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PIKE RIVER ROYAL COMMISSION OUTCOMES

Stewart Bell

ABSTRACT: On the 19th November 2010 29 men died when a methane explosion ripped through the Pike River coal mine near Greymouth on the South Island of New Zealand. Two survivors staggered out of the mine one hour after the initial explosion but the mine remains a tomb for the Pike 29. Over the next few weeks three further explosions occurred until the mine was inerted using the GAG jet inertisation device and then sealed.

This paper summarises the finding of the Royal Commission of Inquiry that was convened in December 2010 by the New Zealand Government, to address the questions of: What went wrong at Pike. Why were the previous lessons from mine disasters in developed countries around the world not learned and what is the potential to learn from this event. The report from the Royal Commission was provided to the Governor General of New Zealand on the 30th October 2012.

Pike was a coal mine with difficult geological and topographical conditions. This mine needed the best of everything but this didn't happen and 29 people paid the ultimate price.

This presentation will set the context of Pike, look at the rescue recovery operation and cover the Royal Commission report and what the future holds for the New Zealand coal mining industry. The paper extensively references the information contained within the report of the Royal Commission.

The bodies have not been recovered and the definitive cause of the disaster has not been determined but the Royal Commission uncovered a litany of problems that lead to the explosion on the 19th November. These problems should have been addressed. This disaster was avoidable

INTRODUCTION

Pike River underground coal mine is located on the eastern side of the Paparoa Range about 45 km north east of Greymouth. The seam lies below the Paparoa National Park and dips in an easterly direction. The resource is estimated to contain approximately 40 Mt of a coal that is a low ash, high fluidity, coking coal (Whittall, 2006). The Brunner seam dips from the outcrop in the western escarpment to the east at an angle of between 11 and 20 degrees and varies in thickness between 2 and 13 m mainly lying in the range 4 to 9 m (Whittall 2006). There is a predominantly methane seam gas, generally the gas content ranging between 3 and 6 m³/t, though some bore samples have been higher than this (Whittall, 2006). The seam was accessed via a single 2.3 km long tunnel driven in stone to access the eastern side of the coal seam where it intersected the Hawera Fault. Development of pit bottom began in early 2009. By November 2010 the development had reached the stage outlined in Figure 1 below. Of particular significance to the development of the mine was the collapse of the bottom of the main ventilation shaft during construction requiring a bypass to be constructed to connect to the upper shaft. The seam depth below the surface varies considerably because of the surface terrain ranging between about 60 m to over 100 m.

In November 2010 Pike River was still in start up mode and was behind in its development schedule.

At the time of the first explosion ventilation was provided by a single fan placed underground adjacent to the base of the upcast shaft extracting about 120 m³/s of air.

Methane concentrations within the mine were managed through a combination of ventilation and some pre-drainage through in seam holes originally drilled to map the limits of the coal seam. Development was undertaken by continuous miners and a road header was used to excavate roadways in stone. Secondary extraction was to be undertaken using the hydro mining technique. This technique uses high pressure water jets to cut the coal, which then was washed into a flume to be transported out of the mine.

Hydromining is not a commonly used mining technique and with the thick coal seams prevalent at Pike River ventilation needs to be carefully managed.

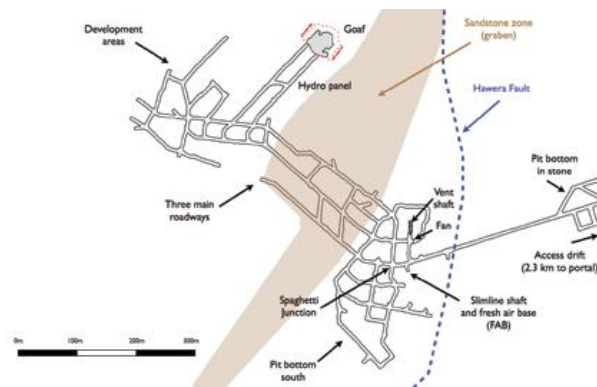


Figure 1 - The mine plan as at November 2010 (PRRC, 2012)

THE TRAGEDY

At approximately 3:45 pm on Friday November 19 2010, there was a violent explosion within the mine. All communications and power were lost to the underground mine. The main fan stopped and the auxiliary fan failed to initiate. At the time of the explosion 31 men were underground, 29 perished and two who were within the stone drift were able to escape after about an hour and a half. Analysis of the gases exiting the fan shaft was consistent with a methane explosion having occurred. Detailed analysis suggests that the volume methane involved would have been somewhere in the range of 1000 to 2000 m³. This volume of methane suggests that it must have originated in the goaf of the hydropanel. The volume of gas that exploded is thought to have been somewhere in the range 10 000 to 30 000 m³. It is not clear what ignited the atmosphere, though there were a number of potential ignition sources identified. It is believed that all men died instantaneously either from the pressure wave of the explosion or from asphyxiation or carbon monoxide poisoning.

There were three subsequent explosions on 24, 26 and 28 November. Again it is thought that the primary fuel was methane though there is evidence of coal dust contributing to the fourth explosion. These appear to have been ignited close to the fan shaft, probably by an ongoing fire within the mine.

Suppression of the residual active fire(s) and prevention of subsequent explosions was achieved by deploying the GAG jet inertisation system (Figure 2 and 3). The process of establishing control was complicated by the rugged surface terrain and access to the area above the mine only being feasible by helicopter. It took many weeks to drill boreholes to establish that the mine atmosphere had been rendered inert and for the mine portal to be sealed and the fan shaft capped safely (Figure 4).

Since that time it has not been possible to safely re-enter the mine and retrieve the bodies. Some progress has been made in recovering a limited section of the stone drift.

RECOMMENDATIONS OF THE ROYAL COMMISSION

The Royal Commission investigated the tragedy and made 16 recommendations in an effort to prevent a repeat of this tragedy. The recommendations are listed below verbatim from the report (PRRC, 2012).

Recommendation 1: To improve New Zealand's poor record in health and safety, a new Crown agent focusing solely on health and safety should be established.

- The Crown agent should have an executive board accountable to a minister.
- The chief executive of the Crown agent should be employed by and be accountable to the board.
- The Crown agent should be responsible for administering health and safety in line with strategies agreed with the responsible minister, and should provide policy advice to the minister in consultation with the Ministry of Business, Innovation and Employment.

- The ministry should monitor the Crown agency on behalf of the minister.
- The Crown agency should be funded by the current levies but the basis of the levies should be reviewed for high-hazard industries.



Figure 2 - Fire burning at top of fan shaft after fourth explosion (NZ Police, 2012)



Figure 3 - The GAG jet inertisation system in operation at Pike River (NZ Police, 2012)

Recommendation 2: An effective regulatory framework for underground coal mining should be established urgently.

- The government should establish an expert task force to carry out the work. Its members should include health and safety experts and industry, regulator and worker health and safety representatives, supported by specialist technical experts.
- The expert task force should be separate from the ministerial task force that is reviewing whether New Zealand's entire health and safety system is fit for purpose.
- The expert task force should consult the Queensland and New South Wales frameworks as best practice.
- In the interests of time, the expert task force should consider the immediate development of approved codes of practice, to be replaced by regulation where appropriate.

- The expert task force should consider addressing urgently the specific issues identified by the commission including:
 - the removal of the 'all practicable steps' qualification from the mandatory provisions of the regulations, including those relating to ingress and egress;
 - the provision of better health and safety information by the employer to the regulator, including notification of all high-potential incidents;
 - requiring employers to have a comprehensive and auditable health and safety management system;
 - mandating the statutory positions necessary to ensure healthy and safe mining (including a statutory mine manager and ventilation officer), and identifying their key functions and the relevant qualifications, competencies and training;
 - defining standards for ventilation control devices, such as stoppings;
 - defining the requirements of underground gas monitoring systems;
 - prohibiting the placement of main fans underground and requiring them to be protected against
 - explosions and other hazards, in accordance with the most appropriate international standards;
 - clarifying the restricted zone within which electrical equipment requires protection; and
 - updating electrical safety requirements in the light of new technology.



Figure 4 - The capped fan shaft, showing the evasee where it was deposited after the fourth explosion (NZ Police, 2012)

Recommendation 3: Regulators need to collaborate to ensure that health and safety is considered as early as possible and before permits are issued.

Recommendation 4: The Crown minerals regime should be changed to ensure that health and safety is an integral part of permit allocation and monitoring.

- The proposals in Review of the Crown Minerals Act 1991 Regime are endorsed.
- Mining permits should have a general condition requiring the need for compliance with the Health and Safety in Employment Act 1992 and regulations.
- The Ministry of Business, Innovation and Employment should provide information to prospective permit holders on health and safety laws and regulations.
- The ministry should review the information required from applicants for mining permits and the way it assesses applications against the criteria in the minerals programme.

Recommendation 5: The statutory responsibilities of directors for health and safety in the workplace should be reviewed to better reflect their governance responsibilities.

Recommendation 6: The health and safety regulator should issue an approved code of practice to guide directors on how good governance practices can be used to manage health and safety risks.

Recommendation 7: Directors should rigorously review and monitor their organisation's compliance with health and safety law and best practice.

Recommendation 8: Managers in underground coal mines should be appropriately trained in health and safety.

Recommendation 9: The health and safety regulator should issue an approved code of practice to guide managers on health and safety risks, drawing on both their legal responsibilities and best practice. In the meantime, managers should consult the best practice guidance available.

Recommendation 10: Current regulations imposing general health and safety duties on the statutory mine manager should be extended to include detailed responsibilities for overseeing critical features of the company's health and safety management systems.

- The new regulations should have regard to the Queensland legislation applying to the mine's senior site executive.
- The statutory mine manager should be protected by new procedures requiring disclosure to the regulator when the employer does not accept the manager's proposals for improving health and safety.

Recommendation 11: Worker participation in health and safety in underground coal mines should be improved through legislative and administrative changes.

- Legislative changes should:
 - require operators of underground coal mines to have documented worker participation systems;
 - ensure all workers, including contractors, are competent to work safely, are supervised and are included in the mine's worker participation system;
 - empower trained worker health and safety representatives to perform inspections and stop activities where there is an immediate danger of serious harm;
 - require the results of monitoring and investigation of health and safety in the workplace to be automatically made available to workers; and
 - allow unions to appoint check inspectors with the same powers as the worker health and safety representatives.
- The regulator should:
 - issue an approved code of practice on employee participation;
 - promote workers' rights and obligations through education and publicity; and
 - ensure that inspectors routinely consult workers and health and safety representatives as part of audits and inspections.

Recommendation 12: The regulator should supervise the granting of mining qualifications to mining managers and workers.

- The regulator should lead the work to strengthen standards so that they are comparable with those of Australia.
- The regulator should work with Australian counterparts towards developing a joint accreditation process with Australia and an Australia/New Zealand board of examiners.
- Additional statutory roles and qualifications are required in new regulations, including a statutory ventilation officer and an agreed level of industry training and supervision for all new or inexperienced workers.

- The regulator should work with the Accident Compensation Corporation and others on raising the standards of health and safety consultants.

Recommendation 13: Emergency management in underground coal mines needs urgent attention.

- Operators of underground coal mines should be required by legislation to have a current and comprehensive emergency management plan that is audited and tested regularly.
- The emergency management plan should be developed in consultation with the workers and the Mines Rescue Service.
- The emergency management plan should specify the facilities available within the mine, such as emergency equipment, refuges and changeover stations, and emergency exits.
- The emergency management plan should contain a strategy for notifying next of kin and ensuring that genuine enquirers receive appropriate information.
- The mining operator must keep and regularly update a comprehensive list of emergency contact details for all workers.
- The emergency management plan needs to be compatible with CIMS, the co-ordinated incident management system used by New Zealand's emergency services and the police.
- The regulator should include the emergency management plan in its audit programme.

Recommendation 14: The implementation of the co-ordinated incident management system (CIMS) in underground coal mine emergencies should be reviewed urgently.

- The implementation of CIMS should be reviewed to ensure that emergencies in underground coal mines are well managed.
- The review team should include the mining industry, police, emergency services, the Mines Rescue Service and the regulator.
- The CIMS framework should be rigorously tested by regular practical exercises at underground coal mines.
- The incident controller at an underground coal mine emergency must have mining expertise and, together with the incident management team, must be responsible for co-ordinating the emergency effort and approving key decisions. This does not prevent a government agency such as the police from being the lead agency or from maintaining its command structure.

Recommendation 15: The activities of the New Zealand Mines Rescue Service need to be supported by legislation.

- The Mines Rescue Trust Act 1992 should reflect the functions performed by the Mines Rescue Service.
- The adequacy and fairness of the current levies imposed on mines to fund the service need to be reviewed.

Recommendation 16: To support effective emergency management, operators of underground coal mines should be required to have modern equipment and facilities.

- Operators should be required to have equipment and facilities suitable for self-rescue by workers during an emergency.
- Operators should be required to include, in their emergency management plans, provisions for continued monitoring of underground atmospheric conditions during an emergency.
- Operators should be required to install facilities that will support emergency mine sealing and
- Inertisation

DISCUSSIONS

The Royal Commission concluded that there was need for major reform of the way coal is mined in underground coal mines in New Zealand. These changes must be enacted urgently. There are lessons for government, regulators, employers and workers (PRRC, 2012).

There is a need to reform the way that the government administers health and safety in mining. Health and Safety should be an integral part of the design for a new mine long before it starts development or operation. Health and Safety compliance should be a condition of mining permits.

The mines inspectorate requires major reform in order to be effective. There are inherent difficulties in attempting to adequately inspect a very small, specialized high risk industry. There are a number of changes that the Department of Labour (DOL) must undertake in order to have an effective mines inspectorate. These relate to such things as:

- Adequate resourcing and support of inspectors
- Recognising the particular needs of high hazard industries
- Improving transparency of DOL reporting
- Improving the focus on health and safety
- Defining a clearer role for DOL in administering the legislation
- Implementing a modern compliance strategy

The legislation needs to be improved. The Commission recommended an expert task force be convened to investigate the way forward. The legislation relating to worker participation should be strengthened, including the right to have trained workplace representatives to carry out inspection and stop work if workers are in immediate danger. The Commission identified the lack of union check inspectors as a serious deficiency. Employers and workers in general need to be better educated in the advantages of active worker participation in health and safety management. In addition the governance by boards of directors of companies needs to be improved to overtly include health and safety responsibilities.

The mining regulations require major improvement to keep pace with industry changes and best practice. The major change should be the requirement of employers to have comprehensive and auditable health and safety management systems including principal hazard management plans (PHMPs). The regulator needs to issue an approved code of practice describing the minimum specifications of PHMPs. In addition the regulations should be changed to comprehensively identify key statutory roles, duties and qualifications, including the positions of statutory mine manager and ventilation officer. They should align the new regulations with the Australian approach to determining the training requirements for all workers.

Workplace safety and health legislation has been weakened in New Zealand over the last 20 years with a greater reliance on self regulation and cooperation between the regulator and those being regulated. This "soft touch" legislation has resulted in New Zealand having one of the worst health and safety records in the developed world.

The management of emergencies needs major enhancement. There should be regulatory guidance for the development of procedures for emergency management, including the requirement for regular testing of the emergency management plans, this testing should include the demonstration of the capacity for every worker to be able to safely escape the mine, as well as demonstrating that the mine emergency management process is effective. The application of the emergency services Coordinated Incident Management System (CIMS) needs to be overhauled so that it can be applied more effectively where high hazard industries are involved. The review should include a range of stakeholders including employers, the Mines Rescue Service, the regulator, worker representative and the emergency agencies. It is vital that the key decision on whether to enter a mine or not lies with the incident controller and the incident management team on the spot.

The funding mechanism for the Mines Rescue Service should be reviewed to ensure it has the capacity to provide the services required to help mines manage emergencies. The Commission was not critical of the New Zealand Mines Rescue Service but recognised that funding for the service was an issue

It is essential that mines have the equipment and facilities to enable miners to rescue themselves, including the capacity to monitor the early warnings of gas levels, modern breathing apparatus, changeover stations, navigation aids, alternate means of egress, adequate transport, robust and redundant communications systems and personnel tracking equipment. The mining company should be able to monitor the mine environment independent of underground power, through a tube bundle sampling system. These things should be legislative requirements.

The Commission was of the view that Pike River had a sub standard gas monitoring system and this made immediate re-entry into the mine impossible. In fact the mine had no fully functional gas monitors in the mine ventilation return.

As has been found elsewhere, it is essential that mines have the capacity to rapidly seal all or part of a mine in an emergency, so that the atmosphere can be controlled. The capacity to externally inert a mine should be investigated.

There is no doubt Pike River was a difficult mine to operate. The topography, highly faulted geology, high methane levels, poor gas monitoring and ongoing financial constraints lead to the fact that the mine never operated on a sustainable basis and lurched from one problem to the next. A workforce with a large percentage of greenskins and a fluid management structure meant that a reservoir of corporate memory was never achieved. The Commission looked to find areas where Pike River had met normal standards but were unable to do so. In the words of several witnesses this mine was a disaster waiting to happen and with 21 high methane events, reported but not acted upon, in the month before the disaster an explosion was inevitable and 29 men paid the ultimate price.

It is recommended that interested persons access the full Royal Commission report available on their website <http://pikeriver.royalcommission.govt.nz/>.

These reforms need to be made as soon as possible. It is the view of the Royal Commission that:

"The Pike River tragedy was preventable but administrative and regulatory reforms are urgently needed to reduce the likelihood of further tragedies.

The Pike River tragedy contains lessons for government, regulators, employers and workers, especially in high-hazard industries such as coal mining, where the frequency of major accidents is low, but accidents can have catastrophic results." (Page 29, PRRC, 2012 Volume 1)

ACKNOWLEDGEMENTS

The author would like to dedicate this paper to the families of the 29 miners who died at Pike River in the hope that we will learn from this disaster and prevent such a tragedy from ever happening again.

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