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SOUTHERN DISTRICTS EMERGENCY ESCAPE SYSTEM

Peter Baker [1]

ABSTRACT: A new emergency escape system has been implemented into the coal industry in the Southern Districts of New South Wales. It has eventuated from a long process of trials and risk assessments and has involved every facet of the mining industry. A team of over 20 people had direct input into the development of this system, as well as the countless others who have helped refine initial ideas and avail themselves of a series of tests and trials. This paper The culmination of their combined efforts is presented.

INTRODUCTION

In September 1999, a new set of Regulations, Coal Mines (Underground) regulations 1999 (NSW Government 1999), under the Coal Mines Regulation Act, 1982 was introduced in New South Wales. Part of these new Regulations specified the escape equipment that must be supplied to all underground personnel. The Regulation specifies in Part 5 Clause 106 (1):

> *"A mine manager must provide sufficient escape equipment (including adequately maintained approved types of self rescuers) to allow safe egress of persons from the mine through conditions of reduced visibility and any irrespirable or irritant atmospheres that may be encountered."*

McKenzie-Wood (200) completed an ACARP study on the availability, reliability and the use of Self Rescuers world wide. The study included investigations in Australia, USA and South Africa, with a limited amount of information from Europe.

The results of the study led to two conclusions;

1. Inference that the new legislation leaves little room for the W65 Filter Self Rescuer in an escape system for potentially gassy mines, and

2. Although manufacturers are progressing through the issues, there is little to allay industry concerns over the reliability and durability of Self Contained Self Rescuers (SCSR) that rely on the chemical technology of Potassium Superoxide.

EMERGENCY ESCAPE

The new system now allows all mining companies to comply with recently introduced legislation. More importantly, it gives underground mine workers the best possible chance of detection, notification and escape in the event of a potentially devastating underground emergency such as fire or explosion

In keeping with the NSW Department of Mineral Resources Guidelines MDG 1020 (2001), the system has a heavy focus on early warning systems such as real time gas monitoring and training of underground personnel in detecting change.

COMMUNICATION

Communication systems are vital at this point, and the use of Davis Audio Communication (DAC) and telephone communications to a central control room allows rapid dissemination of critical information to all underground personnel by use of a Personal Emergency Device (PED) system.

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CSE 100 SELF CONTAINED SELF RESCUER

All underground personnel wear a CSE 100 self contained self rescuer unit on their belt, which can be rapidly donned to protect against any irrespirable or irritant atmosphere. The unit has a rated duration of fifty minutes which will allow outbye personnel to readily reach a changeover or refill station. It also allows the use of self contained self rescuer escape right back to a place of safety if this is the employee's preferred option. The unit was chosen because of its history in the US market (10 years without a major recall), its duration, the fact there is a twenty five minute unit with identical donning procedure, and its 'starter' mechanism which gives the wearer oxygen immediately upon donning (considered particularly necessary in outburst prone mining areas).

FIRST RESPONSE EMERGENCY EVACUATION KIT

The use of an air shower in the changeover process minimises the risk to personnel during changeover in a potentially irrespirable atmosphere. These will be located at the First Response Emergency Evacuation Kit (FREEK) as well as locations where SCSR to SCSR changeovers may be necessary (eg. L/W tailgate).

Spare SCSRs and enough Compressed Air Breathing Apparatus CABA suits for all personnel in the district are located at the FREEK, or first response station, which will be used by the crew as ~~a~~ meeting points. These are located at a designated point outbye the face (within a few hundred metres) and must be accessible from both intake and return roadways. The FREEK will also contain all equipment, such as brattice, pogo sticks, and stretchers necessary for response to an outburst at the working face

COMPRESSED AIR BREATHING APPARATUS

At the FREEK, the self contained self rescuer is replaced by CABA, which will be worn by the underground personnel for the rest of their escape journey. A single cylinder, nine litre, three hundred bar Drager CABA suit is used in the Southern District. The single cylinder, 9L configuration was chosen because it is the same CABA configuration that has been used in the underground coal Mines which mine the Bulli Seam for over 10 years. The cylinders are Kevlar wrapped aluminium, capable of a filling pressure of 300 bar, giving an expected duration slightly greater than that of the SCSR.

The changeover technique needs to be well rehearsed, and requires the use of the positive pressure within the suit to clear any potentially fouled atmosphere from around a person's breathing zone during changeover. Crews have undertaken initial training at the Southern Mines Rescue Station, followed by a 'refresher' training on site as the equipment has been installed. Further training is planned to be conducted 'inseam', as well as an annual refresher training at the SMRS.

After securing the CABA suit to the person and turning on the air supply, it is one last breath from the self contained self rescuer and the next from the CABA face mask. A manual 'purge' button on the suit allows the compressed air from the cylinder to be used to clear any fouled atmosphere around the user's breathing zone. This of course means that at no time during the changeover are personnel exposed to-potentially lethal atmosphere.

After securing the face mask, personnel move to the one quick fill outlet located at the FREEK to top up their suits before proceeding outbye. It therefore doesn't matter how much air has been lost from the cylinder in the changeover process. The coupling from the outlet is securely connected to the quickfill attachment on the CABA suit, and using the beer tap arrangement, the pressure in the suit can rapidly be topped back up to three hundred bar. This will ensure all personnel have sufficient air supply to make their way outbye to a refill station with at least fifty bar left in their suit.

DISTANCE BETWEEN REFILLS

The distance between refill stations at Appin Colliery was determined by walk out trials and is currently one point two kilometres. The trials involved people attempting to escape in 'worst case' conditions (i.e. on foot in nil visibility but with lifeline as guidance system). The shortest distance traveled by any individual in these conditions before their warning whistle sounded (indicating 50 bar left in cylinder) was 1.5km. It was then decided to add another safety factor to the system and the 1.2km spacing was implemented.

ESCAPEWAYS AND GUIDANCE SYSTEM

The quickest and least demanding means of escape for the crew will be on transport, and this is still easily achievable wearing CABA suits. Transport also means the whole crew will remain together and their consumption rates (whether they are wearing CABA or SCSRs) will be substantially reduced.

If transport is not available and visibility allows, the travelling road is a good option as it is known to all personnel and usually provides better walking conditions. There is no lifeline however in the traveling road and reliance is placed on signs as indicators for refill stations and caches.

In cases of very poor visibility it may be necessary to escape down the return roadway using the tactile guidance system. A lifeline is located in each secondary escapeway consists of five millimetre diameter radio aerial which is held securely in place by rods attached to the roof or rib. The walkway beside the lifeline should be free of debris to allow a reasonable rate of travel without fear of slips, trips and falls.

Directional cones ensure the risk of total disorientation is minimised in cases of extreme visibility by allowing personnel to know with confidence they are heading to a place of safety. These cones are placed along the lifeline at nominal intervals of up to 100m. At places where there is an opportunity to move from the return roadway back to intake (i.e. trapdoors in overcasts or stoppings), there are 6 cones located back to back followed by a plastic disk. A 'spur line' then guides personnel to the trapdoor where an inspection is made followed by a decision on the most appropriate action.

REFILL STATIONS

The cascade refill system allows up to five people to refill their suits simultaneously without having to be exposed to the outside atmosphere. Timing of the refill varies between thirty seconds and three minutes, depending on the number of people attached to the refill unit. The refill units come in two different sizes though both have identical operating panels. The 'C-20" unit comprises 10 large 'G' size cylinders and has the capacity to refill 20 CABA sets from 50 bar (minimum pressure any person escaping would expect to arrive at the refill station with) back up to 300 bar. The 'C-40' unit comprises 20 large cylinders and refills 40 CABA sets. If there is a requirement for more than 40 refills at any one point (i.e. some outbye locations common to all panels escape routes), there would be more than one refill unit at the site.

The capacity at each of the refill stations provides the possibility of refuge for injured or fatigued crew members. Residual air in the large cylinders allows for many hours of refuge for up to 5 persons. Although the air supply remaining may be too low in pressure to continue to refill CABA suits to 300 bar, there is sufficient volume for 1 man to refuge for up to 40 hours (based on 35 litre/minute consumption rate) at the C-20 unit, and obviously longer at the C-40.

Telephone communication will be located at each refill station and should be used by escaping crews to obtain updates of the incident and inform surface control of current locations.

If the crew reaches a refill station and is not yet on the outbye side of the incident, escape continues to the next refill station, using the guidance system if required.

The system will continue to guide the crew to a designated place of safety, which is anywhere on the outbye side of the problem, or to a place that needs to be determined at each mine that has been determined as a place of guaranteed fresh air.

ADVANTAGES

The major advantages of the escape system are:

- The PED communication system allowing quick dissemination of critical information to all underground personnel
- The guidance system which the trials proved was necessary to guide experienced personnel through underground workings that were familiar to them before poor visibility was encountered – disorientation can be equally as deadly as a fouled atmosphere.

- CABA is preferred by the workforce because of the cool air supplied by the set and the minimal breathing resistance
- CABA also allows communication between the crew as they are escaping, as well as with surface control.
- Crews can train with actual equipment, rather than rely on simulation of the system as has been used to in the industry with Filter Self Rescuers and Self Contained Self Rescuers.
- The system is simple to use giving appropriately trained personnel the ability to operate in high stress circumstances.
- The system allows both a refuge and response option, and could possibly be linked into first response or rescue teams.
- The system now gives the underground workforce in the Southern Districts the best possible chance to escape to a place of safety in the event of an emergency which adversely alters the mine atmosphere.

CONCLUSION

The introduction of the Southern Districts Emergency Escape System is one of the largest changes to the underground mining industry in recent times – akin to the introduction of the Filter Self Rescuer in 1966. The introduction process will not be without problems and these will be dealt with as they arise. It is important though, that right through this process sight is not lost of the reason such an elaborate escape system is being introduced – It is for the same reason our industry has made many changes throughout the years – to make the underground mining industry a safer place for all who sail in her.

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