



Royal Commission on the Pike River Coal Mine Tragedy

Te Komihana a te Karauna mō te Parekura Ana Waro o te Awa o Pike

Volume 1

+ Overview

Author: Royal Commission on the Pike River Coal Mine Tragedy

Date of Publication: October 2012

Place of Publication: Wellington, New Zealand

ISBN: 978-0-477-10378-7

Cover image: Western Escarpment, Paparoa Range, West Coast, New Zealand

Website: www.pikeriver.royalcommission.govt.nz

Letter of transmittal



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To His Excellency, Lieutenant-General The Right Honourable Sir Jerry Mateparae GNZM, QSO,
Governor-General of New Zealand

Your Excellency

In accordance with the Letters Patent dated 14 December 2010, as amended on 7 February and 27 August 2012, we have the honour to present to you the report of the Royal Commission on the Pike River Coal Mine Tragedy.

It has been a privilege to undertake this work. We hope that our report will help to ensure that New Zealand does not see a repetition of the tragedy of 19 November 2010 when 29 men lost their lives in the Pike River mine.

Dated this 30th day of October 2012.

A handwritten signature in cursive script that reads "Graham Panckhurst".

The Honourable Graham Panckhurst

Chairperson

A handwritten signature in cursive script that reads "Stewart Bell".

Stewart Bell PSM

Commissioner

A handwritten signature in cursive script that reads "David Henry".

David Henry CNZM

Commissioner

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Preface

The explosion at the Pike River mine on 19 November 2010 brought home to New Zealanders once again the risks of underground coal mining. The 29 men who died follow a long line of other people who have perished in New Zealand mines over the previous 130 years. This, sadly, is the 12th commission of inquiry into coal mining disasters in New Zealand. This suggests that as a country we fail to learn from the past.

The commission was established in December 2010 to report on what happened and what should be done to prevent future tragedies. The terms of reference are on pages 6–9.

In making our inquiries we have gathered voluminous evidence, both written and oral. We have necessarily had to be selective in determining how much can be included in our report. The commission has aimed to be fair to all concerned in the tragedy and has avoided criticising individuals, unless it was necessary to do so to properly explore what happened. The commission is not a court of law and its views and conclusions should not be interpreted as determining, or suggesting the determination of, criminal or civil liability of any person.

The commission has tried to uncover the systemic problems lying behind the tragedy so that recommendations can be made for the future.

One difficulty the commission faced in making its inquiries was that, at the same time, criminal investigations into the tragedy were being conducted by the New Zealand Police and the Department of Labour (DOL). The commission arranged its public hearings in four phases for efficiency and in an endeavour to minimise any conflict with the criminal investigations. The commission used the DOL investigation report and associated material, where it was appropriate to do so, to gain an understanding of what had happened.

The commission's report is organised into two volumes:

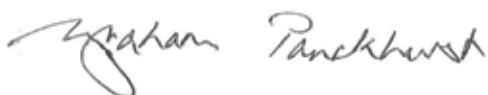
Volume 1 is an overview of what happened at Pike River and what should be done for the future to avoid such tragedies. Sixteen primary recommendations then follow.

Volume 2 is a more detailed and technical analysis of the tragedy, together with the reasoning that led to our recommendations. Volume 2 also contains appendices that further explain the conduct of the commission.

We wish to acknowledge and thank the many people who have assisted us with our inquiries, and our counsel, executive director and staff who have worked so hard. We wish to acknowledge the families of the deceased men. Many attended the commission's hearings and provided evidence. We were impressed with their fortitude and courage. The commission would also like to acknowledge John Haigh QC, who died during the course of the commission.

The lessons from the Pike River tragedy must not be forgotten. New Zealand needs to make urgent legislative, structural and attitudinal changes if future tragedies are to be avoided. Government, industry and workers need to work together.

That would be the best way to show respect for the 29 men who never returned home on 19 November 2010, and for their loved ones who continue to suffer.



Hon. Justice Graham Panckhurst
(Chairperson)



Stewart Bell PSM



David Henry CNZM

Pike River Mine

Atarau, Greymouth, New Zealand



Conrad Adams
43, Greymouth



Daniel (Dan) Herk
36, Runanga



David (Dave) Hoggart
33, Greymouth



Richard (Rolls) Holling
41, Blackball



Koos Jonker
47, Limpopo, South Africa



Peter (Pete) Rodger
40, Perth, Scotland



Blair Sims
28, Greymouth



Keith Valli
62, Nightcaps



Terry Kitchin
41, Runanga



Joshua (Josh) Ufer
25, Charters Towers, QLD, Australia



Zen Drew (Verhoeven)
21, Greymouth



Kane Nieper
33, Greymouth



Riki (Rik) Keane
28, Greymouth





Malcolm Campbell
25, St. Andrews, Scotland



Glenn Cruse
35, Greymouth



Allan Dixon
59, Runanga



Christopher (Chris) Duggan
31, Dunollie



William (Willie) Joynson
49, Maryborough, QLD, Australia



Stuart (Stu) Mudge
31, Runanga



Peter O'Neill
55, Runanga



Brendon Palmer
27, Greymouth



Samuel (Sam) Mackie
26, Christchurch



Milton (Milt) Osborne
54, Ngahere



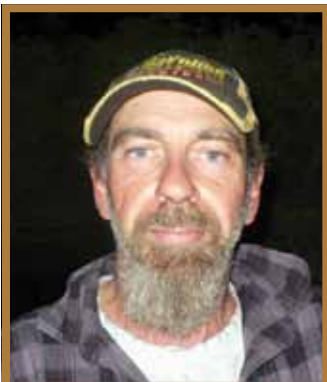
Joseph Dunbar
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21, Singleton, NSW, Australia



Michael Monk
23, Greymouth



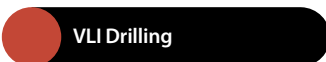
John Hale
45, Hokitika



Andrew (Huck) Hurren
32, Hokitika



Francis Marden
41, Barrytown



VLI Drilling



Boyd Kilkelly Builder



Graeme Pizzato Contracting



CYB Construction

Terms of reference

Royal Commission on the Pike River Coal Mine Tragedy

Elizabeth the Second, by the Grace of God Queen of New Zealand and her Other Realms and Territories, Head of the Commonwealth, Defender of the Faith:

To The Honourable GRAHAM KEN PANCKHURST, of Christchurch, Judge of the High Court of New Zealand; DAVID ROBERT HENRY, CNZM, Consultant; and STEWART LYNN BELL, Commissioner for Mine Safety and Health for Queensland:

GREETING:

Recitals

WHEREAS on 19 November 2010, at the coal mine at Pike River, near Greymouth, operated by Pike River Coal Limited, there occurred a major explosion within the mine while 31 employees of, or contractors to, Pike River Coal Limited were underground. Two men escaped the mine; the rest were missing:

WHEREAS on 24 November 2010, before the mine was declared safe for search and rescue operations, a further explosion occurred that was of such severity that expert assessment was that none of those trapped underground could have survived:

Appointment and order of reference

KNOW YE that We, reposing trust and confidence in your integrity, knowledge, and ability, do, by this Our Commission, nominate, constitute, and appoint you, The Honourable GRAHAM KEN PANCKHURST, DAVID ROBERT HENRY, and STEWART LYNN BELL to be a Commission to inquire into and report upon (making any recommendations that you think fit upon) —

- (a) the cause of the explosions in the Pike River Coal Mine (the **mine**) on, around, or after 19 November 2010; and
- (b) the cause of the loss of life of the men working in the mine; and
- (c) the practices used or other steps taken at the mine for, or related to, its operations and management, including, without limitation, their effectiveness in achieving —
 - (i) compliance with the law or recognised practices; and
 - (ii) a healthy and safe place of work; and
- (d) the search, rescue, and recovery operations contemplated or undertaken after the explosion on 19 November 2010, including, without limitation, —
 - (i) the practices used, other steps taken, and the equipment and the other resources available; and
 - (ii) preparedness for those operations; and
- (e) the requirements of the Acts, regulations, or other laws, or of any recognised practices, that govern each of the following:
 - (i) underground coal mining and related operations;

- (ii) health and safety in underground coal mining and related operations; and
- (f) how the requirements in paragraph (e) interact with other requirements that apply to the mine or to the land in which it is situated, including, without limitation, those for conservation or environmental purposes; and
- (g) resourcing for, and all other aspects of, the administration and implementation of the laws or recognised practices that apply to the mine or to the land in which it is situated; and
- (h) how the matters referred to in paragraphs (e) to (g) compare with any similar matters in other countries; and
- (i) any other matters arising out of, or relating to, the foregoing that come to the Commission's notice in the course of its inquiries and that it considers it should investigate:

Matters upon or for which recommendations required

And, without limiting the order of reference set out above, We declare and direct that this Our Commission also requires you to make recommendations upon or for —

- (a) the prevention, as far as possible, of similar disasters, and the safe working in future of the mine and other mines; and
- (b) what ought to be done, if the mine is not reopened, to ensure the safety of the mine and the surrounding area; and
- (c) practices or other steps for the purposes of search, rescue, and recovery operations in similar disasters; and
- (d) whether any changes or additions should be made to relevant laws and practices:

Exclusions from inquiry and scope of recommendations

But, We declare that you are not, under this Our Commission, to inquire into and report upon the wider social, economic, or environmental issues, such as the following:

- (a) the social consequences, for Greymouth and the West Coast, of the tragedy; and
- (b) the economic impact, on Greymouth and the West Coast, of the tragedy and of coal mining, or any other mining, and related operations; and
- (c) the merits of coal mining, or any other mining, and related operations in New Zealand (including, without limitation, in respect of land, or an interest in land, held under, or held under an Act or Acts listed in Schedule 1 of, the Conservation Act 1987):

"Practices" defined

And We declare that, in this Our Commission, unless the context otherwise requires, **practices** includes, without limitation, each of the following (however described):

- (a) decision making:
- (b) procedures:
- (c) processes:
- (d) services:
- (e) systems:

Appointment of chairperson

And We appoint you, The Honourable GRAHAM KEN PANCKHURST, to be the chairperson of the Commission:

Power to adjourn

And for better enabling you to carry this Our Commission into effect, you are authorised and empowered, subject to the provisions of this Our Commission, to make and conduct any inquiry or investigation under this Our Commission in the manner and at any time and place that you think expedient, with power to adjourn from time to time and from place to place as you think fit, and so that this Our Commission will continue in force and that inquiry may at any time and place be resumed although not regularly adjourned from time to time or from place to place:

Information and views, relevant expertise, and research

And you are directed, in carrying this Our Commission into effect, to consider whether to do, and to do if you think fit, the following:

- (a) adopt procedures that facilitate the provision of information or views related to any of the matters referred to in the order of reference above; and
- (b) use relevant expertise, including consultancy services and secretarial services; and
- (c) conduct, where appropriate, your own research:

General provisions

And, without limiting any of your other powers to hear proceedings in private or to exclude any person from any of your proceedings, you are empowered to exclude any person from any hearing, including a hearing at which evidence is being taken, if you think it proper to do so:

And you are strictly charged and directed that you may not at any time publish or otherwise disclose, except to His Excellency the Governor-General of New Zealand in pursuance of this Our Commission or by His Excellency's direction, the contents or purport of any report so made or to be made by you:

And it is declared that the powers conferred by this Our Commission are exercisable despite the absence at any time of any one member appointed by this Our Commission, so long as the Chairperson, or a member deputed by the Chairperson to act in the place of the Chairperson, and at least one other member, are present and concur in the exercise of the powers:

And We do further declare that you have liberty to report your proceedings and interim findings under this Our Commission from time to time if you judge it expedient to do so:

Reporting date

And, you are required to report to His Excellency the Governor-General of New Zealand in writing under your hands, as soon as is reasonably practicable but in any event not later than 31 March 2012*, your findings and opinions under this Our Commission, together with the recommendations, required and otherwise, that you think fit to make in respect of them:

And, lastly, it is declared that these presents are issued under the authority of the Letters Patent of Her Majesty Queen Elizabeth the Second Constituting the Office of Governor-General of New Zealand, dated 28 October 1983,* and under the authority of and subject to the provisions of the Commissions of Inquiry Act 1908, and with the advice and consent of the Executive Council of New Zealand.

* Extended to 28 September 2012 on 7 February 2012 (CAB Min (12) 3/1); further extended to 30 November 2012 on 27 August (CAB Min (12) 30/7).

In witness whereof We have caused this Our Commission to be issued and the Seal of New Zealand to be hereunto affixed at Wellington this 14th day of December 2010.

Witness Our Trusty and Well-beloved The Right Honourable Sir Anand Satyanand, Chancellor and Principal Knight Grand Companion of Our New Zealand Order of Merit, Principal Companion of Our Service Order, Governor-General and Commander-in-Chief in and over Our Realm of New Zealand.

Governor-General

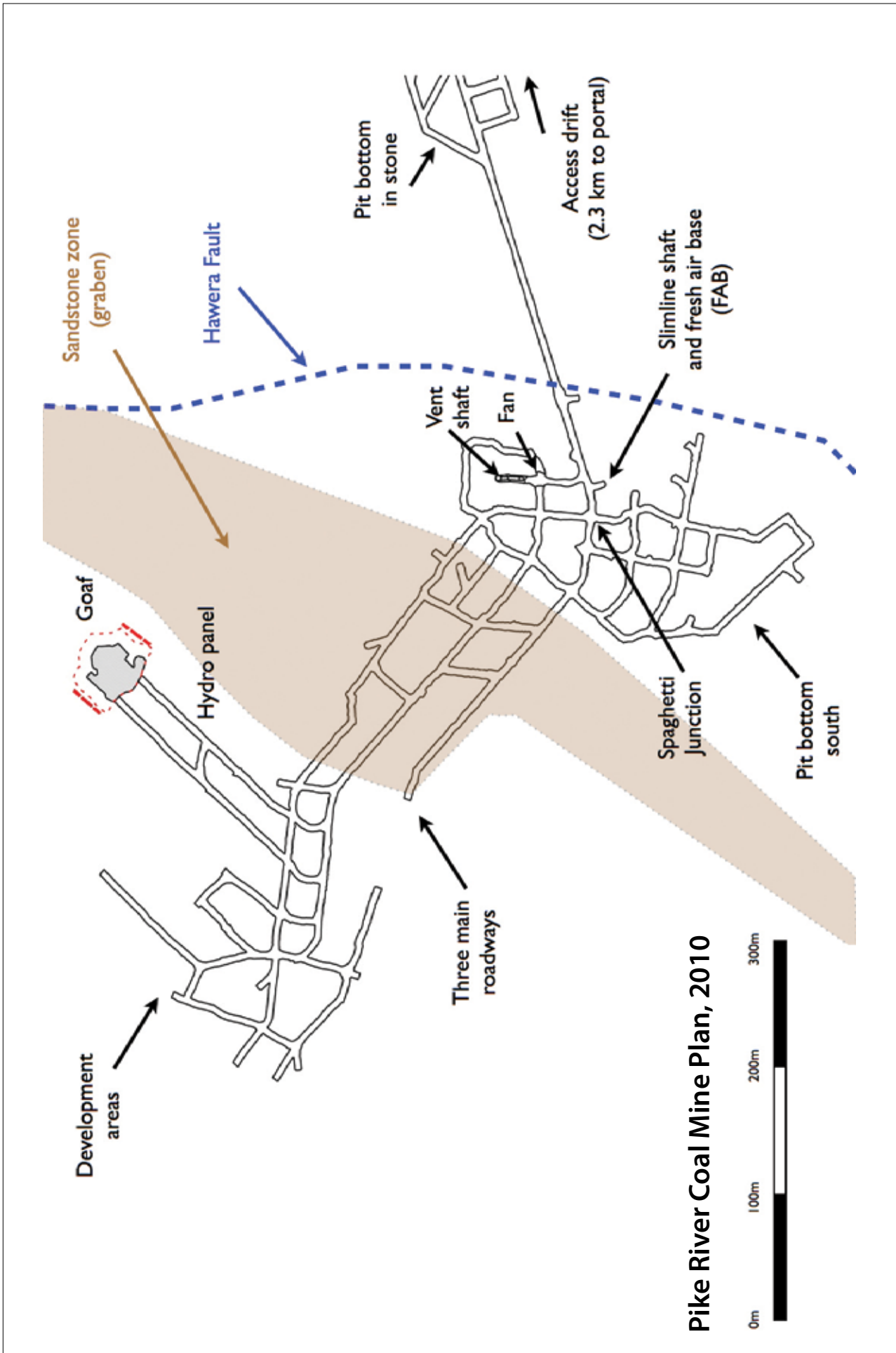
By His Excellency's Command —

Prime Minister

Approved in Council —

Clerk of the Executive Council

* SR 1983/225





Overview

This overview is in three parts.

First there is a snapshot of the report, identifying some main points. The second part, which is essentially factual, sets out the commission's views on what happened at Pike River and why. The third part takes a broader view, identifying the lessons learnt from the tragedy and the significant changes required to avoid future tragedies. Recommendations are then made.

Readers requiring more detail should consult the main report (Volume 2).

Snapshot

The Pike River underground coal mine lies high in the rugged Paparoa Range on the West Coast of the South Island. Access to the mine workings was through a single 2.3km stone drift, or tunnel, which ran upwards through complex geological faulting to intersect the Brunner coal seam.

On Friday 19 November 2010, at 3:45pm, the mine exploded. Twenty-nine men underground died immediately, or shortly afterwards, from the blast or from the toxic atmosphere. Two men in the stone drift, some distance from the mine workings, managed to escape.

Over the next nine days the mine exploded three more times before it was sealed. There is currently no access to the mine.

The commission is satisfied that the immediate cause of the first explosion was the ignition of a substantial volume of methane gas. The commission's report identifies a number of possible explanations for the source of that accumulation of methane, and the circumstances in which it was ignited.

Methane gas, which is found naturally in coal, is explosive when it comprises 5 to 15% in volume of air. In that range it is easily ignited. Methane control is therefore a crucial requirement in all underground coal mines. Control is maintained by effective ventilation, draining methane from the coal seam before mining if necessary, and by constant monitoring of the mine's atmosphere.

The mine was new and the owner, Pike River Coal Ltd (Pike), had not completed the systems and infrastructure necessary to safely produce coal. Its health and safety systems were inadequate. Pike's ventilation and methane drainage systems could not cope with everything the company was trying to do: driving roadways through coal, drilling ahead into the coal seam and extracting coal by hydro mining, a method known to produce large quantities of methane.

There were numerous warnings of a potential catastrophe at Pike River. One source of these was the reports made by the underground deputies and workers. For months they had reported incidents of excess methane (and many other health and safety problems). In the last 48 days before the explosion there were 21 reports of methane levels reaching explosive volumes, and 27 reports of lesser, but potentially dangerous, volumes. The reports of excess methane continued up to the very morning of the tragedy. The warnings were not heeded.

The drive for coal production before the mine was ready created the circumstances within which the tragedy occurred.

A drive for production is a normal feature of coal mining but Pike was in a particularly difficult situation. It had only one mine, which was its sole source of revenue. The company was continuing to borrow to keep operations going. Development of the mine had been difficult from the start and the company's original prediction that it would produce more than a million tonnes of coal a year by 2008 had proved illusory. The company had shipped only 42,000 tonnes of coal in total. It was having some success in extracting coal as it drove roadways but it was pinning its hopes on hydro mining as the main production method and revenue earner. Hydro mining started in September 2010 but was proving difficult to manage and output was poor.

It is the commission's view that even though the company was operating in a known high-hazard industry, the board of directors did not ensure that health and safety was being properly managed and the executive managers did not properly assess the health and safety risks that the workers were facing. In the drive towards coal production the directors and executive managers paid insufficient attention to health and safety and exposed the company's workers to unacceptable risks. Mining should have stopped until the risks could be properly managed.

The Department of Labour did not have the focus, capacity or strategies to ensure that Pike was meeting its legal responsibilities under health and safety laws. The department assumed that Pike was complying with the law, even though there was ample evidence to the contrary. The department should have prohibited Pike from operating the mine until its health and safety systems were adequate.

After the explosion a major search and rescue effort was launched. There was no predictable window of opportunity within which the Mines Rescue Service (MRS) could have safely entered the mine. Pike had no system for sampling the mine atmosphere after an explosion and without that information it was impossible to assess the risks of entry. The placement of the main fan underground and the damage caused to the back-up fan on the surface meant that the mine could not be reventilated quickly.

The New Zealand Police led the emergency response and made the major decisions in Wellington. There had been no combined testing of an emergency response of this nature involving Pike, mining specialists, the MRS, the police and emergency services.

For the first few days the families were given an over optimistic view of their men's chances of survival, but this was inadvertent. When the second explosion occurred five days later any remaining hope disappeared.

The new owner of the mine, Solid Energy New Zealand Ltd, has agreed that it will take all reasonable steps to recover the bodies provided this 'can be achieved safely, is technically feasible and is financially credible.'¹ Any recovery will hinge on a resumption of commercial mining operations.

The mine is sealed and its atmosphere is inert. Solid Energy is ensuring the safety of the mine, including physical security, monitoring of the underground atmosphere, checking of seals and contingency planning.

New Zealand has a poor health and safety record compared with other advanced countries. The government has set up an independent ministerial task force to determine if New Zealand's health and safety system is fit for purpose. The task force will no doubt examine on a broader scale some of the matters that the commission has considered.

To reduce the risks of future tragedies, the commission makes 16 principal recommendations, set out at the end of this volume. Some recommendations have implications beyond the underground coal mining industry.

The commission recommends that there should be a new regulator with a sole focus on health and safety. The new regulator should be a Crown entity with an expert board accountable to the minister and working closely with the Ministry of Business, Innovation and Employment, employers and workers.

Based on the commission's inquiries, the Health and Safety in Employment Act 1992 is generally fit for purpose but many changes are required to update the mining regulations. The commission recommends that the changes be progressed by an expert mining task force separate from the ministerial task force. The Queensland and New South Wales regulations provide good precedents.

More worker participation in managing health and safety is needed and will require legislative change and guidance from the regulator.

Major improvements to emergency management are required. The first step should be a joint review by the organisations that responded at Pike River, then amendments to the co-ordinated incident management system and finally a programme of testing and simulation of emergencies to iron out any problems.

The statutory responsibilities of directors for health and safety should be reviewed to reflect their governance responsibilities, including their responsibility to hold management to account.

Leaving aside regulatory change, the commission recommends that directors should rigorously review their organisation's compliance with health and safety laws and assure themselves that risks are being properly managed. Managers should access the best practice guidance available on leading health and safety in the workplace.

The changes recommended by the commission rest firmly on the principle that health and safety in New Zealand can be improved only by the combined efforts of government, employers and workers.

What Happened at Pike River

The tragedy

On Friday 19 November 2010 at 3:45pm there was an underground explosion at the Pike River coal mine. Twenty-nine men lost their lives, and their bodies have not been recovered. Their names and details appear on pages 4-5.

Two men survived the explosion. They were in the stone access tunnel (drift), a distance from the pit bottom area where the main workplaces were located. Although initially overcome, Daniel Rockhouse rescued himself and his colleague Russell Smith.

The New Zealand Police led the emergency response that involved emergency services, and mines rescue crews from New Zealand, New South Wales and Queensland. Despite strenuous efforts by everyone involved, a lack of information concerning the conditions underground prevented a rescue attempt.

A second explosion on Wednesday 24 November extinguished any hope of the men's survival. The emergency focus changed to recovery of the bodies.

The commission

On 29 November 2010 the prime minister announced the government's intention to establish a royal commission. In December 2010 the commission's terms of reference and the appointment of three commissioners, the Hon. Graham Panckhurst, David Henry CNZM, and Stewart Bell PSM, the Commissioner of Mine Safety and Health for Queensland, were announced. The terms of reference are on pages 6-9. In broad terms the commission was required to report on:

- the cause of the explosions and the loss of life;
- why the tragedy at Pike River occurred;
- the effectiveness of the search, rescue and recovery operation;
- the adequacy of New Zealand mining law and practice and the effectiveness of its administration; and
- how New Zealand mining, and associated conservation and environmental, law and practice and its administration compares with that in other countries.

The commission was also asked to make recommendations about the prevention of mine disasters, the improvement of search, rescue and recovery operations, any necessary changes to mining law and practice and how to make the Pike River mine safe should it not be reopened.

The immediate cause

The immediate cause of the tragedy was a large methane explosion. Methane is found naturally in coal. It is released during mining and also accumulates in mined out areas. A group of mining experts assembled by the police and the Department of Labour (DOL) concluded that a substantial volume of methane fuelled the explosion. The area most likely to contain a large volume of methane was a void (goaf) formed during mining of the first coal extraction panel in the mine. A roof fall in the goaf could have expelled sufficient methane into the mine roadways to fuel a major explosion. It is also possible that methane which had accumulated in the working areas of the mine fuelled the explosion, or at least contributed to it.

Methane is explosive only when diluted to within the range of 5 to 15% in volume of air. Following a roof fall methane would be diluted as it was carried through the mine by the ventilation system. It is not possible to be definitive, but

potential ignition sources include arcing in the mine electrical system, a diesel engine overheating, contraband taken into the mine, electric motors in the non-restricted part of the mine and frictional sparking caused by work activities.

Effective methane management is essential in an underground coal mine. Undoubtedly there was a failure to control methane at Pike River on 19 November 2010.

The underlying causes

The commission has endeavoured to establish both the operational factors and the systemic reasons that contributed to the tragedy. The inquiry was not limited to events at the mine, but extended to the actions of the regulators and the effectiveness of mining regulation and practice in New Zealand.

Some major themes became evident in the course of the inquiry:

- This was a process safety accident, being an unintended escape of methane followed by an explosion in the mine. It occurred during a drive to achieve coal production in a mine with leadership, operational systems and cultural problems.
- Such problems coincided with inadequate oversight of the mine by a health and safety regulator that lacked focus, resourcing and inspection capacity.
- The legal framework for health and safety in underground mining is deficient.
- Those involved in the search and rescue were very committed, but the operation suffered from an absence of advance planning for a coal mine emergency and from a failure to properly implement the principles of the New Zealand co-ordinated incident management system (CIMS).
- The families of the 29 men received generous community support, but would have benefited from better communications during the search, rescue and recovery phases.

The New Zealand mining industry

Background

Coal has been mined in New Zealand since about 1850. It was initially mined almost exclusively underground, but open cast mining is now predominant, producing over 80% of total production. New Zealand mining conditions are typically complex and characterised by faulted and dipping coal seams. Comprehensive geological exploration is essential to define the coal reserve and facilitate the planning and development of a successful mine. Mining methods such as hydro mining, suited to the difficult conditions, are required.

The New Zealand coal mining industry is small. Annual production is about 5 million tonnes – approximately 2% of Australia's production. In 2010 fewer than 2000 people were working in 22 coal mines, only five of which were underground.

A failure to learn

New Zealand's health and safety record is inferior to that of other comparable countries. The rate of workplace fatalities is higher than in the United Kingdom, Australia and Canada, worse than the OECD average and has remained static in recent years.

New Zealand also has a history of underground coal mine tragedies including:

1879	Kaitangata mine	34 deaths
1896	Brunner mine	65 deaths
1914	Huntly, Ralph's colliery	43 deaths
1939	Huntly, Glen Afton No. 1 mine	11 deaths
1967	Strongman mine	19 deaths

Lessons from the past, learnt at the cost of lives, have not been retained.

Comparative analysis

The commission's terms of reference require it to compare New Zealand mining law and practice, its administration and implementation, and its interaction with other requirements to that in 'other countries'. New Zealand's most appropriate comparators are Queensland and New South Wales. These states mine 97% of Australia's coal production. The New Zealand industry has a close working relationship with the Queensland and New South Wales industries. There is a mining labour flow across the Tasman, and New Zealand operators consult Australian mining standards. These two states are frequently used for comparative analysis throughout the report.

The Pike River mine

Location of the mine

The mine is remote on the eastern side of the rugged Paparoa Range, 45km north-east of Greymouth. The coal seam lies deep below the surface and mainly within the Paparoa National Park. The seam dips in an easterly direction between a sheer escarpment to the west and the Hawera Fault to the east.

Conception

Pike River Coal Company Ltd (Pike) was formed in 1982 and acquired by New Zealand Oil & Gas Ltd (NZOG) in 1998. Over a 13-year period Pike explored and then acquired the necessary authorisations for the mine, including a mining permit, an access arrangement and resource consents. Initial exploration indicated a recoverable coal reserve of 19 million tonnes of high-quality hard coking coal.

In 2005 the Pike board decided to proceed with development of the mine. In May 2007 Pike offered shares in the company for public subscription and allotted 85 million one-dollar shares to over 5000 new investors. NZOG remained the major shareholder, but no longer held a controlling interest. Development costs were estimated at \$124 million, with annual coal production of more than a million tonnes projected by 2008. Pike River was developed as an underground mine, because open cast mining was not economic owing to the depth of the Brunner coal seam.

Development

The construction of an access road began in September 2006, followed by a 2.3km tunnel (drift) driven through stone to access the eastern side of the coal seam. In November 2008 the mine was officially opened.

The coal seam was intersected to the west of the Hawera Fault and development of the pit bottom area began in early 2009. By November 2010 the extent of underground development was as shown in the mine plan below.

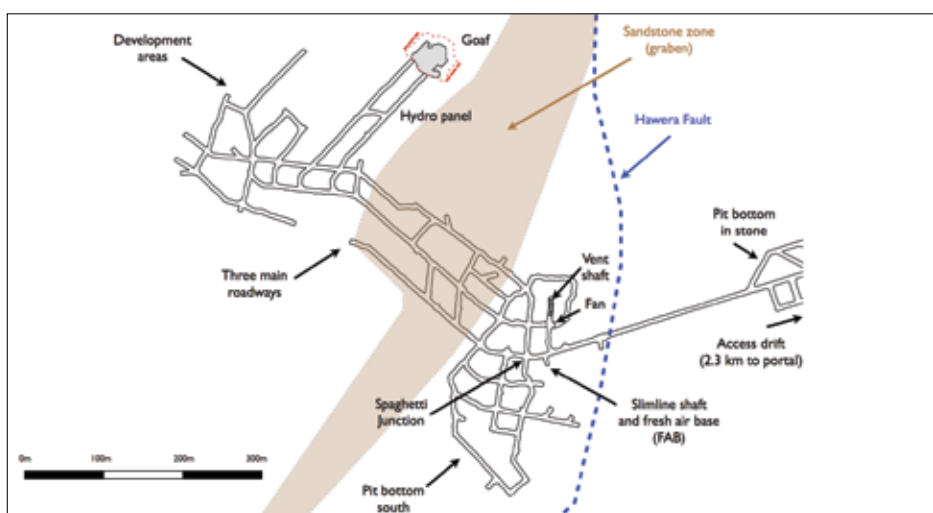


Figure 1: The mine plan as at November 2010²

There were two mine infrastructure areas (pit bottom in stone and pit bottom south), three main roadways, the hydro-mining panel and further development areas to the north-west. Spaghetti Junction was the meeting point of the drift and pit bottom, with two surface-to-mine shafts nearby – the main ventilation shaft, and the slimline shaft, at the bottom of which was a so-called fresh air base (FAB). Pike River was a small mine, still at an early stage of development.

The company situation

Pike's knowledge of the geology and the extent and location of the coal seam was based on an initial 14-borehole exploration programme, supplemented by a similar number of boreholes drilled subsequently. These provided insufficient geological information, which led to adverse unexpected ground conditions hindering mine development. Construction of the drift took much longer than anticipated, as did mine roadway development. Delays were caused by a downthrust between faults, called a graben, which created a zone of sandstone instead of coal, and the collapse of the bottom section of the ventilation shaft during construction. The collapse meant that a bypass had to be built to reconnect to the upper part of the shaft about 50m above pit bottom. The first coal sales, totalling 42,000 tonnes, were delayed until 2010.

Development costs escalated over the \$143 million figure projected in 2007. Pike required capital and during 2010 it raised \$140 million from shareholders, was seeking another \$70 million as at 19 November and also borrowed \$66 million from NZOG.

In September 2010 the Pike chief executive, Gordon Ward, resigned and was subsequently replaced by Peter Whittall. The board demanded 'better' forecasting from management, as Pike had 'over-promised and under delivered'.³

In November 2010 Pike was still in start-up mode and considerably behind its development schedule. Market credibility, capital raising, higher coal production, increased ventilation capacity, methane management and upskilling the workforce were significant challenges facing the company.

History demonstrates that problems of this kind may be the precursors to a major process safety accident. Whether an accident occurs depends on how the company responds to the challenges and the quality of its health and safety management.

Pike River Coal Ltd

Pike's vision

Pike River Coal Ltd (renamed from Pike River Coal Company Ltd in March 2006) set out to develop a safe, world-class coal mine. The company was also very committed to good environmental management, as was acknowledged by conservation leaders. Underground coal mining is both hazardous and complex at the best of times. Pike faced added challenges as it developed a new mine in a mountainous area where difficult geological conditions required some innovative solutions.

Pike recruited some well-qualified managers, many from overseas, including, for instance, Douglas White in early 2010, who was a former deputy chief inspector of mines in Australia. Over several months he tried to introduce some health and safety initiatives at the mine.

Pike also obtained advice from New Zealand and Australian consultants throughout the various stages of the mine's development. The commission's attention was drawn to the number, 36, and qualifications and experience of these consultants. They provided advice across a range of disciplines, including geotechnical engineering, ventilation, strata control, electrical safety and methane management, to mention a few.

These aspects are acknowledged at the outset partly because the commission's analysis of Pike River's operation and systems in 2010 is necessarily concerned with aspects, often negative, of likely relevance to the cause of the explosion. This does not mean that the commission has overlooked the company's aim to develop a productive and safe mine. Unfortunately Pike lost sight of that aim as its drive for production intensified.

A short-term focus

Pike's long-term mine plan had been to develop roadways to the north-west corner of the mine, establish a second intake and begin hydro mining in that area, and for mining to retreat back to pit bottom over the life of the mine – approximately 19 years. However, development delays and the consequent need for cash flow led to the need for a quick solution.

In September 2010 Pike started mining in the hydro panel close to pit bottom. The second intake, had it been developed, would have doubled as a walkout egress from the mine and also improved the efficiency of the ventilation system.

Governance by the board

The Pike board of directors was required to set the strategic direction of the company and delegate its implementation to management. The directors then had to ensure that appropriate systems were in place, including risk management, internal reporting and legal compliance systems, and also monitor the performance of management. A two-man health, safety and environment committee was to lead this process and report to the board. It could commission external reports and audits.

The board received a monthly report containing a health and safety section. Although this was helpful, it did not cover the hazards relevant to a catastrophic event such as an explosion. The board did not assess critical design and health and safety issues, including, for example, the location of the main fan underground at pit bottom. An insurance risk survey received in July 2010 identified serious concerns about the hazards posed by hydro mining, windblast and a gas explosion, and urged the need for a comprehensive risk assessment of the mining operation. Neither the board nor its committee saw the report.

The mine manager attended a board meeting four days before the explosion and told the directors that gas management was 'more a nuisance and daily operational consideration than a significant problem or barrier to operations'.⁴ The board was not well placed to assess this assurance.

The board did not verify that effective systems were in place and that risk management was effective. Nor did it properly hold management to account, but instead assumed that managers would draw the board's attention to any major operational problems. The board did not provide effective health and safety leadership and protect the workforce from harm. It was distracted by the financial and production pressures that confronted the company.

Management

At the time of the explosion the management team at Pike River comprised Peter Whittall, chief executive officer; Douglas White, site general manager; Stephen Ellis, production manager; and seven department managers. However, there was constant management change over the years. There were six mine managers in the 26 months before the explosion. Mr Ellis was to become the next mine manager as soon as he acquired the required New Zealand qualification. In the meantime Mr White was the mine manager on top of his other duties. Gordon Ward was the chief executive until succeeded by Mr Whittall in October 2010. There was also significant change in other management positions.

Throughout 2010 the management team faced planning changes and operational challenges, including improving coal production, establishing the hydro panel, commissioning the new main underground fan, upgrading the methane drainage system and resolving problems with mining machinery. These coincided with the drive to achieve coal production.

Pike's mine management plans and procedures needed considerable attention. The health and safety management plan was largely in draft, partly while awaiting technical input from other managers. The ventilation management plan was deficient, and Mr White assumed responsibility for ventilation in the absence of a ventilation engineer when his workload was already formidable.

The investigation of incident reports was haphazard, with the result that in October 2010 a backlog of outstanding investigations was written off. Other information from underground, including methane readings from fixed and portable sensors, was not systematically analysed and the problems addressed.

Executive management, Messrs Ward, Whittall and White, was focused on hydro coal production, as was the board. Associated risks were not properly assessed. At the executive manager level there was a culture of production before safety at Pike River and as a result signs of the risk of an explosion were either not noticed or not responded to.

The workforce

Pike recognised the need for good training programmes, given the inexperience and diversity of much of its workforce. Miners received comprehensive induction training and continuing training was introduced in 2010 but deferred as the push for production gathered momentum. Numerous contractors were engaged on a long-term basis. Contractor health and safety management was less effective. The induction and underground supervision of the smaller contractors in particular was lax. This was recognised and was about to be addressed when the explosion intervened.

Underground, difficulties arose because of a shortage of underviewers and deputies, a high ratio of inexperienced to experienced miners and the presence of overseas miners unused to New Zealand mining conditions. A serious problem was the workers' practice of bypassing safety devices on mining machinery so work could continue regardless of the presence of methane. This was reckless behaviour. There were also reports of other conduct and incidents caused by inexperience, inadequate training and failures to follow procedures.

Ventilation

A mine ventilation system must provide fresh air throughout the workings, and take return (foul) air out of the mine. At Pike River the intake of fresh air was from the portal, and return air was expelled to the surface up the ventilation shaft. The main fan and movable auxiliary fans circulated the air, with the assistance of ventilation control devices that guided air flow and stopped the mixing of intake and return air.

The original mine plan specified two main fans located on the mountainside next to a ventilation shaft. Two planning changes were made. Pike decided to relocate the fans underground in stone at the bottom of a ventilation shaft. In 2007 the site of the ventilation shaft was moved to its eventual location north of Spaghetti Junction. Placing a main fan underground in a gassy coal mine was a world first. The decision was neither adequately risk assessed nor did it receive adequate board consideration. A ventilation consultant and some Pike staff voiced opposition, but the decision was not reviewed. Putting the fan underground was a major error.

The fan significantly increased Pike's ventilation capacity, at least in the short term. After the explosion, however, the joint investigation expert panel used computer modelling to establish the ventilation sufficiency at the time of the explosion and found air supply to the inbye (further into the mine) areas of the mine would have been fragile, particularly in an emergency.

Ventilation consultants advised Pike on an as required basis, but no one at the mine had dedicated responsibility for ventilation management.

The main fan failed in the explosion. It was not explosion protected. A back-up fan at the top of the ventilation shaft was damaged in the explosion and did not automatically start as planned. The ventilation system shut down.

Methane management

To provide safe working conditions in a gassy coal mine effective methane management is essential. Methane levels at Pike River were managed through the ventilation system and some pre-drainage of the coal seam from in-seam boreholes.

The in-seam boreholes were primarily to map the limits of the coal seam and were not designed for pre-drainage. Some pre-drainage still occurred, requiring Pike to install a gas pipeline to vent methane to the surface. By April 2010 the pipeline could not cope and an underviewer emailed management, stating: 'History has shown us in the mining

industry that methane when given the write [sic] environment will show us no mercy. It is my opinion that it is time we took our methane drainage ... more seriously and redesigned our entire system.⁵

Gas consultants were engaged and advised that the pipeline required urgent upgrading. As a stopgap measure methane was 'free vented' into the mine's return airway to be handled by the ventilation system. The upgrade of the drainage pipeline was put on hold and free venting of large volumes of methane continued up to the time of the explosion. Free venting is no longer recognised as normal practice in modern underground coal mines.

Continuous monitoring of methane levels is essential to understanding the underground atmosphere and trends. Pike installed fixed sensors that reported to the control room, but at the time of the explosion there were too few and they were not well sited. There were only four fixed sensors in return air. One in the hydro panel reported to the operator of the water jet, and another was not functional. Sensors were also located at the bottom and near the top of the ventilation shaft. The bottom one was broken for 11 weeks before the explosion and the other was unreliable and could not read above 2.96% methane. There were no fixed sensors reporting to the surface from the working areas of the mine inbye of the main fan.

Gas readings were also taken throughout the mine using hand-held detectors and readings were noted in shift reports. Methane sensors attached to machinery were generally well maintained and calibrated to trip power at a set methane level. There was constant tripping on some machines, which led to the bypassing of sensors by some workers.

Despite its limitations, the monitoring system showed there was a serious methane management problem. After hydro mining began, high readings – many dangerously high – were recorded most days. This information was not properly assessed and the response to warning signs of an explosion risk was inadequate.

Electrical safety

Considerable electrical equipment was located underground at Pike River. High-voltage cables through the drift supplied power to underground. At Spaghetti Junction cables were intertwined with utility services, including drainage pipes carrying methane, creating a hazard.

Regulations require a gassy mine to have a restricted zone where all electrical equipment must be incapable of sparking an explosion. The dividing line at Pike River is shown below.

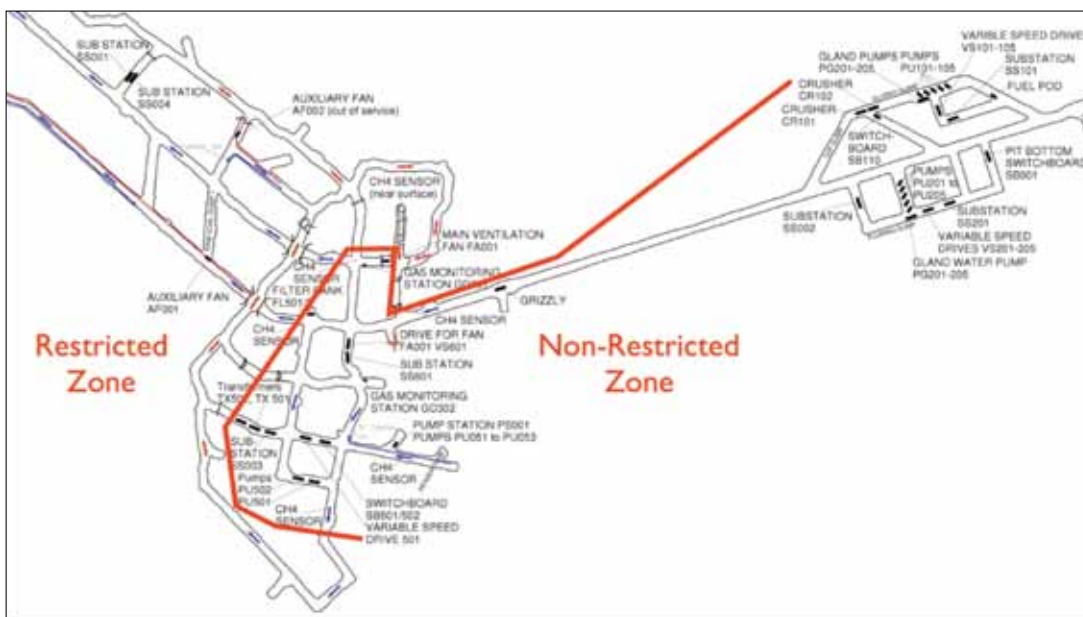


Figure 2: Boundary between the restricted and non-restricted zones⁶

The non-restricted zone, as drawn, allowed unprotected electrical equipment to be located on the right-hand side of the line in most of pit bottom south. The zone was fixed without a risk assessment, after electrical equipment was

already installed and after the location of the main fan motor had been determined.

A number of variable speed drives (VSDs) were located underground. VSDs controlled power supply to the fan and water pumps. There were problems with the VSDs, one of which was replaced and a number of which were removed for repair. The extent of these problems underlined the need for a comprehensive risk assessment of the electrical installations underground at Pike River.

Mine documents suggested the appointment of a senior electrical engineer to oversee electrical safety in the mine. An appointment was made but he had not started at the time of the explosion. DOL did not have the capacity to inspect Pike's electrical systems following the major underground installations.

Investigations are continuing to establish whether an electrical cause could have initiated the explosion, but answers will depend on gaining entry into the mine.

Hydro mining

Hydro mining started at Pike River in September 2010. This is an uncommon and specialised mining technique that uses a water jet to cut the coal face and requires expert design of the mining panel and equipment. Operators must be trained to follow a set cutting sequence and to direct the water jet to avoid the undue disturbance and release of methane. The hydro panel was developed as shown in this plan.

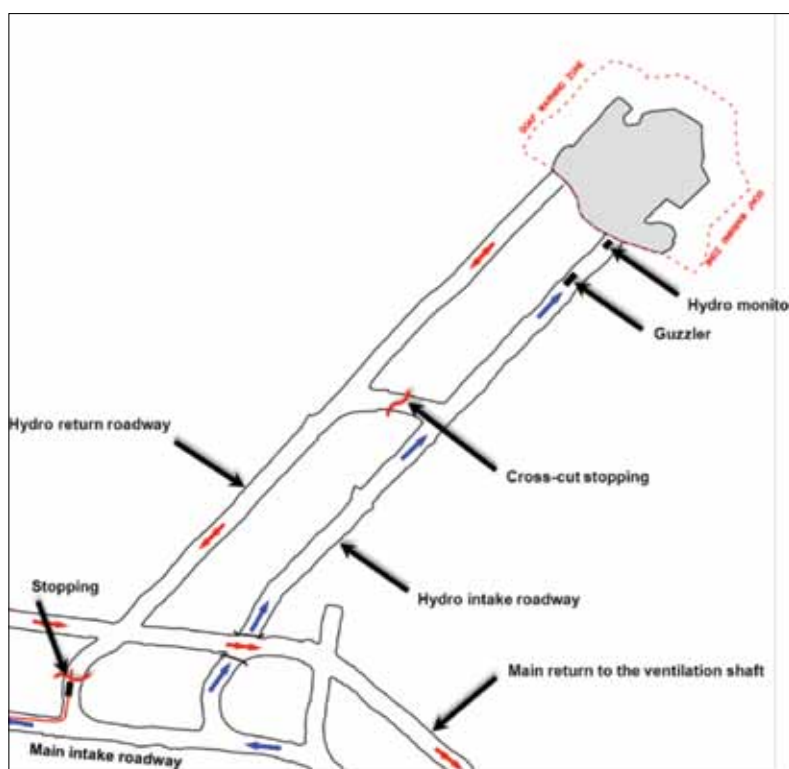


Figure 3: Diagrammatic outline of hydro panel⁷

The water jet was mounted on the monitor, with an operator stationed at the guzzler. The goaf was unsupported and roof falls were expected. The intake of fresh air is represented by the blue arrows and the outflow of return air by the red arrows.

When hydro mining began, the workers had the incentive of a \$13,000 bonus if they met production targets by late September, after which the payment would decrease from week to week. Despite a number of set-up problems the targets were met towards the end of the month. After the new fan was commissioned, ventilation to the hydro panel improved and during October 2010 hydro mining became a two-shift, 24-hour operation.

In October the width of the extraction area was increased from 30m to 45m, although a consultant geotechnical engineer had indicated the risk of a major roof collapse in the goaf could not be excluded. On 30 October a significant

roof fall did occur, causing a pressure wave that took out the stopping in the hydro cross-cut intended to separate intake and return air. Methane readings were high, but there was no explosion.

Hydro mining continued into November without reassessment of the risk of further roof falls in the goaf. Production levels did not improve, and spikes in the methane levels continued to be recorded in the weeks leading up to the explosion.

The regulators

The Coal Mines Act 1979

This was the main act governing coal mining activities until 1992. A specialist coal mines inspectorate administered mining. The inspectorate reviewed applications for exploration and mining licences and inspected the mine once it was developed. This meant that the inspectorate had a hand in the safety of a mine from its planning to closure.

By 1992 a new legislative framework was in place. The granting of exploration and mining permits, the assessment of environmental effects and the regulation of health and safety in coal mining were administered by separate entities under separate acts. The mines inspectorate no longer had a role throughout the life of a mine.

Ministry of Economic Development (MED)

MED approved the issue of Pike's mining permit in 1997. Its focus was the economic benefits to New Zealand. MED did not fully apply the criteria set out in its coal policy programme, which included requirements to check the experience of the applicant and its proposed mining methods, and to ensure that these represented good mining practice. In terms of the coal programme, health and safety, which is intrinsic to good mining practice, was not MED's concern. MED did not consult DOL so no one looked at the health and safety implications of the proposed mine.

MED's subsequent monitoring of the mine development was limited to ensuring that work statements were filed and storing mining plans.

Until 1 January 2009 MED carried out electrical safety inspections for DOL. After that date MED ceased to conduct inspections and DOL had no capacity to continue them.

Department of Conservation (DOC)

In 1998 Pike applied for access to the conservation land where the mine was to be developed. Over the next six years the potential environmental effects of the development were assessed in detail. DOC was concerned to minimise disturbance from surface activities and ensure that underground mining caused only minimal subsidence. In late 2004 an access arrangement was signed. It set out detailed controls.

DOC discharged its statutory function to protect the conservation value of the land. During development of the mine it met the company regularly to manage operational issues and accommodate a number of variations to the access arrangement.

Pike gave no evidence to indicate that DOC's controls compromised its ability to develop a productive and safe mine. The explosion, when the mine was still in start-up mode, limited the commission's assessment of whether underground coal mining and conservation and environmental values would have been compatible at Pike River over the longer term.

Local and regional authorities

Pike required resource consents from the Grey and Buller District Councils and the West Coast Regional Council. These were initially granted in 1999, but a number of appeals were not resolved until 2004. The councils considered environmental and public safety issues in terms of the Resource Management Act 1991. Health and safety in the workplace was not part of their mandate.

Department of Labour (DOL)

DOL's function was to ensure that Pike River was a legally compliant coal mine. The first workplace inspection was conducted in early 2007 when the drift was under construction and the mine design was already settled. From then, mining inspectors conducted quarterly inspections.

DOL's policy was to tailor a regulatory approach appropriate for individual employers. Because Pike was assumed to be a 'best practice' and 'compliant' employer the inspectors adopted a low-level compliance approach. This proved ineffective, as was most evident regarding the need to provide two emergency exits from the mine. In mid-2009 the main ventilation shaft was designated the second means of egress out of the mine. To use it involved a 110m ladder climb that was physically exhausting in normal conditions, but probably impossible in an emergency.

In April 2010 an inspector told the mine manager that the shaft, although technically compliant, was not a suitable emergency escapeway. In August DOL advised Pike by letter that a new egress was required 'as soon as possible'.⁸ In November 2010 Pike said a new egress would be established by mid-2011. DOL considered this unsatisfactory, but took no further action before the explosion.

Pike was not a best practice or compliant employer in relation to this and some other obligations. The workforce had voiced concern to management about the unsuitability of the second egress. The start of hydro mining in September 2010 increased the level of risk in the mine to the point where DOL should have issued a notice prohibiting hydro mining until a suitable second egress was in place.

DOL's compliance strategy did not require an assessment of Pike's safety and operational information. The inspectors did not have a system, training or time to do so. When, at the hearings, they were shown examples of safety information obtained by the commission from Pike's records, the inspectors were visibly dismayed. This was not a case of individual fault, but of departmental failure to resource, manage and adequately support a diminished mining inspectorate.

The cause of the explosions

Activities in the mine

Sixteen Pike workers and 13 contractors perished in the mine. Their locations at 3:45pm on 19 November 2010 are not known with any certainty. Eight men, mainly contractors, were probably in the pit bottom area. The other 21 men were most likely at various workplaces, including the hydro panel and four work areas inbye of the panel.

The contractors, other than an in-seam drilling crew, were due to finish work at 4:00pm and could have been preparing to leave the mine when the explosion occurred.

Source of the methane

The expert panel concluded that the size and duration of the explosion indicated it was fuelled by a large volume of methane, perhaps up to 2000m³. Methane accumulated in the hydro goaf following mining was estimated at up to 5000m³. Another roof fall like that which occurred on 30 October 2010 would have caused a large pressure wave bearing a substantial volume of methane.

The pressure wave would have flowed down the hydro panel roadways and entered the main mine roadways, with the potential to flow inbye, particularly if a temporary stopping failed and allowed the wave to enter the main intake roadway. Methane carried along the roadways by the pressure wave would be diluted by air into the explosive range.

Another potential source of methane was an accumulation in the elevated inbye western areas of the mine. High methane readings were reported in these areas right up to the morning of 19 November.

Potential ignition sources

There are a number of possible ignition sources, since a spark is sufficient to ignite methane diluted to within the explosive range.

About midday on 19 November the water supply to the mine was stopped for a maintenance shutdown and mining and roadway development underground had to cease. Late afternoon, the maintenance work was completed and the control room operator reactivated a main pump at pit bottom in stone to restore water to the mine. He then called underground to advise the miners and as he spoke to an engineer all reporting to the control room from underground was lost. The coincidence of the switching on of the pump and the explosion seconds later suggested that an electrical cause may have been the ignition source.

An electrical expert thought that the VSD used to power the water pump could have produced electrical wave form distortion, called harmonics, and caused sparking in the mine earthing system or in a metal pipeline. This theory, however, is disputed and unless experts can re-enter the mine and examine the electrical systems the timing coincidence will remain a matter of conjecture.

Another potential ignition source is contraband. Smoking materials and battery-powered devices, including wristwatches and cameras, are prohibited underground because they are an ignition risk. Contraband incidents occurred at Pike River, despite preventative actions taken by management. Underground vehicles powered by diesel engines incorporated flameproof enclosures to prevent hot surfaces igniting gases, but these systems can be prone to failure. Frictional ignitions caused by metal to metal contact during vehicle or work activity underground could also ignite a gas explosion. The main fan was not flameproof, and other underground electric motors could also have been potential ignition sources.

The site of the ignition

The characteristics of the explosion, its effects upon the two survivors in the drift and computer modelling undertaken by the expert panel indicated that the most plausible ignition site was one inbye of the main fan, in about the middle of the mine workings.

The subsequent explosions

There were three further explosions on the afternoons of 24, 26 and 28 November. These were also methane-fuelled, but were shorter and more violent than the first one. They were probably sited nearer to the main ventilation shaft. The pattern of the explosions indicated that, during the afternoon, air was naturally drawn into the mine from the portal and became mixed with accumulated methane so that an explosive fringe developed. An underground fire or hot coal could then have ignited the explosive atmosphere.

The cause of the deaths

Following an inquest the chief coroner found that the men died 'at the immediate time of the large explosion . . . or a very short time thereafter' from the force of the explosion or the effects of the irrespirable atmosphere.⁹ This finding was based on reports from medical experts produced at the inquest. The commission heard additional evidence concerning survivability.

The evidence from a number of mining experts generally supported the inquest finding. Based on the history of similar disasters, the small area of the mine, the force, heat and toxicity of the explosion, and the effects experienced by the survivors in the drift, the experts considered that survival for any appreciable time in the working area of the mine was most unlikely.

Laser images of the FAB taken by a device lowered down the slimline shaft showed that the lid of a box containing self-rescuers was open, raising the suggestion that someone could have survived to open the box. This, however, is only one possible explanation. The lid could have been left open before the explosion, opened by someone afterwards or possibly blown open during the explosion.

The commission considers these suggestions speculative and insufficient to alter the chief coroner's finding. It agrees that the men probably died at the time of the explosion or a short time after it.

Search, rescue and recovery

The initial emergency response

Pike's emergency response management plan required the most senior manager on site to take control of any emergency. Within minutes of the 3:45pm explosion the mine manager was told that all reporting from underground had stopped and no one had called the control room – an unprecedented situation. An electrician was sent underground and drove 1500m in by before a toxic atmosphere forced him to retreat, but not before he saw a vehicle and someone lying on the roadway. He reported this at 4:25pm. Emergency services were then contacted.

It would have been better to call for emergency help once it was clear the situation was unprecedented. Emergency services could have been stood down if necessary. The delay probably made no difference to the survival of the men, but the mine manager was not to know this.

Police assume control

Within the hour local police officers reached the mine and officers at Police National Headquarters in Wellington decided that the police would lead the emergency response. This brought initial order to a very difficult situation as Pike managers, mines rescue crews, the New Zealand Fire Service, DOL, St John Ambulance and others rallied at the mine site.

The next day further New Zealand and Australian mines rescue and mining experts arrived at the mine, their travel needs facilitated by the police, who expertly managed many logistical demands throughout the response effort.

Conducting the emergency response was very complex, given the need to co-ordinate multiple agencies, make crucial decisions and maintain external communications, including with the families, when time was of the essence.

Self-rescue

After an underground fire or explosion coal miners worldwide are trained to self-rescue by walking or driving out of the mine. It is standard practice for miners to carry a self-rescuer, a form of breathing device for use in a toxic atmosphere. The workers at Pike River carried 30-minute duration self-rescuers and were trained to use the drift as the preferred escapeway in an emergency.

As at November 2010 it was the only useable means of egress. Climbing up the 110m ventilation shaft – the designated second egress – would not have been possible wearing a self-rescuer and with the shaft effectively functioning as a chimney after the explosion. As far as is known, the explosion did not cause a roof fall sufficient to block off the drift, so the absence of a second means of egress probably did not affect the men's chances of survival.

The Mines Rescue Service (MRS)

The MRS operates through a charitable trust to provide training and emergency response services to the mining industry. It is funded from a coal levy and payments received for its ancillary services.

Mines rescue crews were deployed to Pike River immediately after the 4:30pm callout. Throughout the rescue phase local crews made up of volunteer miners, assisted by their Australian counterparts, were on standby, but to their frustration conditions did not permit entry into the mine.

The MRS also played a major role in sealing and using the Queensland MRS inertisation device to stabilise the mine following the sequence of explosions, and successfully led an operation to reclaim and reventilate the first section of the drift in 2011.

The fresh air base (FAB)

During the emergency response reference was made to a place in the mine where the men could be waiting in fresh air to be rescued. This was the stub near Spaghetti Junction and at the bottom of the slimline shaft called the FAB. The

methane drainage pipeline passed through the stub, which also contained a supply of spare self-rescuers, and first aid and fire-fighting equipment. There was a roll-down brattice curtain at the entrance, but it did not provide an effective seal. Nor was there any assurance that, following an explosion, fresh air would flow down the slimline shaft.

The stub was an FAB in name only, not a place of safety in an emergency. Nor was it suitable as a changeover station for anyone wanting to don a fresh self-rescuer.

A lack of information

The emergency response was hampered by a lack of information. The number of men missing underground remained uncertain until Saturday morning, 20 November, when the correct figure and the breakdown between employees and contractors was announced.

There could be no rescue attempt without information on the mine atmosphere. Reporting from underground stopped at the time of the explosion and Pike had no back-up system. For the first five days the only samples available for analysis were taken from near the top of the ventilation and slimline shafts, but they were not considered representative of conditions underground. A new borehole drilled into the heart of the mine reached pit bottom on the morning of 24 November. The availability of representative samples stimulated hope, but the second explosion that afternoon put paid to any thought of a rescue attempt.

The window of opportunity fallacy

There has been criticism that rescuers did not go into the mine during a so-called 'window of opportunity' when it was supposedly safe to enter immediately after the explosion. The commission rejects this criticism and any suggestion of a lack of courage on the rescuers' part.

There is no predictable period during which a gassy coal mine may be safely entered before a second explosion may occur. Secondary explosions are unpredictable, and the window of opportunity fallacy has claimed many lives in mines throughout the mining world. International best practice is to re-enter an underground coal mine only on the basis of representative and reliable atmospheric information. This did not exist at Pike River.

Entry into the mine would also have been unusually challenging with no ventilation or second egress, and a 2.3km inclined drift to negotiate.

The co-ordinated incident management system (CIMS)

CIMS is a system designed to co-ordinate the response activities of New Zealand emergency services. CIMS is generic, not specific to mining. A core concept is an incident management team comprising planning/intelligence, operations and logistics managers who formulate an incident action plan. That plan must be approved by an incident controller. The controller and the management team are based close to the incident site, where decisions are made promptly and with the benefit of expert advice.

After the police assumed the lead agency role at Pike River the three management and the incident controller roles were assigned to police officers, meaning the leadership group at the mine lacked mining expertise. Superintendent Gary Knowles, the incident controller, based himself at Greymouth, but was required to refer many decisions to an assistant commissioner at Police National Headquarters in Wellington.

This three-level structure was cumbersome and unsuited to the rapidly changing situation faced by the rescuers at the mine. Instead of decisions being made at Pike River, where mining and rescue experts were gathered, many were made by non-experts in Wellington. This slowed the emergency response and could have impeded a rescue had one proved possible. Preparations to seal the mine to reduce the chances of further explosions were hindered, and some experts at the mine became disillusioned.

The commission considers that management of the response over the crucial rescue period was not in line with CIMS principles. The difficulties experienced highlighted the need for advance planning for an underground coal mining emergency, involving all the relevant agencies, including the MRS.

Recovery of the men's bodies

After the explosions the mine entrances were sealed and inert gas was pumped underground. This extinguished fires and stabilised the atmosphere, which became methane rich and irrespirable.

In March 2011 the police handed control of the mine to receivers, appointed following Pike's voluntary receivership. Late that year the receivers, assisted by the MRS, established permanent seals that enabled the drift to be reclaimed and ventilated to 170m inbye of the portal.

In July 2012 Solid Energy New Zealand Ltd purchased the mine and also signed an agreement with the government to recover the bodies as part of any future mining operation if it 'can be achieved safely, is technically feasible and is financially credible'.¹⁰ The government has a watchdog role, and may also contribute to any recovery costs over and above the costs arising from a resumption of commercial mining.

There is no prescribed timeframe and the risks involved in re-entering the mine workings beyond the drift make body recovery from this area very uncertain.

The families of the men

Attendance at the hearings

The loss of 29 lives at Pike River exacted an enormous toll on the men's families, friends and colleagues. Many family members attended the commission's hearings. A number provided written witness statements and some provided heart-breaking oral evidence to the commission. The commission was impressed with their fortitude and courage.

Were false hopes raised?

Some families consider they were given false hope concerning the prospects of their men's survival. The families were initially briefed twice daily by Superintendent Knowles and Peter Whittall, based on information they received from the mine site shortly beforehand. Over the first weekend Mr Whittall in particular referred to fresh air being pumped into the mine, men waiting underground and the possibility of a rescue attempt when the mine conditions were better understood.

The commission has concluded that Mr Whittall gave false hope, but did not do so deliberately. Although some of his comments were over optimistic, even unwise, they reflected his state of mind at the time. Under extreme stress he allowed his desire for a successful outcome to intrude, showing that someone not so close to the situation should be selected for the spokesperson's role.

Advice of the second explosion

Superintendent Knowles and Mr Whittall were at the mine at 2:37pm on 24 November when the second explosion occurred. Experts agreed that no one could have survived this even more forceful explosion. People were advised by text message of a 'significant update' at the 4:30pm family briefing.¹¹

Mr Whittall began by referring to improved gas levels and preparations to go into the mine. This caused great excitement. But as soon as order was restored he referred to the second explosion and Superintendent Knowles added that it was not survivable, so the operation had moved to a recovery phase. The scene turned to one of profound distress.

Mr Whittall agreed that this announcement went horribly wrong. However, the commission accepts his evidence that this outcome was unforeseen and entirely unintended. The stress of the occasion and a few ill-chosen words raised hope before all hope was dashed, but this was a human error.

The recording of the first explosion

The CCTV recording of the first explosion was not shown to the families until Tuesday 23 November. Some were critical of the delay and there was also a suggestion that the recording was edited and was shorter than the original.

The delay, although unfortunate, arose because the recording was not drawn to Mr Whittall's attention until Sunday 21 November. He then acted promptly in obtaining and arranging for the recording to be shown to the families. The evidence of those who supplied the recording to Mr Whittall confirmed that it was not an edited version.

Body recovery

Following the second explosion most families sought the recovery of the men's remains above all else. Early comments to the effect that recovery could be only 'some weeks' off led to optimism.¹² Then, during 2011, progress towards re-entry into the mine stalled, frustration set in and family members felt that they were alone and unsupported.

The sale of the mine to Solid Energy in 2012 revived hope, but in May the families were told that the prospects of body recovery were remote. They were ill prepared for this news.

The commission received expert evidence that the delay and uncertainty concerning body recovery had hindered the grieving process and increased the toll on many family members. This was clearly evident as relatives gave evidence at a hearing in late 2011, and emphasised the need for communications with families to be both factual and balanced.

Support for family members

The commission acknowledges the outstanding level and value of the support given to the families from the time of the first explosion. Family members expressed heartfelt appreciation for the comfort and assistance they received.

A Pike liaison group, police and Air New Zealand family liaison teams, St John Ambulance, the Red Cross, the Focus Trust, the mayor, churches and people of Greymouth, Tai Poutini Polytechnic, the Salvation Army, central and local government agencies and others offered support in a variety of ways. Based on the lessons learnt from this tragedy, the police are training 40 staff members as victim liaison officers and developing liaison guidelines for major crisis management. This is commendable.

Safety of the mine and the surrounding area

The main shafts into the mine were capped in late 2010, a step towards extinguishing any hot spots underground. In December 2011 permanent steel doors were installed at the mine entrance. The mine atmosphere remains methane rich, and therefore inert. Gas samples taken from six boreholes are continuously monitored.

Control of the mine is now the responsibility of Solid Energy. Access to the site is controlled by a series of security gates and, following a recent review, increased remote monitoring of the site and access road is under development. These steps are sufficient to safeguard the mine in the meantime. If the mine is not to be reopened measures to permanently seal it should be effected by the mine owner in consultation with the local authorities and the land owner.

ENDNOTES

¹ Deed relating to body recovery at the Pike River Coal Mine, 17 July 2012, SOL0503445.001/2.

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³ Pike River Coal Ltd, Minutes of a Meeting of Directors, 13 September 2010, DAO.007.05996/9.

⁴ Pike River Coal Ltd, Minutes of a Meeting of Directors, 15 November 2010, DAO.007.29383/3.

⁵ Email, Brian Wishart to Jimmy Cory, 11 April 2010, DAO.025.32975/1.

⁶ Pike River Coal Ltd, Plant Location and Ventilation Plan: Rescue 101119_181, 22 March 2011, DAO.010.13140/1. (Extract of the plan modified by the commission)

⁷ Ibid.

⁸ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 2 September 2010, DOL3000090046/3.

⁹ Counsel's Submissions and Coroner's Findings, 27 January 2011, INV.01.27510/8.

¹⁰ Deed relating to body recovery at the Pike River Coal Mine, 17 July 2012, SOL0503445.001/2.

¹¹ Wendy Robilliard, witness statement, 1 July 2011, POLICE.BRF.54/4, para. 12.

¹² Andrea Vance, Michael Fox and Amy Glass, 'New Blast Makes Mission More Difficult', The Press, 29 November 2010, <http://www.stuff.co.nz/the-press/news/pike-river-disaster/4399940/New-blast-makes-mission-more-difficult>

Proposals for reform

Introduction

The commission now provides an overview of its proposals for reform and sets out its recommendations. Most of these relate to the underground coal mining industry, but some have wider relevance. In formulating its recommendations the commission has taken into account the changes made or announced by the government and the regulator since the tragedy.

Major change required and fast

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.

The need for administrative reform

Approval of permits

Oversight of health and safety planning should start early in the life cycle of a mining project. Pike, a new company with no underground coal mining experience, was able to obtain a permit to develop the mine, with no scrutiny of its initial plans for meeting health and safety requirements, and little ongoing scrutiny.

The origins of many health and safety problems lie at the design stage of a project. Health and safety considerations should be built into the design. They are not 'add-ons'.

Health and safety compliance should be a condition of mining permits. Information should be progressively supplied by the permit holder to demonstrate compliance. Regulators should co-operate and exchange information before permits are issued, as the mine is designed and developed, and throughout its life.

The changes recommended by the commission have been foreshadowed in government proposals for strengthening the Crown minerals regime. The commission endorses those proposals.

The mining inspectorate

The effectiveness of the mining inspectorate had been declining for many years and by the time of the tragedy DOL had only two mining inspectors. They were unable to discharge their statutory functions. As well as inspecting underground coal mines they were also responsible for other mines and for quarries. The inspectors could not cover so many workplaces and in practice underground coal mines, including Pike River, were not paid sufficient attention.

The inspectors held first class mine managers' certificates. They relied principally on physical inspections. They were not trained to audit the employer's health and safety systems or analyse trends in data. Nor did DOL provide expert assistance to carry out specialised inspections of electrical systems or mechanical equipment. The inspectors favoured negotiated agreements with mining companies rather than using the range of tools available to them. This was in accordance with departmental policy.

The inspectors were at the bottom of the organisation and their managers were unfamiliar with their speciality and had difficulty in understanding their work. A Mining Steering Group was established to improve the effectiveness of the inspectorate and in February 2010 it advised senior DOL management about the lack of capacity and the potential for another mining disaster. The group's request for a third inspector was not approved.

Changing the strategy

In 2005 the government issued a 10-year strategy to improve New Zealand's poor record in health and safety. In 2009 DOL received submissions on the strategy from employers, unions and experts, which painted a sobering picture of the administration of the legislation by DOL and the department's lack of capacity.

In 2011 the government issued a three-year action plan that identified five industries for priority attention. The strategy paid little attention to high-hazard industries. The risks in high-hazard industries are not revealed by personal safety statistics, such as injury rates, on which the strategy relied. Data on process safety (including preventative measures, analysis of high-potential incidents and assessment of safety plans) is required. This requirement has been known for 40 years and its implications have been widely discussed internationally.

Government strategy and action plans must give proper weight to the risks posed by high-hazard industries.

Improving transparency

DOL's main public accountability documents, the statements of intent and annual reports to Parliament, did not reveal any concern about DOL's ability to administer the health and safety legislation. The statements of intent and the annual reports contained many high-level statements on outcomes and outputs but it was impossible to gain much insight into the performance of the mining inspectorate, or the health and safety inspectors as a whole. Measures used, such as the raw numbers of investigations carried out by the health and safety inspectorate, were not informative.

The gap between the high-level statements in those documents and the reality on the ground was remarkable.

Better focus

DOL's organisational strategies and structures have not helped. Administration of the health and safety legislation was delivered through the Labour Group, which was also responsible for employment relations services. Only at the inspectorate level was the focus exclusively on health and safety.

Clearer role

The Health and Safety in Employment Act 1992 (HSE Act) placed primary responsibility for health and safety on the employer. This was appropriate, but was unfortunately seen by DOL as somehow reducing its responsibility to actively administer the legislation. DOL's approach did not accord with the scheme and purpose of the legislation. The act requires the regulator to provide information, education and guidance to employers and to take all reasonable steps to ensure that the act is being complied with.

The regulator requires a major change in thinking that is reflected in its strategy and structures.

A modern compliance strategy

A modern compliance strategy, like that operated by a number of other government agencies, identifies the extent to which employers do not comply with their health and safety obligations, the characteristics of those employers, the drivers of non-compliance and the remedial action required.

Implementation of the strategy includes selecting the right mix of interventions: changes to regulations, education and information, publicity, approved codes of practice, general or specific guidance and enforcement. Information systems and communications technology are designed to support the strategy.

Enforcement under a modern compliance strategy requires a risk-based selection of employers for audit and inspection, intelligence gathering, audit and inspection methodologies, work measurement and a graduated use of enforcement tools. Results should be continually fed back to the strategic level and into policy development. The work of the mining inspectors would then take place within a coherent framework.

The aim should be to develop an initial health and safety compliance strategy that can then be progressively improved.

A new regulator

Although the commission is aware that structural change is not a panacea for righting performance ills, it considers that the major improvements required cannot be accomplished rapidly without organisational change. The sad reality is that DOL's performance in relation to health and safety in the mining industry has been so poor, at both the strategic and operational levels, that the department lost industry and worker confidence. DOL's strategic approach to health and safety in general has also provided cause for concern, including its lack of national leadership, the need for approved codes of practice to guide employers and insufficient focus and expertise regarding health and safety at senior management levels.

Work to improve the machinery of government is ongoing. In July 2012 DOL's functions were transferred to the new multi-functional Ministry of Business, Innovation and Employment (MBIE). The commission has been briefed on the high-level design of the new ministry. This separates policy and regulator functions for health and safety and places the regulator's functions into a regulatory practice group responsible for administering a disparate range of laws and regulations.

Given the major improvements required to health and safety in New Zealand, the commission considers that it would be more effective for there to be a single organisation concentrating exclusively on health and safety.

There are three possibilities:

- The first is to establish a dedicated health and safety group within MBIE headed by a group manager reporting within the MBIE hierarchy.
- The second possibility would be to create an 'autonomous' unit within MBIE, headed by an independent statutory officer who has a direct relationship with the minister and who is required to report directly to Parliament. This is in line with the government's proposed 'departmental agency' concept, which is the subject of a bill before Parliament.
- The third possibility is to establish a Crown entity headed by an executive board that sets direction, appoints the chief executive and maintains oversight. The board's membership would recognise the responsibilities for health and safety shared by employers, workers and government.

On balance, the commission considers that the creation of a single-purpose Crown agency would be the best way to urgently improve New Zealand's poor health and safety performance. The agency would work with MBIE on health and safety policy and would be accountable to the minister for health and safety administration in accordance with agreed performance measures.

Recent government initiatives

Following the Pike River tragedy the government has taken three steps towards improving health and safety administration. In August 2011 the minister announced the establishment of a dedicated inspectorate for two high-hazard industries: mining and petroleum. In May 2012 the minister announced extra funding of \$37 million for health and safety administration, including an increase in the number of health and safety inspectors. The commission commends these initiatives.

The minister has also appointed an independent task force with a wide-ranging mandate to review whether New Zealand's health and safety system is fit for purpose. The task force is to report back by 30 April 2013.

The need for better legislation

The current legislation

The HSE Act placed general and specific duties on employers to ensure the safety of their workers. The aim was to achieve the highest possible level of self-management by employers and the lowest level of compliance cost. The act was based on the reforms recommended by the Robens Committee in the United Kingdom 20 years earlier.

The idea was to replace 'prescriptive' legislation and regulation, which tended to focus on specific hazards in specific industries, with principles that could be flexibly applied to the health and safety hazards confronted by all employers.

The HSE Act imposed a general duty on employers to 'take all practicable steps' to ensure the health and safety of workers. The act promoted the 'systematic' management of health and safety, specified the order in which serious hazards should be managed and provided the regulator with a flexible range of enforcement methods.

Regulations and approved codes of practice

The move towards more self-management by the employer was appropriate but the necessary support for the legislation, through detailed regulations and codes of practice, did not appear. Instead, the opposite happened: such regulations as existed were repealed when the HSE Act came into force. The special rules and safeguards applicable to mining contained in the old law, based on many years of hard-won experience from past tragedies, were swept away by the new legislation, leaving mining operators and the mining inspectors in limbo.

After some years new mining regulations were issued including, in 1999, detailed requirements in relation to common hazards such as methane. Approved codes of practice or more informal guidance were never issued. The industry, through its association, the MinEx Health and Safety Council, issued some guidance to its members but without endorsement by DOL.

As a result New Zealand's regulatory framework for underground coal mining is years behind those of other advanced countries, including Australia. It does not provide the support that employers and workers need.

Expert task force

Review of the legislation and regulations should be carried out by an expert mining task force. The members should include health and safety experts representing the mining industry, the regulator and the workers. (The expert mining task force should be separate from the independent ministerial task force that is reviewing whether New Zealand's entire health and safety system is fit for purpose.)

The expert mining task force's work programme should include designing approved codes of practice and other guidance. In relation to critical matters, approved codes of practice could be issued as an interim measure in advance of legislative and regulatory changes so that employers, workers and the inspectors receive immediate help.

Queensland and New South Wales mining regulations, standards, approved codes of practice and other guidance should be consulted extensively to avoid reinventing the wheel.

Legislative change required

Fit for purpose

The HSE Act remains generally fit for purpose. The commission has identified a few changes, although the suggested expert task force may well identify more. Two areas in the act require early attention.

Worker participation (including contractors)

The legislation on worker participation should be strengthened. Workers sometimes do not understand health and safety rules or ignore them to get the job done. They should be entitled to receive key information on health and safety risks without having to ask for it.

Trained worker health and safety representatives should have the power to carry out inspections. Check inspectors appointed by the union should also be reinstated but must have special expertise in underground coal mining. Union check inspectors should operate on behalf of all workers, whether they are union members or not.

The worker representatives and the union check inspectors should have the power to stop operations if, and only if, workers are in immediate danger. There should be provisions for the regulator to remove an inspector if he or she attempts to use the power in other situations. The commission recognises that some mining companies do not favour this proposal but considers it would provide an extra defence against tragedies like that at Pike River.

Finally, the regulator needs to better promote the advantages of worker participation to both employers and workers. An approved code of practice is required and need not wait for legislative change.

Duties of the directors

The second area of legislation requiring early attention is that of governance by the board of directors. Directors should see health and safety risks as their concern and should give them the same careful attention they apply to other risks facing the company. Current health and safety legislation places general duties on employers, managers and others but not on directors. The statutory responsibilities of directors for health and safety in the workplace should reflect their responsibilities for good governance.

Regardless of legislative change, it is essential that directors and those in equivalent positions rigorously review and monitor their organisation's compliance with health and safety law and best practice.

Fundamental changes to the mining regulations

The mining regulations need major improvement. They have not kept pace with industry changes or best practice. Both the regulator and the commission have identified many necessary changes. The commission recommends that the following should receive immediate attention.

All practicable steps

The Health and Safety in Employment (Mining – Underground) Regulations 1999 often provide that the employer must 'take all practicable steps' to comply with the regulations. This formula, which makes sense in the HSE Act, makes no sense when applied to the mandatory requirements of the regulations, such as the requirement to provide a second egress from the mine. The qualifying words should be removed and consequential changes made.

Notifying the regulator

The employer's obligations to notify the regulator of incidents need to be clear and comprehensive, especially in relation to 'high-potential incidents' (those that could have caused serious harm). This is vital so that the regulator has a better picture of the health and safety risks of the operation.

Health and safety management systems

The employer should be required to have comprehensive and auditable health and safety management systems, including principal hazard management plans. This is implicit under current law, which requires serious hazards to be identified and managed, but the requirement should be explicit. Australian and New Zealand standards already describe how the plans should be prepared and the standards against which they can be audited. Operations should

not begin until the plans are developed and assessed by the mines inspectorate. The plans should be progressively updated and expanded as the mine is developed.

The regulator should issue an approved code of practice describing the minimum specifications of principal hazard management plans, including those relating to gas management, methane drainage, ventilation, spontaneous combustion, outburst potential, strata control and emergency response. Employee participation in the design and implementation of the plans should be a requirement. The code of practice could usefully provide a simplified template for small operators to use.

Training and accreditation

The regulator needs to supervise the granting of mining qualifications to managers and workers. This should be supported by changes to the regulations to comprehensively identify the key statutory officers, their roles, duties, qualifications and training. At present some positions are identified but only the certificates of competence are mandated. For example, there is no requirement for a mine to have a ventilation officer. The aim should be to align the new regulations with Australia, determine the training required and work towards a joint examination and accreditation process with that country. This will mean the mining workforce in both countries will be working to the same standards.

The statutory mine manager

The responsibilities of the statutory mine manager should be defined. Current regulations require the employer to appoint someone to manage the mining operation and personally supervise health and safety. No detailed responsibilities are defined. The Queensland law provides good guidance.

In some circumstances the statutory mine manager may not have the power to discharge the new responsibilities, for example because of budgetary constraints. The regulations should provide some protection for the manager by providing that if a health and safety proposal from the manager is not approved, copies of the proposal and the employer's response are to be sent to the regulator.

Ventilation and gas monitoring

Placing main ventilation fans underground in coal mines should be specifically prohibited. It is unlikely that a mining company would do so in the future, given the consequences at Pike River, but the matter should be put beyond all doubt. Main fans should be required to be protected against explosion and other hazards, in accordance with appropriate international standards.

In addition to requiring a ventilation officer, standards for ventilation control devices, such as stoppings that control airflow, need to be specified.

Minimum requirements for gas monitoring systems are needed so that the mine's atmosphere can be continually and comprehensively analysed.

Better emergency management

Lack of guidance

The health and safety legislation requires employers to develop procedures for emergency management but no regulatory guidance is provided. There is guidance in Queensland and New South Wales, where the Moura No. 2 disaster was the catalyst for action. In New Zealand, the industry association, MinEx, has published guidelines based on the Australian procedures.

Lack of testing

Central to Queensland's approach is regular testing of emergency management plans at four levels of intensity, from desktop exercises (Level 4) through to a state-wide exercise (Level 1) requiring the participation of the emergency

services. This approach exposes in advance many of the problems that will be experienced in the difficult task of managing a major emergency.

The co-ordinated incident management system (CIMS)

CIMS is used by emergency services and the police to co-ordinate their activities in an emergency. It is sound in principle but requires review in relation to major emergencies at underground coal mines and in other high-hazard industries. CIMS does not contemplate a role for the mining company or specialists such as the MRS.

The review should include employers, the MRS, worker representatives, the regulator, the police and other emergency services. There should then be site-specific training and testing of the agreed approach, followed by fine-tuning.

The commission considers that the incident controller, co-located with the incident management team and experts, is in the best position to make the rapid decisions required. The incident controller needs underground coal mining expertise. This does not preclude the police from being the lead agency. CIMS is concerned with the horizontal co-ordination of agencies and alignment of their action plans, and does not displace the command structures of the police or other agencies.

The commission recognises that disasters have a political dimension and may require co-ordination at senior levels of government, high-level logistical support and sometimes the commitment of public funds. But the key decisions, for example on re-entering or sealing a mine, must remain with the incident controller and the incident management team on the spot.

The Mines Rescue Service (MRS)

The specialised MRS, operating under legislation through a charitable trust, is crucial to managing mine emergencies. In practice, its activities are wider than envisaged by the legislation. For the services it provides to new mines the MRS is not funded appropriately through the industry levies it collects, because the levies are based on production. A legislative and funding review is required, in consultation with the service and the industry.

Emergency equipment and facilities

The nature of emergencies in underground coal mines normally means that miners must rescue themselves, rather than wait for rescue from outside. The mine should have the equipment and facilities to facilitate self-rescue, including early warnings of gas levels, modern breathing equipment, changeover stations, navigational aids, alternative means of egress, adequate transport, communication systems and personnel tracking equipment. The mining company should be able to continue sampling the mine atmosphere through a tube bundle system. These emergency requirements must be addressed in regulations.

Sealing capacity

Operators are not required to provide the means to rapidly seal a mine so that its atmosphere can be controlled after an emergency. At Pike River shipping containers had to be used as an airlock to seal the mine until a permanent solution could be found. The need for airlocks and for docking stations to support the use of inertisation equipment should be examined.

Conclusions

New Zealand has a poor overall health and safety record compared with other advanced countries. In relation to underground coal mining New Zealand has had a tragedy every generation or so, after the lessons of previous tragedies have been forgotten. This time the lessons must be remembered. Legislative, structural and attitudinal change is needed if future tragedies are to be avoided. Government, industry and workers need to work together.

That would be the best way to show respect for the 29 men who never returned home on 19 November 2010, and for their loved ones who continue to suffer.

Recommendations

Explanation

There are 16 primary recommendations, supported, where necessary, with more detailed recommendations. Not every view expressed or conclusion reached by the commission has resulted in a recommendation. The commission trusts that those charged with responding to this report will also attach weight to the views and conclusions in the text of the report. Those recommendations, couched directly in terms of the underground coal mining industry, may have wider relevance to other industries. The detailed reasoning behind the recommendations is in the relevant chapters of Volume 2, Part 2, 'Proposals for Reform'.

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.

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.

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.
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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.
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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.

