiness to go operational.

Team 1 proceeded to the irrespirable area and completed all necessary checks required as per their procedures and laid out the radio ribbon while advancing.

Upon entering an irrespirable atmosphere all required checks where completed to a high standard. Good control and communication to team by captain.

At 114 shield the radio ribbon ran out, the person controlling this advised the team of situation but captain did not hear or was not advised by his team – the person running out the ribbon was the last man – the captain was some 8 shields in front of him and was not made aware of the situation. Face was closed up and all people where in single file.

Some 20 shields later when requesting a message to the free air base he became aware and immediately back tracked to the end of the ribbon and advised fresh air base of the situation, confirming with fresh air base that the team would continue searching the remainder of the face towards the tailgate. Fresh air base confirmed message and advised operational team that a second team was deployed from fresh air base to assist them.

Captain returned to team and continued search towards the tailgate

At 05:35 and approximately 15 shields from the casualties and within viewing distance the Captain stopped the team to carry out oxygen readings and checks. He then took his team to the casualties and began rendering first aid. There were three patients lying in a confined area on or between the shields and the armoured flexible conveyor pans at the tailgate transition shield. One of the casualties was unconscious, bleeding from the abdomen and had a leg pinned between the pontoons of two chocks. Another was suffering a broken leg but was conscious. The third man was “deceased”. There was some confusion for the rescue crew as the casualties were not actually wearing self rescuers. For the purpose of the exercise the teams were reminded that the atmosphere was irrespirable and the patients were all wearing self rescuers but it was uncertain how long they had had the units in for. The captain then gave the instruction to immediately change the rescuer on the conscious patient. Despite this the teams continued to ask the patients questions during their assessments. The primary assessment conducted on the unconscious patient took place before any attempt to administer the MARS unit. Again there was confusion as the patient was asked questions. The deceased patient was assessed by the captain and then appropriately covered and marked with a cylume stick and note. The confined area where the patients were located made treatment difficult. As the teams began to stabilise the patients a second team was arriving at the site.

Figure 7: Mines rescue treating casualties on the longwall face

Areas for improvement

- It was known to ICT and the QMRS Superintendent that there was no ignition source present (from non-verbal communication and gas trends). Gas data available showed methane above 140% of the upper explosive limit (UEL). However the decision to deploy was not made based upon the fact that the mine fans were not running. Deployment was being delayed pending re-establishing mine ventilation. The effect of dilution on the explosibility of the atmosphere once the fans were restarted was not made available to the QMRS.
- Three rescue teams ready for deployment at 01:00. There was a three hour delay before actual deployment underground at 04.00.
- Once decision to deploy teams was made a risk assessment still had to be completed. Teams had been formed and most of the information available since 01:00, this risk assessment could have been previously prepared and simply reviewed prior to deployment.
- There was a delay between the decision to deploy QMRS and the risk assessment completion at 03:15 and the actual deployment at 04:00 due to the need to complete task sheets and QMRS paperwork.
- Authorisation to deploy signed by ICT at 03.45 but task sheets not available at the subsequent team briefing.
- The QMRS teams were delayed at pit top by a surface marshal recording the names of all rescue personnel at tag board before letting them proceed underground.

- The evacuation of mine left all vehicles at Grasstree West and not available at shaft bottom. Vehicles had to be brought in from Grasstree West by crew at that end of the mine.
- When the QMRS teams were driving into panel they encountered a PJB broken down in a heading at 14c/t blocking entry. The teams spent 19 minutes trying to move PJB, ended up releasing brake and pushing the vehicle out of the way. QMRS could have set up the fresh air base there and deployed teams. Communications were available in the changeover bay. There was obviously a communication break down from the debrief operations as the evacuating personnel were fully aware that the PJB had been left in this location.
- There were issues with the handling of a patient with known pelvic/abdominal injury and pinned broken leg as well as a delay in administering MARS to an "unconscious patient".

Recommendations

Industry

- Key personnel evacuating from underground should be debriefed for all relevant information by experienced mine site personnel. This should be passed on to QMRS teams entering the mine.
- QMRS should streamline the approval process and paperwork for the briefing of rescue teams entering the mine.
- QMRS should formalise their 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 lower explosive limit (LEL) of explosive gases.
- Mine sites should have streamlined processes for re-entry whereby QMRS and other personnel entering the mine in response to an incident are recorded.

Incident management process

Assessors: Greg Dalliston, David Cliff, Marc Kirsten and John Danckert

Mine Emergency Management System (MEMS)

Underground mines in Queensland participate in a mutual response system organised through the QMRS. In 2004 there was a move to adopt the ICS used by the Department of Emergency Services for dealing with catastrophes. QMRS adopted the process and prepared the MEMS course based on the principles of ICS. To date over 80 personnel have been trained in MEMS with the mines with most trained personnel being Broadmeadow, Grasstree and Oaky North. Kestrel Mine has also trained personnel in the ICS process. Of the three mines which have used MEMS/ICS for their incident response at the Level 1 Mine Emergency Exercise there was an improvement in incident control, however, because they had insufficient numbers trained in the process and had not practiced, the net result was still poor.

The traditional role of IMTs is to have all specialists and senior management involved in one group for gathering information, interpretation and decision making in an effort to control incidents.

ICS maintains the integrity of the participating agencies' chain of command and information systems, in accordance with their legislation and policies whilst coalescing capabilities of each into a cohesive emergency response.

ICS when applied at a mine breaks the former mining type IMT into smaller specialist groups of:

- Planning
- Operations
- Logistics

Each of these sections has an area controller who reports directly to the Incident Controller who is responsible for the overall incident management.

Incident Control: typically the Mine Manager, responsible for the overall approval and authorisation for actions and activities being implemented for the control of an emergency situation. Leads the formation and direction of the IMT. Other functional areas are:-

Planning: responsible for the collation of incident and resource information, predictions of development of the incident scenario, development of potential solution options and a recommended solution for authorisation by the Incident Controller.

Operations: responsible for the management and supervision of workgroups and response teams such as mines rescue.

Logistics: responsible for the provision of facilities, services, materials and finance that will support the operational response.

The IMT under the ICS process then comprises the Team Leader from each of these respective groups. This promotes the IMT to the roles of decision-making and management of the incident. In addition to the above team members is the inclusion of statutory and other specialist roles, e.g. SSE, Mines Inspectorate, ISHR and QMRS. The IMT would typically include – Incident Controller, Planning Group leader, Operations Group leader, Logistics Group leader, ISHR, Mines Inspector and a scribe.

The introduction of an ICS requires a disciplined approach, as groups, once set up, must concentrate on their core functions, as well as timely integration of actions and communication.

It is unfortunate that the Mines Inspectorate and ISHR did not attend at site during the exercise as this would have tested the systems proposed interaction with ICT and EMT. This also applies to the Site Safety and Health Representatives (SSHR) who it appears were not contacted or recognised in the emergency management systems.

Grasstree Mine has only recently made the decision to move from the traditional mining type emergency process to a MEMS/ICS based system and have conducted a number of individual training sessions in this area. The system is based on having an Incident Controller and three subgroups Logistics, Planning and Operations. Grasstree also has an EMT in their process which is supposed to act as support to the ICT and MEMS process. This was the first major test of the mines newly adopted system.

In general, the management of information during the Grasstree Level 1 Mine Emergency Exercise was at least as good as any previous exercise, if not better. This was often achieved through informal processes instead of the official designated systems, many of which were not used, or only partially used. There was no recognition of the urgency of the recovery of the injured persons until more than three hours into the incident.

Whilst individuals had been trained in the MEMS process the mine had had limited time to practice the system on a mine site basis.

Unfortunately the Level 1 Mine Emergency Exercise did not get to the stage of “post incident” and as such did not assess the effectiveness of:

- Coordinating the development of an Incident Recovery Plan
- Implementation of an Incident Recovery Plan
- Conducting a post incident review of events and ICT overall performance
- Preparation of a post emergency report

Training in MEMS/ICS needs to be done at various levels within the mine as persons who take up positions subordinate to the IMT members will also need to have an understanding of the system to enable the system to function smoothly.

All organisations should review the MEMS/ICS for application in emergency incident control. Key areas of learning are: discipline in adhering to the system, utilising but limiting the span of control (i.e. no greater than five particular resources per person), clear authority in authorising plans and actions and managing the communication flow.

The emergency management plan, associated duties, duty cards and forms should be revised in the light of the experience gained during this exercise.

Incident control team (ICT)

The mine utilised the MEMS system to manage the incident and although the overall result was good there are a number of opportunities to improve the process. The key to the MEMS system, or any other system used to control and manage an incident, is in the ability of the Incident Controller to successfully manage the team available to them and keep people focused on the 'job' at hand. The team considered a number of ideas but did not fully analyse alternative actions in case the primary action did not succeed.

Initial notification to the mine manager occurred at 22 minutes into the exercise and the manager was on site within 50 minutes of being notified.

The objectives of the ICT were set prior to any details of incident being defined and did not relate to the specifics of the incident. It was not till 04:35 on the incident action plan version 5 that recovery of personnel from longwall tailgate became an official objective.

The Incident controller used two scribes, not one, to carry out the administrative tasks. This seemed to work well, one managed the electronic information, the other the paper system. There was no evidence that central collection of all the forms and documents was occurring.

Initially, the scribe in ICT tried to use all nine forms but eventually settled on using an incident action plan. The Incident Controller still used a manually completed personal event log to identify actions from each functional area, responsibilities etc. Other area controllers used personal event logs for varying purposes often without putting times on them.

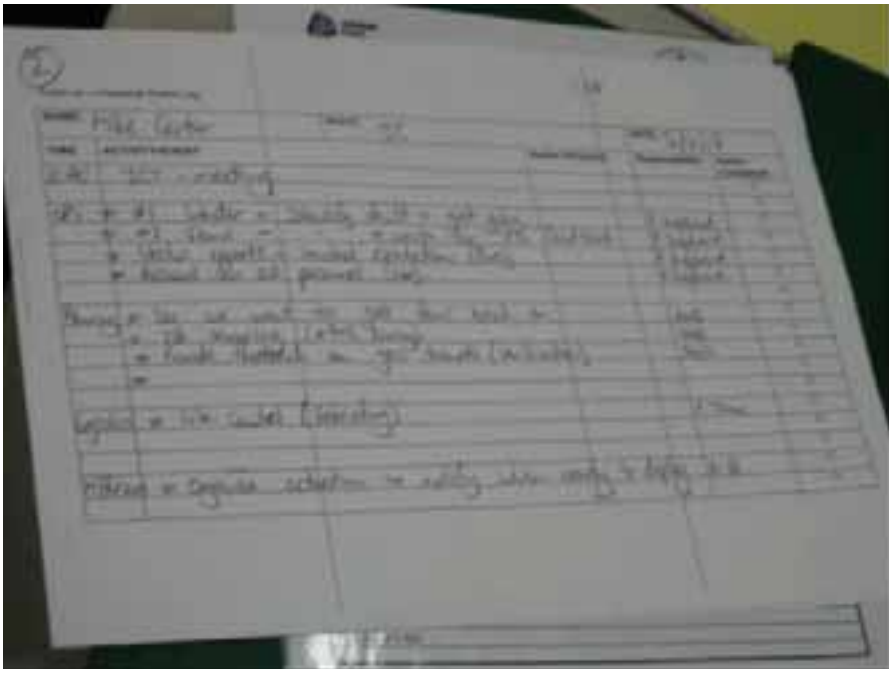

Figure 8: Example of personal event log of Incident Controller

Generally, debriefing information was not reaching ICT except from EMT, though some informal reporting did occur on the status of underground personnel via Duty Card O4 and the Undermanager. There is only a record of one debrief document being used.

The ICT duty card set consists of 30 duty cards, not all of which were issued during the incident.

The roles and responsibilities in the duty cards overlap each other.

Only one situation update report was issued. The incident action plan was used to fill this role routinely. This form overlaps with others including the ICT to EMT notification checklist.

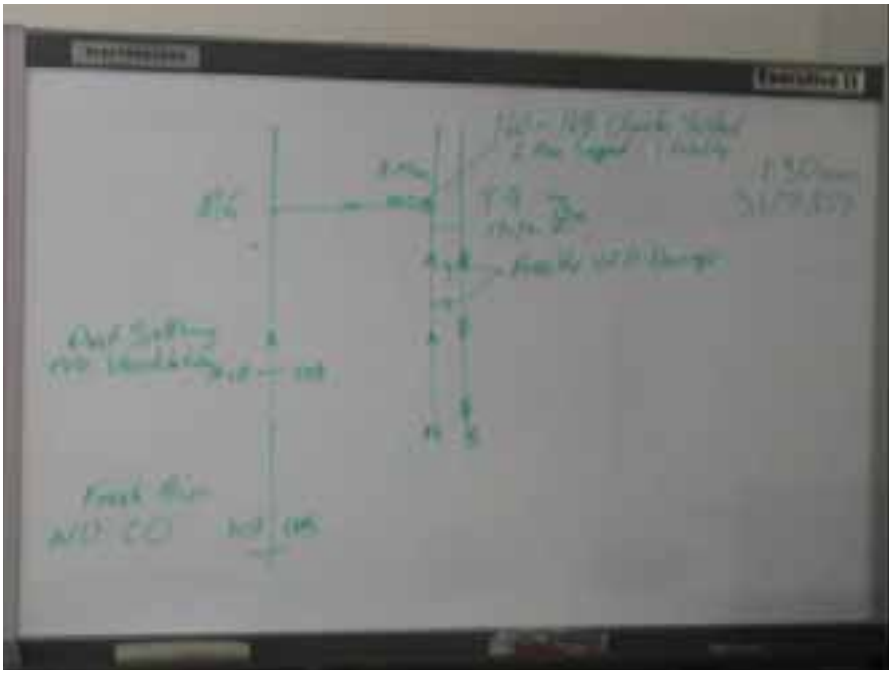

Figure 9: Undermanager briefing of ICT about circumstance of injured persons 01:30

The occupational health and safety advice duty card (Duty Card 1.3) morphed into a process check function. The original focus of this duty card is on compliance with legislation, and covering legal issues, interacting with inspectors, police, etc. There was no evidence that this function was carried out.

Almost all duty cards indicate that personal event logs should be completed – very few actually did this. **Personal event logs may not be necessary.**

When a risk assessment was carried out it was identified that the atmosphere at the face was beyond 140% of the UEL and thus was safe for the mines rescue team to re-enter under mines rescue guidelines. They would be entering this environment from fresh air, thus the atmosphere they passed through would transit between the two and at some point be in the explosive range, which would violate the mines rescue guidelines for safe re-entry.

Changeover of all ICT personnel and other functional areas was to occur in short period of time – process as per MEMS guidelines. Staging over a longer period of time may be better to give continuity. In addition it appeared that all front line personnel were involved in the first shift – all alternates would be on second shift. This occurred due to the positive response by the mine site management with all wanting to be involved in the exercise to gain valuable experience in emergency response. In a real event once the initial response has been made and an evaluation made of the possible duration key staff should be sent home to ensure that a suitable team with relevant experience can be available for subsequent shifts dealing with the incident.

QMRS captain's task sheet identified time of incident as 22:54, while it was in fact 22:00. There was no comment about potential damage to ventilation system with the consequent assumption that the ventilation was working. CO concentration was mistyped as 100 ppm and not > 1000 ppm.

What worked well

- The use of a "process checker" to audit key roles of the ICT (planning, logistics and operations) and to ensure the accuracy of the incident action plans was effective. This has been found to be the case at Kestrel Colliery where the ICS process has been used to respond to a number of underground incidents.
- In general the use of electronic information sharing between the ICT and EMT was effective.
- The Incident Controller used his personal event log to identify tasks and responsibilities. This was photocopied and circulated to each functional area to clearly enunciate their tasks. He then checked against this at the next ICT meeting to monitor progress (*see Figure 7*).
- A folder containing templates of all required documents for managing the incident was available for quick access from the Incident Controller's desktop – unfortunately it was password protected and could not be accessed directly. The scribe was able to circumvent this.
- The ICT was well provisioned though the organisation of the room though access to white boards could be improved.
- The ICT scheduled regular meetings and held them on schedule.
- Use of electronic documents allowed for acceleration of the risk assessment process – could cut and paste essential details into risk assessment document.
- There was a printed list of who was underground and what work areas they were supposed to be in. This made reconciliation of known and missing persons easy.
- Regular ICT meetings all achieved some outcome.

Areas for improvement

- Too many duty cards.
- Logistics, operations and planning all tended to do all facets of MEMS/ICS, e.g. logistics, planning and operations as well as provide logs.
- The emergency cabinet contained many items not required for the ICT but required by others and access to these disrupted the operation of the ICT.
- The provision of gas interpretation information to ICT was too slow.
- Names of injured and fatality were on notes but this information was only from non-verbal communication.
- Lack of familiarisation with forms by ICT.
- Unable to open files on the computer at the start of the exercise.
- Early on the meeting room became a thoroughfare for all people coming on site and this disrupted the process and stopped the flow of the meeting.
- Focus was lost on numerous occasions and this resulted in important outcomes not being clearly defined. This included the clear and definitive definition of the emergency objectives and the confirmation of strategies.
- The meeting room layout requires modification and the resources available to the ICT are insufficient and not laid out to assist in the meeting to run efficiently.
- Should consider some initial system to manage the call out and arrival of people onto site and where they go to get instructions.

Recommendations

Mine

- The functions of key personnel and duty cards of the emergency management plan should be revised in light of the outcomes of this exercise to remove anomalies, duplication and streamline operations. For example, the duties of the Planning Coordinator included participation in face-to-face debriefing of personnel, maintaining an information update service and coordinating the development and dissemination of the incident action plan. These functions were actually carried out within the ICT room, except debriefing. The duty cards need to consistent with the role outlined in the Emergency Management Plan (EMP) – Preliminary EMP.UGOP.002.
- The number and use of forms should be revised in light of what documents were actually used and for what purpose, e.g. incident action plan was the basic document used in conjunction with personal event logs. Communications logs, etc. were generally not used.
- The potential to use a video link between the EMT and the ICT should be explored. This would remove the need for information transfer and phone calls. However the connection would have to be managed and not continuous as it is recognised that this

may otherwise facilitate disruption of the ICT process and then contribute to the tendency for the EMT to be too involved in ICT activities

Industry

- The QMRS should investigate whether or not MEMS should be modified to include a formal role for a process checker and also the streamlining of the forms used.
- The use of audio recordings should be investigated to supplement the paper system especially at times where multiple functions are being carried out and there is no time to complete logs. Software exists to digitise this and transfer it to text (better than 90% accuracy).
- Access to and exit from ICT should be controlled to maximise focus of ICT personnel.
- Clocks should be provided in functional areas to assist in timing and data entry into logs.
- The objectives identified by the ICT should be better defined and prioritised, e.g. rescue underground workers, identify nature of incident, restore mine ventilation., etc.
- Gas monitoring information should be available electronically rather than requiring manual transcription.
- The mine should consider larger white boards better placed in the room, a table with plans under perspex to allow for easy reference, ability to place signs to limit access to room during meetings and a single point of contact to get information into meeting.

Exercise team

- Provide printers connected to simulation computers or provide access to site networked computers.
- Care needs to be taken to ensure communications are prefaced with “this is an exercise only”.
- The simulation system should emulate the process that the Ventilation Officer would have used to transfer gas data from one system to the other for analysis.

Figure 10: ICT room, showing computer screen and white board with objectives

Figure 11: ICT room showing, copy of personal event log, gas data (on post it note) and email from EMT requesting information

Planning

What worked well

- Planning used a sound structure to work through key issues and identify required actions that was well facilitated by Duty Cards DC P2/P3.
- The staffing level of the Planning Group was good. There were two people able to undertake ventilation analysis. In addition there were other trained people available to operate the GC and take bag samples
- There was recognition early that GC analysis was required and this was activated and properly resourced.

Areas for improvement

- The fitting out of the Planning area was not adequate for its purpose. There was nowhere to display mine plans centrally and no way of displaying computer output.
- The Planning Group had difficulty in setting and maintaining priorities.
- There was no recognition that personnel trapped had a finite oxygen supply until well into the incident (approximately 01:00).
- No planning for mine recovery was undertaken until prompted by the assessor.
- The emergency management plan identifies that the Planning Group is responsible for the preparation of incident action plans –this function was actually carried out in the ICT.
- Incident status was also determined by the ICT not Planning. The duty card of the Planning Coordinator (DC P1) clearly indicates responsibility lies with Planning to assess current status and forecast incident situations.
- Gas data was interpreted using the "carbon ratio" – actually CO to CO_2 ratio and Graham's ratio which were compared to laboratory spontaneous combustion results. This interpretation is only valid if spontaneous combustion exists. Values applicable to post explosion gases should have been used.
- The tube bundle sample points were assumed still to be in place and not damaged and sampling from elsewhere in the mine.
- The Planning Group consisted of ventilation engineers, mining engineers, a geologist and surveyors. Most of the time was spent dealing with the ventilation issues relating to the exercise. There was an imbalance in the skill levels in each of the MEMS teams.

Recommendations

Mine

- A balance of skills should be put in place in the teams in order that they can fulfil the requirements of MEMS.
- Grasstree continues to practice and improve on its incident management processes.

- The facilities in the planning room should be improved to include display of mine plans and other associated information.

Logistics

What worked well

The Logistics Group worked well as a group and reported and participated efficiently in the ICT meetings.

From the early stages of management of the incident, after notification from the CRO, the knowledge and ability to functionally apply this was demonstrated by the efficient manner in which duty card holders applied themselves. Examples of this were the actions and information supplied by Duty Card L2 Maintenance Support and L3.1 Portal Shaft Guard (who held Duty Card DC O3 Muster Area prior to 3.1). The persons in these positions had the most work in the field and displayed a sound technical and safety knowledge on those issues.

The group continuously delivered quality outcomes to the ICT processes but as with the other functional areas. Planning and Operations worked outside the parameters of a normal ICS process. This was that all groups when charged with a task did the whole three groups' work, by planning the tasks assigned, organising the equipment and resources and conducting the task required.

While in this instant this appeared to work well, it was outside the system's functional areas. This could have been because of the fact that in each of the three functional areas most of the members held the same type of competencies, i.e. Logistics members were mostly of a mechanical engineering background, where Planning members were mostly of a technical services background, and Operations members were mining coordinators.

Areas for improvement

The mine needs to review this and decide if they want to retain current make up of the logistics, planning and operations teams or reorganise the group to meet the current systems approach.

As the exercise was initiated just after shift change, a number of persons were recalled to site and most of the functional area groups were made up of all the senior persons from the mine. At a debrief for Logistics at the end of the exercise, most of the group agreed that it had been a very exhaustive process and if they were required to return for another 12 hour session the next night shift would have been difficult to sustain.

The next issue is that there would have been a serious depletion of human resources with all senior people being kept together on one shift and there is a need to consider changes to the response call out system to ensure that there is an equal level of response available for an extended emergency response.

Recommendations

Mine

- The mine review the skills make up of the three teams planning, logistics and operations

Operations

The operations room was located in the Development and Coordinator's Room and had no other facilities than that of a normal office. Whilst handwritten notes were taken there was no visible display of information.

The Operations Group at times got involved with the planning side of the operation – this is their normal everyday duty. The team analysed that there had been an explosion and that information was available to confirm that there was no underground ignition source.

The team also discussed the merits of discussing the fact that there was a fatality from what was non-verbal communication and the issue relating to the reliability of such information.

Operations are the team which carry out the plans put in place by the planning team. In reality it was the mine re-entry when the operations team actually had to do anything.

What worked well

The operations team diligently worked through their roles throughout the exercise. In reality they had little to do until the actual deployment underground so they actively discussed other elements of the process often identifying and resolving issued faced by logistics, planning and the ICT

Areas for improvement

Facilities within in the room were limited and the core skills of the group were biased to operational duties

Recommendations

Mine

- The facilities in the operations room should be improved to include the electronic access to forms, mine plans, etc.
- Systems should be established for conveying of information on issues relating to other groups roles when identified within a different group.

Emergency management team

Assessor: Mick Farrag

The Emergency Management Team carried out regular process checks, this enabled the team to remain on track with the personnel coordinator instrumental in this process

The communication flow process from the ICT to the Emergency Management Team was good, although could have been more frequent.

The mine should ensure that they have back up power supplies to enable continuous availability of the email system.

The recordkeeping was of an exceptional standard.

The room set-up was of a high standard, although perhaps better use could have been made of the TV screens and white boards in the room and the location of the printer could be reviewed to allow a better flow of personnel in the room.

The mine EMT put the GAG on standby, but this just happened in passing rather than having been justified by the ICT/ Emergency Management Team. Possibly this was due to a requirement in the old approved standard for the conduct of emergency exercises (Queensland Department of Mines and Energy Safety and Health Division 1999).

Call out – ISHR, SSHR and on duty Mines Inspector

Mines Inspector

The Undermanager in charge requested the Grasstree West controller undertake the emergency call out including the ISHR and the on duty mines inspector around 20:30. Contact was not made until 00:10. The inspector missed the call but called back to the mine for further information and was updated and informed that emergency exercise was under way, there had been a frictional ignition and four persons were missing. The inspector responded he could be there in 45 minutes, if required, as he was in Blackwater. The mines inspector was not aware of the requirement for him to attend the exercise.

The district inspector was also contacted around 01:10. He responded that he was on leave but if the incident was real he could have been on site in three hours.

The Mines Inspectorate are commonly in the field and often are out of mobile range.

Landlines at the Rockhampton office are forwarded to their mobile phones. This is a good idea for every day contact but in an emergency situation delays may be experienced in contacting and advising the Mines Inspectorate.

ISHR

The ISHR was contacted around 00:00. The ISHR asked a number of questions of the Grasstree contact to establish the nature of the incident. Scant information was available as this process was carried out by the EMT and information had not been provided by the ICT. The ISHR asked if the local SSHR had been notified and was informed that he had

not. The ISHR responded that he could be on site with an estimated time of arrival of 03:30. He was in Mackay and did not attend the exercise.

SSHR

The SSHRs were not notified of the incident by Grasstree management. As a result there was no external involvement in the incident management process other than that from QMRS. This was a lost opportunity.

What worked well

EMT regularly conducted process checks to ensure that they followed the process.

Transfer of information via email to IMT ensured that accurate information was being conveyed and both parties had an electronic copy of the information.

Areas for improvement

- The make up of the Emergency Management Team requires a review, there is some cross-over of some functions with the ICT and some of the positions could have been better utilised in the ICT, e.g. Commercial Coordinator, Media Affairs, Site Security and the Personnel Coordinator.
- The role of the Emergency Coordinator (leader of the Emergency Management Team) is to manage the external impacts (family, community, media, legal and financial) of the incident and support the ICT. It is easy to lose sight of managing the overview of the incident and get involved in the detail of an incident. It is critical to stay focused on the core role.
- There were too many duty cards, some doubled-up and some were not issued.
- With the timing of changeovers, there are things to consider such as the time personnel have been working prior to the incident, the stress of the incident and the ability of the personnel to continue to process information and make effective decisions.
- A changeover of the Emergency Management Team may have been better planed for around 03:00 to 04.00, as around this time the decision making process had slowed (don't get locked into changing over at 06.00 because that is what we always do).
- The emergency management system needs to be able to deal with the media that may arrive on site.
- With shift rosters we work with and more and more people living in towns other than the local town, employee assistance and family welfare can be harder to manage. Consideration needs to be given to the management of staff and families in other locations.
- Calls from the Emergency Management Team were made from other offices and the numbers of those phones left as a contact and then these phones were left unattended.

Recommendations

Mine

- In the event of an emergency the Emergency Management Team should report to the Incident Controller.
- Grasstree should modify their emergency response plan to include the call out of an SSHR in the event of an incident/emergency.

Industry

- A mines inspector and ISHR should respond and attend all Level 1 Mine Emergency Exercises. The Mines Inspectorate and the ISHRs should have fatigue policies in place to ensure that attendance can be undertaken without compromising personal safety.
- All mines must modify their emergency response plans to contact the Mines Inspectorate via the emergency number 07 3237 1696. This means that the Mines Inspectorate emergency response can start immediately.

Media coverage/crisis communication

Assessor: Kirrily Star

Phone calls were made to the mine during the exercise to test the response to media inquiries. The initial response was limited because of the time of day. A draft press release was prepared by the EMT during the course of the exercise. A phone call was made to the Brisbane headquarters of Anglo Coal on the morning of 31 July, no response was available. This section of the report deals with the issues relating to crisis communications during an exercise.

Communicating the correct information at the right time is critical in effectively managing a crisis. It is, in essence, the link to effective emergency response management. During a disaster, an organisation's ability to communicate accurate and consistent information increases the perception and ability of the organisation to effectively handle the crisis. We all understand the importance of perception. The line between perception and reality is often quite thin and actions taken or not taken by a spokesperson during the first moments of a crisis can affect perceptions of individuals or a company long after the crisis has been resolved.

It is important that preparation of a crisis communication plan is completed in advance and is incorporated as part of the organisation's holistic emergency preparedness and response system to ensure that all communications are efficient and effective.

To ensure effective management during a crisis a communication spokesperson should be identified. This person should have the necessary skills and training to be able to handle this role, but also have knowledge about the organisation and the crisis at hand to be able to establish credibility with the media.

During a crisis, dealing with the media can be difficult. It is important that the spokesperson spend time preparing statements and answers to possible questions that may be asked by reporters. It is also important to anticipate and practice new questions as the crisis evolves. If the company does not communicate information immediately, you lose your greatest opportunity to control events. The following should be considered:

- Identify all the disasters that conceivably could happen and practice formulating responses to these potential crises.
- Identify the person/s that will be your organisation's spokesperson. This should be someone with authority or in a senior role within the organisation who is comfortable speaking in public. Communication tips for the designated spokesperson include:
    - Be honest and clear with your information.
    - Respect the media and the public's concern and intelligence.
    - Give the facts – admitting the unknown and committing to a continuous flow of information as it becomes available.

- Acknowledge the crisis as early as possible – even if the facts or implications are not known.
- Only quote credible and trusted sources.
- Show empathy and compassion to those affected by the crisis.

Develop your crisis communications plan with clear, easy to access instructions. The most useful crisis communication plans are brief, easy-to-reference documents. As the management and communication functions are closely linked, the crisis communication plan should be incorporated into the emergency management system rather than being a stand alone plan. A checklist for crisis communications may include:

- notification of key communications staff
- initiate a briefing on the incident to communications staff
- begin initial media release drafts
- initiate a log for media calls
- determine the organisation's response to any media calls
- determine the need to schedule press conferences and notify your designated spokesperson so that they can begin preparing
- if press conferences are scheduled determine the location, time, notification, opening statement to be used, anticipated questions and answers and conduct a quick rehearsal.

Assemble material you may find to be relevant during a crisis, either as background information for the media, or as a quick reference for your spokesperson.

No matter how comprehensive your crisis communication plan becomes, it is vital that it is reviewed and updated on a regular basis.

Your first media release should include, as a minimum, the who, what, where and when of the situation. Only provide facts that are from reliable sources and have been confirmed. A prepared statement should be on hand for the first initial response for the media when knowledge regarding the crisis first becomes known. As the crisis progresses and new information and facts become available, it is advisable to develop prepared statements to be made by the designated spokesperson. These prepared statements can also be used as phone statements for any media calling to request information. It is also vital that an area is designated for the occurrence of scheduled information releases. It should be some distance from where the incident management team and emergency operations are situated. The location for any interviews and timeframes for scheduled information releases should be designated within the crisis communication plan and all interviews should be restricted to the crisis communication officer with designated time limits.

An example that highlights the criticality of communications is the Sago Mine disaster which occurred on 3 January 2006 in West Virginia, USA. The blast and ensuing aftermath trapped thirteen miners for nearly two days, only one of whom survived. This was the worst mining disaster in West Virginia since 1968. Sadly, the Sago Mine disaster is also widely remembered for its high level of publicity and around-the-clock news

coverage. For nearly two days the world sat on the edge waiting as events unfolded in front of our eyes. As a result of the high profile nature of the transpiring events, major misinformation was given to the public.

The most significant misinformation led to the wide-spread announcement in the news that 12 survivors were found and only one had died, only to then report shortly after that in fact there had been only one survivor and the other 12 miners had perished. The mine confirmed the miscommunication at a press conference shortly thereafter. Initial information indicated that the miscommunication occurred between the rescue team in the mine and the command centre at the surface. According to the mine, several personnel at the centre were able to simultaneously hear the communications directly from the rescue team and due to the number of officials and staff in the commend centre, approximately 20 minutes had elapsed before the miscommunication was realised.

When asked by reporters why the company allowed rumours to circulate for several hours, the mine responded that officials had been trying to clarify and verify information before putting family members on an "even worse emotional roller coaster".

During testimonies for the Sago Mine Disaster the following two questions were asked:

"How did the communication breakdown occur in which the world believed that these miners were alive? *First, when the mine rescue team reached the miners, a rescue team member called into the Command and Control Center, telling them that they had "located 12". Command and Control them asked, "Are they alive?" The rescue team member answered, "I think so – 10.4." We believe this is what people overheard and communicated to the miners' families.*

However, this was also the first time during a mine disaster where MSHA's professional press relations staff did not play a role. The two MSHA employees with the most experience in mine disasters – Amy Louviere and Rodney Brown – have been moved out of the press office. The person who was sent to the mine site by the Dept. of Labor was Dirk Fillpot, who, to the best of our knowledge, has never been to a mine disaster and dealt with the press in a time of crisis. The person at MSHA headquarters in Arlington, Va., was Suzy Bohnert, who also has never been to a mine disaster. We at Mine Safety and Health News believe that had Amy or Rodney controlled the media relations, this miscommunication would never have occurred, or if it did, the record would have been immediately corrected."

"Why has MSHA been the one to deal with the media in the past and not the operator? *The operator must help with the rescue. The operator knows the mine and knows the trouble spots and must be part of the rescue team effort. MSHA professional staff are also part of the rescue effort, but as we know, this agency also has a professional press staff who are experienced in dealing with the media as well as the families in times of crisis. Since the Wilberg Mine disaster in 1984, MSHA has played an active role in informing the families of the rescue efforts, and educating the media as to what is occurring and why. This is the first time in which MSHA did not have its seasoned press staff at a mine disaster."*

. http://www.minesafety.com/pages/sagominefacts.html *(Smith et al 2006)*

25 April 2006 saw us once again waiting in hope for the rescue of two miners trapped in the Beaconsfield Mine collapse. During this eventful two weeks, Mike Lester from CPR Communications and Public Relations, Hobart was hired by Beaconsfield mine management to control the huge media throng that gathered at the goldmine expecting nothing less than a miracle. To read the interview with Mike Lester on how the Beaconsfield mine collapse was successfully handled go to www.abc.net.au/rn/mediareport/stories/2006/1635097.htm. (Tooth et al. 2006)

An essential component of any crisis communication plan is effective information management and dissemination. Effective and timely release of information can help diffuse a crisis as well as minimise the detrimental effects. When an emergency occurs it is too late to begin planning how to respond. Time is of the essence, and a delay in communications may result in news stories that are inaccurate or damaging to an organisation, or as shown during the Sago disaster detrimental to families and friends waiting for news. It is imperative for an organisation to be prepared with a crisis communications plan and ensure that staff are trained in its implementation.

Recommendations

Industry

- To ensure effective management during a crisis a communication spokesperson should be identified.
- No matter how comprehensive your crisis communication plan becomes, it is vital that it is reviewed and updated on a regular basis.
- Your first media release should include, as a minimum, the who, what, where and when of the situation. Only provide facts that are from reliable sources and have been confirmed.

Conclusions

1. All aspects of the mines response were conducted professionally and demonstrated the mine's commitment to the Mine Emergency Management System (MEMS) process.
2. The mine is to be commended for its implementation of the MEMS system and training of a significant number of personnel.
3. The mines rescue response from available trainees was excellent.
4. There were again delays in the deployment of mines rescue.
5. Non-verbal communication enabled the Control room operator (CRO) to obtain a great deal of information from the underground personnel.
6. The mine site emergency response plan contains too many duty cards which are not clear to follow.
7. The call out of the on-duty mines inspector and the Industry Safety and Health Representative (ISHR) was not successful.
8. No Site Safety and Health Representative (SSHR) was notified of the exercise.
9. The on-duty Mines Inspector was unaware of the requirement for him to attend the Level 1 Mine Emergency Exercise, suggesting a failure in his induction process.
10. In some cases the Level 1 Mine Emergency Exercise is being regarded as a pass or fail test by mines, whereas in fact it is a test of the statewide response with an opportunity for an individual mine to test, trial and learn about its own emergency response plan.
11. CROs when responding to an incident do not have time to fill out detailed event logs.
12. The mine SCADA system has many alarms associated with it which complicate the acknowledging of gas alarms.
13. The Planning and Operations rooms at Grasstree have inadequate facilities for the handling of an emergency.
14. There is no ability to put tubes on hold other than when the Ventilation Officer is on site and using the Safegas system.
15. Debrief and transport of personnel from Grasstree West to Grasstree was not effective.
16. The use of vehicles to escape speeded the evacuation process.
17. The mines rescue station at Grasstree is not clearly identified and lacks equipment.
18. There are still issues within the industry with the donning and changing of SCSRs.
19. Some of the self contained self rescuers (SCSRs) opened were faulty.
20. Compressed air breathing apparatus (CABA) has been introduced into the mine with no obvious training/instruction in its use.

Recommendations

There are a large number of recommendations made within the body of this report and they are summarised in this section. Full detailed recommendations are in each section of the report. Many of them are minor modifications to the Grasstree processes which will enable the mine to improve on its individual emergency response plan (ERP). This is one of the objectives of running a full scale exercise as it enables a full test of all aspects of the response plan to identify areas for improvement. Many ERPs evolve to become unwieldy plans with complicated control systems and large numbers of duty cards. The number and format of duty cards within ERPs has been identified as an issue in many of the previous Level 1 Mine Emergency Exercises.

Some of the recommendations are applicable to industry as a whole and unfortunately are similar to recommendations from previous reports.

Mine

- Training in MEMS/ICS needs to be implemented for various levels within the mine as persons who take up positions subordinate to the IMT members will also need to have an understanding of the system to enable the system to function smoothly.
- The emergency response management plan, associated duties, duty cards and forms should be revised in the light of the experience gained during this exercise.
- Training in donning and changeover protocols for SCSRs should be conducted for all underground personnel.
- Underground personnel staff should be trained in the use of CABA for self escape.
- The layout of the changeover bays should be reviewed to ensure that congestion at the entrance is eliminated and the availability of floor space is maximised.
- All changeover bays should be checked to a schedule as part of the ERZ Controller's inspections.
- Review non-verbal question list with those underground and the CRO to eliminate questions that can't be acted on and add those that would give more information.
- Put in place a more structured and better resourced people control mechanism for the crews when they exit the mine.
- Review the process for the debrief of mineworkers to ensure that relevant information reaches IMT ie the ERZ controller from the longwall was debriefed several times and the key information about a broken down vehicle in the maingate was not identified
- Consider a system for effective transport of persons from Grasstree West to Grasstree.
- Program a schedule of works to ensure the main escape-way between Grasstree and Grasstree West is kept in a trafficable condition.
- Give CROs the capability to modify tube bundle sample sequence and put tubes on hold.

- The alarm protocols on the mine SCADA system should be improved to flag the TARP involved and what level of the TARP has been triggered. It should be possible to link the alarm to the TARP electronically and thus provide a quick prompt of required actions by the CRO and senior mine officials.
- Implement monthly tube bundle integrity testing and determination of draw times.
- Install vacuum gauges to monitor and log vacuum pressures for each tube.
- Make a list of people to contact in an emergency readily accessible. Possibly expand this to the use of speed dial for contacting mine site personnel.
- A camera or perhaps a manual control at the gates would have made operating the gates more effective. These were of left open for 10 to 15 minutes due to CRO not knowing the remote actuator didn't work or being busy with other tasks.
- Test CROs' workload in Level 2 and 3 Mine Emergency Exercises to ensure their workload in an incident is not too high.
- Test call-out systems for effectiveness - time taken to call out as well as time taken for response.
- Use the emergency number 07 3237 1696 for notifying the Mines Inspectorate rather than phone their mobile phones.
- Improve communications in tube bundle room. No modem connection exists for communication with Simtars for assistance during any incident.
- Access to and exit from ICT should be controlled to maximise focus of ICT personnel.
- Provision of clocks in functional areas would assist in timing and data entry into logs.
- The objectives identified by the ICT should be better defined and prioritised, e.g. rescue underground workers, identify nature of incident, restore mine ventilation., etc.
- Gas monitoring information should be available electronically rather than requiring manual transcription.
- The facilities in the operations room should be improved to include the electronic access to forms, mine plans etc
- Grasstree should modify their emergency response plan to include the call out of a SSHR in the event of an incident/emergency.

Industry

- Continued focus on donning and changeover of SCSR is critical in ensuring personnel are able to effect self escape.
- Training is required in the use of changeover bays so that personnel recognise that they are potentially areas of fresh air. This is subject to checking with a gas detector to verify the status of the atmosphere in the changeover bay. (At the 2002 North Goonyella exercise it was recommended that mines install sensors at changeover locations so that personnel evacuating with out access to a gas detector would know the status of the mine atmosphere at that location.)
- Mine workers require training and need to demonstrate competency in the evacuation protocols of their mine.

- A mines inspector and ISHR should attend all Level 1 Mine Emergency Exercises. The Mines Inspectorate should have fatigue policies in place to ensure that attendance can be undertaken without compromising personnel safety.
- All mines modify their emergency response plans to contact the Mines Inspectorate via the emergency number 07 3237 1696. This means that the Mines Inspectorate emergency response can start immediately.
- Emergency management plan and other associated hazard management plans , associated duties, duty cards and forms should be revised in the light of the experience gained during this exercise
- All organisations should review the MEMS/ICS for application in emergency incident control. Key areas of learning are: discipline in adhering to the system, utilising but limiting the span of control (i.e. no greater than five particular resources per person), clear authority in authorising plans and actions and managing the communication flow.
- Establishment of standard cross industry non-verbal communication practices would supply a common knowledge necessary due to the transient nature of many mine workers in Queensland.
- Industry should review first response capability and define what actions can be taken in first response
- All mine sites should implement a personal tracking and recording system or process to identify who is where at what time. Systems are under development but the industry and testing/approval process could be improved to encourage private investment in further development and cost reductions.
- Investigate easy and readily available methods to transfer data in an emergency.
- Care should be taken when releasing the names of injured/deceased personnel to the police. Mines should have a protocol in place for this.
- Look at “text messaging” possibilities for underground phones.
- Training and awareness of the maximum concentrations that can be measured on the mine’s monitoring systems.
- Have an experienced CRO(s) that can assist the CRO(s) throughout any incident.
- Monthly leak checks and determination of draw times for each tube for tube bundle system.
- Monitoring and logging of vacuum pressures for each sample tube.
- All mines should ensure that they have adequate emergency phone coverage on the mine site and should install a mobile phone repeater dish on site where necessary
- Where mines have CABA deployed and available for use underground personnel should be trained in its use for evacuation purposes. .
- Mine sites should have streamlined processes for re-entry whereby QMRS and other personnel entering the mine in response to an incident are recorded.

- To ensure effective management during a crisis a communication spokesperson should be identified.
- No matter how comprehensive your crisis communication plan becomes, it is vital that it is reviewed and updated on a regular basis.
- Your first media release should include, as a minimum, the who, what, where and when of the situation. Only provide facts that are from reliable sources and have been confirmed.

Mines rescue

- Mines rescue deployment - teams on site ready to deploy but not able to for three hours. If this is to remain acceptable, then mine sites must develop their own first response capabilities to protect life. The Mines Rescue risk assessment process needs to be streamlined to mitigate risk but also to provide a prompt response to mineworkers in need.
- QMRS should streamline the approval process and paperwork for the briefing of brigadesmen entering the mine.
- QMRS 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.
- The QMRS should investigate whether the MEMS system should be modified to include a formal role for a process checker and should also streamline the forms used.

Exercise team

- Base briefing for all the underground crews needs to be done by the assessors around communication protocols (starting communications with “this is an exercise”) and safety protocols (ensure you do nothing that is unsafe) etc.
- Try to reduce “fear” of Level 1 Mine Emergency Exercises.
- Increase efforts to communicate/review exercise to industry.
- When training SCSRs are to be used assessors need to be instructed in their use. The SCSRs should also be opened and assembled immediately prior to use - not set up in advance.
- If mine site personnel are to be injured in the scenario ensure that they are given food/water/extra clothing etc so they are comfortable for the duration of the exercise.
- The computer system for the scenario be set up on site days prior to the actual exercise.
- Minimise the amount of assessors in the control room during the incident.
- Provision of printers connected to simulation computers or provide access to site networked computers.
- The simulation system should emulate the process that the ventilation officer would have used to transfer gas data from one system to the other for analysis.

Appendices

Appendix A: Exercise timeline

Appendix B: Previous recommendations

Appendix C: Management team/assessors

Appendix A: Exercise timeline

Table 2: Detailed timeline for the exercise

Location	Surface observation	Time	Underground observation	Location
	Exercise commenced.	22:00	Longwall team SCSRs donned by team.	Longwall face
Control room	CO at the fan. Fans stopped.	22:02		
Control room	Undermanager advised evacuate mine following advice fans stopped.	22:04	Mains development ERZ Controller and mine workers decided to leave the area by vehicle. ERZ Controller did not check effectively that all of crew was accounted for. Asked "is everyone here" Crew at this stage did not don SCSRs.	
Control room	CRO advised 803 development over DAC to evacuate, that main fans had stopped and that primary escape way should be ok.	22:05	Mains development crew reached mobile changeover bay Informed CRO that crew were evacuating via primary escape way. Did not give CRO detail of all his crew accounted for.	
Control room	Non-verbal communication from longwall.	22:06		
Control room	CRO requests Shift Maintenance Engineer to check main fans.	22:07	Mains crew start to don SCSRs. Crew were not familiar with training units or expired SCSRs not used before. One crew member repeatedly removed mouthpiece. Some talking with SCSR on. One mineworker took approx 5 mins to don SCSR.	
		22:10	Contact made with control through non-verbal communication.	MG802 C-heading
Control Room	DAC call to control room from longwall - non-verbal.	22:11		
Main fans	Shift Maintenance Engineer checks main fans control boards, and conducts visual inspection of fan house using torch (no gas detection equipment used) used hand held radio to report damage and observations to CRO at each stage of inspection. Knowledge of operational functions of fans was good.	22:13		
Control room	Undermanager identifies problem as "frictional ignition at longwall".	22:14		
		22:15	Mains development crew reached shaft, crew removed SCSRs. Mine evacuation siren sounded through DAC.	

Location	Surface observation	Time	Underground observation	Location
Control room	Shift Maintenance Engineer reports -fans stopped on vibration fault - explosion doors moved and some damage - could not access inspection doors as no gas detector.	22:16		
		22:17	Mains development ERZ Controller contacted control. Informed shaft was out of service by assessor. DAC used was breaking up in communication. Informed CRO escaping via Grasstree West.	
Control room	Contractors advised via DAC they were at pit bottom. CRO advised them to evacuate via Grasstree West.	22:19	Three outbye workers arrived, totally confused, had trouble operating phone - used DAC first then worked out phone and used it. Advised they would evacuate through Grasstree West - asked the assessor how they would get there - told them to make their best way possible, they had a PJB and decided to drive.	Pit bottom
		22:20	Mains development ERZ Controller and one mineworker walked outbye two pillars on belt road to find two fitters and one contractor. These persons split up to find fitters.	
Control room	Undermanager left message for Mine Manager advising situation.	22:21	Longwall crew reached cache and commenced SCSR changeover.	Longwall crib room
Control room	CRO indicated that he would have phoned 000 requesting police and ambulance.	22:22		
Control room	CRO tells Shift Maintenance Engineer that shaft winder is out of action and that mineworkers are evacuating via Grasstree West.	22:25		
		22:26	803 ERZ Controller attempted to call CRO on DAC. Tried twice. and was unsuccessful.	Bleeder heading 803
Control room	Contract team advised via DAC they were heading out. CRO asked them to wait for others.	22:26		
Grasstree West Control	Call from Grasstree CRO re incident. Grasstree West CRO repeated all information back including evacuation point, communication status and call outs required for key personnel and Inspectorate.	22:26		

Location	Surface observation	Time	Underground observation	Location
Control room	Control contacted by Emains crew. They also had two fitters, two electricians, five contractors (two companies) plus all of the Emains crew.	22:27		
Control room	Non-verbal communication initiated underground using emergency phone from 14c/t changeover bay. 802 maingate identified that 3 persons missing.	22:29	Longwall crew reached 14c/t changeover bay and phoned control and used non-verbal communication. SCSRs were removed from crew by the assessors due to some members having been wearing the units for 30 minutes. Units in use were out of date and therefore use was minimised.	14c/t 802 changeover bay
Grasstree West Control	Workers reported to Control post alarms, CRO issued Duty Cards DC03 - Muster Area, DCL3.1 - Portal Security, DCL3.2 - Perimeter Security and DCL2 - Diesel Attendant. CRO also issued 2 way radios to each of these positions.	22:30		
Control room	Police onsite. Asked CRO if they needed them to do anything.	22:33	Mains development crew and outbye workers departed shaft area in 2 vehicles.	
		22:34	Stopped at brattice roller door. Access to Grasstree Tree West. Took four mins and four persons to open.	
Logistics	Shift Maintenance Engineer rang Mechanical Superintendent to request that he comes to mine. He located equipment and replaced explosion doors and bratticed damaged areas.	22:35		
Grasstree West Control	Gave instructions and crew list to portal security as well as two x 5ltr water bottles. For hydration of escaping personnel.	22:35		
Control room	CRO advised Undermanager that three people were missing.	22:38		
Control room	Undermanager contacted CRO at Grasstree West advised explosion at 802 longwall face, 3 people unaccounted for need to contact mines rescue, Inspectorate, etc. Repeat of request at 22:26.	22:39		
		22:40	Longwall crew left changeover bay and used vehicle to effect escape.	802 A-heading
Grasstree West Control	Grasstree CRO called asked Grasstree West CRO to activate mines rescue.	22:41		
Control room	Undermanager contacted Ventilation Officer.	22:43		

Location	Surface observation	Time	Underground observation	Location
Grasstree West Control	Called QMRS emergency number to activate mines rescue to Grasstree West also asked QMRS to activate Inspectorate. (This is not their role).	22:43		
		22:44	Vehicles full and left changeover bay along primary escape way (A Heading 803).	
Grasstree West Control	Grasstree CRO called asked Grasstree West CRO to activate key personnel except Mine Manager.	22:44		
Control room	QMRS phoned control talking to Undermanager.	22:46		
		22:47	Longwall crew passed 11c/t changeover bay. Did not stop.	11c/t
Grasstree West Control	Called Bundoora CRO and asked to activate mines rescue team to Grasstree and fax names of personnel attending to Grasstree West control. Repeated this action for Aquila CRO.	22:47		
Grasstree West Control	Commenced key personnel call-out.	22:49		
Control room	Non-verbal communication with longwall crew at 3 c/t changeover bay. CRO recorded that John Morris, Scott Black and Shane Taggart were the three missing personnel. This list requested by police and given.	22:50	Longwall crew arrived changeover bay 2c/t 108. Contacted control using non-verbal communication.	2c/t 802 changeover bay
		22:55	Mains Dev crew Reached surface. At Grasstree West.	
Control room	CRO contacted Grasstree West CRO to ask if they could put tube bundle points on hold, but not able to.	22:55	Longwall crew found CABA units in changeover bay - no personnel in crew trained.	2c/t 802 changeover bay
		22:57	Mains Development crew reached Grasstree West go-line. Met by diesel attendant.	
Control room	Following phone conversation with longwall crew, CRO advised Undermanager that those missing were John, Scott, and Joe (different to previous list and that released to police) and that they were in the tailgate. Those that got out were in the maingate, asked if it was a frictional ignition. Reply- "Could have been". Told they were to evacuate via Grasstree West.	22:57		

Location	Surface observation	Time	Underground observation	Location
		22:59	803 Dev crew -High levels of CO noted at 34c/t. Vehicles stopped. ERZ controller gave instruction to don self rescuers. Rescuers donned by 10 people with varying degrees of competence. (training rescuers issued did not work).	B heading 34c/t
Control room	Police overheard above conversation and asked for updated list of missing. Longwall crew advised CRO that they were heading out primary escape route, that they were in fresh air and only three tags remained on panel tag board.	23:00	Longwall crew - arrived at tag board, verbally contacted control over DAC. Information passes to control including ventilation, respirable atmosphere present and intended movement. Instructed by CRO to exit via Grasstree West.	MG802 Tag board
	Undermanager requested Duty Card O3 (muster area) to contact Grasstree West for assistance in accounting for mineworkers coming out of mine. This person then took up Duty Card L3.1 and went to Grasstree West entrances with copy of lamp numbers and names.	23:04		
Main fans	Maintenance Superintendent arrives at mine and assists L2 to barricade fan area then assumed DC L6.	23:06		
		23:07	Longwall crew passed shaft in mains, ERZ controller got out of vehicle and spoke to outbye workers and instructed them to follow and evacuate via Grasstree West.	23c/t D-heading mains
Grasstree West Control	Assistant CRO arrived and received instruction from Grasstree West CRO.	23:08	Stopped at roller stopping. Both cars into chamber. Lowered stopping. 803 crew.	20c/t mains
Logistics	L2 prioritised issues from duty card and went to shaft winder to ascertain status.	23:10		
Control room	Longwall crew contacted CRO. Advised that they were at double doors Western Mains with four contractors.	23:12	Reached brattice roller door at vent split for Grasstree West - crew had difficulty raising the door high enough for the machine. Doors catching on pipes.	12c/t Grasstree mains
Control room	CRO advised that cage would be operational in approx 20 minutes.	23:13		
ICT	Underground Mine Manager arrived and went to incident control room, got duty cards out and sorted into functional areas. Started to list objectives.	23:15		
Logistics	L2 contacted CRO to report status of winder. Load cell trip and will take approx 30 minutes to get back to auto operations.	23:15		

Location	Surface observation	Time	Underground observation	Location
Grasstree West Control	Technical Services Manager and Human Resources Manager arrive at gate.	23:15		
Grasstree West EMT	SSE (emergency coordinator) arrived at site.	23:16		
Control room	Grasstree West CRO advised which Grasstree personnel had been contacted CRO advised Grasstree West CRO which procedure he should be following for contacts.	23:16		
Grasstree West	Completed call-out key personnel.	23:16		
Grasstree West Control	Updated Grasstree CRO on key personnel confirmed as attending.	23:17		
Grasstree West EMT	Emergency Coordinator conducts briefing.	23:19		
		23:22	Arrived at changeover bay at 5c/t and joined up with development crew. Telephone in changeover bay did not function, ERZ controllers conferred and told the 15 men in changeover bay 3 personnel were missing in longwall.	5c/t mains changeover bay
Grasstree West Control	Aquila mines rescue (two persons) arrive at Grasstree West and directed to Grasstree	23:23		
Grasstree West EMT	Two team members put on standby for a 05.00 start.	23:29		
	Development Coordinator arrived on site and was allocated the Operations Controller Duty Card.	23:30		
Grasstree West Control	Incoming call from longwall worker at Grasstree West cut-through 1 reporting 21 workers with him.	23:30	Contact control and informed of a convoy of 4 man transports and 1 Eimco. Longwall and 803 crews.	Turn off eastern mains at Grasstree West.
ICT	Ventilation Officer arrived.	23:34		
Control room	QMRS phoned. Control talking to Undermanager.	23:34		
Grasstree West Control	Grasstree West CRO passed on information from longwall workers to Grasstree CRO.	23:37		
Control	First QMRS team members arrived at CRO from Aquila Mine.	23:38		

Location	Surface observation	Time	Underground observation	Location
Control room	Undermanager requested that key people be brought back from Grasstree West first, identified that there was no gate security.	23:39		
Control room	CRO advised that winder back in operation.	23:43		
Grasstree West Control	CRO commenced filling out duty card holder list 75 minutes after issuing first duty card.	23:44		
Operations Control	Development Coordinator arrived and assumed DC O1 (Operations Co-coordinator), and Assistant Development Coordinator DC O4 (Emergency Superintendent). O1 briefed O4 with information he had to date. He also checked if DC O3 had been issued.	23:45		
Grasstree West Control	Surface marshal reported to CRO advising names of underground workers escaped to Grasstree West.	23:46		
Control room	QMRS onsite (Operations Manager).	23:47	Longwall team and convoy cleared portal at Grasstree West.	Grasstree West portal
ICT	First ICT meeting - Undermanager briefed ICT from memory. Supported by personal event log details. Scribe fills out incident action log electronically projected onto screen in ICT as briefing being undertaken. Recognition of possibility of explosion at longwall tailgate, CO/CO) and Grahams Ratio, manually recording gas data. Other personnel arriving on site entering ICT to report for duty - disrupts process.	23:50		
Logistics	L2 reports to ICT that shaft winder is operational in automatic mode again.	23:50		
Grasstree West Control	All phone outs completed.	23:50		
EMT	Advise ISHR and on duty Mines Inspector.	23:53		
Control room	Assistant CRO communicating with Grasstree West reconciling who was accounted for, wouldn't give names of those missing over radio.	23:55		
Grasstree West Control	Surface marshal reported to Grasstree CRO by phone the names of all three missing underground workers.	23:58		
Grasstree West Control	Longwall ERZ controller briefed Grasstree West CRO on events underground.	00:00		

Location	Surface observation	Time	Underground observation	Location
Grasstree West Control	Underground workers accounted for and unaccounted for faxed to Grasstree CRO and EMT.	00:06		
Grasstree West Control	First taxi from Grasstree arrived to transport ERZ Controllers and mines rescue personnel to Grasstree.	00:07		
Grasstree West Control	Contacted EMT and Longwall ERZ Controller taken to EMT for debrief.	00:09		
Tube bundle room	Mining Engineer went to tube bundle room to commence GC analysis.	00:10		
EMT Room	SSE debriefs ERZ Controller from longwall. Scribe records ERZ Controller's statement and emails to Grasstree ICT.	00:12		
Planning	Planning Coordinator briefed his group and issued duty cards	00:14		
Tube bundle room	Tubes 9,2,3,6 and 13 put on hold.	00:14		
EMT room	SSE instructed Safety Manager to organise vehicle to transport Longwall ERZ Controller back to Grasstree for debrief by Mine Manager.	00:15		
Grasstree West Control	Grasstree CRO called and asked for Longwall ERZ Controller. Informed that he is with EMT.	00:15		
Rescue sub station	First four men arrived from Aquila mine, instructed by QMRS manager to commence checking rescue equipment and ensure it is ready for use. Total of 19 rescue trainees and two QMRS Managers had arrived by 01.00	00:20		
Grasstree West Control	ICT called asking for Longwall ERZ Controller, Grasstree West CRO provided information relayed to him by ERZ Controller. ICT after details the CRO did not know. Advised again that he was with EMT.	00:25		
Planning	Planning focus was on fans, not people recovery/rescue.	00:47		
Debrief room	Debriefer and Undermanager debriefed Longwall ERZ Controller.	00:50		

Location	Surface observation	Time	Underground observation	Location
ICT	ICT meeting – Operations Coordinator identified up to eight people missing – three tailgate and five other. Shaft back in action. Undermanager interrupted IC process to debrief with drawing on whiteboard - this not captured as not connected to printer - memory card option - not used. IC recognised two injured in tailgate, one slight and one dead. CH_4 off scale.	01:00		
ICT	ICT meeting Operations Coordinator stressed need to act quickly. Mines Rescue Coordinator identified that there was no apparent ignition source, referred to QMRS Guidelines.	01:00	Non-verbal communication from longwall face initiated (made call from longwall maingate ~4 shield DAC).	Longwall face
Grasstree West Control	Grasstree CRO called to confirm that Inspectorate had been called, advised that Grasstree West CRO had asked QMRS to do it.	01:00		
Rescue sub station	Three rescue teams ready to deploy underground - all equipment checked.	01:03		
Tube bundle room	First sample analysed on GC.	01:10		
Grasstree West Control	ICT called to advise Grasstree West CRO that non-verbal communication had taken place with trapped workers and confirmed 1 deceased and 2 trapped at tailgate drive.	01:18		
ICT	ICT meeting System Coordinator raised issue of fatigue management - succession planning requirement - need to deal with consequences of fatality.	01:30		
Grasstree West Control	Phone call from media transferred to SSE.	01:35		
Rescue sub station	QMRS manager briefs trainees with current information.	01:40		
Logistics	L7 to EMT, Courier Mail reporter has phoned (no one got a return number for her) when she rings back EMT want her to be invited to EMT for briefing.	01:50		
Logistics	Logistics develop two options for testing of fans prior to starting once cleared by Ventilation Officer.	01:57		
Rescue sub station	QMRS manager instructs trainees to load all gear into ute and take it to surface muster area at lamp room.	02:00		

Location	Surface observation	Time	Underground observation	Location
Grasstree West Control	ICT called, advised media coming to Grasstree West to see EMT.	02:00		
	All QMRS members are given briefing in muster area and team captains are requested to attend risk assessment, with Planning, for re-entry.	02:20		
Planning	Planning doing risk assessment for re-entry by mines rescue.	02:30		
ICT	ICT meeting - details of survival time of injured persons, who they were and nature and severity of injuries - emailed to EMT.	02:35		
ICT	Discussion on number of SCSRs available for miners trapped on longwall face, and available air time for them. This was determined to expire at approx 06:00.	02:40		
ICT	Ventilation Officer gives first presentation on gas trends, CH_4 levels underground on wall high so need to start fans, CH_4 at fans 0.4% to 0.6%. Risk assessments for starting fans (Logistics) and re-entry both Grasstree West by vehicle and QMRS by shaft (Planning).	02:42		
Grasstree West Control	Mines rescue entering portal to conduct vent survey.	02:42		
Logistics	Logistics risk assessment for fan restart finalised.	02:55		
Planning	Risk assessment for mines rescue deployment.	02:56		
Training room	Risk assessment started by Technical Services Manager for mines rescue to enter below ground. Discussion with Mines Rescue Operations Manager about guidelines relating to ignition source.	03:00		
Tube bundle room	Explosibility of samples already run checked (first time).	03:12		
ICT	Restarted fans - fresh air to base of shafts.	03:15		
Tube bundle room	Tubes 9,2,3,6 and 13 run through GC, confirmation of what samples to be run now.	03:15		

Location	Surface observation	Time	Underground observation	Location
EMT	The EMT failed to recognise that some families may not live in Middlemount.	03:20		
ICT	Changeover for ICT sections teams developed by each individual team.	03:20		
Grasstree West Control	Grasstree West CRO called ICT for food and relief for sentries.	3:20		
Mines rescue	Still discussing rescue protocols at 03.25. QMRS reconvene risk assessment for re-entry.	03:25		
	QMRS team 3 captain gave his team a briefing on current situation in isolation to the rest of QMRS.	03:35		
	General briefing of QMRS members by QMRS.	03:40		
Grasstree West Control	Mines rescue entering Grasstree West portal with 3 vehicles.	03:40		
Surface tag board area	Cage driver told he could just put tag on board when escorting mines rescue (no written authority).	03:43		
Lamp room area	Rescue trainees briefed with current information from QMRS manager with regards to current underground situation - advised still has to do risk assessment before being deployed underground.	03:45		
	QMRS briefing to team captains and vice captains prior to deployment.	03:48		
Lamp room area	Risk assessment completed, teams briefed - asked for task sheet as per procedures - further delayed till this done. Advised transport was being made available from Grasstree West and would be at pit bottom when they arrived.	04:10		
Mines rescue	First teams underground at 04.10.	04:10		
Pit bottom		04:18	All teams in transport, travelled into longwall panel.	
Longwall panel		04:28	Encountered abandoned PJB at 14c/t - spent 19 minutes trying to move it, eventually jacked brakes off and pushed it out of the way.	
Control room	CRO advised by mines rescue that vehicle broken down at 14c/t so setting up fresh air base at 14c/t.	04:37		

Location	Surface observation	Time	Underground observation	Location
Longwall crib room - fresh air base		04:47	Arrived at longwall crib room at 17c/t - advised control via phone that all had arrived and setting up fresh air base at this location as instructed.	
Control room	CRO used DAC to contact face and advise that mines rescue on their way.	04:53		
		04:55	Fresh air base established efficiently - all checks completed, control advised. Fresh air base controller advised teams fresh air base operational. Both captains performed radio checks to fresh air base.	
		05:04	First team deployed to search for missing men, team checks and radio checks performed upon entering irrespirable area. Run out radio ribbon as advancing towards tailgate, ran out of ribbon at #114 shields - captain advised but did not hear or confirm message from team member. Advance another 20 shields before becoming aware that he had no communication back to fresh air base - back tracked to ribbon and advised fresh air base of situation. Confirmed to fresh air base he would continue searching towards the tailgate area. Regular oxygen readings taken and recorded whilst advancing along the face.	
Control room	CRO phoned fresh air base, Red Team going active, rescue asked for cap and lamp numbers for missing persons.	05:05		
Control room	Camp and lamp numbers given to rescue, Blue team given the go ahead to go active.	05:10		
Control room	CRO advised IMT of two active teams.	05:15		
Control room	Blue team active.	05:20		
		05:37	Reached casualties and commenced treating the injured - cover placed over the deceased person. Went back to radio ribbon and advised fresh air base of situation - advised back up team on way to assist..	
Control room	Fresh air base phoned CRO - Blue team standing guard at 114 chock, where ribbon ran out, Red Team continued.	05:40		

Location	Surface observation	Time	Underground observation	Location
Control room	Red Team at patients; 1 person deceased, 2nd head and abdominal injuries, lower limb fractures on MARS, 3rd lower leg fractures.	05:54		
IMT	Exercise concluded.	06:00	Teams advised to return to fresh air base, uncouple, decommission fresh air base and return to the surface	
Control room	Exercise deemed to be over.	6:05		

Appendix B: Previous recommendations

This appendix contains all the previous exercise recommendations and there are a number of them which have been repeated on one or more occasions.

Recommendations which are in **bold are from the 2006 Mine Emergency Exercise at Broadmeadow mine.**

Control room

1. **All relief CROs must get more regular exposure to the GC, perhaps running the samples once a tour, so as to keep abreast of changes with the instrument and sample introduction.**
2. **A system for non-verbal notification of an emergency should be developed. This may be as simple as an initial triggering of the emergency button on the phone or a non-verbal dial up code on the DAC or phone. A protocol for this type of communication should be developed with sample questions. All questions asked should be read from a written copy so that the answer options can be reviewed against the exact question.**
3. To overcome the problems with providing paper based gas monitoring data, an on-line incident simulation was used that emulated the mine monitoring system. This system known as MEMS allows for modifications of the scenario in real time as the incident changes and site personnel attempt to control the situation, with changes able to be fed to the IMT via secure communications.
4. Translation of information via the phone led to a number of incorrect calls/information i.e. gas concentration levels.
5. Formal procedures need to be introduced and personnel trained in the emergency procedures for site i.e. the use of the DAC system to indicate location underground to control room not recognised.
6. Key personnel need to be aware of key factors of their system such as response times and analyser ranges.
7. The supply of two-way batteries for radios for surface use is insufficient to allow long term use of the sets available.
8. IMT is to ensure that the CRO is informed of intended actions so that he can confirm actions as required. This should be done by one of the duty card holders. This way the CRO only gets information from one person in contact with the IMT.
9. Limited access to the control room is imperative to stop people wandering in and out.
10. An extra phone point for personnel with duty cards is necessary so as not to use the control room as a telephone room.
11. GC operator was useful as a backup for the CRO although he was not required to take a large number of bag samples due to the scenario.
12. Ensure that duplicate tasks are not given to duty card holders and that duty card holders stick to their duties.
13. Consider increased and more regular use of the Personal Emergency Device (PED) to send messages to trapped personnel. Short, accurate messages can often provide a moral boost and perhaps can also be used to provide advice/directions. This should be further investigated.

14. A more autonomous/automatic mechanism to identify where personnel are located underground and when they have returned to the surface would be of great value.
15. Relief duty card operators need to be fully trained in their roles, responsibilities and functions.
16. CRO (or some other delegated person) should regularly continue ringing the phone. This not only provides orientation to those people lost in poor visibility, it gives a reassurance to persons who maybe able to hear it but not respond. Regular broadcasts down the DACs could have the same effect.

Data analysis, interpretation and monitoring

1. **The visual display of information in the communication room could be improved. Activities and options were listed with names of responsible persons. It is important that all established facts are displayed to allow each participant and new IMT member the opportunity to view the current status of the incident. The established objectives of the group should also be displayed. Another white board could be used to list activities and allocated responsibilities. These white boards should be printable to ensure a record is kept of the IMT process. A terminal with a display of the gas monitoring system should also be present in the room.**
2. **Install a second phone line that supports data transfer for the GC to allow modem transfer of data, and real time support from Simtars.**
3. **GC - The frequency of and complexity of GC training should be reviewed. In addition the number of people available per shift competent to operate the GC needs to be reviewed. It is not appropriate to expect the CRO to run the GC during an incident.**
4. **A systematic regime should be established for reporting and displaying monitoring information. Without systematic recording of information it is impossible to effectively brief external bodies or undertake changeover of key personnel.**
5. Safegas access should be extended to each key area.
6. There should be more personnel trained in the operation of the tube bundle systems and Safegas, including all its functionalities (especially the taking of bag samples and how they can be analysed in a timely manner).
7. Consideration should be given to installing differential pressure sensors/velocity sensors to enable changes in ventilation to be accurately monitored.
8. Consideration should be given to installing further real time gas sensors – CO and O_2, at more key points in the mine to allow characteristics of mine atmospheres to be determined. This would allow personnel underground who do not have personal gas monitors to be aware of the mine atmosphere at the sensor location. Locations could include: escapeways, caches, belts, transformers and intakes.
9. Computer access to the mine environment monitoring system in the IMT is essential. Ventilation simulation software should also be on this computer.
10. A mine plan in the IMT should show monitoring locations.
11. Ventilation flow sensors in key roadways would enable more accurate interpretation of makes and effects of changes in ventilation.
12. Off-scale readings on the tube bundle should trigger immediate bag sample collection. There is slow response to obtaining and analysing bag samples.

13. It is recommended that the functions inherent in current gas monitoring software be explored, particularly the facility to store and retrieve documents detailing required action response plans. Such software has much to offer CROs and IMT personnel.
14. Review location of types of gas detection equipment underground in light of ability to detect changes in mine gas atmosphere.
15. Review tube response times and cycle time – reduce ballast volumes.
16. The maintenance of gas monitoring after an incident should be completed to include the redundancy of sensors and tubes/borehole back-up for sampling of key areas and communications.
17. There should be a designated role of a person on the incident control team to be responsible for accurate gas monitoring information.
18. The role of Simtars when assistance is called for should be known thoroughly.
19. Safegas system should be connected to the control room monitors. The absence of the Safegas system means that the trending of gases from the tube bundles and any derived indicators can only be done by hand.
20. Further training needs to be undertaken by control room personnel regarding AMR sensors and gas concentrations and what type of reading an unserviceable, disabled or destroyed sensor would give.
21. Gas monitoring station numbers and AMR sensor numbers need to be matched appropriately.
22. Personnel would benefit from increased training and awareness in the capabilities of Safegas software, particularly in trending of gases, especially Quick Trend; SPLUS; Multiple site analysis and holds on key monitoring locations; Further understanding of the separate sources of lags and delays in analysis and their cumulative effect.
23. Use “Instruction” feature of Safegas for TARP implementation and recording of actions.
24. Modify Safegas so that login time lasts for the shift duration of the CRO. CRO had to log out whenever he left the control room. This will reduce frustration on accepting alarms.
25. A better understanding of the operation of the tube bundle sampling regime, the capabilities of the software and the computer control system is necessary to optimise the collection of relevant information.
26. It is important that samples of gas taken are labelled with the time taken and location of sample.
27. The mine monitoring system should include a facility to print a table of the latest data for all locations with date and time of all gases and be able to export to other programs or for email. This would allow error free transfer of data to other interested persons.
28. Ensure that GC analysis of the atmosphere is undertaken as soon as practicable. Utilise Simtars or other relevant expert for additional review and verification of gas data.
29. Mine monitoring systems should ensure that trend graphs include the latest data.
30. Mine monitoring systems should include a label of tube numbers as well as locations – mine plans only refer to monitoring points by tube number when doing trending and analysis.

31. When a monitor reaches full scale, it should read “full scale”, instead of displaying a value. The value -999 can be interpreted as actual.
32. The mine monitoring system should have the ability to display trends of more than one sample point at a time.
33. Nitrogen dioxide should not be monitored via the tube bundle system. Underground personal monitors should be used instead.

Debrief

1. **Consideration should be given to refreshing all employees as to what to do when they exit a mine in an emergency e.g. identify who they are, where they are and their physical condition.**
2. **Re-hydration should be identified as a key initial requirement of the debrief process.**
3. **Medical examinations by on-site medical personnel should take priority over debrief and that such examination should include objective medical observations of these persons (e.g. pulse, blood pressure, physical examination). If absolutely necessary, debrief/gathering of critical incident information could occur whilst such examination is occurring.**
4. Debrief sessions must be structured with adequate resources, such as mine plans and question prompts sheets to facilitate accurate and complete capture of information.
5. There needs to be a formal debriefing procedure in place, including a scribe to record all information to ensure that there is no lost information, wrong conclusions and poor recording.
6. All personnel being debriefed need to be made comfortable, provided with adequate food and drink and given first aid as needed.
7. Security needs to be placed on debriefing rooms to control who enters and exits the room.
8. It is essential that identification of any casualties be verified and accurate prior to the release of information to outside parties.
9. Review debriefing procedures – suggest a prompt sheet be developed and/or utilised.
10. Training personnel available to debrief persons after they evacuate the mine. The knowledge evacuees have is vital to the IMT.
11. Information from debriefing sessions to be incorporated into the decision making process e.g. the operator of the vehicle may have provided useful information to assist that decision making process (the fire was relatively small, the fire was actually 20m inbye 9 cut-through). Critical witnesses should be identified and also debriefed by IMT so that they can get a better understanding of underground conditions.

Emergency initiation

1. **It is recommended that the Mines Inspectorate mobilise a Simtars response in response to the exercise scenario in all future Level 1 Mine Emergency Exercises. This will test the interaction and communication process between the inspectorate and Simtars.**
2. The CRO position should be a competency based position which includes knowledge of monitoring systems and gases.

3. Refuge bays/changeover stations should include communications and gas supplies and monitoring lines.
4. A computerised system should be introduced for duty card operation and logging of actions. This should also be used to check validity of duty cards for use of back shifts and practicality of operations.
5. It is recommended that one of the training rooms be set up as an incident management room, and that a person, detailed in the emergency procedures, be positioned as a door guard to prevent disruptive entry to this room.
6. It is recommended that duty card sheets are made "tick and flick" style sheets, and that senior management adhere to their defined areas. This ties in with IMT as a specific team in a specific place with defined areas.
7. All personnel should be trained, including refresher training, in the location and basic content of the emergency response plan.
8. It is essential that the incident control room be complete with a number of electronic whiteboards, accurate mine plans, desktop space, communication facilities – preferably with automatic call forwarding of all incoming underground phone calls, video/audio recorders, secretarial/shorthand support and security against intrusion.
9. All persons, including managers and supervisors, must be trained in the use of self rescuers and their changeover procedures in genuine environments, including underground, after heavy work and in limited visibility.
10. Rescue room needs to have up-to-date and suitable rescue plans in the room at commencement of emergency.
11. There should be a mine surface controller function to liaise with operations base and organise any requirements e.g. task allocation for personnel.
12. When using the Macroview systems, computers in the control room to monitor the tube bundles gas monitoring system, site personnel should have approval to move monitoring locations – not having to contact a Brisbane computer consultant to modify the diagram.
13. Alarm points in the Macroview system should be reviewed as all red alarms look the same and can be misinterpreted.
14. A log should be kept of active monitoring sites in the control room.
15. Utilise email system to send information between IMT and the CRO.
16. Ergonomics of control room to be reviewed e.g. location of DAC, 3 phones and 4 computers – with three people using these at once, no one can hear clearly or operate without distraction, increasing the risks of error.
17. It is recommended that in future the scenario be created with false alarms and staged introduction to allow for more realistic response from site personnel.
18. A mine must have an established, structured and comprehensive system for managing an emergency with a trained, disciplined response team. Duty cards are not a comprehensive system; they are simply a functional aid for the overstressed cognitive processes of the human brain in the early stages of an emergency.
19. All organizations should review the ICS for application in emergency incident control. Key areas of learning are – discipline in adhering to the system, limiting the span of control (i.e. no greater than five particular resources per person), clear authority in authorizing plans and actions and managing the communication flow.

First response

1. Consideration should be given to have a ladder or some other implement available to reach the isolation valves in an emergency.
2. Consideration should be given to implementing a first response system at the mine to deal with emergencies until professional help arrives and can be deployed to assist. Industry needs to seriously address the issue of first response by way of clearly identifying what a first response team is expected to do i.e. fight the fire plus any other identified duties and what equipment they require. This will also mean that intensive fire fighting training and other associated training will be required ASAP.

Self escape

1. Training in donning and use of SCSRs needs to be addressed as indicated by previous Level 1 Mine Emergency Exercises, and highlighted in recent forums in the United States of America (USA). It is recommended to industry that a similar competency based training regime to that proposed by the USA mining industry (at refresher intervals of 3 months) is implemented as well as ensuring that all mineworkers have used a real SCSR or a training rescuer that has simulated heat and resistance capabilities.

   Not only should training in the use of SCSRs be reviewed, but also the option of installing "changeover" stations, or equivalent, where escaping mineworkers can changeover the SCSR in a less hazardous atmosphere, communicate with surface and also have the option of remaining in the station for a period of time.
2. Whenever possible mine workers utilise underground transport for evacuation purposes.
3. Serious consideration should be given to providing a SCSR (or equivalent) with a face mask that would allow communication. This does not necessarily mean to every worker, but of sufficient numbers to facilitate reasonable communication.
4. SCSR training to include information on non-verbal communication and the dangers of talking through self rescuers.
5. Consideration should be given to installing a pull-down lifeline (on bungee cord) with directional cones, positioned above the wheel ruts, which formed a natural track.
6. Consideration should be given to attaching some type of chime (like a wind chime) to a lifeline or similar device, which would be activated by the movement of people as they approach the cache.
7. All mines conduct an audit of their evacuation routes to identify and rectify any defects that may be found.
8. It is recommended that cache layouts should be standardised and lifelines provided which lead directly to the cache box.
9. Consideration should be given to supplying simple hook on ropes in each emergency breathing apparatus (EBA) cache, or training in an alternative hook-on method, such as using the cap lamp cables (each person hooking on the lamp of the person behind—forming a chain).
10. Well designed changeover stations similar to some current "refuge chambers", included in EBA cache areas, would have helped safeguard workers during the SCSR process or would facilitate refuge for those in difficulty. Such changeover stations

would allow for mineworkers to rest, change SCSR in fresh air, plan their method and route of escape and, as a last resort, leave an injured person(s) who cannot travel to await rescue. Audible signs (chimes) would have assisted workers identify their location and the proximity of key emergency infrastructure.

11. Review protocols for donning and changeover of SCSRs and provide appropriate training to all personnel.
12. Review footage of self-rescuer changeovers from the exercise as a learning tool.
13. Review time frame for removal of MSA Lifesaver 60.
14. Develop a standard evacuation protocol that includes:
    a. Use of transport
    b. When to change self-rescuers
    c. Non-verbal communication
    d. Route of travel
15. Consideration should be given to the provision of whiteboards at muster points to assist with non-verbal communication.
16. Mine personnel should spend some more time in brainstorming/training sessions to utilise available equipment innovatively to make air showers, barricades etc. This will improve the likelihood that panic won't set in should some personnel be unfit to facilitate self escape. It would be particularly beneficial where there is more than one person to use the airline.
17. Escapeways, and their alternatives, must be walked regularly until all personnel are familiar with them.
18. All personnel, including managers and supervisors must undertake regular genuine emergency evacuation incorporating poor visibility to best test the adequacy of the current systems and accurately determine emergency preparedness.
19. There must be an integrated approach to emergency evacuation focusing on enhancing survival covering: self rescuer changeovers to occur in safe havens; safe havens to be fitted with lighting, drinking water and mine plans of where you are and routes of travel to the next haven and explosion proof communication channels; distances between safe havens to be spaced for worst case scenarios of zero visibility; signs and arrows pointing to escapeways, oxygen caches, doors or roadways, delineated by hanging lanyards from the roof, must be visible and all escapeways must be maintained in good order free from excessive walking hazards.
20. It is recommended that the provision of audible call sirens be installed in the safe havens in the face areas to help lead people to them. This would allow a full accounting of persons and the provision of appropriate breathing apparatus and the ability to render any necessary first aid.
21. It appears almost impossible for a changeover of self rescuers to be done under duress without the protection of a safe haven.
22. Audible signals may be the best method to guide personnel back to face area safe haven.
23. Safe havens can be used as 'hubs' from which guidelines can extend, at a reachable height, to a number of escape ways.
24. Safe havens to contain suitable compressed air breathing apparatus that may be utilised to provide 'search capability' or 'first aid' and 'fire fighting'.
25. Explosion proof communication systems such as buried telephone lines should be explored.

26. It is strongly recommended that the process of self rescuer changeover be closely investigated and through consultation with the manufacturer, a standard procedure for the changeover of these sets be formulated to minimise the problems associated with the donning of self rescuers.
27. The mine should re-investigate the escape timelines and distances between cache locations in longwall returns – particularly where poor visibility may be experienced.
28. Investigate the number of SCSRs in the longwall return caches. In this scenario there were sufficient numbers, but there were only six people on the face. If there had been one more person on the face, there were no spare units in the caches. The escaping crew expressed concerns during the debrief of this point. Self escape routes need to be planned and serviced by sufficient SCSRs for the maximum number of personnel in the panel in both primary and alternate routes.
29. During the refresher training for SCSRs, mines must ensure that duration times of "at work" and "at rest" are explained to wearers.
30. Communication using pens and notebooks, and not talking through mouthpieces, should be adopted as an industry standard.
31. Self rescuer training should focus on entrapped procedure i.e. walking with O_2 turned off, resulting in an extra 20 minutes of O_2 time.
32. Self rescuer manufacturers to investigate modifying units to have "fluoro" mouthpieces and breathing tubes; worn over shoulder; have harder mouthpieces; have wire reinforcing in breathing tubes to prevent their constriction when heavy breathing; be easier to open and handle with wet/slippery hands; have interchangeable mouthpieces...
33. Walkways over overcasts should have handrails to prevent falling off, and not have raised steps or trip hazard and ladders traversing overcasts should be lined up or have guidelines joining them..
34. The provision of water-proof notebooks for recording information underground should be investigated.
35. Trial the use of walking sticks in areas of excessive rib spall. The trial to consider the appropriateness of using "candy cane" shaped curve handles, or the current right angled "elbow" shaped handles.
36. Treat any person who 'escapes' in the hot and humid conditions as a patient to ensure they recover from the experience – particularly re-hydration of the patient..
37. It is recommended that the ergonomics of the CABA main valves be reviewed and modified (if possible). The need to turn two valves in different directions using different hands will inevitably give rise to circumstances where both cylinders are not fully operated.
38. Access and storage of CABAs could be improved to enable easier donning of the units; review the number of CABA units and accessories (buddy masks); review pre-start checks – is the one minute high pressure leak test necessary?; training on CABAs to include oxygen cylinder use philosophy – turn one on, when warning whistle sounds turn the other on (as used in search and rescue).
39. Protocol to be developed for information transfer in an emergency – should prompt any user about the important points to be communicated.
40. Link-lines between members of the group would prevent separation of members. Link-line would need to consider distance between members e.g. buddy mask line is a limiter. A life-line would facilitate escape speed and route.

41. Indication required at cut-throughs (both sides and ribs) to identify escape facilities such as telephones, DAC and caches. Suggest that only two levels of demarcation/indication be used – one for communications and one for escape apparatus.

42. Review CABA training to ensure contingency actions are known and rehearsed. This should cater always for the unexpected. Review maintenance program to ensure that CABAs are maintained in a state of operational readiness – the program should meet, as a minimum, manufacturer's recommendations. Back-up facilities to any escape system/apparatus are required in the event of equipment failure.

43. Review emergency escape protocols to ensure the issues of how many units to carry and when to changeover are clearly outlined. It is recognised that people in a stressful situation are liable to follow their instincts.

44. Review entry barrier to Quick Fill Station – the single pogo stick hung horizontally could be split into 3 – 4 lengths to allow easier negotiation. Quick Fill Station orientation to be reviewed to enable easier and quicker access and also facilitate the use of the multiple refill points – recommend that the station be turned 90°so that the refill points are in line with the cut-through and do not face the rib. Main valve operation on refill side of the Quick Fill Station should be reviewed – is it required? Can it be arranged to turn on when any quick fill outlet is operated? Maintenance and inspection program to be reviewed to include external fittings and their operation.

45. To assist in locating phones in thick smoke, phones should give an audible beep on a regular interval.

46. When the Deputy or ERZ Controller is taken away from the crew there is no gas detection capability to determine the necessity of continuing to wear self rescuers. The provision of a fixed station's visible display of gas readings e.g. at positions in the primary escape roadway may be worth investigating. The potential for the provision of multi-gas detectors and relevant tubes in caches and training in their use should be investigated.

47. The introduction of changeover stations to the mines should be evaluated. This would allow verbal communication with the surface en-route and provide a place to leave injured persons if required. It also allows a safer environment for the changeover of SCSRs.

48. Instructing crews to discuss escape options and to have a plan and to nominate a leader prior to starting escape.

49. Consideration should be given to developing procedures and systems that allow:

50. Competent persons to use more than one fire extinguisher prior to it being classified as a major emergency. The standard operating procedure allows no objective way of risk assessing and managing the fire. Consequently, there is a reluctance to assess a fire and take other appropriate action. There are situations where more than one fire extinguisher is required to douse a fire. That does not necessarily increase the risk profile.

51. Competent persons (other than mines rescue trained teams) to be deployed in inspecting and/or fighting fires with water hoses (e.g. ERZ Controller). In some cases it is an acceptable risk to allow persons to inspect fires. The time taken to deploy mines rescue teams allows fires to increase in intensity.

52. Personnel that have evacuated to the outbye side of a fire (subject to appropriate health and fitness checks) to inspect or participate in fighting fires under the guidance of a suitably trained person.
53. Resources to be used to fight fires to be identified prior to mobilizing fire fighting teams.
54. Personnel assigned fire fighting duties should be competent and adequately briefed of the risks and their duties. The fire watch team was not considered competent to perform their duties to standard.
55. Training for personnel working alone in the mine for the discovery of fires, incidents and their actions to minimise the affects to the underground environment.
56. A realistic fire gallery should be used to train mine personnel in fire fighting.

Communication and decision-making

1. **Review maintenance of personal emergency devices (PEDs) and remove faulty PEDs from service.**
2. **Review CRO evacuation procedures to include a general PED message to all personnel required to evacuate.**
3. **Review training of statutory officials (and other personnel who may be required to lead in an emergency e.g. rescue personnel, leading hands) to include decision-making, leadership, communication and accounting for personnel.**
4. There must be established a central, clearly identifiable, decision-making process, based on risk assessment principles.
5. All underground communications should be capable to being call-forwarded to the incident control room with automatic recording devices attached.
6. Accurate information flows must be established to minimise decisions that may result in catastrophic consequences.
7. It is important that there is provision for communications out of the control room as all stakeholders must be kept regularly briefed on currency and status of events.
8. The lack of a formal recording system would be seen as a major discrepancy by a Warden's Inquiry in the process of determining true nature and cause as vital information can be lost.
9. Communication between the control room and IMT needs improvement regarding: access of people in and out of control room; phone systems installed; how information is passed on, etc.
10. There must be clear authority of exactly who is in command and how decisions will be made with a definition of the composition of the incident control team.
11. Implement a communication system to the surface from each of the main cache locations for tracking of crews escaping and one-way communications from Control for updates etc.
12. Implement a system to ensure ALL personnel underground receive notification of an emergency as quickly as possible.
13. The communications interaction between the various operation areas needs to be systematically organised such that all operational areas are provided with the necessary information and updated regularly. Consideration should be given to undertaking this electronically to minimise the disruption of phone calls.

14. Provision of at least two telephones with people assigned as scribes to take incoming calls and make outgoing calls. One telephone should be assigned for incoming calls and one telephone assigned for use by the IMT for outgoing calls only. Lines of communication need to be clearly defined so that 'closed loop' communications can be achieved, with automatic feedback. Lines of communication will curtail some telephone traffic to the IMT and allow improved operation.
15. IMT needs to have direct communications to all critical personnel and functions. This may include debriefing of key witnesses, briefing initial team, briefing persons/teams for a critical tasks and getting direct updates from crucial areas underground. The more important the person's/team's task is to a successful outcome, the more direct the communications need to be with IMT.
16. There needs to be a clearly defined decision-making and validation process in place for all decisions, particularly those of the IMT.
17. The decision-making process needs more focus and each option needs to be driven to completion before allowing digression.
18. All IMT members need to be encouraged to actively participate in the decision-making process.
19. There needs to be more urgency in decision-making when retrieving persons underground who are injured or have limited life support equipment available.
20. An automated emergency callout system should be utilised and triggered from the CROs computer, with a voice message to land lines and SMS to mobile phones.
21. Improve information flow back to the communication officer. The system needs to specifically address how communication is to flow around the site and to which particular team members or individuals.
22. Communication via the emergency button on the phones was difficult, neither the underground evacuees nor control could understand each other. An adequate means of communication needs to be implemented.
23. Consider using electronic reporting systems.
24. Incident action plans should be developed and documented with time and date on them to enable all persons to be briefed on current situation and for clear understanding of required actions by operational teams.
25. If the mines drift block lights are used as an additional means to stop personnel from entering the mine the underground light should remain green to enable personnel to exit to the surface. Normal controls will be needed when a mine re-entry or deployment of vehicles from the surface is undertaken.

Incident management and control

1. Incident Management Process—in recent years the mining industry has started to adopt the ICS training provided by the Queensland Fire and Rescue Service or the mining version called MEMS. Mine sites need to clearly evaluate which system they are going to utilise to cope with emergency response (including the conventional systems already in place). Each mine must then ensure that their staff are trained, practiced and competent to fulfil their roles and responsibilities as identified in their own system.
2. ICS - The personnel need to be trained in the functions required for the ICS system to work. This training relates not only to the functions of an individual but also to the

recognition of the roles and responsibilities of others and the appropriate interaction mechanisms.

3. The Planning Group is also required to maintain an information service. This is critical to ensure that we are dealing with accurate information and that all groups are dealing with the latest and validated information.
4. Allocate activities based on the functional grouping of the ICS.
5. Risk assessments must be documented and structured for all actions and decisions being undertaken.
6. Develop a procedure or a list of questions to maximise the most of this type of interaction, and to ensure accurate information is obtained.
7. Mine site Level 2 exercises should be carried out to test the practicality of personnel to carry out designated functions with available resources.
8. Personnel should consult duty cards to ensure functions required were carried out. Duty cards should reflect required functionality. By implication duty cards specify the roles of key personnel – if function is not listed it is not part of role – e.g. what is role of Ventilation Officer? – part specified by duty card 2, but clearly the role extends beyond this.
9. Do not carry out informal or non-documented risk assessments.
10. Structure - Follow a structure for risk assessments and discussions to ensure that conclusions are reached and digression does not occur. Personnel in the Planning Group need to follow the discipline of the meeting process to ensure effective operation of the Planning Group.
11. Review the Emergency Response Principal Hazard Management Plan (PHMP):
    a. Review of the base risk assessment to ensure it covers the mine's current risk profile
    b. Documented standards for cache layout and design and for egress marking
    c. Initial response to a fire
    d. Early warning of fire through the correct location and alarm levels of real time monitor, and TARPs for gas monitoring alarms that provide for a graduated response
    e. Defined review periods/triggers for the PHMP and associated TARPs and Standard operating procedures (SOPs).
    f. Set KPIs suitable for management review to determine the health of the PHMP such as training compliance, audit and review compliance and audit results
    g. Determine the appropriate training, assessment and retraining scheme for senior management, CRO, mining officials and duty card holders in the PHMP and associated protocols.
    h. Determine the appropriate training assessment and retraining scheme for all underground personnel in escape equipment and consider the action to be taken when persons are not in training compliance.
    i. Review the duty cards. Consider the provision of a simple duty card system for the CRO to assist in the direction of initial response and the tracking of personnel underground in an emergency. The current numbered duty cards (No. 1 to 8) should be reviewed as a result of and taking into account the results of the exercise.

12. **Consideration should be given to the processing of incident information and decision making online so that all parties, including SSE and QMRS have all information readily available.**
13. Succession plans must be developed and implemented – people were getting tired.
14. Emergency duty card systems must be reviewed as to achieving objectives using realistic numbers of personnel.
15. There must be a central, clearly defined incident control team.
16. An adequately resourced incident control room from which to exert central control is absolutely essential.
17. Recording and logging of events is essential and must be maintained throughout an emergency.
18. Provision must be made for impounding and securing evidence i.e. Deputy or ERZ controller mini-gas instruments.
19. Gathering of experts to provide specialist advice – proximate cause, predictive analysis, options and choices, process control experts specifically to ensure essential process occur/flow.
20. It is essential to have an evacuation trigger point flow chart on the control room wall, similar to the call-out procedure flow chart.
21. There must be clearly defined goals, objectives and priorities established by the Incident Control Team including the establishment of an action plan.
22. There must be effective recording procedures, especially by the Incident Control Team of any actions taken, decisions made and reasons/evidence supporting these decisions.
23. Operational base membership should be pre-planned and have identification vests on and have pre-designated times for reconvening for updates on situation.
24. Urgent need to improve the water collecting/dividing manifold.
25. A central point is needed where all current duty card holders are identified with name, location and contact phone number and possibly have something to identify them to outsiders who come to the site.
26. When duty card holders change, this needs to be identified formally. Handover procedures for the Incident Management Team and a range of suitable personnel to fill various roles should be defined.
27. Numbers of people in Incident Management Team room needs to be reduced, maximum should be 5 or 6, not 13 as was the case at various times. Possibly only have sufficient seating for the main players.
28. Process management (decision-making process, time wasting, verification of data, information flow in and out of the incident management room, briefings done on time, checking milestone events, interaction of members) remains a vital part of incident management and must always be at the forefront of the operations within the IMT.
29. Authorities between the Underground Management Room and the IMT need to be revisited and operational effectiveness analysed.
30. The Mine Manager should be part of the IMT.
31. Reviews and assessments of critical issues need to be done in a coordinated manner and followed through to completion.
32. IMT members should not be going in and out of the room while the IMT is meeting.

33. Fire Officer to review quantities of low expansion foam held on site and the first response capability of people with respect to fire fighting.
34. Develop improved incident management aids for the IMT to assist the application of a disciplined system for information management, recording and decision-making. Possibly pre-designed whiteboards on the back of the day-to-day whiteboards, that is, flip them over and they are laid out ready.
35. Develop a structured 'decision' (authority) delegation tool for assisting the IMT to remain strategic.
36. Emergency incident management training is to be considered for mid and upper level management.
37. The creation of a position of "Emergency Officer" specifically to address and facilitate expertise in emergency management, fire fighting, chemical hazard management and emergency safety training and systems (not simply another hat but a specific position). The Health and Safety Officer is a different role from this position but they would work with each other.
38. More frequent simulated exercises in atmospheres of impaired vision should be conducted. Everyone in the industry should be exposed to this scenario.
39. Ensure that the number and balance of the IMT is correct. This is a question of fatigue and how long a team should remain constituted until relieved.
40. Ensure that key personnel can be contacted at all times. The location of the Ventilation Officer was incorrectly logged and it was only when the Underground Mine Manager was contacted that the control room officer became aware of the Ventilation Officer's location.
41. The system to record the names and location of personnel below ground needs improvement as when some personnel evacuated the mine their tags were not relocated on the tag board causing confusion.
42. All personnel must remove tags or replace lamps, dependent on the system of accounting for personnel when they are safely on the surface.
43. At one point the contact numbers of persons to be notified in case of emergency for the contractors still underground was discussed and how they could be acquired. If the contractor log books had been in use at the mine, as had previously been agreed to by all underground mines, the details would have been readily available.
44. Develop a card system whereby sufficiently training personnel are available to conduct the tasks required by the duty card list.
45. The impact of unstated intrinsic objectives such as – complying with established written procedures, mitigating legal liabilities and favourable judgment of performance by peers against attaining extrinsic objectives such as – saving lives, protecting property and recovery operations as research indicates that incident management systems have little, if any, impact on the survival rates of underground personnel in the first two hours following a major event.
46. Consideration should be made towards the 'closeting' of the IMT for the greater part of the exercise. This may mentally reduce the potential of individuals to develop independent and innovative solutions due to long periods of intense pressure and an increase in the likelihood of developing a 'group think' mentality.
47. Duty card holders need to recognise the need to remain with the IMT unless authorized to leave. This is especially true if there is an exchange of roles.

48. A systematic process for evaluating fatigue should be implemented rather than rely on the individuals to notify the Incident Controller of their status.
49. Calculators should be included in the duty card briefcases.
50. Suitable techniques should be used to capture ideas, generate alternatives and evaluate the different options to allow for systematic comparison.
51. The IMT members change-over should be conducted on a staggered basis with no more than 2 persons being shifted at a time. This will provide for much more cohesion in the team and limit the possibility of loss of information.
52. A written chronological record of milestone events be kept, updated and regularly referred to.
53. Consideration be given to allowing the display of this information (through windows) so that persons can update themselves without having to constantly interrupt the IMT discussions with questions.
54. A series of check sheets should be developed for IMT2 to act as memory prompts in the same way as a debriefing officer ensures capture of information. The prompt sheets could include such things as: options discussed and reasons for not doing and/or doing; current goals/actions with expected outcomes, responsibilities and timeframes; any alternative or secondary thrusts being investigated; any limits established....time, gas levels, temperatures; problems or difficulties experienced to date.
55. It is recommended that IMT is to directly brief anybody being dispatched from the surface (mines rescue fresh air base personnel, transport drivers, mines rescue teams, etc) or at least be present during the briefing.
56. It is recommended to allocate a person as surface coordinator to oversee all of the surface tasks, movement of personnel in and out of the mine and liaison with IMT. The control, allocation and updating of the deployment and availability of resources is a vital function of a coordinated emergency response and cannot be overlooked.
57. It is recommended that whiteboards for IMT be pre-formed and ready to be filled in with information like: goals, priorities, location of men underground, known facts, assumptions or data to be confirmed (and how to confirm), gas trending, intervention activities, contingency plans (who and what), etc.
58. The CRO cannot be the first aid attendant at the same time during an incident.

Mines rescue

1. **Consideration should be given by QMRS to review its communication methods with operational teams – this equipment is outdated.**
2. **Consideration is to be given to review the minimum number of mines rescue trainees – with most people working 12-hour shifts this effectively reduces the number of trainees available to respond by half (fatigue related policies), also with people choosing to live remote from mining areas response times/availability of trainees is prolonged.**
3. **Site based mines rescue personnel should be trained in mines rescue protocols to provide mines rescue input into the Planning Group/IMT before mines rescue arrive on site.**
4. **Review response protocols for QMRS.**
5. **QMRS need to consider response times to all underground mines and factors which may affect this.**

6. It is recommended that further efforts are implemented to ensure that all team members are aware of the task they have been asked to perform and each person's role in the team (there appeared to be confusion on team roles when the original team captain was reassigned to mines rescue fresh air base control).
7. It is recommended that consideration be given to the use of 'ex-brigadesmen' in roles such as mines rescue fresh air base officials to allow full use of "BA current" men (this is particularly relevant when rescue volunteers are few).
8. QMRS teams are to ensure all team protocols are adhered to – even in the absence of reality, it is good practice (e.g. communications and information left with FAB official, captain/team checks on equipment, etc).
9. A formal log be kept of the location and status of all rescue equipment (this task is probably best done by surface control, although it requires input from mines rescue fresh air base officials). This becomes particularly important when two types of breathing apparatus were available for use.
10. Guidelines be developed and implemented for use of vehicles in potentially poor visibility.
11. Emergency communication protocols be reviewed. The rescue efforts were hampered by a lack of effective communications between the mines rescue fresh air base and the surface. The solution presented by the rescue controller to cut the telephone lines at 2 cut-through and install a phone was prevented by the assessment team. In the scenario, this would have cut communications to the remaining survivors underground – and in reality, it would have severed communication to the rest of the mine (some sections of which were still operating). There should have been better options.
12. An expert working party be established to develop and implement a set of guidelines on the protocols for a combined mine-site and QMRS intervention effort (i.e. when is it okay to keep a panel crew on breathing apparatus? When should mines rescue teams take over? How should these two groups interact with each other? What are the potential risks?).
13. A need exists to clarify the call out process to mines rescue mutual assistance to ensure that not every trainee is called to attend the site immediately and that only those required be called initially.
14. The Mines Rescue Superintendent has a responsibility to obtain information and keep his personnel fully informed of the status of events, not just wait to be told.
15. The use of home answering machines interfered with the mines rescue call out procedure.
16. A reference system needs to be introduced to ensure that only those trainees current under medical and oxygen time are placed on active duty.
17. Mines Rescue Superintendent vehicle should have 'hands-free' provisions to answer calls and received updates whilst in transit to an emergency.
18. Station Superintendent should be part of operations based team to assist management on mines rescue, gas interpretation, ventilation, fire fighting, escape systems and intervention strategies.
19. Mines rescue key staff need to be identified and should have colour identification jackets on.
20. Mines rescue and team captains need to be present at witnesses debriefings or read their reports.

21. Mutual assistance standard needs to be looked at as call out response times were outside the one hour limit.
22. An expert working party be established to research the use of flameproof vehicles in atmospheres containing levels of flammable gases in excess of the current legislative requirements, and guidelines to be developed on how and when they may or may not be used in life threatening scenarios. The outcome of this research may result in changes in the wording of legislation.
23. QMRS and mines through their mines rescue agreement should ensure that competencies are developed and persons training for the key positions of fresh air base controller and substation mines rescue controller so that in the event of QMRS staff members not being available, competent persons will be available for these key roles.
24. Whilst QMRS have developed controls to attempt to minimise the effects on mines rescue personnel deployed in hot and humid conditions, these controls (administrative controls) are low on the list of hierarchy of controls. It is recommended that QMRS investigate modern control methods to minimise this hazard. Some controls may include cooling vests, cooling of breathing tubes, etc.
25. When developing mines rescue team tasks, position, status and content of the mine's emergency equipment which may be relevant to the task being undertaken should be marked on the plan and communicated to the mines rescue teams and fresh air base controller.
26. The exercise clearly showed that the better the escape systems (and therefore survival systems) in place at a mine, the more likely it is that mines rescue teams will be required to enter and search for survivors, some of whom may be at distances not able to be covered on foot within the time constraints placed by use of self-contained breathing apparatus. The industry as a whole needs to ensure we are ready for this.
27. It is recommended that a forum of stakeholders be urgently established to develop and implement a set of protocols covering the interactions between mine-site first response teams and external aided-rescue organizations. Each of these practices provides specialist, but separate, skills and resources and it is vital that the issues involved in their interactions be identified and coordinated. There is little doubt that CABA teams will increasingly form part of emergency response capabilities in our industry and we must be prepared.
28. It is apparent that some protocols may be hindering the ability of the QMRS to achieve its goals of search and rescue, therefore, it is recommended that a review of mines rescue protocols and procedures be undertaken to determine their continued compatibility with the industry change from traditional aided rescue to the current preferred strategy of self escape. This should specifically cover the policies on team sizes, minimum equipment, stand-by team protocols, etc.
29. There needs to be a review of the number of brigadesmen that the mine can supply at any time of the day or work roster. This could also be expanded to other mines in the mutual assistance group.
30. Consideration could be given to training more of the workforce in basic fire fighting.
31. Protocols on how mines rescue trained personnel on site are to be utilised should be developed. This can take into account the type of emergency, number available and specific duty card or other specialized needs.
32. Protocols need to be developed regarding what inseam personnel can and cannot do while they are still underground. This commences with a company protocol and

leads to a mines rescue guideline on actions and barriers that are required for inseam intervention e.g. could the mine's three rescue trained personnel coming out of the mine have gone to the fire and put it out?

33. Greater effort and focus from key mine and mines rescue personnel needs to be given to getting the first team off the surface.
34. Whiteboards should be developed for use in the rescue room which clearly show: locations and state of critical equipment; team membership and their equipment; captains type board with basic emergency information and team deployment information and critical times.
35. Risk assessment of critical and/or hazardous activities should be undertaken e.g. when Team 1 decided to fight the fire – how many men should they have had; what BA should they have had (there was CABA on the surface also); what communications should they have had; what turnout gear and first aid equipment do they have; method of fire fighting; active times, etc.
36. The Incident Controller or senior IMT member should brief mines rescue teams or at least be present to ensure that all information is being passed on and that questions can be answered by somebody familiar with the mine.
37. Testing of mines rescue equipment should be continued until all of it is completed.
38. Greater concentration on getting the first team off the surface, properly debriefed and equipped is needed as this is the hardest thing to do in reality. Once the actions and limits are set by the IMT, this must become the priority.
39. The role of the QMRS within the IMT should be clearly defined e.g. formally recognised as part of the decision-making team and/or advisory and/or implementation.
40. Clearly defined instructions to be issued to rescue teams. One way of doing so could be writing the instructions on the electronic whiteboard in the IMT room and giving the printout to rescue teams.
41. The role of preparing and issuing plans during an incident should be clearly defined. Additional plans will always be required. This may be a role for the mine surveyor.
42. It is recommended to allocate a designated coordinator to the critical area underground to oversee operations and to communicate directly to IMT – this is especially critical when there are multiple groups operating in one area.
43. It is recommended that a clear decision and instruction on what breathing apparatus is to be used by persons, that is, BG174 or CABA, when both are available.
44. It is recommended that the mines rescue briefing room have schematics indicating location (surface and underground), type, quantity, pressures of all breathing apparatus equipment that can be used. This schematic could include poor visibility walking times between caches and CABA locations.
45. It is recommended that the mines rescue room have a wall prompt indicating priority actions for QMRS personnel as they arrive and when allocated to rescue room duties.
46. Use QMRS cards rather than having to make up visitors' cards for rescue teams.
47. Mines rescue activities should be coordinated through the operations team with a clear communication strategy between mines rescue teams and operations centre, then onto the IMT and Incident Controller.
48. Mines rescue must be fully briefed on who and where people are expected to be underground.

GAG

1. Time delay for the arrival of the fuel tanker for the GAG engine (5 hours) is unacceptable.
2. Maintenance on the GAG was poor in the following areas: fuel leaks around the afterburner injectors; requirement to clean spark plug should not be performed at deployment.
3. It is essential that enough water pressure be available to safely operate the GAG unit.
4. The circumstances regarding the GAG inertisation equipment must be addressed as a matter of priority and in accordance with the current mines rescue agreement in the provision of adequate docking facilities and water supply.
5. Site provisions for use of GAG and mobile laboratory to be investigated and documented to include provision of power, communications to incident control team, parking and the ability to connect the tube bundle systems and other sample locations.

Appendix C: Management team/assessors

Anthony Alexopoulos

Mining Engineer, Anglo Coal (Capcoal Management) Grasstree Mine, Queensland

Anthony graduated UNSW Bachelor of Engineering (mining) with honours 2004. Graduate mining engineer at Grasstree Mine working in technical services and operations as well as spending time underground on the longwall and in development and on development improvement projects. Anthony is currently working as ventilation and gas drainage engineer for the Capcoal group.

Jon Balcomb

Mining Engineer, BMA Crinum Mine, Queensland

Jon graduated in 2004 from UNSW as a Mining Engineer and started on a two year graduate program at Crinum rotating through various departments to gain experience, including longwall development. Jon has currently been working as a Development Shift Supervisor for the past nine months. Jon have also been a brigadesman with QMRS for two years and competed in a number of mines rescue competitions during this time.

Darren Brady

Principal Scientific Advisor, Simtars, Queensland Department of Mines and Energy

Darren, a qualified chemist and member of the Royal Australian Chemical Institute, is the Principal Scientific Advisor at Simtars and has been involved in mine gas analysis and interpretation for the past 16 years. During this time he has been responsible for the ongoing development and support of the Simtars gas chromatograph based Camgas system. He has worked with mines in Queensland, New South Wales and overseas to functionally implement the system. He has developed an extensive knowledge and experience in monitoring and interpretation of mine gases during emergency situations and he has also extensive practical experience in mine sealing operations. He heads Simtars' mine emergency response group, which has responded to mine explosions, fires and spontaneous combustion events. He is also involved in spontaneous combustion training, testing and research.

Steve Bullough

Longwall Coordinator, BMA Crinum Mine, Queensland

Steve is currently the Longwall/Services Project Coordinator for Crinum Coal Mine. He has an extensive mining background, having worked underground for 32 years in varying roles from miner through to shift coordinator at coal mines throughout Queensland and NSW. Steve was a former board member for the QMRS and has been an assessor for the

Blackwater district mines rescue competitions for the past 12 years. Steve has been involved in mines rescue activities since the 1982.

Brett Capper

Development Superintendent, Anglo Coal Australia Moranbah North Mine, Queensland

Brett is currently the Development Superintendent at the Moranbah North Mine. He joined the industry in 1998 after graduating from the University of Queensland with a Bachelor of Engineering (Mining). Since that time he has worked at mines in Queensland and New South Wales in both underground and open cut operations. Positions over that time have ranged from contract management of major drivage contracts, longwall and development coordinator roles to technical roles. He also holds an Undermanager's Certificate of Competency.

Dave Carter

Emergency Response Coordinator, BMA Broadmeadow Mine, Queensland

Dave has held various positions in the mining industry for 6 years, including Health and Safety Officer at Anderson Industries, Fire Technician at Flametech Engineering and Contract Fire Officer at Broadmeadow. Most recent position is Emergency Response Coordinator at Broadmeadow.

David Cliff

Acting Director, Minerals Industry Safety and Health Centre (MISHC) University of Queensland

David is an Associate Professor at MISHC. His primary role is the undertaking of applied research and consulting in health and safety in the mining industry. Previously David was the Safety and Health Adviser to the Queensland Mining Council, and prior to that Manager of Mining Research at Simtars. In these capacities he has provided expert assistance in the areas of health and safety to the mining industry for over eighteen years. He has developed particular expertise in gas analysis, spontaneous combustion, information management, decision making, fires and explosions. In recent times he has also devoted a lot of energy to fitness for duty issues and the health and safety impacts of hours of work.

John Coughlan

Mainroads Superintendent, RTCA Kestrel Mine, Queensland

John is currently at Kestrel Mine and responsible for mains drivage, in seam dewatering and mine roadways integrity. A mining engineer with 20 years experience, John commenced coal mining in Queensland at Collinsville in 1988. He has underground and opencut mining experience in coal, gold and iron ore. He has worked in a number of states in Australia as well as New Zealand and Indonesia. John has previous mines rescue

experience, an open cut examiners ticket and is currently studying for his Ventilation Officer's ticket.

Greg Dalliston

Industry Safety and Health Representative, CFMEU Mining and Energy Division, Queensland

Greg has been involved in the mining industry for 32 years and has gained experience in numerous areas. He started his career as a Cadet Mine Manager with the Queensland Coal Association prior to working in a variety of positions within the industry, including eight years as a Mine Deputy/ERZ Controller. Greg is employed as an Industry Safety and Health Representative with the CFMEU, a position that he has held for the last fourteen years.

Some of the roles pertaining to this position have included:

- Participating in tripartite industry committees to develop new safety and health legislation for the Queensland coal mining industry;
- Member of state and national training committees for the mining industry;
- Conducting safety audits and inspections at coal mines throughout Queensland;
- Investigating serious and fatal mining accidents and assisting the mining warden as a reviewer into mining accidents;
- Conducting debriefs after incidents and providing critical incident management services;
- Development of manager, undermanager and Deputy statutory national competency standards, including risk management and emergency response;
- Role in organising the 2006 Fight or Flight Seminar from which industry best practice is being developed for mine emergency response;
- Member of the Queensland Level 1 Organising Committee since its inception in 1998; and
- Member of the Coal Mines Safety and Health Advisory Council and Inspectorate Review Committee.

John Danckert

Underground Mine Manager, Douglass Colliery, South Africa

John is currently employed as underground mine manager at Douglass Colliery and is the team manager of the mines rescue team. He has held various management positions from shift overseer, mine captain to mine manager. John was on assignment from South Africa at the time of the exercise and acted as an assessor of the incident management response.

Seamus Devlin

Manager - Northern Operations, New South Wales Mines Rescue Service

Seamus is currently the Manager of Newcastle and Hunter Valley Mines Rescue Stations. He has thirty two years coal mining experience and thirty years in mines rescue and has worked in both NSW and Queensland. He is an Associate Fellow of the Risk Management Institute of Australia.

Mick Farrag

Manager - Operations, Queensland Mines Rescue Service

Mick joined the industry in 1996 as a miner and subsequently a Deputy (ERZ Controller) at Kenmare Mine. He moved to Moranbah North and undertook the roles of Longwall Deputy, Mines Rescue Coordinator and Statutory Fire Officer. In November 2003, Michael was appointed Manager of Operations for QMRS. As Manager of Operations, his principal areas of responsibility include the continuation and development of operational systems, policy, procedures, audits and standards. Michael has also been instrumental in the development and implementation of MEMS.

Bryan Harrington

Mine Manager, Terrace Mine, Solid Energy, New Zealand

Bryan has worked in the New Zealand mining industry for 25 years, working at various mine sites around the west coast region, gaining experience in a number of development methods. Bryan was involved in the initial trial of the hydro monitor extraction method in New Zealand mining, which has since become the preferred extraction method used in west coast mining. Bryan has held a number of positions in Solid Energy from a development machine operator to Production Supervisor to Undermanager through to his current role as Mine Manager of the Terrace Underground Coal Mine.

Marc Kirsten

Underground Mine Manager, Newlands Northern Underground, Xstrata Coal Queensland

Marc is currently working as the Underground Mine Manager at Xstrata Coal Queensland's Newlands Northern Underground Coal Mine. He has broad experience in the underground mining industry both in NSW and more recently Queensland. Marc has worked in various positions within the industry including technical, statutory and production based roles. He has exposure to numerous technical positions were he has been involved in areas such as ventilation, mine planning, geotechnical and geological roles. He has also worked in various statutory positions in NSW including as a Deputy (ERZ Controller) and Undermanager. Marc was a NSW Mines Rescue Brigadesman for a number of years and has been involved in rescue competitions through site teams in NSW.

Alex Mackay

Mining Engineer/Ventilation Officer, Anglo Coal Aquila Mine, Queensland

Alex joined the mining industry as a Mining Engineer in 2002. After an all too brief stint in the Hunter Valley area working at Anglo's Drayton Open Cut operation, Alex moved to Central Queensland in 2004 and has worked at Anglo Coal's Capcoal underground operations since then, moving between the five underground operations in changing roles. He is currently the appointed Ventilation Officer for the thin-seam Aquila mine.

Larry Ryan

Computer Systems Engineer, Simtars, Queensland Department of Mines and Energy

Larry has been involved in the development of Safegas, Segas Professional, Ezgas Professional and other gas monitoring software for the coal mining fields for 8 years. During the Level 1 Mine Emergency Exercise, Larry was involved in the actual running of the software simulation on the Safegas software. Larry has developed, tested, installed and commissioned the Safegas gas monitoring software at mine sites in Queensland, NSW, New Zealand and the USA.

Kirrily Starr

Project officer, Strategic Procurement, Queensland Department of Natural Resources and Water

Kirrily worked for the Safety and Health Division of the Queensland Department of Mines and Energy for 12 years and was the Logistics Coordinator for seven previous Level 1 Mine Emergency Exercises. Kirrily was also the Technical Officer for safety management system audits for both coal and metalliferous mines throughout Queensland and the Training Officer for the Queensland Mines, Explosives and Petroleum and Gas Inspectors. Kirrily acted as the "press" making phone calls to the mine seeking information on the incident.

Maree Tanner

Executive Secretary, Simtars, Queensland Department of Mines and Energy

Maree has worked at Simtars for almost 10 years as Executive Secretary to the Director and has an Associate Diploma in Business (Management). Other responsibilities at Simtars have included Conference Coordinator for the 31st International Safety in Mines Research Institutes Conference in October 2005 and administrative support for various projects, including an AusAID project in India, various international trade missions and mines rescue vehicle demonstrations. Prior to working at Simtars, Maree was the Site Manager at Australian Coal Industry Research Laboratory (ACIRL) Ltd and has held senior administration positions at HLA-Envirosciences and Ipswich City Council.

Alan Wardle

Safety Coordinator, BMA Broadmeadow Mine, Queensland

Alan has been working in underground coal for 10 years in several mines in the Bowen Basin including Newlands South, Oaky 1 and Moranbah North. Alan is experienced in development and longwall mining from roles as miner, mechanical fitter, Mine Deputy (ERZ Controller) and Emergency Response Coordinator. Alan is currently at BMA Broadmeadow Mine as Safety Coordinator, recently completed lead auditor and "G" Three competency and looking to extend his education to a Diploma in Risk Management.

Martin Watkinson

Principal Mining Engineer, Simtars, Queensland Department of Mines and Energy

Martin is the Acting Manager, Occupational Hygiene, Environment and Chemistry Centre at Simtars and is responsible for the professional activities of over 30 professional staff. He has been involved in all the Level 1 Mine Emergency Exercises since 2001 and has been the chair of the Executive Organising Committee since 2006.

Martin was employed as Technical Services Manager at North Goonyella Coal Mine, Senior Mining Engineer and Ventilation Officer at Moranbah North Coal Mine during the initial mine development and longwall installation. Prior to accepting his appointment at Moranbah North, Martin worked for International Mining Consultants for seven years, undertaking assignments in China, India, Iran, Siberia, Tanzania and Vietnam.

Tim Watson

Inspector of Mines, Queensland Department of Mines and Energy

Tim is an Inspector of Mines based in Mackay. He has over 17 years experience in coal mining and rescue training. He has held a variety of positions at coal mines, including coal mine worker, Deputy (ERZ Controller), Undermanager and Manager.

Glossary

Term	Definition
AMR	A brand of gas detector
Approved standard	A standard made for safety and health under the repealed Coal Mining Safety and Health Act 1925 stating ways to achieve an acceptable level of risk to persons arising out of coal mining operations.
Armoured flexible (face) conveyor (AFC)	A chain conveyor that conveys coal along the longwall face and transfers it to the beam stage loader.
AusAID	Australian Government's overseas aid program
Beam stage loader (BSL)	A chain conveyor which transfers coal from the armoured flexible (face) conveyor to the gate conveyor.
Bleeder heading	An underground roadway in a mine where air is allowed to circulate around a working longwall face.
Blindman stick	Plastic conduit bent into a hook and used to guide persons who have no or limited visibility in the same way that a blind person uses a white cane.
Brattice	Plastic sheet material made from fire resistant antistatic material used to construct temporary ventilation control devices in an underground coal mine.
Brigadesman	Mines rescue team member
c/t	Cut-through
CABA	Compressed air breathing apparatus
CD	Compact disk
CFMEU	Construction, Forestry, Mining and Energy Union
CH_4	Methane
Changeover bay	A place for the changeover of one self contained self rescuer to another, possibly with ventilation to ensure that this can be achieved with no exposure to contaminated air.
CO	Carbon monoxide

Term	Definition
CO_2	Carbon dioxide
Continuous miner	Coal cutting machine used to develop new roadways in a mine.
Crib room	Location where mineworkers eat, and a meeting station for the ERZ Controllers.
CRO	Control room operator
Cut-through	A passage cut through the coal, connecting two parallel entries.
Cylume stick	Plastic sleeved container of two chemicals which when twisted the chemicals combine and provide a light source as a result of the chemical reaction.
DAC	Underground intercom system also referred to as the tannoy
Deputy	Mine worker responsible for safety inspections. This is the name given under old Queensland legislation. See also ERZ Controller.
EBA	Emergency breathing apparatus
Eimco	Brand name of a flameproof mechanical shovel
EMP	Emergency management plan (interchangeable with ERP)
EMT	Emergency management team
ERP	Emergency response plan (interchangeable with EMP)
ERZ	Explosion risk zone
ERZ Controller	Mine worker responsible for safety inspections traditionally referred to as a Deputy.
Face	The exposed surface of a coal deposit in the working place where mining is proceeding.
Face-road	Underground roadway which is driven to install the longwall equipment on. Usually wider than the normal roadways driven underground.
Flameproof	Explosion protected. In relation to underground coal mine vehicles flameproof means the vehicle and engine have been modified and fitted with extra safety equipment to ensure it will not propagate or generate flame or sparks which could initiate an explosion of the surrounding atmosphere.

Term	Definition
Flaps	Brattice sheets hung from the mine roof used as a ventilation control device.
Fresh air base	A continuously monitored station for dispatch or return of rescue teams in close proximity to irrespirable zones.
GAG	A device based on a Polish military jet engine used to produce large quantities of inert exhaust gas for extinguishing underground mine fires
Gas chromatograph.	A laboratory instrument used to analyse the composition of gas samples.
Gate conveyor	The gate conveyor is the belt conveyor which conveys the coal from the BSL to the outbye conveyors
GC	Gas chromatograph
"Go Line"	An assembly area on the surface where mobile plant is left after servicing and when available for use.
ICS	Incident control system
ICT	Incident control team (term is interchangeable with IMT)
IMT	Incident management team (term is interchangeable with ICT)
Inbye	Mining term for into the underground mine (away from the surface) from the point of reference
Industry safety and health representative	A person who is appointed under section 109(1)5 of the Coal Mining Safety and Health Act 1999 to represent coal mine workers on safety and health matters and who performs the functions and exercises the powers of an industry safety and health representative mentioned in part 8, division 2.
Inertisation	The act of decreasing oxygen concentration in the mine atmosphere by the introduction of other gases such as nitrogen or carbon monoxide to prevent a possible explosion
ISHR	Industry safety and health representative
Key performance indicator	A measure performance against a required outcome.
LEL	Lower explosive limit

Term	Definition
Level 1 mine emergency exercise	State level mine emergency exercise to test the mine's emergency response system; test the ability of external services to administer assistance and provide a focal point for emergency preparedness in the state.
Level 2 mine emergency exercise	A major mine site exercise to test the mine's emergency response system and communication with external services.
Level 3 mine emergency exercise	A minor mine site exercise to ensure all personnel are familiar with the mine's emergency evacuation plan and provide practical training in emergency response including evacuation.
Longwall face	A method of mining flat-bedded deposits, in which the working face is advanced over a considerable width at one time.
Lower explosive limit	The concentration in the atmosphere of an explosive gas or vapour that must be reached before an explosion of that gas can occur. Below this concentration there is insufficient quantity of fuel to propagate a reaction.
Macroview	A brand of mine SCADA system.
Maingate	The principal or central heading along which the coal is conveyed from the longwall face.
Man transport	Vehicle used for transporting men into and out of the mine.
MARS	Manual and automatic resuscitator system
MEMS	Mine emergency management system
MG	Maingate
Mines Inspector or District Inspector	Official employed to make examinations of and to report upon mines and surface plants for compliance with mining laws, rules and regulations, safety methods
Mines Inspectorate	The organisation who control the mines inspectors
Mines rescue fresh air base	Location established by mines rescue when entering the mine which is known to be fresh air, i.e. uncontaminated.
MISHC	Minerals Industry Safety and Health Centre
MSHA	Mine Safety Health Administration, USA - Department of Labour
Mole	Name used to refer to the mine site representative on the

Term	Definition
	organising committee for the Level 1 mine emergency exercise.
Non-verbal communication	Method of communicating using beeps on a telephone or DAC similar to morse code.
NSW	New South Wales
O_2	Oxygen
Outbye	Mining term for out of the underground mine (towards the surface) from the point of reference.
Panel	The working of coal seams in separate panels or districts; e.g., single unit panel. A longwall face is sometimes referred to a panel.
PED	Personal emergency device
Personal emergency device	Ultra low frequency through-the-earth communication system used for paging. Originally developed to provide a fast and reliable method of informing underground miners of emergency situations. Due system enhancements and the ability to readily contact personnel wherever they are underground, PED is also sometimes referred to as Productivity Enhancement Device.
PHMP	Principal hazard management plan
PJB	Flameproof diesel powered man-riding vehicle carrying up to 12 personnel
Portal	The surface entrance to an underground mine
Portal guard	Person on security at the surface preventing unauthorised entry into the mine in an emergency and reporting all personnel evacuating from the mine
ppm	parts per million
QMRS	Queensland Mines Rescue Service
Principal hazard	As defined in the Coal Mining Safety and Health Act 1999, a principal hazard is a hazard at the coal mine with the potential to cause multiple fatalities.
Principal hazard management plan	A plan developed to manage a principal hazard as required by section 62 of the Coal Mining Safety and Health Act 1999.
Radio ribbon	The radio wire pulled out by mines rescue to use as a conduit of

Term	Definition
	radio communications between the active rescue team and the fresh air base.
Recognised standard	A standard made for safety and health under the Coal Mining Safety and Health Act 1999 stating ways to achieve an acceptable level of risk to persons arising out of coal mining operations.
Reflective droppers	A plastic strip hung from the roof in the mine with a reflective strip used to highlight the location of a changeover bay.
Rib	The solid coal on the side of a gallery or longwall face; a pillar or barrier of coal left for support.
Rib spall	The action of the ribs breaking down and breaking off in flakes.
Safegas	Brand name of a mine gas monitoring system (developed by Simtars).
Safesim	Brand name of gas simulation software used to input simulated gas values into Safegas (developed by Simtars).
SCADA	Supervisory control and data acquisition
SCSR	Self contained self rescuer
Self contained self rescuer	A respiratory device used by miners for the purpose of escape during mine fires and explosions; it provides the wearer a closed-circuit supply of oxygen for periods of time usually less than 1 hour.
Shearer	Mechanical device used for cutting and loading the coal on to the AFC on the longwall face
Simtars	Safety in Mines Testing and Research Station
Site safety and health management plan	Refer to principal hazard management plan
Site safety and health representative	As defined in the Coal Mining Safety and Health Act 1999, a site safety and health representative is a coal mine worker elected under section 93 by coal mine workers at the coal mine to exercise the powers and perform the functions of a site safety and health representative mentioned in part 7 division 2.
Site senior executive	As defined in the Coal Mining Safety and Health Act 1999, a site senior executive is the most senior officer employed by the coal mine operator for the coal mine who—

Term	Definition
	(a) is located at or near the coal mine; and (b) has responsibility for the coal mine.
Smoke glasses	Light weight goggles sprayed with paint to wear over normal safety glasses to reduce visibility to simulate possible conditions after an explosion or fire
SOP	Standard operating procedure
Spall	Flakes of a coal that are broken off a larger solid body of coal.
SSE	Site senior executive
SSHR	Site safety and health representative
Standard operating procedure	As defined in the Coal Mining Safety and Health Act 1999 a standard operating procedure is a documented way of working, or an arrangement of facilities, at the coal mine to achieve an acceptable level of risk, developed after consultation with coal mine workers.
Stopping	A ventilation control device which stops ventilation flow
Stowage	In longwall mining the space from which the coal has been extracted and which has been filled with waste. Sometimes containing coal and other waste material.
Supervisory control and data acquisition	A system that collects data from various sensors at a factory, plant, mine or in other remote locations and then sends this data to a central computer which then analyses and manages the data and uses it to control the process being monitored.
Surface controller	Person in charge of surface operations in an emergency
Surface marshal	Person responsible for coordinating personnel in an emergency
Tag board	Peg board where underground personnel place a token to indicate their presence in a section of the mine.
Tailgate	A subsidiary gate road to a conveyor face as opposed to a main gate. The tailgate commonly acts as the return airway and supplies road to the face
TARP	Trigger action response plan
UEL	Upper explosive limit

Term	Definition
Trigger action response plan	A documented plan which details actions to be taken when some predetermined trigger point is reached, e.g. the actions to be taken if increasing concentrations of carbon monoxide in a mine reach a predetermined limit.
Upper explosive limit	The concentration in the atmosphere of an explosive gas or vapour that once exceeded ensures that an explosion of the gas cannot occur. This results from the explosive gas displacing sufficient air such that there is not enough oxygen to promote a reaction.
Undermanager	Mineworker who is in charge of the mine on a shift basis, i.e. shift supervisor.
USA	United States of America
Winder	An electrically driven engine for hoisting a cage or cages up a vertical mine shaft.

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Notes

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