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TEN YEARS OF CONDUCTING LEVEL 1 SIMULATED EMERGENCY EXERCISES IN QUEENSLAND'S UNDERGROUND COAL MINES

Martin Watkinson[1] Darren Brady[1]

ABSTRACT: The 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 state-wide emergency response by holding a Level 1 Mine Emergency Exercise at one mine on an annual basis. From 1998 to date (January 2008) ten Level 1 Mine Emergency Exercises have been held in Queensland. This paper discusses each of the exercises conducted to date as well as the logistics, scenario preparation, planning and organising required to conduct emergency exercises at this level.

INTRODUCTION

There have been ten Level 1 Emergency Exercises held in Queensland since 1998 and many more Level 2 and Level 3 exercises at all of the underground coal mines in Queensland as required by the "Approved Standard for the Conduct of Emergency Procedures Exercises". The procedure followed for each Level 1 Exercises was as follows:

- Visit to the mine to determine local site conditions and hazards
- Determination of objectives of the exercise
- Development of alternative scenarios to test the objectives
- Ventilation modeling and preparation of gas data to reflect the scenario and objectives
- Full team meeting to brief all assessors and arrange for site inductions
- Conduct of exercise
- Debrief at mine site and report preparation
- Release of final report and dispersion of findings to industry.

The following sections briefly identify the scenario and some of the issues identified within the reports. Copies of all reports can be obtained in PDF format from simtars@dme.qld.gov.au.

1998 SOUTHERN COLLIERY

Scenario

The scenario was built around unauthorised alteration of a district regulator, affecting the ventilation flow on the operating longwall. The reduced flow, plus barometer fall resulted in a frictional ignition of methane. The resulting explosion destroyed and damaged several of the mines ventilation control devices. This exercise was conducted at 12:05 am to test call out of mines staff and responses in the early hours of the morning.

Issues Identified

- Communications between control room and Incident Management Team (IMT)
- Emergency call out procedures for staff off site
- Duty cards impossible to follow
- Need to conduct rapid evaluation of ventilation and gas trends
- Need for a clearly defined IMT process
- Need for adequately resourced IMT room
- Need for training in evacuation in zero/poor visibility
- Escape ways to be adequately maintained
- Safe havens for changeover of Self Contained Self Rescuers (SCSRs).

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1999 KENMARE COLLIERY

Scenario

This exercise was conducted at 3:43 pm and based on a conveyor belt fire in the intake that resulted in the whole of the mine being evacuated. The scenario was designed to test the IMT process and contractor training in emergency response. Unfortunately there were very few contractors underground at the time of the exercise due to the fact that they had been withdrawn prior to the commencement of the exercise.

Issues Identified

- Communications between control room and IMT
- Need for adequately resourced IMT room
- Need to conduct rapid evaluation of ventilation and gas trends
- Inflexibility in the duty card systems
- Need for training in evacuation in zero/poor visibility
- Training required for changeover of SCSR's
- Debriefing of evacuating personnel.

2000 NEWLANDS SOUTHERN UNDERGROUND

Scenario

This scenario was based on a transformer fire leading to the ignition of the coal ribs in the cut-through and was conducted at 21:00 on a Saturday night. The scenario was aimed to test the first response of personnel using Compressed Air Breathing Apparatus (CABA) as well as issues relating to call out of mine staff who traveled two hours away from the mine site to Mackay on weekends.

Issues Identified

- Call out of staff on a weekend when most are in Mackay
- Successful use of CABA as a first response tool
- Communications between control room and IMT
- Need for training in evacuation in zero/poor visibility.

2001 KESTREL MINE

Scenario

The Kestrel exercise was based on a massive roof fall on the maingate end of the longwall some 2.5 km inbye from the mains at 21:30 on a Tuesday night. The resulting air blast injured two of the longwall personnel. The remaining longwall personnel evacuated down the tailgate in an irrespirable atmosphere created by the lack of ventilation and normal seam gas make (carbon dioxide). This atmosphere was also above the 1.25% methane level for the operation of diesel vehicles.

Issues Identified

- Need for adequately resourced IMT room
- IMT process and data capture
- Need for a mines rescue vehicle for deployment into non-standard atmospheres
- Mines rescue deployment to recover injured personnel at distances of 2.5 km in an irrespirable atmosphere
- Issues of deployment of mines rescue personnel into hot and humid conditions
- IMT changeover process.

2002 NORTH GOONYELLA COAL MINE

Scenario

This scenario was run at 9:13 on a Monday morning with most of the mine staff present. It was designed to test the response with the mine manager and ventilation officer absent in Mackay (some two hours away by car) for "training". The scenario was based on a vehicle fire which the operator could not put out. If a sufficient response was mounted the fire would have been deemed to be extinguished. There was also a simulated roof fall on the longwall, which allowed products from a spontaneous combustion deep in the goaf to report to the tailgate air

stream. Unfortunately the mine staff went into emergency 'evacuation mode' because of the 'exercise mentality" and forgot to tackle the fire. An adequate response was not mounted until six hours after the commencement of the exercise.

Issues Identified

- IMT process
- IMT changeover process
- Need for the staff to respond to the scenario and not just evacuate the mine
- Need for training in evacuation in zero/poor visibility
- Need for training in fire fighting procedures.

2003 CRINUM MINE

Scenario

The Crinum scenario was designed to raise awareness of the issues relating to the transport of gas cylinders, in particular acetylene. Acetylene cylinders can be very unstable if damaged. All mines should seriously review how they deal with acetylene and normal gas cylinders during transportation. The cylinder was "damaged" during a vehicle collision creating a vehicle fire, which subsequently developed into a coal fire. To completely pollute the intakes to the mine an air door between the intakes and the conveyor belt line was deemed to be left open for the purposes of the exercise. This again stresses the importance of conveyor belt segregation and the need for training/education to the workforce to ensure that all ventilation appliances are correctly used and any damage is reported. Without the simulation of this door being open, evacuation from the mine would have been much simpler along an uncontaminated conveyor road. An added complication for the mine was an underground visitor. "*How readily do you think your mine would deal with an underground visitor in such a situation?"*

Issues Identified

- Communications in and out of IMT
- Control room communications to personnel underground in the refuge bay (The men in the refuge bay sometimes got information before IMT)
- Recognition that burning coal can liberate explosive gases in sufficient quantities to create an explosive atmosphere in a mine with no methane seam gas
- The issues relating to inertisation with personnel underground
- The need for the ventilation officer/delegate to be free to do ventilation interpretation/modeling then feed the information back into IMT
- Safe transport of gas cylinders
- Need for well maintained and operated ventilation control devices.

2004 OAKY NO 1 MINE

Scenario

This exercise was based on a frictional ignition in a development panel resulting in a *small* coal dust explosion, "*if such a thing exists*". All the men in the development panel were deemed to have been killed in the explosion. (These men also conducted a zero visibility evacuation to an area outbye of the explosion zone using training self rescuers while waiting for rescue teams to be deployed). The explosion was deemed to have destroyed several ventilation structures and polluted the other development sections of the mine. A series of photographs were prepared and each of the evacuating teams was briefed on what they would have seen as they traveled out of the mine.

One point of interest is that the exercise committee had made the decision that all personnel in the sandy creek area would have been killed by the initial "explosions"; however the last part of the exercise was where the mine located the "deceased". This left the mine with a feeling of failure when in fact they had succeeded in taking the exercise to its fruition. This is an important part for anyone preparing industry scenarios and on reflection it would have been better if the mine staff could have at least found one survivor.

Issues Identified

- Trial of the Incident Control System/Mine Emergency Management System. (ICS/MEMS)
- The need for gas analysis and interpretation
- Debrief of personnel to get information into IMT
- Industry to recognize the need for adequate stone dusting to prevent coal dust ignitions.

2005 MORANBAH NORTH MINE

Scenario

The Moranbah North exercise was based on an Eimco traveling underground with a pod of Polyurethane (PUR) turning into a cut-through, hitting a transformer and causing a fire at 9:40 pm on a Sunday. The aim of the exercise was to highlight the requirements for fighting a PUR fire and the off gases produced, as well as to test the callout of mine staff on a Sunday evening. The location of the scenario enabled inseam response from an unaffected area.

Issues Identified

- The need for the mine to have a clearly defined and understood emergency response system
- The need for quick interpretation of the mine atmosphere and ventilation assessment
- Need for training in evacuation in zero/poor visibility
- Need for training and awareness when dealing with non-standard fires particularly PUR
- Automated call out procedures.

2006 BROADMEADOW MINE

Scenario

In order to create an evacuation scenario to test underground personnel a simulated fire in the intakes was coupled with a roof fall at the tailgate (T/G) end of the face preventing egress, forcing the men to evacuate inbye and undertake several changes of self contained self rescuers (SCSRs).

The exercise was based on a major fire on the hydraulic pump station and transformer in 4 cut-though in the maingate. The "fire" was caused by a catastrophic failure of the pumps/transformer and the burning oil and subsequent coal fire prevented egress out to the surface along the conveyor and travel road. The tailgate fall prevented egress through the longwall and along the tailgate roadway(s).

Issues Identified

- The needs for mines to develop a first response capability
- Improved training required in the donning and changeover of SCSRs
- Mines sites to evaluate the emergency response system they are going to use in light of the development of the Mine Emergency Management System (MEMS) by Queensland Mines Rescue Service (QMRS)
- Industry to adopt the draft recognized standard for the conduct of emergency exercises.

2007 GRASSTREE MINE

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. The exercise commenced at 20:00 on a Monday night to test the call out of site and other personnel.

- 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 for the deployment of mines rescue teams.

Issues Identified

- All mines to conduct a gap analysis on their emergency response plans to recommendations made in 2007 report as well as previous exercises
- The draft recognized 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
- Improved training required in the donning and changeover of SCSRs
- A mines inspector and industry safety and health representative should respond to and attend all Level 1 Mine Emergency Exercises.

DISCUSSION

The total number of assessors involved in ten years of emergency exercises is 180 giving an average of 18 assessors required per exercise. Assessors are invited from Queensland and New South Wales with representatives from Solid Energy New Zealand being present on the last four exercises. There is a core team of assessors on the management committee who have been involved in most of the exercises. One member has been present for all ten exercises. The management committee consists of representatives from:

- Simtars (Current Chair of the committee)
- Department of Mines and Energy Inspector
- Queensland Construction, Forestry, Mining and Energy Union Industry Safety and Health Representative (CFMEU ISHR)
- QMRS
- Minerals Industry Safety and Health Centre University of Queensland (MISHC)
- Mine site representative "mole".
- With other assessors called in for the full team briefing. Organizations represented include:
- Mine managers from Queensland coal mines, including the mine where next years exercise will be held
- New South Wales (NSW)Mine Rescue Service
- NSW CFMEU ISHR
- NSW Mining Inspector
- Solid Energy New Zealand
- Compliance unit Department of Mines and Energy, Qld
- Around four "younger" mining engineers from Queensland mines are invited to join the assessment team each year to increase their awareness of emergency response requirements.

Approximately 200 man-days of professional time are involved in each level 1 process. That is from the initial site visit to the final printing and mailing of the report. This is a considerable investment in time and energy by coal industry professionals, but what has been gained by industry by undertaking these exercises and what are the issues that need to be addressed?

- Industry is sometimes slow to adopt or modify the emergency response plans after the running of the level 1 exercise. This can be seen by the number of times the same or similar recommendation has been made.
- All of the reports have identified issues with the training and donning of SCSR's. An issue raised in the Sago Mine Disaster Report (J. Davit McAteer and associates July 2006).
- The amount of time taken to write and release the final report has varied from 1 month to over six months. The report often loses it impact if it is released several months after the exercise.
- The size of the reports (over 100 pages). Some personnel in the mining industry have indicated that the report is too large. *Surely it is not too much to ask to read the executive summary, the conclusions and recommendations for a report which takes 200 man-days to compile?*
- The mechanism of communicating the findings to industry in general. Different approaches have been tried from road shows, to articles in the Queensland Government Mining Journal to papers given at technical conferences such as this. None have proven to be the optimum solution.
- Some mines have approached the exercise as a pass or fail test generating a "Fear of the exercise". The exercise committee needs to address this to ensure that all appreciate that this is a learning experience where everyone benefits. This is also covered in the draft recognized standard.
- The 2001 report on Kestrel Colliery recommended the development of a mines rescue vehicle. Subsequent research into an escape vehicle/rescue vehicle by Simtars funded by industry through the Australian Coal Association Research Program ACARP (AU$ 800 K) has resulted in a design specification for a vehicle equipped with compressed air breathing apparatus (CABA), a sonic navigation system and onboard infrared methanometer. As yet this concept is still to be adopted, however several mining companies are prepared to provide further funding for the intrinsic safety (IS) certification of the navigation system. The other elements are now available commercially.
- Once a mine has undertaken the level 1 exercise it appears that the lessons learned and information are not freely available. For example one mine where the level 1 was held had 20 hard copies of the report mailed to them and not one copy could be found approximately 18 months later when a new owner took over the running of the mine.

We are living in an information age where possibly too much information is provided at once and electronically to be completely understood by the recipient.

Why are the safety management plans perceived to be the responsibility of the management team by the workforce? Ownership of safety management plans is required by the whole workforce, they need to realize this is

a way that they can impact on their own safety and in fact a mine with a good safety system often has good productivity as well. Being systematic is what improves safety and productivity.

Logistics

The logistics of coordinating hotel accommodation, transportation for up to 20 assessors is undertaken by a dedicated administration officer. Everything has to be arranged from food to take to site for the exercise, bus transportation, motel accommodation and booking of briefing rooms for the team. All of this has to be done with out alerting the mine site.

Note that for 20 people a 40 seat bus is required to take the additional work-wear, computers gas samples for testing the site gas analysis systems and associated food and clothing that is required.

Underground video footage has been taken by the site mole in the last two years. This simplifies the issues of site authority of gas detectors and taking non-intrinsically safe equipment underground. The voice-over for the footage is also best done by the site person who can best explain what is happening and what the current location is.

Scenario Preparation

The scenario preparation is undertaken by visiting the mine to assess site conditions and underground mining standards. The preliminary site visit takes place approximately five months before the anticipated exercise date.

Reference is made to previous exercises and high potential incidents in Queensland to determine the objectives of the current exercise, ie SCSR change over, first response call out of mines inspectorate and Simtars. Once these objectives have been agreed a scenario is proposed which will enable the objectives to be tested.

Ventilation modeling is undertaken in Ventsim, the Australian standard for coal mine ventilation modeling. This software contains a function where the percentage contamination from a single source event can be determined for the mine as well as the time taken for that pollutant to arrive at any working place/ monitoring point.

Data is then prepared for entry into Safesim (a Simtars program which acts as a dummy PLC) to feed real time gas information, for both real time and tube bundle analysers, into a duplicate Safegas system established on the mine site. Safegas is an industry standard for gas monitoring and interpretation in Queensland. The actual "severity" of the incident is sometimes tempered to ensure that mines rescue deployment can take place, ie ensuring that the gas levels are within the guidelines for the deployment of mines rescue teams in Queensland.

Once all ventilation modeling and gas pollutant levels have been established a meeting is called with three mine managers form other mines in the area. This is to validate the process and get industry "buy-in" to the objectives and selected scenario.

From there fine tuning is undertaken and information prepared for the full team briefing and site visit/inductions which are undertaken two weeks before the nominated exercise window. The venue for the 2008 Level 1 Exercise will be Newlands Northern Underground coal mine.

Planning and coordination

The planning of the exercises is now a streamlined process with ten exercises being completed. The amount of work is, however, underestimated by those who have not been involved in the process.

This is where dedicated administration support is required to compile contact lists, email information and coordinate motel room bookings etc to ensure that the base functions all run smoothly and prevent any adverse affects on the running of the exercise.

Each year the core team starts to prepare outline scenario's for the following year along with the identification of the mine mangers to be invited to the next exercise. As a rule the manger whose mine will be the subject of the next exercise is invited as an assessor in the year before his mine is the host mine.

Discussion is held between the core team as to the make up of each year's assessment team. Around four younger mining engineers are invited to participate as part of the assessment team. There are no observers allowed, anyone present is given an activity to assess and provide input to the report.

A target two week window is identified for when the exercise is to be run. This is communicated to the mine site after the initial site visit and a mine site "mole" has been selected. The mine site mole is the point of contact for obtaining mine plans, ventilation models and copies of site safety management plans. These are all used to prepare briefing information for the underground assessors so that they have a pictorial view of the incident and the level of pollutants as they spread around the mine.

The briefing of the mine managers normally takes place one month before the full team briefing as this the enables the scenario to be refined and briefing documentation to be prepared.

Two weeks prior to exercise window is set as the time for the full team briefing and site inductions. Assessors are normally given a visitor induction as they will always be in the company of mine site personnel during the exercise.

Once these dates have been set the chair of the exercise team starts to prepare a list of assessors and proposed deployments for the exercise to ensure that all elements of the mines emergency response can be evaluated.
The team is requested to stay on after the exercise for a couple of days to complete their input to the report. History has proven that once personnel get back to mine sites information for the report is very difficult to obtain.

It then takes around 1 month, of dedicated time, to collate the individual assessor reports into one cohesive report which can be released to industry.

SUMMARY AND CONCLUSION

The running of emergency exercises for ten years in Queensland has led to many improvements in mine safety and emergency response. For example the introduction of change over bays at Grasstree mine in 2007.

> A consistent theme is the requirement for training in emergency response, whilst there has been a dedicated thrust to adopt the MEMS/ICS process emphasis should be placed on the workforce to be able to don and change over a SCSR, to have confidence in the unit and be coached in decision making processes. This could alleviate the requirement to deploy mines rescue underground if everyone has successfully evacuated to the surface.
>
> The Queensland Level 1 Exercise is a learning opportunity for the mines and state services to test their response, communication systems and interactions with the aim of continual improvement of the whole system.
>
> With the large number of new employees in the industry due to the growth, some personnel do not appear to be fully aware their responsibility for their own safety and do not appear to have ownership of their escape systems.
>
> Mine workers need to take ownership of the mine site hazard management plans in particular the mine emergency response plans. The need to be clearly aware of their requirement under the plan and ensure that they are completely competent in the donning and change-over process for SCSRs or other system that their mine has in place.

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