

# Virtual Reality Training for NSW Mines Rescue Brigadesmen

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## *ABSTRACT:*

New South Wales Mines Rescue has been using simulation based training as an integral part of their training since 2007.

The system developed by Mines Rescue allows Brigadesmen the opportunity to be immersed within a virtual environment such as an underground mine and test their skills with things such as establishing, advancing and managing Fresh Air Bases, optimizing search patterns without breaching line of sight (LOS) protocols, caplamp and other signal communications, route marking, patient triage and in field decision making.

For example, when doing a search, the system will monitor for breaches of LOS and provide a report at the end of the training session as to where and when the breaches occurred. As each of the training sessions are recorded for playback, any breaches of process and any other learnings can be discussed during the After Action Review. New recruits and experienced teams can learn from 'best practise' examples which are readily replayed.

Additionally, because the system can quickly load new scenarios, it allows brigadesmen the ability to have their skills rapidly and economically refreshed compared to traditional training methods – using significantly less resources.

An important element that Mines Rescue use as part of simulation based training is mixed reality training. By recognising that virtual reality is not a panacea for training, but instead is a tool that complements regular practical training, Mines Rescue uses a blended training approach.

The case study to be discussed is from the 2016 National Underground Mines Rescue Competition. The virtual reality scenario tested the rescue teams skills in searching, mines rescue protocols, communication with fresh air base and incident controllers, use of environmental monitoring equipment, mine ventilation knowledge, route marking and documentation and recording. During the simulation, a practical element was embedded incorporating a BG4 breathing apparatus failure.

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## *INTRODUCTION:*

The NSW Mines Rescue virtual reality systems allow mineworkers to be exposed to dangerous situations and hazardous locations, whilst in a safe and controlled environment. Learning and practicing how to respond in these situations delivers outcomes that could be lifesaving.

We have been developing and delivering our simulation based safety training system for over 10 years. Our virtual reality training solutions have won a number of awards from industry and our peers, including the Simulation Australia Award for Project Innovation in 2012.

Our software has been used to great effect in situations to overcome literacy barriers, such as the International Mines Rescue Competition in 2010, where a variety of non-English speaking teams participated in a range of simulated emergency events with minimal and simple instruction.

Research shows that 90% of trainees find virtual reality is useful in skills development.<sup>1</sup>

## *THE GEN4 TRAINING SYSTEM:*

Our latest simulation software, called 'Gen4', has been built in order to supplement existing training content. As an RTO to the mining industry we deliver a large range of courses and our simulation software allows the trainers an easy method to create simulation based training scenarios, quickly and easily, as needed.

We are not just developers, but practitioners, so the software has been built to allow the trainers to simply, and therefore affordably, create a continued stream of fresh training content. Because of this, virtually any course can simply have VR to supplement the course. As our simulation software is content agnostic, it has been used to train multi-agency groups across a wide variety of disciplines.

Whilst as an RTO we do have the skills and capabilities to deliver a wide variety of courses, our simulation software is available as an enabler for other RTOs to have a simulation based training platform to develop content to supplement their own training courses.

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<sup>1</sup> A Systematic Approach to Evaluate the Impact of VR for Safety – S.Pedram, University of Wollongong

## *AUSTRALIAN MINES RESCUE COMPETITION 2016:*

The Appin team from Wollongong were named the 2016 Australian Mines Rescue champions at a presentation dinner held in Emerald, Queensland after the event. The team were closely followed by Queensland's Oaky North team who came in second, and third place went to Grosvenor mine. Rio Tinto's Kestrel Mine played host to the event, helping put 60 mines rescue brigadesmen from across Queensland and New South Wales through their paces. The competition did more than just decide the national champion; it provided Australia's most elite brigadesmen with the invaluable opportunity to test themselves against the best of the best, and reassure the underground mining industry of their exceptional skill level.

The competition saw eight teams from New South Wales and Queensland mining companies work through a series of scenarios designed to mirror the reality of emergency response situations. The scenarios consisted of a challenging mix of underground and pit-top scenarios. These included technical skills assessment, firefighting, search and rescue exercises as well as testing their first aid skills. A theory exam challenged the depth of teams' mines rescue knowledge and a scenario using virtual reality technology allowed the teams to simulate their application of skills and hazard awareness.

### *VIRTUAL REALITY SCENARIO:*

The team enters the room and interacts with the assessors who are playing the role of FAB in this exercise.



*Figure 1. South32's Appin Mines Rescue Team*



*Figure 2. Team sits at computers*

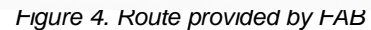


*Figure 3. FAB explains task to Captain*

*This is simply a training exercise. Once you have performed your FAB checks, head inbye under oxygen. Here is your proposed route. (Hand the team the mine plan). You are expected to route mark and take gas readings as per your procedures. You will be carrying your antenna in, and therefore will have communications with FAB throughout the exercise. You will be required to do four tasks.*

1. *Inspect and document the heavy roof at 1CT B-C*
2. *Perform an air reading at the 12N C3-4 air reading station*
3. *Check the state of the water barriers at B10-B11*
4. *Install additional timber props at C14*

The team goes through their appropriate FAB checks and are assessed accordingly. The captain is expected to delegate tasks appropriately throughout the exercise. The team navigates their way through the mine, placing route markers and monitoring gas.



The team reaches 12N 1CT and performs the tasks, including drawing the heavy roof. Appropriate team checks are performed and the team then advances to complete task 2.

As the team heads inbye towards task 3, FAB contacts the team via radio and says the following:

*FAB to green team over.*

*Green team we have detected high levels of CO at FAB. They are currently at 100PPM and rising. We have contacted control who have advised us to relocate FAB back to the belt drift as there has been an incident at the bottom of the man and materials drift. Please return immediately to FAB where we have left a relocation plan and seven oxygen cylinders if you require them. We have marked the route to the new FAB location with red glow sticks.*

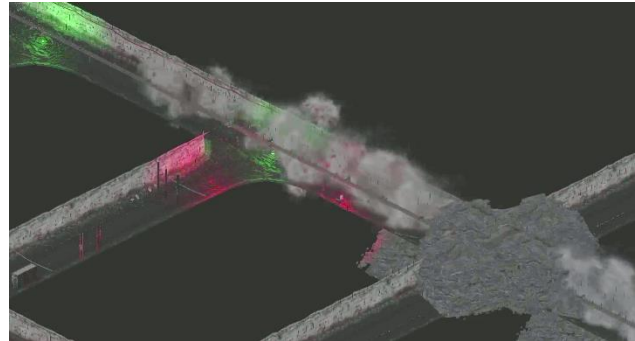


Figure 7. Roof fall severs antenna

Shortly after this, a roof collapse occurs outbye of 12N 1CT, which cuts the antenna, severing communications with FAB.

The team are then expected to effectively navigate their way back to FAB, accounting for the change in conditions.

On their way out, they will enter poor atmosphere where their gas monitor will alarm. They are to pull back from the area, perform appropriate checks on their BA and then proceed onwards.

As the team nearly reaches FAB, one of the brigadesmen's suits will activate their low oxygen alarm, requiring a cylinder changeover at FAB.



Figure 8. Physical cylinder changeover activity

This task is performed and assessed as a physical activity. The intention is to provide a mixed reality experience, where a wide variety of skills are assessed within the one sitting. Other scenarios have seen the use of sling psychrometers, vent bags, etc.

At FAB, the team find a relocation plan and are able to follow the red route markers out to the relocated FAB at the belt drift.



At the conclusion of the scenario, the team are briefed about how they performed, they also get the opportunity to see a replay of their scenario and are provided with an After Action Review.



*Figure 9. After Action Review with team*

## **CONCLUSION:**

The scenario was very well received by all teams, including a number who had not used the VR training system before.

It's useful to note that prior use of the system didn't provide any advantage, as the score of the exercise across teams aligned with their average scores across other exercises. The scenario was designed by NSW Mines Rescue, and our experience allows us to recognise the right things to assess, ensuring that we're assessing on mines rescue knowledge and not on the users ability to operate the system.

A change from previous years was the use of the laptop/desktop form factor instead of our large VR facilities. The 360 theatres that Mines Rescue utilise, have a large amount of floor space, however there is only ever one viewpoint on the screen. The benefit of course is a compelling mixed reality experience where practical tasks play out within the theatre, however a weakness is there only being one viewpoint that the screen can show.

Conversely, in the case of using the individual computers, each participant plays a role during the simulation component, allowing more engagement throughout the exercise and not just during the physical activities.

The use of the mixed reality component provided a useful element to further increase the quantity of skills being tested from the exercise.