

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 2

+ Part 1: What happened at Pike River

+ Part 2: Proposals for reform

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

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Glossary

ABM	Alpine bolter miner. A type of continuous miner that allows simultaneous cutting, bolting and roof support.
Adit	A near-horizontal access or tunnel into an underground mine.
Alimak shaft/raise/rise	The Alimak bypassed the collapsed lower section of the main ventilation shaft, measured 2.5m in diameter and was equipped with a 55m vertical ladder.
Anemometer	Instrument for measuring air velocity within roadways.
Auxiliary fan	Smaller fan used to ventilate dead-end roadways underground. Used in conjunction with ducting to force or extract air to or from the end of the road.
Backbye	See outbye.
Barometric pressure	Atmospheric pressure as indicated by a barometer.
Booster fan	Fan located underground within the main ventilation circuit to increase airflow.
Borehole/drillhole	Hole created by drilling to gather geology information or for gas drainage. Can be done from the surface or underground.
Brattice	Impervious plastic/fabric cloth used in the construction of ventilation control devices, e.g. stoppings.
Bridging panel	Also known as section or panel at Pike River. Mining area connected to the mains roadways consisting of access roads and extraction areas with a separate ventilation circuit. See panel.
Brumby	Multi-purpose four wheel utility vehicle which can be fitted with attachments such as an excavator bucket.
Bypassing	Refers to circumventing or working around safety devices.
CABA system	Compressed air breathing apparatus. A CABA system may include a fixed compressed air supply where units can be refilled while being used or a backpack system similar to scuba diving.
C-ALS	A cavity auto scanning laser system that uses laser beams to create a three-dimensional image of a void.
Carbon dioxide (CO₂)	Formed underground by engine exhaust and/or oxidation of coal or fire and may be a coal seam gas. It is colourless but has an acidic odour at high concentrations.
Carbon monoxide (CO)	A colourless, odourless gas formed by the incomplete combustion of carbon or a carbonaceous material (e.g. diesel machines, mine fire, spontaneous combustion of coal).
Caving	See roof fall.
CIMS	The co-ordinated incident management system provides common management principles, structure and terminology for multi-agency emergency response activity in New Zealand.
Cleanskin	Worker with little or no underground mining experience.
COC	Certificate of competence. Also referred to as ticket, permit or licence.
Continuous miner	Purpose-built machine for driving/developing roadways in coal. Capable of continuously loading the cut material into the coal transport system (e.g. flume, shuttle car, conveyor).
Contraband	Items that are prohibited underground, for example, cigarettes.
Control room	Surface location performing the centralised function of monitoring, operating and controlling the mine.
Conveyor	Fixed equipment used for continuously moving stone or coal.
Core logging	The drilling of holes in an extraction zone's roof and floor to take core samples for geotechnical logging.

CPP	Coal preparation plant. Situated approximately 8.2km from the portal, the CPP received coal through the coal slurry pipeline and then washed and processed it for collection.
Cross-cuts	Underground roadways developed at regular intervals to join one or more main roadways.
Crushing station/crusher	An area at pit bottom stone where the coal from the working faces was sized and crushed to <35mm to form a slurry for transportation by flume and pipeline to the CPP.
Cutter head	Mechanical protection device on the continuous miner that will shear if sufficient force is applied to the cutting head of the machine.
DAC	Digital access carrier system. An underground communications system that operates like a party-line telephone system.
Deputy	Reporting to underviewers, the deputies carried out the safety inspections, examinations and reporting required by the company and by law and gave supervision and guidance to their crews.
DOC	Department of Conservation.
DOL	Department of Labour. Now part of MBIE.
Down-dip	Located down the slope of a dipping coal seam.
Drift/drive/tunnel	An underground roadway.
Driftrunner	Motorised vehicle used to transport miners to and from the surface.
Drill stub	A small area (2–5m) off a main roadway to allow drilling equipment to be set up to avoid blocking the main roadway.
Egress	An exit from a mine.
Emergency refuge	An underground room-like sealed facility to maintain a respirable atmosphere in emergencies. It may have an air source that is independent of the main ventilation air. See FAB.
ERMP	Emergency response management plan. The ERMP outlined Pike's procedures and plan for responding to emergencies.
ESR	The Institute of Environmental Science and Research (ESR) – a provider of forensic services to the New Zealand Police.
Evasé	The exhaust structure for the main underground and surface fans.
EXITO	Extractive Industry Training Organisation.
Explosion panels	Hinged doors/panels on the exhaust structure for the main fan that are forced open by the pressure generated by an explosion, to protect the evasé from the force of the blast.
Explosive range	Methane is flammable and explosive when mixed with oxygen between 5 to 15% methane in air by volume.
FAB (fresh air base)	An underground room-like sealed facility to maintain a respirable atmosphere in emergencies.
Flame arrestor	Metal ribbon flame cell elements designed to inhibit flame propagation by absorbing and dissipating heat from coal-seam gas passing through and venting into the atmosphere. Attached to the top of Pike's 6" gas riser at the surface next to the slimline shaft.
Flameproof	Flameproof equipment is enclosed in a special housing to ensure any ignition of methane is safely contained inside the enclosure.
Floxal	A unit used to generate and pump nitrogen into a mine to make the atmosphere inert.
Flume system/slurry pipeline	An open steel channel for transporting a coal and water slurry downhill from mining areas.
Forcing fan	A forcing fan sends air along the intake towards the working faces of a mine.
FRAS	Fire resistant anti-static. Can apply to brattice.
Free venting	The practice of releasing methane from the drainage boreholes into the return of a mine's ventilation system.

GAG	Górnicy Agregat Gaśniczy unit used to pump inert gases and water vapour into a mine to extinguish fire and stabilise the atmosphere after an explosion.
Gas chromatograph	Gas analysis equipment used to precisely measure the full range of gaseous constituents of a mine gas sample.
Gas drainage	Capturing and removing the naturally occurring gas in coal seams to prevent it entering mine airways. The gas can be drained in advance or after mining using different techniques. Often referred to as methane drainage if methane is the main gas component target to be captured.
Gassing out	Coal mining term for an excessive amount of flammable gas in the general body of a mine's air.
Gassy mine	A mine where tests on three successive days indicate the presence of flammable gas in an area, district, or main airway on the return or exhaust side.
Goaf	The void created by coal extraction that is usually unsupported and susceptible to roof collapse.
Graben	A block of strata between two faults that has moved downward.
Grizzly	Feeder and sizer for the conveyor. Situated 2.1km inbye of the portal.
Gunningham and Neal	Professor Neil Gunningham and Dr David Neal SC in February to July 2011 conducted an independent internal <i>Review of the Department of Labour's Interactions with Pike River Coal Limited</i> . The Australian authors are a social scientist and a senior counsel with specialist interests in occupational health and safety.
Guzzler	A machine located 18m behind the hydro monitor used to collect and direct the slurry away from the mining areas.
Hard coking coal	High-quality bituminous coal suitable to make coke.
Headings	Two or more roadways generally driven parallel to access an area of the mine.
HSE Act	Health and Safety in Employment Act 1992.
Hydro mining/hydro monitor	The use of a high-pressure water jet from a specialised hydro monitor machine to cut coal.
Hydrogen (H₂)	Colourless, tasteless and odourless gas. Highly flammable (4 to 74%).
Hydrogen sulphide (H₂S)	Colourless gas with rotten egg odour. Highly toxic.
Improvement notice	A notice issued by the health and safety regulator (a mining inspector) requiring a health and safety deficiency to be rectified.
Inbye	The direction towards the coal face from any point of reference.
Ingress	An entry into a mine.
In-seam drainage	Removal of coal seam gas with the use of in-seam drillholes and associated pipework.
In-seam drilling	Drilling of boreholes through the coal seam from an underground location.
INSITE	DOL's electronic data management system.
Intake	An underground roadway that has uncontaminated/fresh air moving through it.
Interburden	An interval of sediments of varying depth that lies between two or more coal seams.
Joint investigation	Investigation into the tragedy conducted by the New Zealand Police and Department of Labour.
JSEA	Job safety and environmental analysis. A safety management method to evaluate certain jobs, tasks, processes or procedures and eliminate or reduce the risks and hazards.
Jugernaut	Type of loader (LHD).
Lag indicator	A measure of performance made after a safety incident, e.g. lost time injury rates, methane readings.
Lead indicator	A forward-looking performance measure designed to help organisations introduce preventative measures before a safety incident occurs, e.g. near miss reporting.
LHD or loader	Load haul dump machine – low-profile front-end loader.

Longwall mining	A method of mining coal in long straight slices.
Main fan/primary fan	Largest fan(s) that draws air into or pushes air through a mine.
Main ventilation shaft	Vertical access with a primary purpose to exhaust air out of the mine.
Mains	Roadways that provide long-term access and ventilation pathways to and from the mining areas (panels/sections).
Manometer	Instrument for measuring pressure differences.
MBIE	Ministry of Business, Innovation and Employment.
MED	Ministry of Economic Development. Now part of MBIE.
Metalliferous mine	Defined by regulation as including a surface or underground mine extracting, processing or crushing any mineral.
Methane (CH₄)	Highly flammable coal seam gas, which is tasteless and odourless. Highly flammable (5 to 15%).
Methane make	The volume of methane released into a mine. Can also mean the rate at which a mine produces methane.
Methane outburst	The sudden ejection from the coal face into the mine workings of methane and carbon dioxide, generally including coal and rock.
Methane spike	An increase in the level of methane in a mine atmosphere.
MinEX	MinEx Health and Safety Council, the national health and safety organisation for the New Zealand minerals industry.
MRS	New Zealand Mines Rescue Service, a specialist mines rescue service.
MRT	New Zealand Mines Rescue Trust. It is a separate legal entity to the MRS and was incorporated pursuant to the Charitable Trusts Act 1957.
Negotiated agreement	An agreement between the health and safety regulator (a mining inspector) that a health and safety deficiency will be rectified, usually within a defined time frame.
NOHSAC	National Occupational Health and Safety Advisory Committee. Established in 2003 to provide independent advice to the minister of labour on major occupational health and safety issues. NOHSAC was abolished in 2009.
Northern Lights	Electronic system for tracking workers underground.
NZFS	New Zealand Fire Service.
NZQA	New Zealand Qualifications Authority.
Outbye/backbye	The direction away from the coal face from any point of reference.
Outcrop	A segment of the coal seam or bedrock exposed to the atmosphere.
Overcast	A structure built in an underground roadway intersection to keep air paths separated, so that intake and return air can pass through the intersection.
Overpressure	A pressure peak in a mine ventilation system caused by roof fall/fire/explosion/blast.
Panel	Mining area connected to the mains roadways consisting of access roads and extraction areas with a separate ventilation circuit.
Permit to mine	Weekly detailed plan of the forecast underground mining activities. Production and health and safety risks of the planned activities are identified and mitigation measures outlined.
Personal safety	Addressing the risks of various types of physical injuries (slips/trips/falls/struck-by incidents) usually associated with a hazard that is close to workers.
Pike	Pike River Coal Ltd (in receivership from 13 December 2010). The company name was changed from Pike River Coal Company Ltd on 13 March 2006.

Pike River	The Pike River coal mine and/or the area near or surrounding the mine.
Pit bottom in coal	An area of permanent roadways inbye of the main drift that housed water storage, pumping systems, electrical infrastructure and the main fan.
Pit bottom in stone	A roadway area off the main drift containing underground services for coal collection, crushing and transport, water storage, high-pressure pumping systems and electrical infrastructure.
Pogo sticks	Expandable poles with an internal spring often used to hold up cables or brattice in a mine.
Portal	Surface entry point into a mine.
PPM	Parts per million.
Process safety	The prevention and mitigation of unintentional releases of potentially dangerous materials or energy from the mining process.
Prohibition notice	A notice issued by the health and safety regulator (a mining inspector) requiring that an activity cease until such time as a health and safety deficiency has been rectified.
Range	Refers to Pike's system of boreholes, pipes and other devices designed to capture and remove gas from coal seams to the surface. See gas drainage.
Reflector sticks	At Pike River these were pieces of PVC pipe about 1m long wrapped with reflective tape intended to reflect light or be easily visible.
Rescue station	MRS rescue station at Rapahoe on the West Coast providing logistical support, emergency equipment and 24 hour on-call rescue personnel.
Return	Any underground roadway that has 'used' or 'contaminated' air moving through it towards the surface after it has passed a mining area.
Rib	The walls of a roadway or heading.
Rider seam	The Brunner seam consists of the main seam and above it a narrower rider seam, separated by interburden of variable thickness.
Riser	At Pike River the riser refers to a vertical 6" pipe through which methane-laden air was discharged to the surface. The riser was connected to the 4" methane drainage pipe line running along the roof and ribs of the mine.
Roadheader	Purpose-built machine for driving roadways in stone or coal capable of loading the cut material into the stone/coal transport system (e.g. flume, shuttle car, LHD, conveyor).
Robens report	The seminal 1972 United Kingdom report that resulted in widespread health and safety legislative change in a number of countries, including New Zealand.
Roof bolt/roof bolting techniques/cable bolts	Boreholes from 1 to 2.5m long are drilled upward in the roof and bolts are inserted into the holes and anchored at the top by a chemical resin or mechanical device. Bolts may be inserted in a pattern. The purpose is to clamp together several roof beds to form a composite beam with strength considerably greater than the sum of the individual beds acting separately.
Roof fall/caving	Process where the roof fails to the extent that it collapses. It can be planned or unplanned.
Safegas	SIMTARS automated fire and explosive gas analysis system.
SCADA	Supervisory control and data acquisition is an industrial computer system that monitors and controls processes.
Section	See panel.

Self-contained self-rescuer (SCSR)/self-rescuer	A temporary breathing system for use when the mine atmosphere becomes unbreathable. There are two possible systems: one with a simple filter (rarely used); the other, using potassium super peroxide, reacts with exhaled CO ₂ and water vapour and produces sufficient oxygen for approximately 30 to 60 minutes of use. Intended to allow the user to move from their current location to fresh air or another air source.
Shotcrete	Mortar or concrete sprayed through a hose and nozzle onto a surface at a high velocity. Used to form ground support in roadways and other structures in mines. Shotcrete can be unreinforced or reinforced with steel mesh/bars, steel fibres or synthetic fibres, e.g. polypropylene.
Shot-firing	The operation of dislodging coal and/or stone from a development or extraction face with explosives.
SIMTARS	Safety in Mines Testing and Research Station. A Queensland government organisation focusing on research, consulting, testing, certification and training services for the improvement of mining industry safety and health.
Slimline shaft	Small diameter shaft from the mine to the surface connected to the pit bottom area of Pike River.
Slurry pipeline	See flume system.
Smoke lines	A series of rope lines and small cones hung along underground roadways to assist in guiding people through the mine to a point of safety in the event of an emergency and low visibility.
SOP	Safe operating procedure. Procedure developed for safely undertaking tasks and operating equipment.
Spaghetti Junction	The intersection at the termination of the main drift, 2300m from the portal, so named because of the roadways and services that converged in this area.
Spike	See methane spike.
Spontaneous combustion	Coal reacts with oxygen to create heat. If the heat liberated during the process accumulates, the rate of the reaction increases and there is a further rise in temperature. When this temperature reaches the ignition temperature of coal, the coal starts to burn.
Standpipe	A gland driven into the wall face and grouted into position as a permanent access point to a methane drainage borehole.
Steady state coal production	The point at which a mine achieves a reliable coal extraction rate.
Stone dust	Limestone dusted over the roof, ribs, face, and throughout a mine to render exposed coal dust inert.
Stopping	A structure (temporary or permanent) built across a roadway to direct the air flow.
Stratigraphic (strata) complexity	The structure of sedimentary rocks, which have recognisable parallel beds of considerable lateral extent. The beds deposited reflect the geological history (relative complexity) of a region.
Structural (faulting) complexity	Fractures in the rocks that make up the Earth's crust, along which there has been relative displacement, i.e. rocks on either side have moved past each other.
Stub	A small dead-end extension (2–5m) off main roadway. Stubs may be used for drilling, or locating plant and equipment, or to allow one vehicle to pass another.
Subsidence	Downward movement of the ground surface.
Surface collar	Located at the top of the main ventilation shaft, a reinforced concrete collar designed to take the loads of the raise bore rig and the exhaust structure for the main underground and surface fan.
Tag board	System for identifying who is underground. Tags are placed on a board before entering the mine usually at the portal, and are removed on departure.
TARP	Trigger action response plans. Step-by-step process of what to do, who to call and actions to take when urgent action is required.

Telemetric system (real-time)	System where gas monitoring data is collected and analysed at an underground location and the result relayed electronically to another point (control room) for evaluation. Compare with Maihak system, where gas is pumped from underground but analysed on the surface.
Tell-tale	Device installed into the roof for measuring ground movement in the immediate/near roof strata.
Tool box talk safety advisory notice	Notice produced by the Pike safety and training department to notify underviewers of remedial action arising out of an incident at the mine.
Tube bundle monitoring system	Bundle of tubes spread throughout underground workings to transport gas samples to the surface for Maihak (or other) analysis.
Tunnel	Roadway that links the surface operations to the coal seam. Underground tunnels are sometimes known as roadways, drifts, or headings.
Underground monitor pump	Pump that generates high pressure and high volume water that is used to excavate coal via the hydro monitor.
Underviewer	Underviewers reported to the statutory mine manager. The underviewers were responsible for co-ordinating and planning activities, managing employee attendance and issues, ensuring safety systems were implemented and maintained, and carrying out inspections and examinations.
Variable speed drive (VSD)	Equipment that regulates the speed of an electric motor.
Vent cans	Tubing used to distribute or exhaust air from auxiliary fans.
Ventilation circuit	Pathway that air follows through the mine or a section or a panel of the mine.
Ventilation control device (VCD)	Used to create a ventilation circuit. They consist of stoppings, overcasts or air crossings (which send air over a roadway) and other devices designed to direct or control the flow of air.
Ventilation fan	A mechanical device used to create the air flow within the mine.
Ventilation system	The whole of the system used to direct, control, push, or pull air throughout the mine.
Way-finder beacon	Escape routes out of mines can be marked with way-finder beacons which produce an audible signal and flashing lights to assist people to escape in low visibility.
Windblast	The high velocity displacement of mine airways caused by a sudden strata failure.

Explanatory note on the page numbering of references

The report includes endnotes referencing documents in the commission's Summation evidence database. The page number format is the document identifier followed by a forward slash and the cited page(s), for example, DOL0020010015/10. The page numbering used in Summation commences with the cover or first page and therefore may not match the page numbering used in the document.

Part 1

+ What happened at Pike River



Context

- + Friday afternoon, 19 November 2010
- + Accident analysis - some concepts
- + The promise of Pike

Friday afternoon, 19 November 2010

A tragedy unfolds: Friday afternoon, 19 November 2010

1. The Pike River coal mine lies under the rugged Paparoa Range on the West Coast of New Zealand's South Island. The mine was comparatively new, having shipped its first coal in February 2010, and the mine workings were not extensive. On the afternoon of Friday 19 November 2010 there were 31 men in the mine.
2. The three Pike mining crews, A, B and C, worked overlapping shifts. A crew worked the night shift, which began on Thursday night at 10:00pm and ended at 8:00am on Friday 19 November. B crew started the day shift at 7:00am and left the portal at 2:50pm to finish their shift at 3:00pm. C crew began the afternoon shift early, at 1:00pm. As recorded on closed-circuit television (CCTV), they entered the portal at 1:13pm.¹
3. Miners who manned the hydro monitor worked 12-hour shifts that ran from 7:00am to 7:00pm. The day shift crew of three men was underground at the time of the explosion.
4. In addition to Pike workers, seven companies had men working underground on contract during the day. Men from each of these companies, save for McConnell Dowell Constructors Ltd and Skevington Contracting Ltd, were in the mine when the explosion occurred.
5. Investigators endeavoured to reconstruct the likely locations of the men who perished.

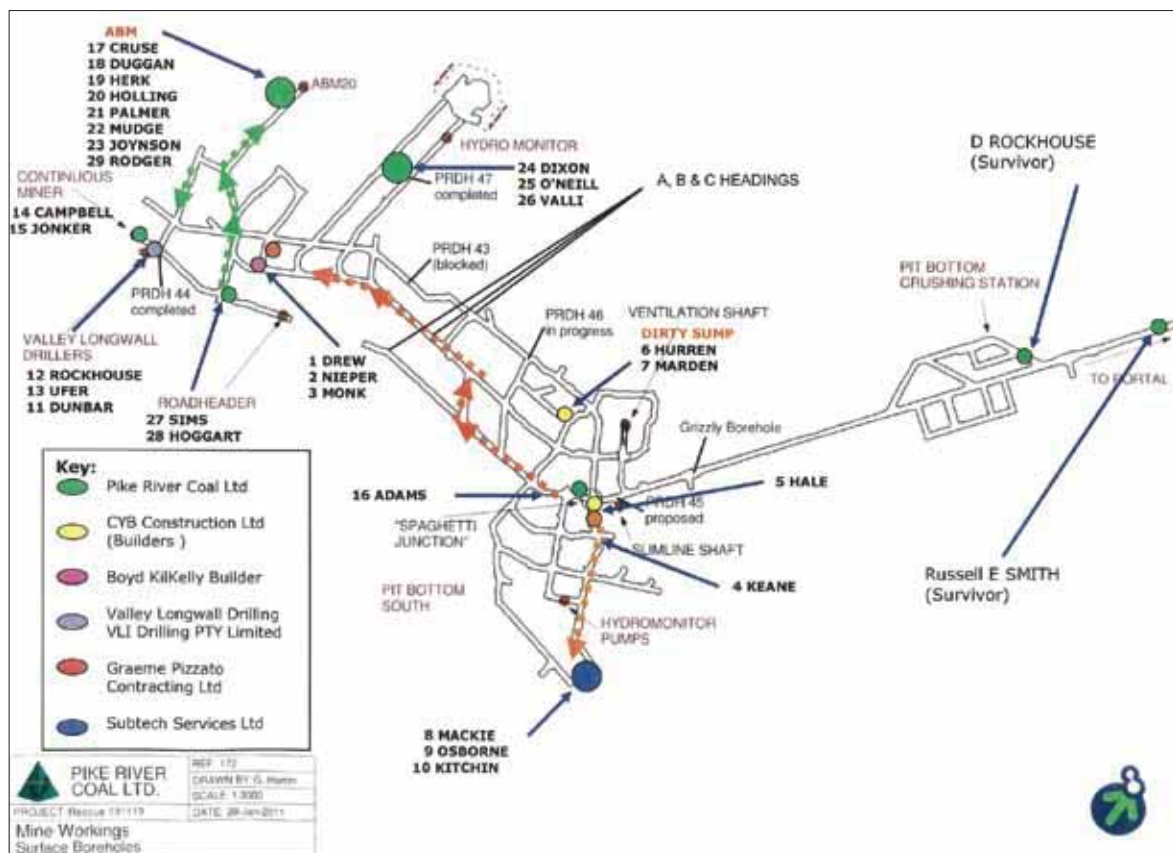


Figure 1.1: Last known position of the 29 deceased and two survivors²

6. The positions can only be indicative. They were fixed from the last sightings of the men by people who were also underground but left before the explosion, and also by reference to the work the men were to undertake that day.

7. Eight men from C crew, Glenn Cruse, Christopher Duggan, Daniel Herk, Richard Holling, Brendon Palmer, Stuart Mudge, William Joynton and Peter Rodger, were manning the alpine bolter miner (ABM), and driving a development road in the north-west corner of the mine. Daniel Rockhouse left the crew, driving a loader to uplift some gravel needed for the roadway. Conrad Adams, the acting C crew underviewer, was last seen near Spaghetti Junction, but could well have headed inbye to rejoin his men at the face.
8. Three men, Allan Dixon, Peter O'Neill and Keith Valli, were manning the monitor in the hydro panel at the most northern location in the mine. Because there were only two men, Blair Sims and David Hoggart, in the roadheader crew – too few to undertake roadway development – they were on maintenance duties near the roadheader. The continuous miner located at the westernmost point in the mine required servicing and engineer Malcolm Campbell and fitter Koos Jonker were undertaking this work.
9. VLI Drilling Pty Ltd employees, Joshua Ufer and Benjamin Rockhouse, were working at the in-seam drilling rig close to the continuous miner. Joseph Dunbar, aged 17, was in the mine on an orientation visit. He was to start work the following Monday, but he went into the mine with two of the company managers and elected to remain with the drilling crew until the end of their shift.
10. Three builders, Michael Monk, an employee of Graeme Pizzato Contracting Ltd, and Kane Nieper and Zen Drew, employees of Boyd Kilkelly Builder Ltd, were constructing a stopping in a cross-cut deep in the mine. Mr Drew, however, was last sighted in a nearby tool box area and could well have been walking back to the worksite at the time of the explosion.
11. John Hale, an employee of CYB Construction Ltd, was a permanent 'taxi driver', ferrying men in and out of the mine on a drifrunner. He was last seen at pit bottom in stone, but was understood to be en route to Spaghetti Junction. Other CYB employees, Andrew Hurren and Francis Marden, were inbye of the junction, preparing a sump area for concrete to be laid.
12. Terry Kitchin, Milton Osborne and Samuel Mackie, Subtech Services Ltd employees, were installing a water pipe in pit bottom south. Mr Kitchin, however, was last sighted in a roadway near Spaghetti Junction and could have been in transit at the time of the explosion. Riki Keane, an employee of Pizzato, was driving a loader used to remove spoil from the work site. His vehicle broke down near Spaghetti Junction sometime after 3:00pm and he was last seen there, trying to restart the vehicle. Daniel Rockhouse assisted him by obtaining hydraulic oil before he continued driving outbye into the drift.
13. As on any work day, others entered and left the mine at various times. A McConnell Dowell day crew of four men worked in stone, developing a stub to house equipment. The day shift finished at 4:00pm and the crew left the portal in a drifrunner at 3:41pm. The night crew of five workers was on the surface preparing to go underground when the explosion occurred.
14. Four employees of Skevington Contracting were also to finish work at 4:00pm and left the mine on the same drifrunner. Two surveyors, Callum McNaughton and Kevin Curtis, were walking out of the mine and flagged down the drifrunner. Earlier still, about 2:00pm, Lyndsay Main, a Coastline Roofing Ltd builder, finished work early and walked out of the mine about 70 minutes before the explosion. Pike technical staff had also been into the mine to undertake various tasks, but had returned to the surface before 3:45pm.
15. Chance played a big part in which men, and how many, remained underground at 3:45pm.

A planned maintenance shutdown

16. Water used in the mine was piped from the Pike River coal preparation plant 8km to the east of the mine, next to the main access road. Because there was to be planned maintenance work at the plant, beginning at midday, underground mining operations were to be halted until water became available again. In the meantime the miners were to undertake pit bottom maintenance tasks.

17. Daniel Duggan was in sole charge of the surface control room. He had started a 12-hour shift at 7:00am. Mid-afternoon he received a phone call from the coal preparation plant to confirm that the maintenance work had been completed and that water to the mine could be restored. He activated the start sequence for the fluming pump system supplying water to the working faces. At 3:44:12pm Mr Duggan used the digital access carrier (DAC) system, which provided simultaneous communication to the work areas at pit bottom, to advise that mining could be resumed.
18. This exchange occurred:
- Daniel Duggan: 'Hello ABM or Road header.'
- Malcolm Campbell: [Eight seconds later] 'Hey Dan, who you looking for?'
- Daniel Duggan: [Three seconds later] 'I was just after ABM and Road header.'³
- At this point an unidentified sound interrupted the conversation. Mr Duggan did not interpret it as an explosion at the time. He recognised the voice from underground as that of Malcolm Campbell, an engineer with a distinctive Scottish accent, who was doing maintenance work on the continuous miner.⁴
19. Mr Duggan continued to make calls using the DAC. Over the next almost four and a half minutes he made calls asking whether there were any 'sparkies' (electricians) underground, anyone at the 'monitor place' and, finally, whether there was 'anyone underground'.⁵ The DAC was functioning, but there was no response to his calls.

Signs that all was not well

20. At the same time as the unidentified noise was recorded on the DAC system, alarms in the control room were activated. This indicated that reporting from underground had ceased. Power, ventilation, pump and gas data were no longer being fed to the control room. Previously, when power to underground had been lost, miners would quickly contact the controller. On this day there were no callers. Mr Duggan also tried ringing different sites underground, using the telephone system which, like the DAC, had a back-up battery system, but there was no reply.
21. Meanwhile Douglas White, the statutory mine manager, Stephen Ellis, the production manager, and George Mason, the hydro-mining co-ordinator, were meeting in Mr White's office in the main administration building. At one point the office lights flickered but no one was concerned. At about 3:47pm Mr Duggan spoke to Mr White and told him they had lost power and communication to the mine. Mr Duggan added that he would contact the communications and monitoring engineer, or an electrician.
22. At 3:48pm Robb Ridl, the Pike engineering manager, and John Heads, a contract electrician, entered the control room. Mr Duggan spoke of his concerns and said, 'I've got a real bad feeling about this.'⁶
23. At 3:52pm Mr Duggan again spoke to Mr White and asked whether the Mines Rescue Service (MRS) should be placed on standby. Mr White replied, 'Oh, we won't go there yet, we'll get someone up there.'⁷ Mr White then left his office and went out to the car park near the administration building, where he spoke to Messrs Ridl and Heads. They noticed an unusual smell in the air, like excessive diesel exhaust fumes. Mr White then returned to his office and between 4:01 and 4:04pm he sent three emails on other matters.
24. The explosion had been recorded on CCTV footage taken by the portal camera. This footage was not seen until some time later. Beginning at 3:45:36pm and continuing for about 52 seconds, there was a pressure wave out of the portal. Movement of a tell-tale indicator tied to the rib opposite the camera showed the duration of the wave, and debris coming from the portal indicated the velocity of the explosion.

An electrician enters the mine

25. Following the car park discussion Mr Ridl approached electrician Mattheus Strydom, who was working nearby. Mr Ridl said there was a power outage in the mine and communications had also been lost. He requested Mr Strydom

to head up to the mine and investigate. Mr Strydom asked whether both 'power and communication' had been lost.⁸ He was concerned. Based on his 28 years of mining experience, he regarded this combination as significant. Messrs Ridl and Heads then drove to the mine and arrived at the portal at 4:03pm.

26. Mr Strydom obtained from the McConnell Dowell crew a drifrunner they had intended to use to enter the mine at 4:00pm. He commented to the crew deputy, 'I hope this isn't bad.'⁹ Strydom then obtained from the control room a hand-held gas monitor that could test only for methane. Other gas monitors could test for methane, carbon monoxide, hydrogen sulphide and oxygen.
27. Mr Strydom filled the drifrunner with water and set off to the portal, where he encountered Messrs Ridl and Heads. Mr Heads said that he had already checked the portal substation and that power was on there. This indicated to Mr Strydom that the power outage must have occurred at pit bottom in stone, 1900m into the mine. At 4:11pm Mr Strydom entered the portal, without a self-rescuer, and Messrs Ridl and Heads returned to the administration area.
28. After sending his third email at 4:04pm Mr White went to the control room. Mr Duggan told him the situation was unchanged: there had been no response from underground, and no telemetric communication. Mr White said he would drive to the mine and test whether the portal DAC was working. He arrived there at 4:16pm and successfully called the control room. Mr Duggan told him that Mr Strydom was on his way and that Mr Ridl was returning to the portal to check the ventilation. Mr White responded that there was ventilation going up the tunnel.¹⁰ At 4:18pm Messrs Ridl and Heads went back to the portal. The three men discussed the situation and satisfied themselves that there was a ventilation breeze entering the portal. At 4:23pm they left the portal area.¹¹
29. As Mr Strydom was driving up the drift, his first thought was that 'something just didn't feel right'.¹² He noted that reflector sticks, pieces of PVC pipe wrapped with reflector tape, were missing from the conveyor belt infrastructure to which they were ordinarily tied. He wondered whether the sticks had been removed by a fitter, as the belt was to be decommissioned the following week. He also noted a cordite-like smell, which he likened to diesel exhaust fumes. The smell became stronger as he continued up the drift. Also missing were signs that identified the position of fire hoses. Other items attached to the ribs were displaced. He drove past the decommissioned fresh air base (FAB) at 1500m into the drift. The substation at pit bottom in stone was a further 400m inbye. The air became increasingly thick and the engine of the drifrunner began to falter. Mr Strydom looked for a place where he could turn the vehicle around.
30. Then he saw a light in the distance. Relieved, he went on, and recognised a Jugernaut and, some metres outbye of it, the figure of a man lying on the roadway. The man was on his back, with arms outspread and his head pointing outbye. From Mr Strydom's training, he knew this was the typical position of a person killed by explosive forces. Breathing had become difficult and the engine of the drifrunner continued to splutter. This was a dangerous situation. In fear of his life, Mr Strydom put the drifrunner into neutral and it began to run backwards downhill.
31. Then the engine revived. He put the vehicle into reverse gear and continued backing as fast as he could. At one point he stopped and considered driving back up the drift to attempt a rescue. Then he recalled his previous breathing difficulties and he continued to reverse. At about the 1150m mark he backed into stub 2 and then drove forward towards the portal.
32. He reached the portal at 4:25pm, only a few minutes after the departure of Messrs White, Ridl and Heads, and immediately called the control room. He told Mr Duggan, 'You better call the Mine Rescue, we've had an explosion and I've seen a man lying on his back in the road'.¹³ He then spoke to Mr White who, thinking Mr Strydom was ringing from the FAB, instructed him to leave the mine and return to the surface.

Calls to emergency services

33. Mr White then accepted that there had been a major event underground and that emergency services must be

contacted. Mr Duggan phoned the MRS at 4:26pm. At 4:35pm he dialled 111 and spoke to a St John Ambulance operator. He reported a major underground incident, possibly an explosion, and requested as much emergency care as possible. He said 25–30 people were underground, with no one yet accounted for and that he had not heard from those underground 'for almost an hour now'.¹⁴ Mr Duggan then telephoned Coastwide Helicopters to order a helicopter so that Mr White could make a fly-over inspection of the main vent shaft.

34. At 4:45pm Mr Ridl phoned chief executive Peter Whittall in Wellington. He told him that there had been a major event underground and referred to Daniel Rockhouse's phone call from inside the mine, (see paragraph 39).
35. At 5:13pm Mr White flew by helicopter from the Pike River administration area to the top of the main vent shaft. He viewed the auxiliary fan site and returned to the administration area at 5:26pm. He saw smoke and damage and concluded that there had been an explosion.

Daniel Rockhouse

36. Nearing 3:45pm Daniel Rockhouse was in the drift en route to stub 2 to uplift the gravel required for road repairs at the ABM worksite. He stopped at the diesel bay at pit bottom in stone to fill his loader with diesel and water. The loader was parked with the engine running. While he was turning on a water valve there was a bright white flash and he felt an extreme pressure blast. Felled by the explosion, Daniel Rockhouse hit his head and ended up lying on his back. His first impression was that the loader had blown up, but he then realised that the engine was still running, although spluttering. He turned it off. Small amounts of debris fell from the roof and the ribs, although there was no cave-in. Within seconds a pungent strong smell, and dense smoke, reached the area. The atmosphere was warm and breathing became difficult.
37. To escape the effects, Daniel Rockhouse went inbye towards the crushing station (see Figure 1.1). It was clearer, but there was no place of refuge. He donned and activated his self-rescuer and moved back out to the main drift. The self-rescuer did not seem to be working properly so he discarded it. In the drift, next to his loader, he was overcome and fell to the ground again. He shouted for help, but there was no response. His eyes watered, his body tingled and he thought he was 'shutting down'.¹⁵ He lapsed into unconsciousness.
38. After some time he revived and sensed that feeling had returned to his fingers and toes. He was shivering with cold from lying in the mud. He tried to roll onto his stomach and push himself up, but he had no strength. Eventually he managed to stand, fell again and then was able to reach compressed air and water lines that ran along the rib. He turned on an outlet valve on the air line. There was only limited pressure, but enough flow to clear the smoke from around him. The fresh air was 'like gold'.¹⁶
39. After a minute or two breathing the fresh air and relieving the stinging of his eyes, Daniel Rockhouse looked for a telephone. Just inbye of his loader he located telephone 353 and rang the emergency number, 555. The telephone rang, but no one answered before the call was diverted to an answering service. He then dialled 410, the control room number. Mr Duggan answered the phone. Daniel Rockhouse said he was not injured, but that he could not see or breathe. At this point Mr White took the telephone, was told that the air seemed to be clearing and instructed Daniel Rockhouse to 'stay low', get to the FAB about 500m outbye and make contact from there.¹⁷
40. There is no record of the telephone call, or of its timing. However, it is apparent that Daniel Rockhouse made the call at approximately 4:40pm and that Mr Duggan answered it soon after his call to St John Ambulance. Immediately after Mr Strydom contacted him, Mr Duggan telephoned the MRS at 4:26pm. He then called and spoke to the St John operator until 4:39pm, twice mentioning he had not heard from anyone underground. Had Daniel Rockhouse already rung Mr Duggan, he would undoubtedly have said so.
41. It follows that Daniel Rockhouse was unconscious for a significant period, perhaps 50 minutes or so, after the explosion at 3:45pm until he made the phone call about 4:40pm.

A rescue

42. After the phone call Daniel Rockhouse followed the compressed air and water lines along the rib and proceeded outbye. As he found outlet valves he opened them and breathed in fresh air. He left the valves open, thinking this would improve the atmosphere. About 300m outbye he encountered a vehicle stationary in the drift. A few metres beyond it, he found Russell Smith lying semi-conscious on the ground, with his eyes open, but rolling back in his head. He could hardly speak. He was not wearing a helmet and light. Daniel Rockhouse removed Mr Smith's self-rescuer from his belt, opened it and tried to insert the mouthpiece into the other man's mouth. He could not do so. Daniel Rockhouse discarded the self-rescuer, lifted Mr Smith from behind and dragged him outbye towards the FAB.
43. Mr Smith was also in C crew. He had missed the bus to the mine and was late for the 1:00pm start of the shift. He was driving into the mine when the explosion struck. Minutes before he had passed the McConnell Dowell drifrunner heading outbye. He received no warning before there was a flash of bright light and a deafening noise, followed by a shock wave. The pressure was unrelenting. In an attempt to escape it, Mr Smith lowered himself to gain protection within the cabin of the vehicle. As breathing became difficult he attempted to remove a self-rescuer from his belt, but he was in an awkward position and could not do so.
44. Mr Smith could remember nothing after this. He had no recollection of his rescue by Daniel Rockhouse. He came to in an ambulance en route to Greymouth Hospital. Subsequently, he realised he had minor pitted abrasions to his face and back. His speech was affected in the short term, as was his respiratory system.
45. On reaching the FAB, Daniel Rockhouse propped Mr Smith up in a sitting position against the rib and said, 'I'll be back in a sec.'¹⁸ The FAB was a shipping container converted to include a two-door sealable entrance. Daniel Rockhouse thought it would provide a fresh air source, a telephone and spare self-rescuers. In fact, he found it had been decommissioned.
46. After venting his anger, Daniel Rockhouse returned to Mr Smith, got him to his feet and continued to drag him in an outbye direction. After a time he paused and asked Mr Smith whether he could walk. He tried, managed a few steps, but then fell. Daniel Rockhouse lifted him up again, and found that, if he supported Mr Smith, they could walk in tandem, with Daniel Rockhouse holding the rail of the conveyor belt to his left side for support. Periodically the pair stopped and looked inbye, hoping to see other lights coming down the drift. There were none. Daniel Rockhouse continued to open air valves as they went. To motivate Mr Smith, he told him to think of his family and to keep his legs moving for them.

Two miners walk out of the portal

47. As they progressed outbye, the atmosphere became clearer and it was easier to breathe. Natural ventilation provided a fresh air flow inbye from the portal. At 5:26pm the two men completed the 1500m walk from the FAB to the portal. From the time of the phone call at 4:40pm it had taken them 46 minutes to walk out of the mine. No one was there to meet them. Daniel Rockhouse used the DAC to call the control room for help. Vehicles arrived at the portal within minutes. Mr Smith was incoherent and Daniel Rockhouse broke down. Paramedics gave both men oxygen and they were taken by ambulance to Greymouth Hospital.

The emergency response

48. By 5:30pm the emergency response was well under way. Police, the New Zealand Fire Service, the MRS and St John Ambulance personnel were en route to or at the mine. Help from overseas would arrive over succeeding days, as a major search and rescue effort was launched to save the 29 missing men.

ENDNOTES

¹ References to times throughout this chapter are taken from various sources, including equipment at Pike and from other organisations. The sources are not synchronised. As a result, there may be minor discrepancies between the times quoted from different sources.

² Department of Labour, Last Known Position of Deceased and Two Survivors. Final Version, 28 January 2011 (DOL Investigation Report, Appendix 3), DOL3000130004/2. ('A, B, & C headings' locations added to the map by the commission)

³ Department of Labour: Transcription of the 'DAC' Underground Radio Communication System, 1 August 2011, INV.03.21043/32.

⁴ Daniel Duggan, transcript, p. 1581.

⁵ Department of Labour: Transcription of the 'DAC', INV.03.21043/32.

⁶ Daniel Duggan, transcript, p. 1585.

⁷ Ibid., p. 1586.

⁸ Mattheus Strydom, transcript, p. 1037.

⁹ Ibid.

¹⁰ Department of Labour: Transcription of the 'DAC', INV.03.21043/32.

¹¹ Video recording, 19 November 2010, CAC0018.

¹² Mattheus Strydom, transcript, p. 1040.

¹³ Ibid., p. 1047.

¹⁴ Audio recording, 19 November 2010, CAC0047.

¹⁵ Daniel Rockhouse, transcript, p. 1076.

¹⁶ Ibid., p. 1077.

¹⁷ Ibid., p. 1080.

¹⁸ Ibid., p. 1086.

Accident analysis – some concepts

Introduction

1. The commission has sought the systemic reasons for the Pike River tragedy. The analysis, therefore, goes beyond the immediate cause to reveal the underlying causes and circumstances that allowed the tragedy to occur. In doing so, the commission has relied on expert evidence and international thinking. This chapter explains some concepts that have helped the commission in its evaluation and in preparing the report.

The ‘what/why’ distinction

2. Causation can be a vexing issue. In determining the cause of an event, it is possible to focus on the immediate or proximate cause or causes, or to look beyond the immediate to identify not just what happened, but why. The commission has taken the second approach.
3. The ‘what/why’ distinction can be illustrated by an example. A machine operator in a factory overrides a protective guard and is injured. The immediate and proximate cause is human error (or violation): but for the operator’s action the machine could have been operated safely and the accident avoided.
4. Identifying what happened, and the result, has the advantage of simplicity. It allows responsibility to be assigned to an individual and blame to be attributed. And then the quest for explanation can stop.¹
5. Until comparatively recently, accidents were routinely attributed to frontline operator error, and contributory causes were not considered, including the actions of those at management and governance level. The broader context, or setting, in which the operator acted was essentially ignored.²
6. If, by contrast, the question ‘why’ is asked – why did the operator act as they did? – a whole range of contributory factors may emerge. Perhaps the machine operator’s training was deficient, fatigue clouded their judgement, the machine guard inhibited production or overriding guards was commonplace in the factory.
7. The emergence of these factors prompts another level of inquiry. Why was operator training inadequate? Why was worker fatigue an issue? Why was the machinery not fit for purpose? Why was rule violation normalised? These questions invite greater scrutiny. Why were such problems not identified and addressed by management or at a governance level, where resources are allocated and an organisation’s direction is set?
8. The explosion and loss of 29 lives at Pike River demands a broad inquiry that extends to all levels of the company. Chapter 3, ‘The promise of Pike’, which examines the conception, approval and development of the mine, provides the backdrop for the examination of the mine and its systems in subsequent chapters.
9. But, as Dr Callaghan³ explained, the inquiry must extend further still: ‘to interrogate the strengths and weaknesses at all levels of the “system” – the company, the industry, the regulator and the wider government’, at least if ‘intervention is [likely] to be as efficacious and efficient as it could be.’⁴ The commission agrees.

Human factors

10. Dr Callaghan also stressed the need to consider ‘human factors’ in accident analysis. Human factors are the ‘environmental, organisational and job factors, and human and individual characteristics, which influence behaviour at work in a way which can affect health and safety.’⁵ The definition identifies three interrelated aspects: the job,

the individual and the organisation, each of which requires consideration. The job is the task to be performed in a specific workplace, including, in particular, the demands posed by that task. The notion of the individual captures the characteristics that influence human behaviour, such as competence, experience, attitude and personality. Some of these are fixed; others are adaptable. The organisation includes such things as resources, leadership and culture – all the company-related factors that influence individual and group behaviour in a workplace.

11. The aim of the human factors discipline is to ‘understand and improve competence and safety at work.’⁶ It seeks to answer such questions as:
 - Why do smart people do unsafe things?
 - Why don’t people do what they’ve been told?
 - Why are the same mistakes made over and over again?⁷

The questions expose the norm that error is a characteristic of human behaviour and therefore inevitable in any human system. It follows that any system relying on error-free human performance is fundamentally flawed. In any event, accidents are rarely the result of a single action, failure or factor, but rather of a combination of personal, task-related, environmental and organisational factors, some longstanding.⁸

Personal safety and process safety

12. These terms distinguish between two types of accidents widely recognised in the literature. As well as having different characteristics, personal safety and process safety accidents require different approaches to their prevention and investigation.
13. Personal safety accidents may involve one person who is both the cause and the victim. The damage may be significant, but is confined to an individual or a small group of people. Such accidents are relatively frequent because they occur as a result of human errors or violations in relation to hazards that are close at hand (as in the machine operator example). Often they can be described as slips, trips and falls. The defences or protections that guard against them are normally simple and few in number. Typically there is little time between the failure and the accident.
14. Process safety refers to the prevention of the unintended escape of toxic substances, flammable material or energy from a plant or other workplace. In a mining context the consequence may be an explosion or a fire. Process safety accidents can be catastrophic, causing multiple deaths and large-scale personal and property damage. Typically the organisations that suffer process safety accidents have complex and layered defence systems intended to eliminate workplace hazards. These systems comprise a mixture of hard and soft controls. Hard controls are physical barriers and devices that guard against, monitor or automatically warn of hazards. Soft controls are the organisation’s practices and procedures, including operating standards, supervisory oversight and worker training.⁹
15. A layered defence system makes it unlikely that one failure, human or mechanical, will trigger an event. Rather, a combination of failures is required before the multiple defence systems are penetrated, with potentially catastrophic results. Hence the term ‘low frequency, high consequence events’ is used with reference to process safety accidents. Because these events are often separated by a number of years, or decades, complacency may develop, even to the point where an organisation becomes blind to a known catastrophic risk.
16. The indicators of personal safety and process safety are also different. The occurrence of personal safety accidents has usually been measured by the lost time injury rate of the company. This is a lag indicator, a measure of performance made after the event, actually a measure of failure. Many companies place considerable store on their lost time injury rate figures. They may be used to measure performance and thereby affect a senior manager’s bonus payment. They may attract the attention of the regulator, or even of an insurer in fixing a premium.
17. A measure of injury rates is of limited use, however, as an indicator of a looming process safety failure. For this, a mixture of lag and lead indicators is required. Lead indicators, sometimes called positive performance indicators, are

obtained from routinely monitoring selected critical risk controls to ensure their continued effectiveness. The choice of risk controls is important. They must be of a kind to measure process safety performance in relation to the major hazards at the particular workplace.¹⁰

18. An example relevant to Pike River illustrates the interaction of lag and lead indicators. Methane explosions in mines are prevented by gas management, a key element of which is methane monitoring. This is done partly by using methane sensors, hard controls, strategically located in the mine. The sensors provide a warning of excessive methane levels, or spikes. A high-level spike is a warning sign, while a number or pattern of spikes may be a critical indicator of a potential process safety failure. An associated soft control may be a maintenance programme used to routinely test the calibration and reliability of the sensors. Data confirming that the maintenance programme is carried out on time, and effectively, gives the added assurance that the information supplied by the sensors is accurate. But all indicators are not equal. Failure data, such as a pattern of methane spikes, may demand an immediate response; other indicators may be less critical. What matters most is that there is a range of safety indicators, and that they are analysed and used to drive improvements in safety performance.¹¹
19. The explosion at Pike River was a process safety accident. Its occurrence raises many questions. Were the hard and soft controls at the mine adequate? How were the defence layers breached? Were lag indicators gathered and responded to? Were lead indicators used to check the effectiveness of hazard controls? Was there complacency about the existence of an explosion risk? These questions require the commission to look at the whole organisation, and to consider the actions of the regulator and others.

The ‘Swiss cheese’ model of causation

20. James Reason also devised a causation method, commonly referred to as the ‘Swiss cheese’ model, which is of particular relevance to process safety accidents.¹²

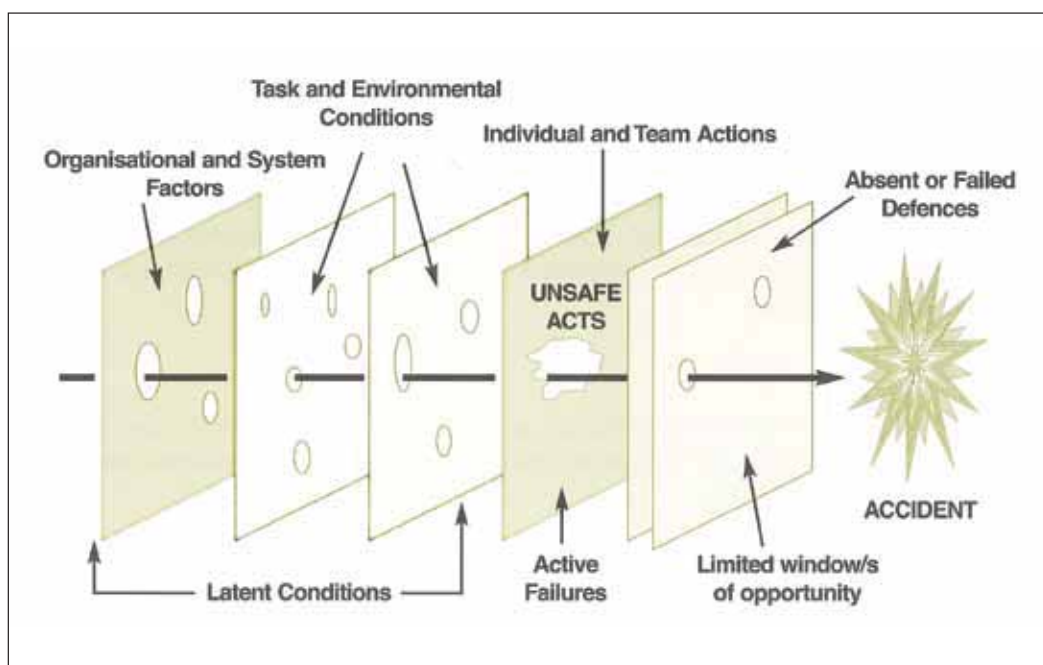


Figure 2.1: ‘Swiss cheese’ model of causation

Each slice of cheese represents one layer of an organisation’s defence system. These are labelled by type (at the top), and also divided into latent conditions and active failures, and windows of opportunity. The holes in each slice represent gaps in the defence system. Some arise from active failures, human errors or violations, which are short-lived. Latent conditions reflect the decisions and actions of the people who design, influence, implement and manage aspects of an organisation’s operational systems, such as equipment selection and monitoring, information

gathering or safe operation systems. These are latent because they can lie undiscovered and dormant for long periods until a combination of failures triggers a near miss or an actual event.¹³

21. An organisation's defence systems reduce the likelihood of major accidents because an accident occurs only when the holes in the multiple defences align, hence the reference in the model to limited windows of opportunity. Chance plays a part in the occurrence, and timing, of accidents. Defence systems are also difficult to understand and manage. No one person can be expected to oversee the entire system.
22. An organisation-wide safety culture can help to keep holes in the defence systems to a minimum. Active failures, worker errors and violations are likely to diminish in a workplace with a good safety attitude. Latent failures should be more readily discovered if those who design, establish, monitor and review the safety systems are also well motivated. And, most important of all, a safety culture should help to ensure that warning signs are not ignored, but heeded and addressed.¹⁴
23. The commission has had regard to this model in its analysis.

ENDNOTES

¹ Andrew Hopkins, *Failure to Learn: The BP Texas City Refinery Disaster*, 2008, CCH Australia, p. 10.

² Ibid.

³ The commission acknowledges the evidence provided by Dr Kathleen Callaghan, the director of the Human Factors Group, Faculty of Medical and Health Sciences, University of Auckland.

⁴ Kathleen Callaghan, witness statement, 31 October 2011, FAM00042/59, para. 213(f).

⁵ Health and Safety Executive (UK), *Introduction to Human Factors*, <http://www.hse.gov.uk/humanfactors/introduction.htm>

⁶ Kathleen Callaghan, witness statement, 31 October 2011, FAM00042/6, para. 9.

⁷ Ibid.

⁸ James Reason, 'Understanding Adverse Events: Human factors', *Quality in Health Care*, 1995, Vol. 4, No. 2, p. 85, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1055294/pdf/qualhc00016-0008.pdf>. Reason, who was Professor of Psychology at the University of Manchester 1977–2001, is a prolific writer on many aspects of safety management, including *Managing the Risks of Organizational Accidents*, Ashgate, 1997.

⁹ BP U.S. Refineries Independent Safety Review Panel, *The Report of the BP U.S. Refineries Independent Safety Review Panel*, 2007, pp. 21–23, http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/SP/STAGING/local_assets/assets/pdfs/Baker_panel_report.pdf

¹⁰ Health and Safety Executive (UK), *Developing Process Safety Indicators: A Step-by-Step Guide for Chemical and Major Hazard Industries*, 2006, <http://www.hse.gov.uk/pubns/priced/hsg254.pdf>

¹¹ Andrew Hopkins, *Thinking About Process Safety Indicators* (Working Paper 53), May 2007, National Research Centre for OHS Regulation, Australian National University.

¹² Safety Wise Solutions Pty Ltd, 'Analyse Findings', in *Incident Investigation Reference Guide*, 2010, section 7, p. 2.

¹³ James Reason, 'Beyond the Organisational Accident: The Need for "Error Wisdom" on the Frontline', *Quality and Safety in Health Care*, 2004, Vol. 13, Suppl. 2, p. ii29, http://qualitysafety.bmj.com/content/13/suppl_2/ii28.full.pdf+html

¹⁴ James Reason, 'Achieving a Safe Culture: Theory and Practice', *Work & Stress*, 1998, Vol. 12, No. 3, pp. 293–306.

The promise of Pike

Introduction

1. This chapter describes the physical characteristics of the Pike River coal field and the history of the mine's development over the 28 years between 1982 and the explosion in 2010. In broad terms there were three relevant periods: exploration of the coal field to 1995, mining feasibility studies to a final investment decision in 2005 and mine development to November 2010.

Physical characteristics of the coal field

Location of the coal field

2. The Pike River coal field is in a remote location on the eastern side of the Paparoa Range, about 45km north-east of Greymouth. It lies between Mount Hawera (1190m) to the north and Mount Anderson (1069m) to the south. The coal field occupies an area of about 7km².



Figure 3.1: Location of the Pike River coal mine

3. Access to the coal field is from the Taylorville–Blackball Road on the western side of the Grey River, then up the Big River Valley on Logburn Road, from where an 11.7km private road leads to the mine.

The land

- The coal field lies under conservation land, and partially under the Paparoa National Park. Its western boundary is a sheer 200m escarpment that is marginally within the eastern perimeter of the park. From the escarpment the coal field dips to the east and terminates at a major fault line, the Hawera Fault. The mine portal, situated more than 2km to the east of the fault, is on the true right bank of the White Knight Stream, 120m upstream from its confluence with the Pike Stream.
- The land area under which the coal field lies is administered by the Department of Conservation (DOC), the western margin and an area to the north under the National Parks Act 1980 and the balance under the Conservation Act 1987. DOC granted an access arrangement that authorised coal mining under the conservation estate. Easements granted by the Crown and a private landowner enabled construction of the mine access road. Pike River Coal Ltd owned an area of 87ha where its coal preparation plant (CPP) was built near the northern end of Logburn Road. Because of its remoteness the land above the coal field contains areas of virgin rainforest.

Geology

- The geology of the coal field is complex, as can be seen from the simplified cross-sectional figure below. There are two coal measures, the Brunner seam, which was mined, and, approximately 200m below it, much older Paparoa seams. The Brunner seam consists of the main seam and above it a narrower rider seam, separated by interburden of variable thickness. The seams outcrop on the western escarpment. The Hawera Fault not only marks the eastern margin of the coal field, but has also deformed the seam upwards adjacent to the fault line.

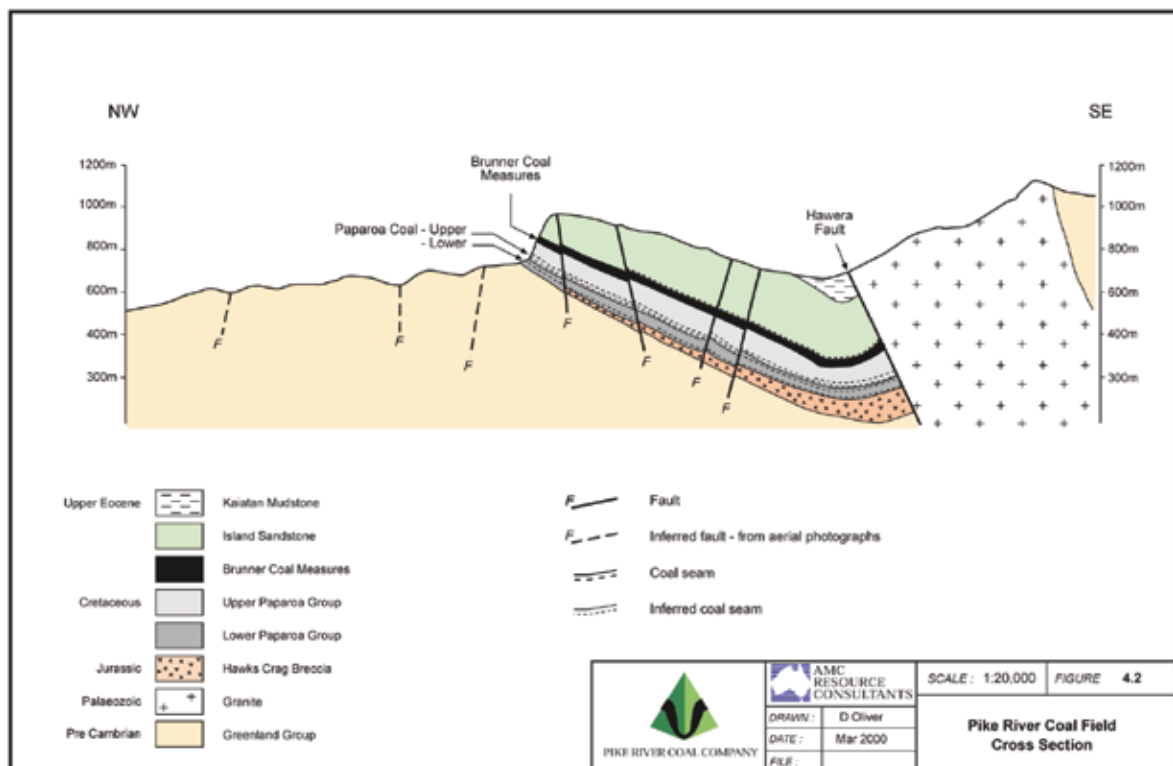


Figure 3.2: Pike River coal field cross-section¹

- Other faults intersect the Brunner seam, which dips at a gradient of between 10° and 20°. Island sandstone of varying depths overlies the coal field depending upon the surface contours. As can be seen in the simplified diagram of the west to east cross-section below, the surface contour is highly variable, this being rugged country intersected by gullies and streams.

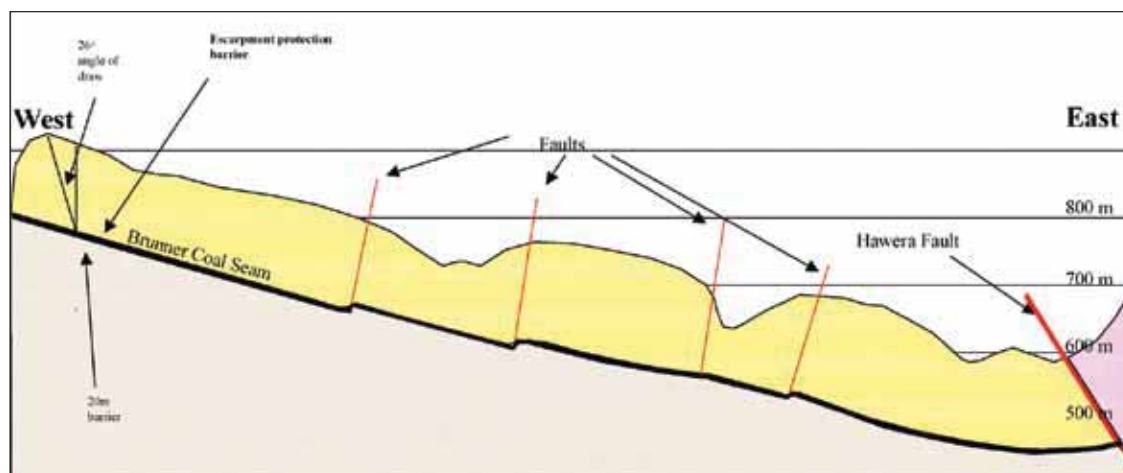


Figure 3.3: Pike River coal field west–east cross-section²

8. The Paparoa Range forms a barrier to the dominant westerly air flow from the Tasman Sea. As a result the coal field area has rainfall of up to 6m per annum. The altitude of the area makes it prone to snowfalls in winter; cloud and rain are the predominant climatic features for most of the year.

Exploration of the coal field

Outcrop sampling and drilling programmes

9. Although the existence of the two coal seams was well known, because of the outcrops on the western escarpment, exploration of the field did not begin until 1980. A mineral exploration company obtained prospecting licences and undertook geological mapping and the sampling of coal from the outcrops.
10. In 1982 the Pike River Coal Company Ltd (as it then was) was incorporated and took over the two prospecting licences by transfer from the previous holder. The following year the new company undertook a six-hole drilling programme (numbered PRDH1–6), using a drilling rig flown to each drill site by helicopter. Numerous core samples were obtained from the holes to a depth of between 130 and 270m.
11. In 1988 Pike became a wholly-owned subsidiary of New Zealand Oil & Gas Ltd (NZOG). Two years later, under a government-funded exploration scheme, one additional hole (PRDH7) was drilled to intersect both the Brunner and Paparoa seams. In 1993 the company obtained an exploration permit for a four-year term over an area of about 1782ha. In 1993 a further seven holes were drilled (M1–7) under a joint venture programme with Japanese firm, Mitsui Mining Engineering Co. Ltd.
12. On the strength of the testing of the cores obtained from these 14 drillholes, the company commissioned a pre-feasibility study in 1995, and the following year applied to the Ministry of Commerce for a coal mining permit. During mine construction, additional holes were drilled, but mainly in the area of the stone drift to the east of the coal measures, or in the area of the mine workings. Angled holes were sometimes drilled from a single site, to avoid moving the drilling rig. These holes provided geological information for the siting of underground infrastructure.
13. Dr Jane Newman gave evidence about the geology of the Pike River coal field. She first studied the area as a PhD student in 1980, was involved in some of the early drilling programmes and a geological modelling project in 2008. She subsequently offered the company informal advice during the construction of the mine. She said the coal field demonstrates both stratigraphic (strata) complexity and structural (faulting) complexity, and that one superimposed on the other does not simply double the complexity but increases it greatly. Given this complexity, it was not unusual for in-fill drilling to provide a grid at 100m spacings, given complex West Coast mining conditions.³
14. Dr Donald Elder, chief executive officer of Solid Energy, concurred, noting that detailed geological and coal information would have required boreholes at about 100m spacing.⁴

15. At Pike River boreholes were drilled on average from 400 to over 500m apart.⁵

Coal characteristics

16. Pike River contains one of New Zealand's largest deposits of hard coking coal. It has a low ash and phosphorus content, which gives it a competitive advantage over other coking coals. Early studies indicated a wide variation in the sulphur content of coal within the Brunner seam. Selective mining would be needed to ensure sulphur limits were not exceeded.
17. In 2007 Pike planned to extract and export high-quality, hard coking coal.⁶

From feasibility to final investment decision

Pre-feasibility study

18. A Christchurch mining consultant, CMS Ltd, undertook the 1995 pre-feasibility study. The key recommendations were that assessment of the coal field should continue to the feasibility stage, that seven more drillholes were required to confirm the coal reserve quality and to provide geotechnical assurance, and that access agreements should be obtained as early as possible. Development costs were estimated to be \$29 million, including \$13.65 million to develop the access road and establish the mine, \$4.55 million for plant and equipment and \$5.85 million as a 25% contingency allowance.⁷
19. NZOG commissioned a further pre-feasibility study in 1998 from Auckland-based Minserv International Ltd. The study included an assessment of the benefits of using hydro mining at Pike River. It described the 'significant dip' of the seam, allowing a water-assisted gravity flow of coal from the workings to pit bottom, from where it could be carried by a slurry pipeline to the CPP. Using this method, annual production of between 460,500 and 502,380 tonnes was estimated.⁸ Minserv also completed a revised financial model, including hydro-mining costings, and arrived at a capital outlay of \$43.26 million for the three initial development years.⁹

Mining permit

20. The company applied for a mining permit in March 1996. The application estimated the total recoverable coal reserves to be 26.7 million tonnes. Three years would be needed to develop the mine to the point of coal production, after which the life of the mine was estimated at 40 years.¹⁰
21. Mining permit number 41-453 for an underground coal mine was granted in September 1997. It was issued for a period of 40 years subject to mining beginning within five years and an average of 300,000 tonnes of coal being mined per annum. The total area covered by the permit was 1611ha, but this area was increased by 333ha in January 1998.¹¹

An access arrangement

22. In June 1998 the company applied to DOC for an access arrangement so it could mine for coal beneath the conservation estate. No application for an open cast mine was made, nor was such a proposal discussed. A detailed six-year process followed before the terms of an agreement were resolved. DOC was concerned to safeguard and preserve the land as required of it under the Conservation Act 1987 and the National Parks Act 1980. Its concerns included land subsidence, fire control, protection of flora and fauna, mine water discharge, protection of the western escarpment and protection of breeding habitats.
23. Numerous environmental reports and risk assessments were obtained to assess the risk from surface activities and underground mining. DOC engaged its own experts and there were exchanges between consultants in an endeavour to find acceptable solutions. In October 2000 the access application was amended after the area of the mining permit had been enlarged to include the area required for the mine access road.¹²

24. In March 2004 the minister of conservation approved the arrangement, but subject to the drafting of conditions.¹³ On 21 October 2004 a 25-year access arrangement was signed. The agreement conditions were extensive. Surface subsidence limits were prescribed, and the company agreed to develop 'trial mining panels' to demonstrate that any surface disturbance fell within the defined limits. A mining buffer zone prevented mining close to the western escarpment, and no 'untreated mine water' could be allowed into the tributaries of the Big River. Specific consent was required for any surface activity that could affect flora or fauna, such as establishment of drilling sites, roadworks or the construction of helicopter landing areas. The company also had to provide an annual work plan, fund a liaison person for the term of the agreement and arrange insurance and bonds for its obligations under the agreement.¹⁴
25. The rigour of the process and the detailed controls contained in the access agreement left no room for doubt concerning the high level of protection to be given to the surface environment of the mine. Pike understood and respected DOC's requirements. Regular liaison meetings occurred, mostly at the mine site. These worked well, so that for example every drillhole approval sought by Pike was approved by DOC.¹⁵
26. During the mine development seven variations to the access arrangement were negotiated to cover unanticipated environmental requirements and 144 work plan variations occurred.¹⁶

Resource consents

27. In mid-1998 the company applied for various resource consents from the Greymouth and Buller District Councils and the West Coast Regional Council. These were granted in June 1999. They covered a wide range of activities, including taking water from the Pike Stream; construction of the stone drive, ventilation shaft, access road, slurry pipeline, bridges, power and telecommunications lines, and the CPP; as well as consents required for a coal stockpile. However, in July 1999 interested parties lodged appeals to the Environment Court against the resource consent decisions.
28. In May 2002, to respond to concerns raised by the appellants, the company obtained a report on the environmental effects of the coal field development from consultant URS New Zealand Ltd. This outlined changes in the company's approach, including relocating the mine portal from beside the Pike Stream to its eventual location on the White Knight Stream. This increased the length of the stone drift by 400m, but avoided the need for road development beside the Pike Stream.¹⁷
29. In the end the Environment Court appeals were resolved by a consent order of the court, which approved numerous resource consents incorporating changes to those originally granted.¹⁸

The final investment decision

30. In June 2000 AMC Resource Consultants Pty Ltd provided the company with a final feasibility study. This assessed all aspects of the mine project from the extent of the resource to the proposed mine systems and required workforce. AMC was not paid a consultancy fee, but instead received a 25% shareholding in the company.
31. The study was not acted upon for some time. Instead the company focused on obtaining the access arrangement and resource consents, which were finally in place by late 2004. Minarco Asia Pacific Pty Ltd (previously AMC) then prepared an updated study, particularly of the capital costs to continue the project.
32. These were reflected in a mine plan and financial model ('the joint report') presented to the Pike board in July 2005 by Gordon Ward, the general manager, and Peter Whittall, the mine manager. Mr Ward was an NZOG appointee who, in 1998, assumed responsibility for the Pike River project. His background was in accountancy and auditing, not mining. Mr Whittall, who joined the company from Australia in February 2005, was a mining engineer and experienced in coal mine development and management.¹⁹
33. The joint report recommended that the board accept the proposed mine plan and development strategy, and authorise management to execute the plan including employing 'such staff as are required to complete the capital works within the approved budget'. On 20 July 2005 the board made a final investment decision in the terms recommended.

34. The capital development of the mine was costed at \$124.1 million to September 2007, including the following amounts and completion dates:

Access road	\$11.75 million	April 2006
Tunnel (drift) development	\$21.3 million	September 2006
Hydro set-up	\$28.4 million	October 2007
Full coal production	-	February 2008

Production capacity was estimated at 'up to 1.4Mtpa' (million tonnes per annum), comprising 20% from mine roadway development and 80% from hydro mining. A peak workforce of about 150 people was contemplated to enable a seven-day, three-shift operation; contractors would be used for 'specialist activities'.²⁰

Optimism prevailed

35. The company embarked upon development of the mine with optimism and confidence. Mr Ward, speaking at the November 2008 annual general meeting, referred to Pike River as a 'special mine', with 'the largest and most valuable hard coking coal deposit in the country' and 'the lowest ash content in the world and a high fluidity level'. These properties would make the coal attractive to the international steel and coke industries. These qualities were complemented by investment in 'new modern machinery and equipment, and [a] recruited skilled mining staff to make sure we achieve that target ... approximately one million tonnes of coal a year for each of the next 18 years'.²¹
36. At the 2009 annual general meeting Mr Ward told shareholders that 'Pike River's state-of-the-art hydro monitors will cut ... around 2,200 tonnes per day; that's about 800,000 tonnes a year' while roadway development would 'add another 200,000 tonnes a year on average'. The mine enjoyed advantages because of 'mining uphill nearly all the time and being able to use gravity to flume and pipe coal out of the mine', and because it had 'much larger hydro-mining pumps' and was generally 'designed to be a bigger mine than all other New Zealand underground mines'.²²

Mine development

37. The mine infrastructure includes the coal stockpile and loadout facility at Ikamatua, 22km from the CPP and bathhouse, and the mine amenities area, about 7km up the access road from the CPP. The amenities area includes offices, the operations control room, and workshop. The portal is a further kilometre up the access road from the amenities area.



Figure 3.4: Pike River mine environs²³

38. Underground, the stone drive, or drift, stretches about 2.3km from the portal to the coal seam. It provided intake air, transport for men, materials and coal, and provision for power, water and communications services. A vertical ventilation shaft, over 100m deep, provided return ventilation and a second means of egress. A second drive was to be established as the mine developed towards the north-west of the licence area.

Access road

39. Work on construction of the access road from the CPP to the mine portal began in December 2005. As well as establishing a single-lane roadway, with passing bays, Ferguson Brothers, the Greymouth contractor, was required to construct several bridges.²⁴ The road was completed in September 2006, five months after the completion date envisaged in the joint report to the board. In November Ferguson Brothers won the Canterbury Contractors Federation Environment Award and Contractor of the Year for projects over \$1 million for its successful construction of the road through virgin native forest and conservation estate.

Pike River share offer

40. On 22 May 2007 Pike River Coal Ltd issued a prospectus offering 65 million \$1 shares for public subscription.²⁵ The company was still a subsidiary of NZOG, which held a 54% stake. The next two biggest shareholders were Indian companies, Saurashtra World Holdings and Gujarat NRE Ltd. Their combined shareholding was about 32%, with smaller investors holding the balance of the shares.²⁶

41. The prospectus included these financial details:

Total development costs:	\$207 million	(exclusive of pre-development costs of \$16 million) being:
	\$64 million	spent to May 2007
	\$99 million	to finish development
	\$11 million	contingency sum
	<u>\$33 million</u>	production working capital
	<u>\$207 million</u>	

The capital required, therefore, was \$143 million, which was to be sourced from the share issue, some cash on hand and new borrowings. The prospectus anticipated coal production (in tonnes) of 243,000 in 2008, 1.039 million in 2009 and 968,000 in 2010.

A total production of 17.6 million tonnes over a 19-year mine lifespan was predicted, at an average annual extraction rate of 967,000 tonnes.²⁷

42. The share offer was oversubscribed and 85 million shares were allotted to new investors. NZOG's shareholding reduced to 31%, so that the company ceased to be an NZOG subsidiary.²⁸ In July 2007 the company was listed on the New Zealand and Australian stock exchanges.²⁹

Construction of the drift

43. McConnell Dowell Constructors Ltd developed the drift and the main ventilation shaft, as well as some surface facilities. Tunnelling work started in September 2006. The drift was to have a horseshoe profile, to form a roadway 5.5m wide and 4.5m high.³⁰ It was inclined upwards by about 5° over its length. This allowed the drift to intersect the Brunner seam near to its lowest point.
44. There were variations to the contract during the development of the mine. The most significant change was the inclusion of an area known as pit bottom in stone.³¹ This comprised 500m of roadways, either side of the drift, at about 1900m inbye, as depicted below. This area was to house a coal crushing station and water pumps used to provide water to the working faces in the mine, and water to the slurry pipeline leading to the CPP. During construction methane was encountered and some frictional ignitions occurred. Until then the work was deemed

tunnel development, but the ignitions caused the Department of Labour (DOL) to designate the tunnel a 'gassy mine'.³² This designation meant that project control also passed from McConnell Dowell to Pike.

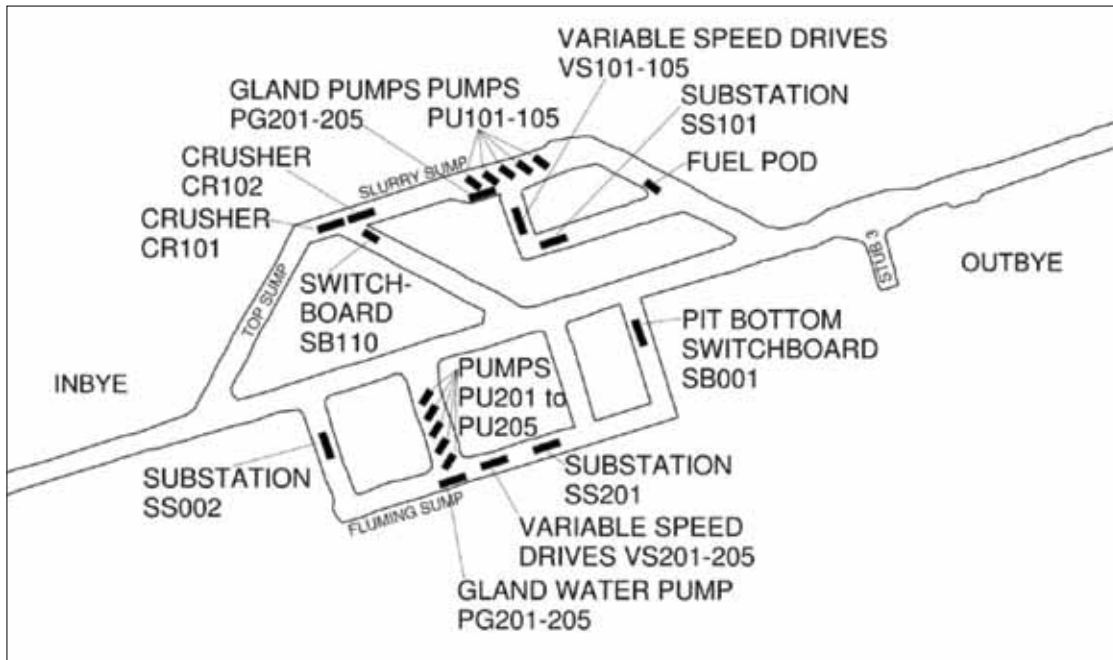


Figure 3.5: Plant location pit bottom in stone³³

Originally this area was to be developed to the west of the Hawera Fault, but a decision was taken to develop it in the hard gneiss stone.

45. In December 2008 the drift and pit bottom in stone were completed. This was two years and three months after the completion date in the joint report, and five months after the estimated date in the prospectus. Even allowing for the additional work, there was considerable delay, caused largely by unfavourable ground conditions. The contract with McConnell Dowell included a per metre payment rate based on rock quality. Because most of the drift attracted the highest metre rate, the total cost was about 100% over budget.³⁴ In August McConnell Dowell won a New Zealand Contractors Federation award for its work on a 'technically and geologically complex project' in the over \$20 million category.
46. On 27 November 2008 the mine was officially opened to mark 'the breakthrough to coal and achievement of operational status'.³⁵



Figure 3.6: Minister of Energy and Resources, the Hon. Gerry Brownlee, Pike Chief Executive Gordon Ward, Chair John Dow and General Manager Peter Whittall at the opening of the Pike River mine

Development of the ventilation shaft

47. By late 2007 a final decision was required about the site of the ventilation shaft, so that McConnell Dowell could develop the surface collar to the shaft over summer. The company did not want it outbye of the Hawera Fault, in stone, because of cost and significant problems with land stability. The site of an existing drillhole (PRDH13) was investigated, and a new drillhole (PRDH31) was bored. In September a site inbye of the Hawera Fault was finalised and in late summer McConnell Dowell constructed and grouted the surface collar.³⁶
48. But the shaft could not be completed until the drift was through the Hawera Fault and a roadway was driven to the ventilation shaft site. In December 2008 a bore began to ream out the shaft from the bottom up to the surface. This was completed in January 2009, but in early February 2009, before the 4.2m diameter shaft was fully lined, the bottom section collapsed, sealing any connection between it and the mine roadway.³⁷
49. Following investigation the company decided to abandon the bottom 35m, cap it with concrete and construct a bypass to reconnect to the upper 70m of the shaft, as shown in the diagram.

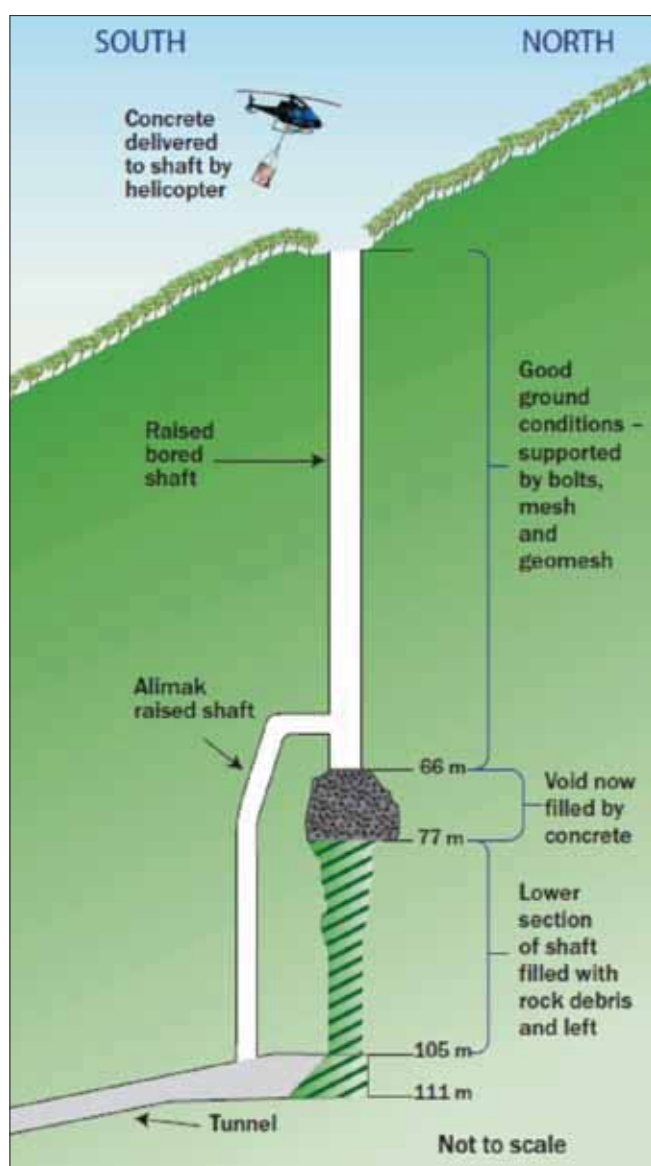


Figure 3.7: Ventilation shaft and Alimak raise³⁸

The bypass, called the Alimak raise, was constructed between April and June 2009. The raise was only 2.5 by 2.5m, and connected to the 4.2m diameter shaft. Obviously, the cost of the Alimak raise was unexpected, as was the five-month delay.

50. During this period, Pike also drilled a 600mm 'slimline' shaft to improve air capacity. It was completed in May 2009. A fresh air base, so called, was later established at the bottom of the slimline shaft to provide air in the event of an emergency.

Mine roadway development

51. From November 2008, when the drift reached its 2.3km design length and was through the Hawera Fault, mine roadway development began. The first roadway was driven 75m north, to the base of the proposed ventilation shaft.³⁹ Further roadway development was planned to the south, where there would be more mine facility infrastructure, and to the west, where coal extraction was to be centred.
52. These roadways, 5.2m wide by 3.6m high, provided access for men and machines, and carried such services as ventilation ducting; water, compressed air and methane pipes; and a coal flume to transport coal and water from the working faces. The roadway walls (ribs) and roof were bolted and secured with mesh for strata support.
53. In anticipation of roadway development, horizontal in-seam drilling of the Brunner coal seam began, using a drilling rig. Exploratory boreholes were drilled hundreds of metres into the seam to define the seam limits and to obtain geological data. The boreholes also released methane from the seam, although this was secondary to seam exploration.
54. Holes drilled to the west revealed the existence of a graben, a downthrust zone between two fault lines, which in this instance had depressed the coal seam and substituted a zone of island sandstone. Situated close to the Hawera Fault, the graben was about 200m wide. Driving roadways through the sandstone 'took several months longer than initially expected' and delayed mine development.⁴⁰
55. By April 2010 roadways through the graben were completed and the rate of development improved.

Mining machinery

56. The company purchased three mining machines for use in roadway development, two continuous miners and one roadheader at a total cost of \$14 million.⁴¹ The continuous miners were configured to cut the width of a roadway in two passes, bolting the roof and ribs at the same time. The roadheader was also suited for cutting stone.
57. The continuous miners proved unsatisfactory for the conditions. They were not fast enough and suffered heavy wear and tear while cutting through the graben. In the third quarter of 2010 one was withdrawn from service so it could be modified. This work was expected to take three months.
58. In August 2010 another brand of continuous miner, called the ABM20, was leased and began operating. It could cut a 5m roadway in a single pass and bolt at the same time. The ABM20 achieved improved daily advance rates. This led the company to buy another ABM20, to be delivered towards the end of the year.⁴²

Hydro mining

59. Initially the mine plan and access arrangement required trial panels in the north-western corner of the coal field to assess whether coal extraction caused surface subsidence. Roadways were to be driven to this area and hydro-mining panels established. Mining would then retreat back in a south-easterly direction, so that the last coal taken would be from the pit bottom area. However, delays and cost overruns forced a rethink. Mr Whittall raised with DOC the concept of a 'commissioning panel' to allow initial coal extraction close to pit bottom. This would provide \$15–\$20 million of revenue, and the company would then revert to the original plan.⁴³ This proposal was agreed to. In early 2010 approval was given to develop a smaller 'bridging panel' nearer to pit bottom.
60. Hydro mining started in September 2010. A hydro monitor cut the coal, using a high-pressure water jet. The coal was then collected and flumed under gravity to the slurry pipeline. The monitor gradually retreated, leaving a void, or goaf, from which coal had been extracted.
61. Teething problems affected hydro extraction. Coal production was not at the desired rate, owing to equipment problems, the hardness of the coal, mining crew inexperience and methane control difficulties.⁴⁴

Ventilation

62. Effective ventilation is essential in an underground coal mine. The ventilation system must deal with coal gases and dust, as well as supplying the miners with sufficient air at acceptable temperature and humidity levels. During the development of the drift a fan at the portal ventilated the mine. It was replaced in mid-2009 by a fan at the top of the ventilation shaft. In mid-2010 a new main ventilation fan was installed underground next to the main vent shaft. It was designed to draw air into the mine from the portal and expel polluted air up the shaft and out of the mine. The fan was commissioned in October 2010.
63. This is thought to be the first time a main fan had been located underground in a coal mine anywhere in the world. Some metalliferous mines have underground main fans, but they do not face a methane hazard. In locating the fan underground the company faced a number of challenges. The fan motor was not flameproof and had to be situated 'in fresh air' in an intake roadway, with the fan blades located in a return roadway to expel polluted air up the ventilation shaft. The fan was vulnerable in the event of an underground fire or explosion, dependent on a power supply cabled into the mine from the portal and inaccessible to electricians in the event of an underground emergency. It also experienced teething problems after it was installed.

Workforce

64. In October 2008 Pike River employed 82 full-time staff members.⁴⁵ Two years later the workforce numbered 174. Over the previous 12 months the company had been engaged in a 'significant offshore recruitment drive to build a top quality workforce'. The workforce included about 80 locals, other New Zealanders and a significant number from overseas.⁴⁶
65. The company also employed between 20 and 60 contractors including 'significant use of local contracting companies'.⁴⁷ This exponential increase in numbers created a demand for training courses, particularly as many people were new to New Zealand conditions, or new to the industry.
66. There was also a staff retention problem. One example of this was the turnover of mine managers at Pike River. From September 2008 until the date of the explosion six men held the position on a permanent or acting basis. A seventh person, Stephen Ellis, was to assume the role, as soon as he obtained a first class mine manager's certificate of competence.

An environmental award

67. In September 2008 DOC recognised Pike River for 'the environmental consideration it had demonstrated in the establishment of [its] mining facilities'.⁴⁸ The surface footprint on conservation land was restricted to only the 13ha needed to establish the 10km access road and locate administration buildings. Predator control programmes, constructing the road to wind through ancient native trees and blending buildings into the native bush setting also won praise. Two months later, on a visit to the mine, Minister of Conservation Chris Carter added that it was a 'showcase development which had set a new environmental standard for coal mining'.⁴⁹

Coal production and capital fundraising

68. In its 2007 prospectus Pike River anticipated that coal production would begin in the March 2008 quarter, with production of 243,000 tonnes for that calendar year, which would generate a cash flow of \$38 million at an average sale price of \$157 per tonne.⁵⁰ The first two coal shipments were not until February and September 2010, when 20,000 and 22,000 tonnes, respectively, were sold for around \$9 million.⁵¹ In October the company announced that its production forecast to June 2011 was downgraded from 620,000 to 320,000–360,000 tonnes.
69. The company therefore had to raise funds to meet operational and capital costs in each of its last three years of operation. In February 2010 Pike River announced a \$90 million fundraising initiative. It raised \$10 million from a share placement in April and \$40 million from a rights issue in May. By October 2010 capital raised over the previous three years had increased the number of ordinary shares on issue from 200 million on listing in 2007 to over 405 million.

70. In May 2010 NZOG advanced the company US\$28.9 million (NZ\$41 million) upon the security of a convertible bond. This sum was required to repay a debt owed to a Goldman Sachs entity (Liberty Harbor), after Pike River breached a production covenant contained in the loan agreement. In September NZOG also granted a short-term loan facility of \$25 million to meet a projected cash shortfall. In October Pike River drew down \$13 million.⁵²
71. On 18 November, the day before the explosion, the company was on the brink of raising a further \$70 million capital involving a share placement to ordinary shareholders of \$25 million and to institutional investors of \$45 million, fully underwritten by a major international investment bank. John Dow, chair of the board, considered that this \$70 million would have carried the company through to the third quarter of 2011 when 'we expected to be in fully steady state hydro-mining.'⁵³

NZOG's review of its investment

72. NZOG reviewed its investment in Pike during 2010.⁵⁴ It obtained management and technical reviews of Pike from Behre Dolbear Australasia Pty Ltd (BDA). The reviews contained recommendations, including the need to address equipment matters, tighten reporting and project management, ramp up production and accelerate training programmes. BDA noted that 'the impression (correct or otherwise) is that there does seem to be more of a focus on the market than the project, and there is a lot of effort being expended on presenting the project to the broking community'.⁵⁵
73. David Salisbury, the managing director of NZOG, says that, on 23 August 2010, he and Antony Radford, chairman of NZOG and a director of Pike, told Mr Dow that NZOG had lost confidence in both Pike's chief executive officer, Mr Ward and general manager, Mr Whittall,⁵⁶ but Mr Dow recalled that the criticism as confined to Mr Ward.⁵⁷ On 10 September Mr Ward's resignation was announced. On 13 September Pike's board announced the promotion of Mr Whittall to chief executive officer. Mr Dow commented in the board minutes that 'Pike River had in the past consistently overpromised and under delivered. This time it was important that we did a better job of forecasting the production schedule.'⁵⁸
74. On 23 November 2010, four days after the explosion, the company sought to draw down the remaining \$12 million under the short-term facility; NZOG agreed.⁵⁹ On 8 December Pike River was insolvent and was placed in voluntary receivership.

Challenges faced in 2010

75. The commission considers that Pike River faced several serious challenges during 2010:
- It was operating in an area where, as Dr Elder said, 'the geology, geography and climate of the West Coast [made] all the processes around coal mining, not just the mining extraction process itself, as hard or harder than most other locations in New Zealand and in the world'.⁶⁰
 - Development of the mine had been affected by uncertainty owing to insufficient geological investigation before construction work began. Problems in driving the drift, the collapse of the vent shaft and the discovery of the graben demonstrated the extent of the deficit, which was likely to cause further difficulties.
 - Unsuitable machinery significantly hindered the mine's development, though good progress had been made towards addressing this issue.
 - The mine was in start-up mode, with a recently recruited and inexperienced workforce, and faced retention problems, particularly in relation to those in statutory and management positions.
 - A new main ventilation fan had been installed in an underground location, a first in the coal mining world, and was still being bedded down.
 - Hydro mining had begun, but production was held back by a combination of inexperience, equipment limitations and a methane control problem.

- Delayed production weakened the company's financial situation, resulting in a need to focus on fundraising.
- Its failure to meet targets, increased borrowings and shareholder discontent meant that the company faced significant risks to its reputation and credibility.

76. Together, these issues represented a major challenge to the company. In her evidence, Dr Kathleen Callaghan highlighted many of these same factors and expressed the opinion that 'the information I have seen shows me recurring patterns of causal factors that I know are well established in the literature to increase the likelihood of a process safety event.'⁶¹ The commission agrees with this assessment.

ENDNOTES

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- ⁴ Donald Elder, witness statement, 8 June 2011, SOL306956_1/26, para. 70.
- ⁵ Donald Elder, transcript, p. 20; Jane Newman, witness statement, 30 March 2012, NEW0069/5, para. 11.
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- ⁷ CMS Ltd, Pike River Coal Mine Pre-feasibility Study, 25 May 1995, DAO.012.03289/33,42.
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- ¹⁶ Craig Jones, transcript, p. 461; Department of Conservation, Tier Two Paper, 3 June 2011, DOC0000010001/63–66.
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- ¹⁸ John Dow, witness statement, 9 June 2011, DAO.001.0003/25–26, para. 146.
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- ²⁰ All preceding quotes and figures from Peter Whittall and Gordon Ward: Pike River Coal Company Ltd, Pike River Coal Company Final Mine Plan and Financial Model, 13 July 2005, DAO.012.03499.
- ²¹ Pike River Coal Ltd, AGM Managing Directors Address, 28 November 2008, DAO.009.10795.
- ²² Pike River Coal Ltd, 2009 AGM – Managing Directors Address, 23 November 2009, DAO.008.16781.
- ²³ Map, DAO.004.11082/1.
- ²⁴ New Zealand Oil & Gas Ltd, Paper Phase One, NZOG0067/57, paras 6.97, 6.99.
- ²⁵ The company name was changed from Pike River Coal Company Ltd on 13 March 2006.
- ²⁶ Pike River Coal Ltd, Prospectus, DAO.012.02790/156.
- ²⁷ Ibid., DAO.012.02790/12.
- ²⁸ New Zealand Oil & Gas Ltd, Paper Phase One, NZOG0067/8, para. 2.8.
- ²⁹ John Dow, witness statement, DAO.001.0003/5–20.
- ³⁰ Jonathan (Joe) Edwards, witness statement, 24 May 2011, MCD0001/12, paras 44–45.
- ³¹ Pike chose to put pit bottom in stone so that large excavations could occur in a stable environment: Peter Whittall, transcript, p. 713.
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- ⁴² Pike River Coal Ltd, Annual Review 2010, 22 September 2010, DAO.008.05092/6.
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- ⁵⁰ Pike River Coal Ltd, Prospectus, DAO.012.02790/7.
- ⁵¹ Pike River Coal Ltd, Annual Review 2010, 22 September 2010, DAO.008.05092/12.
- ⁵² David Salisbury, witness statement, 25 May 2011, NZOG0068/24, paras 95, 147, 151.
- ⁵³ John Dow, transcript, pp. 3931–32.

⁵⁴ NZOG remained the cornerstone shareholder, holding 29.37% of the shares.

⁵⁵ Behre Dolbear Australia Pty Ltd, Independent Management Review, 19 May 2010, NZOG0064/7; Behre Dolbear Australia Pty Ltd, Pike River Coal Project – Greymouth, New Zealand: Independent Technical Review, 20 May 2010, INV.03.28442.

⁵⁶ David Salisbury, witness statement, 25 May 2011, NZOG0068/35, para. 137.

⁵⁷ John Dow, witness statement, 21 July 2011, DAO.001.0005/2, para. 5.

⁵⁸ Pike River Coal Ltd, Minutes of a Meeting of Directors, 13 September 2010, DAO.007.05996/9.

⁵⁹ David Salisbury, witness statement, 25 May 2011, NZOG0068/39, para. 158.

⁶⁰ Donald Elder, witness statement, 8 June 2011, SOL306956_1/11, para. 21.1.

⁶¹ Kathleen Callaghan, transcript, p. 3280.



Organisational factors

- + Organisational structure
- + Governance and management
- + The workforce
- + Health and safety management

Organisational structure

1. This chapter briefly describes Pike's organisational structure at the time of the explosion, including some of the changes that occurred to the structure in 2010. Later chapters include more detailed discussion of the roles introduced here.

Board

2. Pike's board was responsible for 'overall corporate governance of the company including the strategic direction, determination of policy, and matters of finance, approval of significant contracts, capital and operating costs, and financial arrangements and investments.'¹ The board had overall responsibility for Pike's risk management and internal control system.

Directors

3. At the time of the explosion the board comprised John Dow (chairman), Raymond Meyer, Stuart Nattrass, Antony Radford, Dipak Agarwalla and Arun Jagatramka. Gordon Ward was an executive director from July 2006 until 1 October 2010. It appears that none of the directors had underground coal mining experience.² Mr Dow's career was in metalliferous mining, Professor Meyer was a mechanical engineer, Mr Radford was the chairman of New Zealand Oil & Gas (NZOG) and Messrs Agarwalla and Jagatramka were nominees of the Indian shareholder companies, both of which were coke producers.

Committees

4. There were three formally constituted board subcommittees: audit; health, safety and environment (HSE); and remuneration. There was also a less formal due diligence committee, meeting only when required, usually during large-scale projects such as capital raisings.
5. The audit committee reviewed and monitored Pike's financial affairs. Its members were Professor Meyer, Mr Nattrass and Mr Radford.
6. The HSE committee was responsible for ensuring Pike provided a safe workplace, monitoring compliance with environmental consents, permits and agreements, and reviewing projects. Its members were Mr Dow and Professor Meyer.³
7. The remuneration committee was to ensure Pike attracted and retained 'the right people' by offering competitive and fair remuneration packages.⁴ Its members were Mr Dow, Professor Meyer and Mr Radford.

Chief executive

8. As at 19 November 2010, Pike's management was led by the chief executive, Peter Whittall, who was based in Wellington. Before his appointment as chief executive at the start of October 2010, Mr Whittall was the general manager mines. Substantively, he had held this role since he was employed in February 2005. As general manager mines, Mr Whittall had reported directly to Mr Ward.⁵
9. Mr Ward was the chief executive from January 2007 to 1 October 2010. In his role as general manager of NZOG, Mr Ward was responsible from 1998 for 'all aspects of the Pike River coal project, taking it through to construction.'⁶

Site general manager

10. Reporting to the chief executive was the site general manager, Douglas White. Mr White originally started at Pike as operations manager in January 2010. As operations manager, he reported to Mr Whittall and had four managers reporting to him: engineering, safety and training, coal preparation plant (CPP) and the underground mine manager. The remaining managers reported directly to Mr Whittall.
11. Around the time Mr Whittall was promoted to chief executive, the management structure at the mine was reorganised and some roles were reviewed.⁷ Mr White became site general manager, which had previously been the general manager mines role, and the operations manager role was disestablished.
12. As site general manager, Mr White was based at the mine and had general responsibility for the mine's operations. Eight managers reported to him: human resources, environment, project and planning, technical services, underground mine operations, engineering, CPP and safety and training. McConnell Dowell Constructors Ltd also reported to Mr White. He understood his responsibilities as including guiding the mine safely through the project phase into development of hydro production.⁸
13. From 12 June 2010, Mr White was the statutory mine manager, which included supervising the health and safety of the underground operation. In the absence of a dedicated ventilation engineer, Mr White also took on overall responsibility for managing the ventilation system.

Underground mine operations

Underground mine manager/production manager

14. Responsibility for underground mine operations was effectively split between Mr White, as the statutory mine manager, and Stephen Ellis, as the production manager. The production manager role was created following the resignation in June 2010 of then underground mine manager, Michael Lerch. The role was initially filled by a temporary appointee and then by Mr Ellis in October 2010.
15. As production manager, Mr Ellis oversaw the operations underground and, in particular, development operations. He was expected to become the statutory mine manager once he obtained a first class coal mine manager's certificate of competence. That occurred in December 2010, with Mr Ellis appointed to an acting role on 24 December 2010 and then later as the permanent statutory mine manager in May 2011.

Underviewers and deputies

16. There were three underviewers (or shift co-ordinators), one for each shift, and a dedicated hydro co-ordinator, who did not hold a coal mine underviewer's certificate of competence. The underviewers and hydro co-ordinator reported directly to Mr White, in his capacity as the statutory mine manager, rather than Mr Ellis, who was at the same level as them.⁹
17. The underviewers were responsible for co-ordinating activities, planning activities, managing employee attendance and issues, ensuring safety systems were implemented and maintained, and carrying out inspections and examinations.¹⁰
18. Responsibility for the hydro monitor crews' activities lay with the hydro co-ordinator who was responsible for overseeing and managing hydro production, including planning activities, ensuring safety systems were implemented and maintained and ensuring hydro production met or exceeded production targets.¹¹
19. Beneath the underviewers were the deputies, with up to three working on each shift. The deputies carried out the inspections, examinations and reporting required by the company and by law and provided supervision and guidance to their crews.¹²

Mining crews

20. The mining crews comprised, in hierarchical order, senior miners, experienced miners, miners and trainee miners.¹³ They operated the mining equipment, including the hydro-mining equipment.

Contractors

21. Pike used a number of contractors to support mining operations underground. They were involved in a range of activities, including shot-firing, in-seam drilling, electrical and mechanical work, pipe-laying and construction. Many of the contractors in the mine had not previously worked in an underground coal mine and were not miners by trade.

Coal preparation plant

22. The CPP cleaned and separated coal from waste product, ready for transport to the coal handling facility near Ikamatua. The plant was managed by Johan Klopper. His staff included a process engineer, crews working shifts similar to the mining crews, and an Ikamatua crew.

Engineering

23. The engineering department was responsible for maintaining commissioned fixed plant in the mine, mobile mining equipment and diesel vehicles. That included gas monitoring sensors, the electrical system, the surface fan and other auxiliary fans. It appears that handover of the equipment in the hydro panel to the engineering department had not occurred before 19 November 2010.
24. Robb Ridl was appointed engineering manager in August 2010. He had initiated a restructure of the engineering department, including the creation of new roles. Under the new structure, Mr Ridl would have had four staff reporting directly to him: an electrical engineer, a mechanical engineer, a maintenance engineer and a maintenance superintendent. Beneath them were a communications engineer, three co-ordinators and a maintenance planner and then shift engineers, with electrical and mechanical technicians below them.

Technical services

25. Technical services was responsible for mine design (including underground ventilation, but not gas monitoring), surface and underground exploration, strata control, scheduling, surveying and geotechnical functions. Gas drainage, which evolved from in-seam drilling for exploration, was also a function of the technical services department.
26. Pieter van Rooyen had been the technical services manager since February 2009, but resigned effective from 3 November 2010. A new technical services manager had been recruited, but was not due to start at Pike until December 2010. In the meantime, the technical services co-ordinator, Gregory Borichevsky, an experienced mining engineer, was the most senior member of the technical services department.
27. Nine staff reported to the technical services manager: a technical services co-ordinator, a mining engineer, two geologists (including a graduate), a geotechnical engineer, three surveyors and a surveyor's assistant. The contractor carrying out in-seam drilling, VLI Drilling Pty Ltd, reported to the geologist.

Project and planning

28. Underground infrastructure projects, such as building, installing and commissioning the hydro monitor and the main fan, were carried out by the project and planning department. The project/planning manager was Terence

Moynihan. The project and planning department also included a project engineer, a commissioning manager, a project supervisor, an electrical design and installation engineer, and a systems engineer. All but one were contractors.¹⁴ Many of the small contractors working at the mine reported to members of the project team.

Safety and training

29. The safety and training department was responsible for developing a health and safety system. Implementation of the system and associated plans were the responsibility of each of the operational departments.¹⁵ The safety and training department was not responsible for ensuring the health and safety of the workforce; each department was responsible for its own health and safety.¹⁶
30. Following a reorganisation in 2010, the training function was removed from the safety and training department and placed with the human resources department. Neville Rockhouse, who had been the safety and training manager, became the safety manager. He was supported by two administrative assistants, one of whom was a contractor.¹⁷
31. Before the reorganisation, Adrian Couchman had reported to Mr Rockhouse as the training and safety co-ordinator. By 19 November 2010, Mr Couchman had moved to the human resources department and his role had narrowed to training co-ordinator. Mr Rockhouse was required to pick up the safety-related duties that Mr Couchman no longer performed.¹⁸

Environment

32. The environmental department was responsible for all aspects of environmental compliance, including resource consents, access arrangements and subsidence. It was concerned primarily with surface operations. The environmental department had a total of seven staff, including the environmental manager, Ivan Liddell.

Human resources

33. Human resources was responsible for recruitment, remuneration, employment relations and, following the reorganisation in 2010, training. Additionally, the other departments were responsible for training their own staff. Richard Knapp was the human resources manager. Two staff reported to him, a training co-ordinator and a human resources adviser.

ENDNOTES

¹ Pike River Coal Ltd, Corporate Governance Manual, 1 June 2009, DAO.037.00002/5.

² John Dow, transcript, pp. 4120–22.

³ Ibid., p. 3901.

⁴ John Dow, witness statement, 23 November 2011, DAO.037.00001/22, para. 83(c).

⁵ Peter Whittall, transcript, pp. 727–28.

⁶ New Zealand Oil & Gas Ltd, Paper Phase One – Context, 25 May 2011, NZOG0067/55, para. 6.88.

⁷ Compare organisational structure at June 2010 (Pike River Coal Ltd, Organisational Chart June 2010, DAO.003.06725/1) and at 19 November 2010 (Pike River Coal Limited Organisation Chart as at 19 November 2010, PW23a/1).

⁸ Douglas White, transcript, p. 1118.

⁹ Pike River Coal Limited Organisation Chart, PW23a/1.

¹⁰ The description of the roles of the underwriters is taken from a 2008 draft company document and may not reflect their day-to-day practice: Pike River Coal Ltd, Roles and Responsibilities: Management Plan (Draft Document), 9 September 2008, DAO.002.00960/42.

¹¹ Pike River Coal Ltd, Pike River Coal Hydro Superintendent Job Role, INV.03.29025/1.

¹² Pike River Coal Ltd, Roles and Responsibilities, DAO.002.00960/50; Stephen Wylie, witness statement, 31 October 2011, WYL0001/4, para. 12.

¹³ Peter Whittall, transcript, p. 725.

¹⁴ Ibid., p. 734.

¹⁵ Neville Rockhouse, transcript, p. 4177.

¹⁶ Ibid., p. 4200.

¹⁷ Neville Rockhouse, transcript, p. 4161; Michelle Gillman, witness statement, 10 November 2011, GIL0001/3, para. 1.

¹⁸ Neville Rockhouse, transcript, pp. 4203–04.

Governance and management

Introduction

1. This chapter considers the governance of Pike by the board of directors and the consequential effects on health and safety at the mine. The chapter also deals briefly with the actions of executive managers. Their actions emerge in more detail in the subsequent chapters, which describe how the mine was managed.

Composition of the board

2. At 30 September 2010 the Pike board comprised John Dow, as chair, and five other non-executive directors, as listed in Chapter 4, 'Organisational structure'.
3. Mr Dow had retired following an international career in the metalliferous mining industry. He became a director of Pike in February 2007 and chairman in May 2007. Work had started on constructing the stone drive into the mine and a share market float was imminent. At the time of the explosion, the board had been looking to replace retiring directors with people who had underground coal mining experience.¹ Mr Dow provided the commission with written and oral evidence.² Antony Radford, a non-executive director, provided written evidence. Gordon Ward, an executive director and chief executive, refused to provide written or oral evidence to the commission but had provided evidence to the joint investigation.³ Mr Ward had been on the board since July 2006 and resigned in September 2010. He moved to Australia where he was effectively beyond the commission's reach.

Executive management

4. For the purpose of its report the commission has found it useful to distinguish between 'executive management' and 'functional management' responsible for specific areas such as engineering or technical services. Executive management comprised the chief executive, the general manager and the operations manager. Those positions were filled at various times by Mr Ward, Peter Whittall and Douglas White, as explained in Chapter 4. Mr Ward and Mr Whittall played major roles in the company. Mr Ward was chief executive from January 2007 to September 2010. In his previous capacity as general manager of New Zealand Oil & Gas Ltd he had been responsible for the Pike River project since 1998. Mr Whittall was general manager from February 2005 until he succeeded Mr Ward in October 2010. Mr White was the operations manager from January 2010 and became general manager in October 2010.

Legal obligations of directors

5. Under the Companies Act 1993, Pike's board of directors was responsible for managing the company's business or affairs, or directing and supervising that management.⁴ Under the health and safety legislation the company, as employer, was required to take all practicable steps to ensure the safety of its workers.⁵ The legislation places no specific duty on individual directors to ensure the safety of workers. Directors may be prosecuted if the company has committed an offence under the legislation but only when they have directed, authorised, assented to, acquiesced in, or participated in the company's failure.⁶

Governance by the board

6. The commission adopts the following definition of governance: 'setting the strategic direction of the company and appointing and monitoring capable management to achieve this.'⁷ The key point is that directors must not only lead but also monitor management and hold it to account.
7. A range of external guidance on good governance practice was available to help the Pike board to govern effectively. Comprehensive guidance on good governance practices was available from the New Zealand Institute of Directors.⁸ This included the need for the board to systematically manage all business risks, to hold management strictly and continuously to account, and to ensure the company complied with regulatory requirements. Best governance practice on health and safety was also available from the UK Health and Safety Executive (the equivalent of the New Zealand Department of Labour).⁹
8. Three Australia/New Zealand Standards guidelines were also available for directors on governance principles, both generally and in respect of health and safety.¹⁰ Governance principles are discussed in more detail in Chapter 28, 'Improving corporate governance', when considering recommendations for the future.

Pike's governance documents

9. The corporate governance manual included the board charter, the charter of the audit committee and the charter¹¹ of the health, safety and environment (HSE) committee.

The board charter

10. The charter described the responsibilities of the board. The 'managing director' was responsible for implementing strategy and managing operations. The board was responsible for 'reviewing and ratifying systems of risk management and internal compliance and control, codes of conduct, and legal compliance'. According to the charter, the board had overall responsibility 'for the company's system of risk management and internal control, and has established procedures designed to provide effective control within the management and reporting structure.'¹²
11. The charter described three committees that oversaw aspects of governance on behalf of the board: the audit committee (essentially financial), the remuneration committee and the HSE committee. The use of such committees is commonplace. The allocation of health and safety oversight to the HSE committee is in line with international thinking on health and safety and follows good governance practice.¹³ The responsibility remains with the board and committees must report back so that other directors can raise questions.¹⁴

The corporate risk management policy

12. The board was responsible for annually approving the risk management policy¹⁵ and monitoring the management of risks in the company.
13. In its corporate governance disclosure statement filed with the New Zealand Stock Exchange in September 2010, the company described its risk management in reassuring terms:

Pike River has developed a framework for risk management and internal compliance and control systems which cover organisational, financial and operational aspects of the company's activities. . .

Management is responsible for designing, implementing and reporting on the adequacy of the company's risk management and internal control system. The board requires that management reports to it on a monthly basis as to whether material business risks are being effectively managed, and to the Audit Committee and the Health, Safety and Environment Committee. . .

The board has a Health, Safety and Environment Committee comprising two non-executive directors with mining and engineering experience... there is a strong safety culture which is fostered by management... detailed compliance programmes operate to ensure the company meets its regulatory obligations.¹⁶

Risk assessment

14. Risk assessment takes a number of forms and typically operates at different levels of a company. The basic concept is to identify risks faced by the company and assess their likelihood of occurring and their consequences if they do occur. To do this, the adequacy of the controls, or defences, intended to reduce likelihood or consequence have to be assessed and additional controls implemented if necessary. Finally, a decision is taken as to whether the risk is acceptable or not, and the risk is then managed. Risk assessment, which starts with the board, is an integral part of modern governance and a continuous process.
15. In Pike's circumstances, one could reasonably expect to see three interacting levels of risk assessment: corporate, mine site and specific proposal. The risk assessments at the corporate level, viewed by the board, should detail the major risks faced across the company, for example in the areas of finance, people and operations. At the mine, the major risks, such as ventilation, would be similarly documented and assessed by executive and middle managers and, depending on importance, would be summarised and included in the corporate-level risk assessment. Risks posed by specific processes or proposals, such as changes to the ventilation system, would be separately assessed at a detailed level by the relevant managers and experts, then summarised and included in the mine site assessment and, if necessary, the corporate assessment.
16. For a high-hazard activity such as underground coal mining, rigorous and continuous risk assessment, and subsequent management, are crucial at all three levels. According to Mr Dow, the board was 'keenly aware' of the risks posed by methane.¹⁷ But the board had no effective framework for ensuring there was a systematic assessment of risk throughout the organisation. The board commissioned no third parties to carry out such an assessment.
17. The corporate risk management policy required an overall risk management committee but this was not established.¹⁸ Mr Dow said Pike instead had committees that individually managed risk in specific areas. One was the HSE committee, which he chaired.

The challenges facing the board and executive management

18. In 2010 the board and executive management faced serious challenges, some of which had been apparent for years. The company had a history of not delivering on its promises. Coal production was years behind schedule and previous estimates of production capacity had to be severely reduced. Lack of revenue was driving the company to seek further funding. There were major problems with the advent of hydro mining, the company's main production method.
19. It appears that no one on the board had experience in the local underground coal mining industry. The business was new, with the mine still under development, as were its systems, including health and safety.
20. There was a rapid turnover of statutory mine managers and middle managers. Many workers were inexperienced. Morale and absenteeism were of concern. The company relied heavily on contractors and consultants. It had purchased equipment unsuitable for the difficult strata conditions encountered. Some key equipment and systems were unproven when production began. There was no suitable second egress for use by workers in an emergency.

Board meetings

21. The board met monthly, sometimes at the mine. The chief executive normally attended. Included in the monthly board papers was an operations report from the mine site, part of which was devoted to health and safety. Mr

Dow considered that 'quite a significant amount of the report focuses on the safety aspects of it and the board was getting quite a lot of good information'.¹⁹

22. The statistical information provided to the board on health and safety comprised mainly personal injury rates and time lost through accidents. Mr Dow was comfortable with the information provided to the board.²⁰ The information gave the board some insight but was not much help in assessing the risks of a catastrophic event faced by high-hazard industries. Pike had not developed more comprehensive measures which would have enabled the board and executive managers to measure what was being done to prevent catastrophes, such as the analysis of high-potential incidents (near misses which could have caused serious harm) and the steps taken to prevent their recurrence. The board appears to have received no information proving the effectiveness of crucial systems such as gas monitoring and ventilation. The nearest the board came to questioning management on such issues appears to have been on 15 November 2010, when the general manager, Mr White, attended his first board meeting and was questioned about safety systems.²¹
23. In describing his approach to governance, Mr Dow compared the difference between governance and management to the difference between 'church and state'.²² The commission does not accept the analogy. Management operated under delegation from the board. Good governance required the board to hold management strictly and continuously to account.

Meetings of the board's health, safety and environment committee

Composition, mandate and meetings

24. The HSE committee, which was to report to the board, consisted of Mr Dow as chair and another director, Professor Raymond Meyer. According to its charter, the committee was to assess management's effectiveness in providing leadership in health, safety and environment matters; review with management the company's strategy and performance in these areas, 'including receiving reports on any significant incidents and measures arising from them to avoid future incidents'; consider and review the identification and management of health, safety and environmental risks as part of the company's overall risk management system; and 'monitor compliance with legal and statutory obligations'.²³
25. The HSE committee was to meet every six months but by the time of the explosion it had not met for 13 months, with the exception of the board meeting of 15 November when it questioned the general manager on health and safety. Mr Dow said that this was because the board as a whole was taking more interest in health and safety.²⁴ No meetings of the HSE committee had been scheduled for 2011, in contrast to meetings of the board.²⁵

Obtaining information

26. In Mr Dow's view, health and safety were the responsibility of the health and safety manager,²⁶ who had charge of the corporate safety management plan, and the mine manager. The health and safety manager presented information to the committee when it visited the mine. Mr Dow did not consider the committee needed to obtain information from other managers.²⁷ If they wished to raise concerns with him they had the opportunity to do so, for example at company dinners or barbecues.²⁸ Mr Dow considered that neither the board nor the committee felt it necessary to obtain further information or seek independent advice on health and safety. The HSE committee recommended that third-party audits of the safety management systems should be done but did not require this when senior management considered they should be deferred until the systems had been bedded down.²⁹

Warning signals

27. In 2010 there were obvious warning signals that things were amiss. These included two third-party reviews that an alert chair and board would have found very revealing. The first review was a comprehensive risk survey by Hawcroft

Consulting International, commissioned by Pike's insurers. The second was a review of legislative compliance conducted by Minserv International Ltd (Minserv).

The Hawcroft risk survey 2010

28. Hawcroft is a specialist risk assessor for the insurance industry, carrying out over 150 insurance risk surveys annually at over 150 mining/processing operations around the world. Their risk survey at Pike covered underground, coal processing and surface operations.
29. In its 2010 report on Pike, Hawcroft repeated its 2009 recommendations that a 'broad-brush' risk assessment of the operation was needed, in order to develop a risk register and determine core hazards.³⁰ The report also identified that a number of specific risk assessments were outstanding on such vital matters as windblast, gas ventilation and hydro mining. Hawcroft rated the risk of a methane gas explosion as 'possible'. The Hawcroft review also commented on the need for timely and effective action on incident reports.
30. Mr Dow said that although the board was aware of the review, he had not read the report and the board had neither considered it nor been briefed on it.³¹ Mr Dow considered the matters raised would be appropriately dealt with by management at the mine.³² The Hawcroft report was not, in his view, something that would normally come to the board or its HSE committee.³³
31. Mr Dow added that the site managers were responsible for bringing the issues they considered important to the board's attention. These people were very competent and the board had every confidence in them.³⁴ There were plenty of opportunities for site managers to bring safety concerns to his attention in both formal and informal situations,³⁵ and he was surprised that they had not done so.

The Minserv legislative compliance audit 2010

32. In the course of eight visits to the mine between February and April 2010, David Stewart, an experienced mining consultant and principal of Minserv, conducted a legislative compliance audit.³⁶
33. In August 2009 Mr Dow had been approached by a professional colleague who expressed concern about aspects of the Pike River mine, including training and culture. Mr Dow discussed this with Mr Stewart. Mr Stewart said that Mr Dow was concerned about the turnover of senior managers, difficulties in recruiting good managers, morale and the failures to meet production targets.
34. Mr Stewart told Mr Dow that the management team needed help from someone entirely familiar with New Zealand regulations and conditions, and the starting point should be a legislative compliance audit.³⁷ Mr Dow referred Mr Stewart to Mr Whittall.
35. Mr Stewart's review identified serious problems with safety critical systems.³⁸ Among these he noted that:
 - the instrumentation of the main fan was not compliant with regulations;
 - there was no remote gas monitoring systems in the mine connected to the control room;
 - the ventilation structures (stoppings and doors) were inadequate and training on construction was needed;
 - the stoppings needed protection from blast damage caused by shot-firing;
 - there was a lack of information about ventilation air flow;
 - there were obstructions and debris in the main returns leading to the Alimak ventilation shaft;
 - there were no stone dust barriers;
 - the ventilation shaft was impractical as a second egress;
 - intershift reports by mine deputies were inadequate; and

- the methane gas drainage line alongside the main access road in Spaghetti Junction was at risk of damage by mobile equipment.
36. Mr Dow did not ask for Mr Stewart's reports. He did not require the board or the HSE committee to be briefed on them. He told the commission: 'Mr Stewart was engaged to help the management team deal with the issues. He was engaged by them, the reports went to them. I didn't consider that it was necessary for them to come to me as well and Mr Stewart testified that he didn't expect them to come to me either. I had a subsequent oral conversation with him to ask how it had gone.'³⁹ There does not appear to have been a comprehensive management response to all the issues raised in Mr Stewart's reports. The health and safety manager, Neville Rockhouse, did not see them.⁴⁰

Serious incidents at the mine

37. Mr Dow was asked to comment on a range of high-potential incidents at the mine in the month or so before the disaster.⁴¹ A sample of these was summarised in schedules prepared by the commission.⁴² Although Mr Dow was referred to only a few incidents, these were enough to show that over a five-day period in October 2010 there were six occasions when methane was over 5% of the air. Mr Dow viewed these as 'a series of operational incidents that are very much the prerogative of the onsite management team ... In due course I would expect the board to have been advised at its next meeting.'⁴³
38. Mr Dow was then referred to a number of earlier incidents, including one on 23 June 2010 that concerned dangerous recirculation of air. A mine deputy had attributed this to inadequate ventilation, inadequate leadership and supervision, inadequate engineering, inadequate maintenance, safety rules not enforced and poor stoppings. When Mr Dow was asked, 'Would the committee not have wanted to verify for itself whether those matters had been remedied or not?', he answered, 'No, as I've said on a number of occasions these are operational issues on site ... it's a management issue to follow up.'⁴⁴
39. Mr Dow accepted that the schedules presented to him showed many high-potential incidents were not reported to the board. But he did not accept that the systems were not working and said he was comfortable with the reporting.⁴⁵

Challenges facing executive management in 2010

40. The challenges faced by the executive management, and how they handled those challenges, are described in some detail in Chapters 7 to 12, but some general comments are made now. Although they are described in mining industry terms, the issues also relate to the generic management problems faced in other enterprises – strategy, planning, risks, systems, information and people.
41. Executive managers had to translate the board's strategic direction into operational plans but had difficulty in preparing a comprehensive, long-term operational plan because of continual changes in the mine design and production schedules.⁴⁶
42. Executive managers, like the board, focused on production and earning revenue. As noted in paragraphs 14 to 17 of this chapter, risk management was undeveloped at Pike. The risk of catastrophe was not identified by executive management and was not reported to the board. The warnings in the Hawcroft reports that risk management needed improvement were not heeded. Similarly, there was no comprehensive response to the Minserv legislative compliance audit. A number of other reports from consultants on safety critical issues, such as methane management and ventilation,⁴⁷ were not properly addressed by the time of the tragedy.
43. The mine's health and safety management systems, including vital systems such as ventilation management, methane drainage, gas monitoring and hydro mining, were still under development at 19 November 2010, as discussed in Chapters 7 to 12.

44. The management information systems were also undeveloped and vital information was not brought together, summarised and analysed for executive managers. For example, as is clear in Chapter 7, 'Health and safety management', key information on health and safety incidents in the mine was available but was not handled systematically and so did not result in a comprehensive response.

Conclusions

45. The board's focus on meeting production targets set the tone for executive managers and their subordinates. The board needed to satisfy itself that executive managers were ensuring that its workers were being protected. After all, the company was operating in a high-hazard industry. The board needed to have a company-wide risk framework and keep its eye firmly on health and safety risks. It should have ensured that good risk assessment processes were operating throughout the company. An alert board would have ensured that these things had been done and done properly. It would have familiarised itself with good health and safety management systems. It would have regularly commissioned independent audit and advice. It would have held management strictly and continuously to account.
46. Mr Dow's general attitude was that things were under control, unless told otherwise. This was not in accordance with the good governance responsibilities. Coupled with the approach taken by executive managers, this attitude exposed the workers at Pike River to health and safety risks.
47. Focused on production targets, the executive management pressed ahead when health and safety systems and risk assessment processes were inadequate. Because it did not follow good management principles and industry best practice, Pike's workers were exposed to health and safety risks.

The future

48. In Chapter 28, 'Improving corporate governance', and Chapter 29, 'Improving management leadership', the commission discusses governance and executive management more generally, identifies the lessons that the Pike River tragedy holds for directors and executive managers in high-hazard industries, and makes recommendations for the future.

ENDNOTES

¹ John Dow, transcript, p. 3900.

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³ Gordon Ward, Police/DOL interview, 29 September 2011, INV.03.28891.

⁴ Companies Act 1993, s 128.

⁵ Health and Safety in Employment Act 1992, s 6.

⁶ Ibid., s 56.

⁷ David Walker, A Review of Corporate Governance in UK Banks and Other Financial Industry Entities, 26 November 2009, p. 23, http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/d/walker_consultation_261109.pdf

⁸ Institute of Directors in New Zealand, Principles of Best Practice for New Zealand Directors: The Four Pillars of Board Governance, 2010, <https://www.iod.org.nz/Publications/TheFourPillarsOfGovernanceBestPractice.aspx>

⁹ Institute of Directors and Health and Safety Executive, Leading Health and Safety at Work: Leadership Actions for Directors and Board Members, October 2007, <http://www.hse.gov.uk/pubns/indg417.pdf>

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and Supporting Techniques, (AS/NZS 4804:2001), 15 November 2001;

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¹² Ibid., DAO.037.00002/5.

¹³ Health and Safety Executive (UK), Leading Health and Safety at Work, October 2007, <http://www.hse.gov.uk>

¹⁴ Securities Commission New Zealand, Corporate Governance in New Zealand Principles and Guidelines: A Handbook for Directors, Executives, and Advisors, March 2004, p. 13, <http://www.fma.govt.nz/media/178375/corporate-governance-handbook.pdf>

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¹⁸ Ibid., p. 4000.

¹⁹ Ibid., p. 3905.

²⁰ Ibid., p. 4031.

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- ²² John Dow, transcript, p. 3991.
- ²³ Pike River Coal Ltd, Corporate Governance Manual, 1 June 2009, DAO.037.00002/30.
- ²⁴ John Dow, transcript, p. 4012.
- ²⁵ Ibid., p. 3956.
- ²⁶ Ibid., p. 3984.
- ²⁷ Ibid., p. 3993.
- ²⁸ Ibid., p. 4080.
- ²⁹ Ibid., pp. 3947, 3992.
- ³⁰ Hawcroft Consulting International, Pike River Coal Limited, Pike River Mine – Risk Survey – Underground, CPP & Surface Operations: Final Report, July 2010, DAO.003.08710.
- ³¹ John Dow, transcript, p. 4005.
- ³² Ibid., p. 3983.
- ³³ Ibid., p. 3989.
- ³⁴ Ibid., p. 3984.
- ³⁵ Ibid., p. 3922.
- ³⁶ David Stewart, Pike River Compliance Audit – Ventilation, 11 February 2010, STE0004.
- ³⁷ David Stewart, transcript, p. 3324; John Dow, transcript, p. 3927.
- ³⁸ David Stewart, transcript, pp. 3326–34.
- ³⁹ John Dow, transcript, p. 4007.
- ⁴⁰ Neville Rockhouse, transcript, p. 4251.
- ⁴¹ John Dow, transcript, p. 4034.
- ⁴² For example: Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of Pike River Coal Limited Deputy Statutory Reports for March and October 2010, November 2011, CAC0115/15–17; Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, November 2011, CAC0114/10–30.
- ⁴³ John Dow, transcript, pp. 4035–36.
- ⁴⁴ Ibid., pp. 4037–38.
- ⁴⁵ Ibid., pp. 4040–41.
- ⁴⁶ Petrus (Pieter) van Rooyen, transcript, pp. 5181–83; Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/54–55, paras 320–24.
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Introduction

1. The labour market for mine workers is global, and demand for skilled and experienced workers is high. Many mines face shortages of experienced staff and therefore need to recruit new entrants to the industry. Their training and supervision are critical.
2. Training is a significant defence against major mining hazards: an inexperienced workforce is less likely to appreciate inherent risks and know how to mitigate them safely. Training requires a strong focus on health and safety and the teaching of safe practical mining skills. Quality ongoing supervision and mentoring are essential, as is supervisor training.
3. At the time of the explosion Pike employed 174 staff.¹ Several contractors also had their own staff and subcontractors onsite. Many members of this combined workforce were inexperienced in the hazards of underground coal mining.

Workforce problems

4. In 2009 and 2010 Pike faced a number of problems with its workforce, at a time of significant change for the company and when pressure for coal production was increasing daily.

High turnover of staff

5. Pike had a high turnover of miners underground,² and was unable to retain personnel in many key operational management roles.
6. As shown in Figure 6.1, from the time the mine was classified as a gassy coal mine in November 2008, Pike had six mine managers, two technical services managers and three engineering managers. In 2010 the mine had two production managers.
7. The high management turnover 'compromised [Pike's] functioning and continuity',³ owing to inefficiencies, loss of institutional knowledge and the need for employees to adjust to differing management styles. There was no systematic handover process when staff changed; the exception was Pieter van Rooyen's handover when he left Pike in November 2010.⁴

Problems in attracting and retaining experienced staff

8. Lack of experience was a significant problem at Pike. As at November 2010 three key operational specialists in the technical services department, and the data and communication systems specialist, had no prior experience working in gassy underground coal mines.⁵
9. On occasion, Pike hired, for specialised roles, individuals who required intensive on-the-job learning amid the pressure for coal production. An example is the hydro co-ordinator who had no previous hydro-mining experience and had made that clear when interviewed for the position. He was promised training and support and was confident he could up-skill. But he received no formal training and was 'a little out of my depth because of my lack of knowledge of the hydro-machinery and equipment'.⁶ Other applicants with operational hydro-mining experience at West Coast mines applied for the role but were unsuccessful.⁷
10. It was also a 'struggle to obtain tradesmen with mining experience',⁸ and Pike sometimes had to rely on contract tradesmen from Australia.

Underviewers and deputies

11. Pike had an ongoing shortage of underviewers and deputies, which occasionally led to those on shift covering multiple roles.¹⁰ Among other problems, the shortage caused a delay in the training of the person identified as suitable to fill the role of ventilation officer, as the resignation of another underviewer left the mine short staffed at that level. Moving to a 24-hour production cycle in the hydro panel in October 2010, incorporating two 12-hour shifts, also meant that Pike could not have a deputy dedicated full time to the hydro production panel,¹¹ and there was no underviewer responsible for hydro mining.¹²

Percentage of cleanskins

12. Cleanskins are workers with little or no underground mining experience. The prominence of cleanskins within Pike's workforce was described as 'the nature of the modern industry'.¹³
13. There is no set or absolute ratio of experienced to inexperienced miners, but Neville Rockhouse estimated that 40 to 50% of workers at Pike were working in their first underground mine.¹⁴ To David Reece, an expert engaged by the Department of Labour (DOL), that level is a concerning 'sad reality' faced by the industry.¹⁵ Experienced mining consultant David Stewart from Minserv International Ltd (Minserv) considered that the ratio at Pike was not favourable and there were too few experienced miners given the nature of the operation and the conditions,¹⁶ which made it 'very difficult for [Pike] to maintain consistency and development and performance as so much of the work and skills were left to the experienced few'.¹⁷
14. The result of a high ratio of inexperienced miners is either reduced productivity or a lack of time for the experienced miners to 'actually teach and ... mentor all those people in the crews with them',¹⁸ as 'you can't easily do both'.¹⁹ Trainer/assessor George Colligan considered that the ratio at Pike was 'way [too] low' and slowed down the machinery certification process as experienced miners were required to supervise trainees.²⁰
15. Some of the experienced miners working underground had real concerns:

*I have got to admit I've found it very hard here with the young men. They seem to have too much self-confidence, too quick. They've been underground maybe six months and they are a miner. But they can't have in those six months appreciated the dangers down there. ... Some of these young men have called me some serious names while I've been here ... I said, 'Look, I don't care. I've been in this game all my life and I'm not going to die here just because you don't understand where you are working.' And that's why I jacked it in.*²¹
16. Pike recognised the ratio of cleanskins 'was starting to get out of whack' after it employed all the new trainees who completed its second intake of the three-month trainee induction programme, discussed in paragraph 44. Pike decided not to run a third intake for some time.²²

Absenteeism

17. The experience ratio was not assisted by absenteeism. The difficult working conditions underground (the cold, wet environment and steep grades), frustrations with underperforming equipment and low morale were no doubt contributing factors.²³
18. Reginald Matthews, a trainer/assessor at Pike in 2009 and 2010, described the level of absenteeism as 'very high': 'It was almost as if staff took the view that if you could get away with it, and there were no "consequences", then why not do it'.²⁴
19. Adrian Couchman considered that while 'on paper' the ratios per shift were correct, on many occasions experienced staff would be absent but the shift would proceed with trainees under the supervision of the shift deputy.²⁵ The level of absenteeism sometimes had a direct effect on development²⁶ and Pike issued warnings and terminated some employees for absenteeism through 2009 and 2010.²⁷
20. In July 2010 the hydro-mining start-up bonus discussed in Chapter 12, 'Hydro mining', was instituted, although the cause of the absenteeism problem was not clear to the board.²⁸ The bonus was reduced by \$200 for each non-attendance, defined as every day or shift on which an employee was rostered but did not work for any reason,

including sickness or lateness.²⁹ By November 2010, Pike considered that the bonus scheme had led to a 'reduction in sick leave usage'.³⁰

Diverse nationalities

21. Pike employed a diverse workforce. Mr Stewart's impression was that this diversity created a separation:³¹

*The workforce was further complicated by the mix of New Zealanders, Australians and South Africans scattered through all levels. In many operations this can be an advantage, but at PRC mine it appeared to add to the apparent dysfunctional nature of the organisation and communication within the mine and between underground and surface.*³²
22. As well as difficulties with communication and managerial styles, the diversity also meant a lack of consistency in approach and style to decision-making and in operational planning and implementation. At management level there was a notable lack of local mining experience in the West Coast's unique conditions,³³ and many of the overseas staff were used to operating under and complying with much more prescriptive mining regulations than existed in New Zealand.
23. Neville Rockhouse considered that the integration of diverse backgrounds of Pike's staff and contractors was also 'not an ideal situation for generating effective health and safety in the mine' and led to differing levels of understanding of health and safety documents, including risk assessments, job safety and environmental analyses (JSEAs) and safe operating procedures (SOPs).³⁴
24. In 2007 Pike had recognised that 'cultural diversity will certainly become an issue' as the company expanded,³⁵ and proposed training for the management team and employees. This had not occurred before the explosion.

Training at Pike

Obligations to workers

25. Under the Health and Safety in Employment Act 1992 (HSE Act) Pike was required to take all practicable steps to ensure that every employee had adequate supervision and training to work underground.³⁶

Industry qualifications

26. The mining industry in New Zealand has largely determined its workforce skill standards through the work of the Extractive Industry Training Organisation (EXITO). EXITO has set the curriculum and assessment requirements for regulated roles in mines, and worked with employers to develop national qualifications for the mining industry. DOL, as the regulator, has not been involved.
27. There are 24 extractives industry qualifications (national diplomas and certificates) available in New Zealand,³⁷ including several specific to the coal industry, all with a strong focus on health and safety in the workplace. All EXITO's national qualifications are made up of unit standards that set out short statements of what people need to know or be able to do to show that they are competent in a particular skill area.³⁸
28. People carrying out specific roles, including first class coal mine manager, coal mine underviewer and coal mine deputy, must have certificates of competence (COCs), also known as tickets, permits or licences. These are different from EXITO qualifications but are obtained by completing some of the same unit standards, together with relevant experience. DOL delegated authority to EXITO to issue COCs.

Recognition of overseas certificates of competence

29. The necessity to fill statutory positions with overseas workers led Pike to push for the development, through Tai Poutini Polytechnic and EXITO, of an industry programme known as professional conversation.
30. To qualify in New Zealand under this programme, workers holding COCs from other countries must obtain a

New Zealand gas ticket, complete New Zealand Qualifications Authority (NZQA) unit standard 7142 on legislative requirements,³⁹ and then appear before a panel comprising an educator, an EXITO moderator and an industry expert. The panel assesses each applicant to determine whether any further training is required before a New Zealand COC is issued.⁴⁰ Pike used this programme successfully for several of its overseas staff.

31. In 2009 an automatic process was established, under Part 3 of the Trans-Tasman Mutual Recognition Act 1997, allowing workers holding an Australian COC to obtain the New Zealand equivalent without further training, other than gaining their New Zealand gas ticket. Under this process applicants are not required to complete NZQA unit standard 7142, as long as the mine manager is satisfied that they understand New Zealand's mining legislation,⁴¹ a requirement met by Pike by its site induction or specific onsite training.⁴²
32. Peter Whittall was instrumental in establishing this process, suggesting to EXITO that those holding a COC from New South Wales or Queensland should not have to undergo the subjective professional conversation programme when the qualifications were mutually recognised.⁴³ EXITO and DOL eventually agreed. This means that no professional conversation is required,⁴⁴ and there is no objective assessment of an applicant's knowledge of New Zealand legislation.
33. Not everyone agrees with this approach. It is generally accepted in the industry that Australian mining qualifications are of a higher standard than their New Zealand equivalents and are more difficult to achieve,⁴⁵ yet the mutual recognition process also allows New Zealand COC holders to automatically qualify in Australia with limited further training required. This process leads to a perception that New Zealand can be a 'back door' way for Australian miners to more easily obtain their COCs.⁴⁶
34. Alignment of training and qualification standards with Australia and involvement of the regulator are discussed further in Chapter 31, 'Qualifications, training and competence'.

Resourcing of training

35. Organisation of formal training at Pike was the responsibility of the safety and training department. From 2007 Pike outsourced several aspects of its workforce training, including to Tai Poutini Polytechnic. But by late 2010 the increase in Pike's workforce meant those involved in health, safety and training had been overworked and under resourced for some time.⁴⁷
36. Mr Couchman was employed in September 2008 as the training co-ordinator, reporting to Mr Rockhouse. He developed and managed staff induction and training programmes, and had a secondary safety role that included issuing personal protection equipment to miners, underground audits of safety equipment, maintenance of the incident/accident reporting system and random drug and alcohol testing. He also chaired the workforce health and safety committee. Mr Couchman had no previous mining experience and arranged to outsource some of the technical training.
37. From June 2009 to May 2010 Reginald Matthews, a workplace trainer/assessor with over 30 years' mining industry experience, was contracted by Tai Poutini and based at Pike to conduct training and assessments on mobile machinery, and surface and underground safety audits.⁴⁸ He was joined in November 2009 by George Colligan, another experienced miner and trainer/assessor with more than three decades of industry experience.⁴⁹ Together, they were responsible for training and assessing everyone at Pike, including contractors, on their competencies on the mine's machinery and equipment. Messrs Matthews and Colligan established a database or skills matrix that recorded and updated every individual crew member's skill level and certified competencies.⁵⁰
38. After Mr Matthews left Pike, Mr Colligan became the sole trainer/assessor at the mine. Pike was employing more staff and commissioning more plant and equipment, leaving him 'run of [sic] my feet' trying to keep up with the workload.⁵¹ Mr Colligan had either trained or assessed 28 of the 29 men who died in the mine on 19 November 2010 in various roles and on different mining equipment and plant,⁵² and was confident that each had reached their respective certified skill levels and competencies in accordance with Pike's processes and procedures.⁵³
39. From July 2008 the safety and training department also had a part-time contractor, Michelle Gillman, who assisted Mr Rockhouse in controlling the safety management documents and planning safety materials.⁵⁴ Mr Rockhouse

campaigned for more staff and was given some administrative support,⁵⁵ but after restructuring in September 2010 Mr Couchman ceased his safety role and moved into the human resources department as the training officer.⁵⁶ Neither Mr Couchman nor Mr Rockhouse considered the restructuring a positive move, and other commitments left Mr Rockhouse little time to conduct safety audits underground after Mr Couchman was transferred.⁵⁷

Training of workers

Recognition of training needs

40. Pike's response to the difficulty in attracting and retaining experienced staff was to recruit 'suitable local people and to give them appropriate training'.⁵⁸ The company recognised that this meant a need for quality industry-based training, so it developed a number of training programmes from a basic induction through to specialised training for departmental staff.
41. For all its training programmes Pike used a consistent principle that 'three bodies of evidence of competency' were required: attendance at a training course, completion of a written assessment and an assessor's sign-off confirming competency.⁵⁹ Initially, each employee had performance appraisals when their individual training needs were identified by the head of department and signed off by the mine manager.⁶⁰ However, performance appraisals were 'overlooked' from mid- to late 2009, and Mr Rockhouse only had time to do 'a couple' of safety contacts (performance checks of staff underground) in 2010.⁶¹

Basic induction

42. Everyone working or visiting underground was first required to attend Pike's basic classroom-based induction training, which had up to four levels, depending on where an inductee would be working. Underground workers had to complete a 'level 2 – general surface induction' and 'level 3 – underground induction', which together took about two hours and introduced the mine site, covered rules for working on the surface and underground, and included instruction on emergency procedures.⁶² New employees had a more in-depth induction that initially took up to two and a half weeks, but was shortened to a week when employee numbers increased.⁶³ However, on occasion contractors were found working underground with no induction.⁶⁴
43. Every person working underground at Pike also had to pass a medical examination and complete the New Zealand NZQA unit standard 7146.⁶⁵ This two-day course, delivered offsite by the Mines Rescue Service (MRS), required participants to describe and demonstrate the basic skills necessary for working in an underground mine.⁶⁶

Trainee induction programme

44. In 2009, in partnership with Tai Poutini Polytechnic, Pike developed a 12-week trainee induction programme designed for people new to the mining industry. The programme, based on NZQA unit standards, involved an initial two-week induction course at Pike, which included an underground tour and a walk out of the mine, then four weeks offsite completing training from the MRS and experienced consultant trainers. There was a further six weeks onsite at Pike when they were assigned to a crew, rotating around shifts. During that period trainees would work two to three shifts per week under supervision, and spend two days offsite on further theoretical and practical study.⁶⁷
45. At the end of the programme, trainees completed a set of unit standards which gained them a Level 2 National Certificate in Extractive Industries (Introductory Skills). Then, if considered suitable, a trainee would be offered a job at Pike and, after one year underground as a trainee miner, could apply for miner status.
46. This trainee induction programme was described as 'ground breaking and extremely comprehensive', and the polytechnic received positive feedback from Pike management, experienced miners and the trainees themselves.⁶⁸
47. Two intakes were run before November 2010 and 11 trainees completed the programme in each intake, and were offered employment at Pike.⁶⁹

Continuing workforce training in 2010

48. Management appreciated that targeted ongoing training was necessary for its workforce, and made efforts to address training gaps when they were identified. Sources of information on training requirements included the statutory reports, incident/accident reports and the *I Am Safe* booklets completed by workers.
49. The trainer/assessors frequently found 'non-trained or non-competent' people operating machinery underground, and provided specialised training to workers and licensed them for the operation of equipment and machinery.⁷⁰ Shortly after his arrival at Pike, Douglas White brought in a consultant to audit Pike's training packages against the equivalent NZQA unit standards. Mr Couchman had begun to update some of the training packages for mine machinery by the time of the explosion, but it was a time-consuming process.⁷²
50. Pike's engineering department had developed a reputation for isolating itself and not being involved with the safety and training department's objectives and requirements. This changed when engineering manager Robb Ridl was appointed in mid-2010, and Mr Couchman was put in charge of engineering training. Specialist training programmes were designed, a specialist consultant was engaged to provide the training and sessions had begun before the explosion.⁷³
51. In April 2010 Mr White made changes to the shift roster system that meant day and afternoon shifts were shortened and overlapped to allow continuous production and daily one-hour training sessions at the beginning of the afternoon shift. These sessions covered SOPs, where available, supplemented by each department delivering training modules on chosen subjects. Friday was also a designated training day for crews not in production, which usually coincided with a maintenance day for one of the development machines. This session was designed for more advanced or detailed training on specific topics.⁷⁴
52. Mr White also initiated refresher training to be delivered within the Friday training session, targeting miners who had not had any follow-up training for some time. This session was designed to review policies and procedures, and to refresh staff knowledge in such areas as ventilation, use of self-rescuers and first aid training. Outside trainers were often brought in, and in September 2010 Mr Couchman arranged through the polytechnic for Harry Bell, a highly regarded and experienced West Coast miner, to conduct eight of these Friday refresher sessions on gas and ventilation management.⁷⁵
53. However non-attendance at the Friday training sessions had increased throughout the year. On one occasion underwriters told Mr Couchman that they could not afford to release staff for training because they did not have enough staff on shift to continue production. By October and November attendance had fallen so significantly that Mr Bell's training was postponed after only two sessions, and Friday training was cancelled for the rest of the year.⁷⁶ Human resources manager Richard Knapp reported the reasons to the management meeting on 10 November 2010:

The issue of Friday training being poorly attended has led to the decision to cancel the Friday training for the rest of this year (we also need the production). The reasons behind this are that it is costing the training budget over \$1000 per session to arrange this and when only 2 underground staff turn up to one session and on another occasion nobody turned up at all means that it is not good value for money to continue. This has been an ongoing issue and [sic] has been a struggle to get shift managers to release staff to participate in this process from the beginning.⁷⁷

Some training issues

54. Despite Pike's efforts, there were some gaps in the training programme and some worker behaviour underground revealed training failures.

Training gaps

55. The responsibilities of control room operators had become progressively more demanding as the mine developed but they had received only limited formal training. There had been no formal training on gas monitoring using the Safegas and SCADA programmes, with the exception of specific training from Mr White on a system he had put in

place for monitoring carbon monoxide levels.⁷⁸ After a meeting with the operators, management had agreed to provide more training but this had not occurred before the explosion.⁷⁹

56. Specific training was given to the first hydro-mining crew who worked five days a week commissioning the hydro monitor and equipment in September 2010. When Pike moved to a 24-hour four-crew operation there was limited time to train the new crews. Stephen Wylie, a deputy assigned to one of the hydro crews, had some hydro-mining experience from Spring Creek but asked for training on Pike's set-up. None was given, which 'made it difficult, like especially since I was a supervisor on the panel'.⁸⁰
57. There was also insufficient training in emergency preparedness at Pike. As discussed in Chapter 16, 'Search, rescue and recovery', training on the use of self-rescuers was inadequate. Many of the workers at the mine in November 2010 had not been involved in a mock underground evacuation, the last one having taken place in October 2009. There had been no training to test the practical implementation of the mine's emergency response management plan, which had not been reviewed since February 2009.⁸¹

Lack of leadership training for supervisors underground

58. There was no mentoring system for trainee miners once they were employed,⁸² other than being assigned to a deputy or to an experienced miner. But deputies or leading hands were not given any specialised training in how to supervise, mentor and train the trainees.⁸³ At Mr White's request, Mr Stewart had provided some informal mentoring of the underviewers and deputies during his compliance audits, accompanying them underground for a shift and providing feedback and guidance,⁸⁴ but this had not continued after April 2010. Pike was working towards having a qualified workplace trainer/assessor on each shift to run the trainees, but this was not in place by November 2010.⁸⁵
59. Comments made to Mr Couchman in November 2010 by some of the second intake of trainees indicated that the safety approach taught in the classroom was not always evident underground.⁸⁶ This concerned Mr White, who considered there was a 'direct leadership issue, especially with our senior miners and deputies'.⁸⁷ He discussed engaging a consultant to help improve supervision underground, but a proposal from an Australian consultant was declined on 18 November 2010 to give Stephen Ellis, the production manager, an opportunity to 'right things himself'.⁸⁸

Contraband

60. Contraband incidents were reported and tool box talk safety advisory and newsflash notices were circulated throughout the Pike workforce.⁸⁹ Random searches for contraband began in late 2009,⁹⁰ and occurred frequently throughout 2010.⁹¹ A process for searches was included in the mine manager's rules.⁹² Contraband was also addressed in the NZQA unit standard training and in Pike's induction and in-house training, and Pike had signs around the site and at the portal entrance reminding of the prohibitions underground.⁹³ Although there are no completed incident/accident forms regarding contraband after April 2010, statements obtained from workers during the joint investigation suggested that the problem of workers taking contraband underground, intentionally or otherwise, continued.⁹⁴

Bypassing safety systems

61. Analysis of the incident/accident reports exposed incidents of deliberate bypassing of safety systems and tampering with safety locks or covers, rendering them inoperable.⁹⁵ As discussed in Chapter 12, 'Hydro mining', a worker admitted briefly taping a plastic bag over a methane monitor on the morning shift on 19 November 2010.⁹⁶

Unsafe ventilation practices

62. The commission received evidence of a number of incidents involving unsafe ventilation practices, including incidents where air was diverted away from a working face without workers being given prior notice,⁹⁷ where the ventilation had been shut down for over 40 minutes while maintenance work on machines underground continued and workers were overcome by fumes from machinery,⁹⁸ and where inexperienced workers showed a lack of regard for basic ventilation and gas practices and the need for set procedures.⁹⁹ These were the types of practices that Mr Bell had been hired to deal with before his training sessions were cancelled.

Contractor problems

Introduction

63. Under the HSE Act, Pike was required to take all practicable steps to ensure that no employee, contractor or subcontractor was harmed while working, and that no hazard in its workplace harmed people in the vicinity.¹⁰⁰ Pike had a contractor management system, but it was not fully implemented.

Induction of contractors

64. Before working underground at Pike, contractors had to complete only the basic two-hour induction training, a medical examination and the NZQA unit standard 7146. Short-term contractors (fewer than five days on site) working underground had only to complete the two-hour induction training.¹⁰¹ Other than delivering basic inductions and some on-the-job instruction, Pike was not involved in training contractors,¹⁰² and it was hit and miss whether all contractors received Pike's safety information by way of tool box advisory notices, newsflashes and the minutes of the health and safety committee.¹⁰³
65. Mr Couchman was concerned that Pike's standard of induction for contracted workers was deficient compared with that given to new employees.¹⁰⁴ To address the problem, in mid-2010 Mr Couchman designed a standardised five-day induction for employees and contractors, which he presented to Messrs White and Rockhouse. The programme was welcomed but he was told 'we would have to wait until we were in full coal production before it could be introduced.'¹⁰⁵ He understood that was because of the time needed to fully induct the large number of contractors on site, whereas by the time full coal production was reached (estimated for February 2011) there would have been a 'lot less reliance' on contractors.¹⁰⁶

Pike's policy on contractor management

66. Pike's policy and procedures for managing contractor health and safety were set out in its safety manual,¹⁰⁷ which included requirements for contractors to comply with the mine manager's rules, to report incidents or accidents using Pike's forms and to advise the company what risks they and/or their equipment would introduce into the mine.¹⁰⁸ Contractors were to operate under the supervision of Pike staff, usually the project manager who employed them,¹⁰⁹ and a contractor authority to work permit had to be issued by Pike before work started. This was to ensure contractors had the same level of understanding and experience of site operations and hazards as Pike employees.¹¹⁰

Contractor health and safety systems

67. Pike required all contractors without their own site specific health and safety system to complete the contract specific safety management plan in Pike's 'SubbyPack™'.¹¹¹ This was a suite of documentation designed to 'establish a minimum and auditable standard for the management of Occupational Health and Safety by contractors and sub-contractors',¹¹² and to ensure compliance by Pike and the contractor with their obligations under the HSE Act.
68. Both the large contractors, McConnell Dowell Constructors Ltd and VLI Drilling Pty Ltd (VLI), had their own extensive site-specific health and safety systems. McConnell Dowell had a health and safety officer at the mine who attended Pike's health and safety committee meetings and the daily production meetings.¹¹³ Only some of the smaller contractors had their own health and safety systems, but not all of those were specific to Pike or even to underground coal mining.¹¹⁴

Responsibility for contractor management

69. Some Pike staff directly managed contractors,¹¹⁵ and consultants assisting Pike in 2010 were managed by the department staff who engaged them. But from 2009 responsibility for the general management of many of the smaller labour hire contractors (those brought in when necessary to provide labour for projects in the mine) was

given to Terence Moynihan, himself an independent contractor working as manager of the project team,¹¹⁶ and two contractors he managed, Rem Markland and Matthew Coll. The project team managed the day-to-day work of their smaller contractors and were often underground checking on the workers and their tasks, but they did not see their role as including managing the contractors' health and safety, other than in a limited way during construction and installation activities.¹¹⁷

70. In early 2010 Mr Rockhouse learnt that Pike had begun to engage contractors on hourly hire contracts and in about July/August 2010 he asked Mr Moynihan for contractor documentation for the new faces he had noticed around the mine. But it did not exist because the project team was unaware of the health and safety documentation that Pike required from its contractors, or of their obligation to obtain that information before a contractor began work underground.¹¹⁸ This meant many contractors had staff working underground at Pike without their own health and safety system in place, and without the alternative protection of having their staff inducted into Pike's health and safety system, as required by the company's safety manual.¹¹⁹
71. Since management were confident that any safety matters would be addressed by the project team, it was agreed that Pike would improve its safety management system for contractors over the following three months rather than delay the project work (the commissioning of the hydro panel and underground fan) to review each contractor. Those improvements had not occurred by 19 November 2010.¹²⁰

No auditing of contractor safety

72. Although Pike's safety management system required regular audits of contractor safety performance,¹²¹ there is no evidence to establish that Pike audited either McConnell Dowell and VLI or any of the smaller contractors who lost men on 19 November 2010.¹²² As a result of this omission, Pike was missing vital information on its contractors and the hazards that their staff and/or equipment might introduce to the mine.¹²³

Supervision of contractors underground

73. There was no formal system requiring Pike's deputies to regularly check the safety of contractors while working underground.¹²⁴ In practice that was left up to their discretion when checking their areas of responsibility within the mine.
74. There was also no system to keep track of the locations of contractors underground, although the project team had a weekly plan that included information on where their contractors would likely be working each day. Contractors were not restricted from moving around the mine and 'pretty much looked after themselves'.¹²⁵ Visitors and contractors were required to sign in and out but that sometimes did not happen,¹²⁶ and neither that system nor the portal tag board helped the control room or the deputies to keep track of contractors' whereabouts underground.¹²⁷

Conclusions

75. Recognising the training needs of its relatively inexperienced and diverse workforce, Pike set out to create and implement good training programmes. But the company struggled to always train its workforce adequately. This was partly due to underresourcing and work pressures preventing the release of miners from their crews to attend training sessions. Some worker conduct underground reflected inadequate training, inexperience and a lack of underground leadership.
76. Pike's induction training for new employees was comprehensive, but the quality of contractor induction was inadequate. These workers faced the same hazards and should have received the same level of induction.
77. The management of contractors got away from Pike in 2010 and these workers were often left to their own devices. No person or department took overall responsibility for contractor management, and Pike did not ensure sufficient health and safety training and awareness for its contracted workforce. Safety performance audits of contractors were required but did not occur.

ENDNOTES

- ¹ Peter Whittall, witness statement, 22 June 2011, PW0/3, para. 5.
- ² Adrian Couchman, transcript, p. 3827.
- ³ David Stewart, transcript, p. 3344.
- ⁴ Pieter van Rooyen, Pieter van Rooyen Handover Notes, 2 November 2010, PVR002.
- ⁵ Department of Labour, Pike River Mine Tragedy 19 November, 2010: Investigation Report, [2011], DOL3000130010/243, para. 5.10.1.
- ⁶ George Mason, transcript, pp. 3638, 3663–64; George Mason, witness statement, 31 October 2011, MAS0001/5, para. 14.
- ⁷ Matthew Coll, witness statement, 20 November 2011, FAM00055/5, para. 19.
- ⁸ Pike River Coal Ltd, Minutes of a Meeting of Directors, 24 August 2010, DAO.007.28248/4.
- ⁹ Diagram adapted from: Peter Whittall, Selected Management Positions Held at Pike River Coal Limited, January 2005–19 November 2010, PW22/1.
- ¹⁰ Dene Murphy, witness statement, 2 December 2011, FAM00057/15, para. 84.
- ¹¹ George Mason, transcript, p. 3653.
- ¹² Stephen Wylie, transcript, p. 3708.
- ¹³ Peter Whittall, transcript, p. 2786.
- ¹⁴ Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/53, para. 189.
- ¹⁵ David Reece, transcript, p. 4699.
- ¹⁶ David Stewart, transcript, p. 3341.
- ¹⁷ *Ibid.*, p. 3344.
- ¹⁸ David Stewart, Police/DOL interview, 4 April 2011, INV.03.17291/15.
- ¹⁹ Albert (Alan) Houlden, witness statement, 14 November 2011, FAM00053/12, para. 61.
- ²⁰ Alexander (George) Colligan, witness statement, 18 March 2012, COL0001/8, para. 42.
- ²¹ Albert (Alan) Houlden, witness statement, 14 November 2011, FAM00053/8, paras 38–41.
- ²² Adrian Couchman, transcript, p. 3828.
- ²³ Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/54, para. 192.
- ²⁴ Reginald Matthews, witness statement, 29 November 2011, MAT0001/15, p. 96.
- ²⁵ Adrian Couchman, transcript, p. 3828.
- ²⁶ An example occurred in August 2010 when three machines were in position ready to cut coal, but there was a lack of available operators to run them: Pike River Coal Ltd, Operations Meeting, 4 August 2010, DAO.002.14764/6.
- ²⁷ Pike River Coal Ltd, Operations Meeting, 8 October 2009, DAO.002.14097/6; Pike River Coal Ltd, Operations Meeting, 1 September 2010, DAO.002.14860/7.
- ²⁸ John Dow, transcript, p. 3934.
- ²⁹ Letter, John Dow to all staff, 5 July 2010, DAO.011.22212/3.
- ³⁰ Pike River Coal Ltd, Operations Meeting, 10 November 2010, DAO.002.14998/7.
- ³¹ David Stewart, transcript, p. 3369.
- ³² *Ibid.*, pp. 3341–42.
- ³³ Matthew Coll, witness statement, 20 November 2011, FAM00055/6, para. 25.
- ³⁴ Neville Rockhouse, witness statement, 1 April 2012, ROCK0031/8, paras 37–38.
- ³⁵ Pike River Coal Ltd, Leadership Team Meeting – Minutes of the PRCL Leadership Management Team, 28 February 2007, DAO.025.43041/2.
- ³⁶ Health and Safety in Employment Act 1992, s 13.
- ³⁷ National qualifications are those approved and quality assured by the New Zealand Qualifications Authority. They feature in the National Qualifications Framework and levels of difficulty are assessed within this framework, with level 1 being the least difficult and levels 8 to 10 being university qualifications.
- ³⁸ Each unit standard has a level and a credit value, which gives an idea of how long it is likely to take. One credit is roughly equivalent to 10 learning and assessment hours, although this varies depending on the skills and knowledge a candidate already possesses: Extractive Industry Training Organisation, Adding Value to Industry with On-Job Training and National Qualifications, http://exito.org.nz/documents/cat_view/109-corporate-documents
- ³⁹ New Zealand Qualifications Authority, NZQA Registered Unit Standard 7142, Version 7: Demonstrate Knowledge of the Application of Regulatory Requirements to Manage an Extractive Site, 2010.
- ⁴⁰ Peter Fairhall, witness statement, 6 November 2011, FAI0001/1, paras 7–10.
- ⁴¹ *Ibid.*, FAI0001/1, para. 12.
- ⁴² Email, Peter Whittall to Kevin Walker and others, 17 December 2009, DOL3000010036/1.
- ⁴³ Emails between Peter Whittall, Kevin Walker and others, 8 December 2009–4 February 2010, DOL3000010032, DOL3000010036.
- ⁴⁴ Peter Fairhall, witness statement, 6 November 2011, FAI0001/1, para. 12.
- ⁴⁵ Adrian Couchman, transcript, p. 3864; Robert (Gavin) Taylor, witness statement, 11 May 2012, DOL7770060001/2–3, paras 6–11.
- ⁴⁶ Stephen Ellis, transcript, p. 2314. An example at Pike is a mine manager who failed three times to obtain a first class mine manager's COC in Queensland in 2009 and 2010, because he did not pass oral examinations. After arriving at Pike in September 2010, he completed the unit standard requirements and a professional conversation in November 2010, and obtained a New Zealand first class mine manager's COC: Stephen Ellis, witness statement, 17 April 2012, DAO.042.00036; Robert (Gavin) Taylor, witness statement, 11 May 2012, DOL7770060001.
- ⁴⁷ Peter Fairhall, witness statement, 6 November 2011, FAI0001/2, para. 19; Michelle Gillman, witness statement, 10 November 2011, GIL0001/4, para. 17; Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/13, paras 30–31; Reginald Matthews, witness statement, 29 November 2011, MAT0001/8, paras 45–48; Adrian Couchman, witness statement, 28 November 2011, COU0001/7, paras 29–34; Alexander (George) Colligan, witness statement, 18 March 2012, COL0001/97, para. 40.
- ⁴⁸ Reginald Matthews, witness statement, 29 November 2011, MAT0001/4–6.
- ⁴⁹ Alexander (George) Colligan, witness statement, 18 March 2012, COL0001/4–5.
- ⁵⁰ *Ibid.*, COL0001/6–7, para. 38.
- ⁵¹ *Ibid.*, COL0001/7, para. 40.
- ⁵² Mr Colligan had not trained Joseph Dunbar, who was underground at the Pike River mine for the first time on 19 November 2010.
- ⁵³ Alexander (George) Colligan, witness statement, COL0001/8, paras 45–46.
- ⁵⁴ Michelle Gillman, witness statement, 10 November 2011, GIL0001/3, para. 1.
- ⁵⁵ Adrian Couchman, witness statement, 28 November 2011, COU0001/6, para. 26.
- ⁵⁶ *Ibid.*, COU0001/5, para. 18.
- ⁵⁷ Adrian Couchman, transcript, pp. 3823–24; Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/16, 42, paras 39, 41, 141–42; Michelle Gillman, witness statement, 10 November 2011, GIL0001/4, para. 14.
- ⁵⁸ John Dow, transcript, p. 3933.
- ⁵⁹ Adrian Couchman, witness statement, 28 November 2011, COU0001/10, para. 49; Adrian Couchman, transcript, p. 3780.
- ⁶⁰ Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/55, para. 195.
- ⁶¹ Neville Rockhouse, transcript, pp. 4273–74; Pike River Coal Ltd, Corporate Safety Manual: Section 1.7, June 2008, DAO.001.08593.
- ⁶² Adrian Couchman, transcript, pp. 3762–63.
- ⁶³ *Ibid.*, p. 3764.
- ⁶⁴ Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, November 2011, CAC0114/64–65, sch I.
- ⁶⁵ Adrian Couchman, transcript, p. 3762; New Zealand Qualifications Authority, NZQA Registered Unit Standard 7146: Demonstrate Basic Knowledge and Ability Required to Work in an Underground Mine, Version 7, 2010, CAC0142.
- ⁶⁶ Including knowledge and use of self-rescuers, cap lamps and personal protective equipment; safe measures for isolation of energy systems to machinery and equipment underground; knowledge of emergency procedures; personnel security issues (contraband, restricted zones and restricted materials) and accounting systems (tag, paper, cap lamp number); and the ability to describe basic ventilation principles and practices in an underground mine, and demonstrate basic knowledge of mine gases. Knowledge of the requirements of the HSE Act and relevant regulations was

also required.

- ⁶⁷ Adrian Couchman, witness statement, 28 November 2011, COU0001/8, paras 36–39; Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/54, para. 190.
- ⁶⁸ Peter Fairhall, witness statement, 6 November 2011, FAI0001/1, para. 5.
- ⁶⁹ Adrian Couchman, transcript, p. 3772.
- ⁷⁰ Reginald Matthews, witness statement, 29 November 2011, MAT0001/6, para. 31.
- ⁷¹ Adrian Couchman, transcript, p. 3778.
- ⁷² *Ibid.*, pp. 3780–81.
- ⁷³ Adrian Couchman, witness statement, 28 November 2011, COU0001/10, paras 50–51.
- ⁷⁴ Douglas White, transcript, pp. 1119–20; Adrian Couchman, transcript, p. 3782; Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/54, para. 191; Email, Michelle Gillman to Neville Rockhouse and Douglas White, 7 March 2010, ROCK0027/1.
- ⁷⁵ Adrian Couchman, witness statement, 28 November 2011, COU0001/9, para. 45; Adrian Couchman, transcript, pp. 3781–82, 3829–30.
- ⁷⁶ Adrian Couchman, witness statement, 28 November 2011, COU0001/9, para. 47; Adrian Couchman, transcript, pp. 3829–30; Peter Fairhall, witness statement, 6 November 2011, FAI0001/2, para. 17.
- ⁷⁷ Pike River Coal Ltd, Operations Meeting, 10 November 2010, DAO.002.14998/8.
- ⁷⁸ Douglas White, transcript, p. 4923.
- ⁷⁹ Daniel Duggan, transcript, p. 1609; Barry McIntosh, Police/DOL interview, 2 August 2011, INV.03.28697/33–34; Douglas White, transcript, pp. 4921–24.
- ⁸⁰ Stephen Wylie, transcript, p. 3705.
- ⁸¹ Douglas White, transcript, p. 1263; Neville Rockhouse, transcript, p. 1451.
- ⁸² Adrian Couchman, transcript, p. 3776.
- ⁸³ *Ibid.*, pp. 3776–77.
- ⁸⁴ David Stewart, transcript, pp. 3343, 3360–61; Emails between Douglas White, David Stewart, Michael Lerch and Peter Whittall, 15–16 February 2010, CAC0138/4–5.
- ⁸⁵ Adrian Couchman, transcript, p. 3777.
- ⁸⁶ Adrian Couchman, witness statement, 28 November 2011, COU0001/8, para. 41; Adrian Couchman, transcript, pp. 3773–74; Pike River Coal Ltd, Trainee Miner Recommendations: August 2010 Intake, 9 November 2010, INV.04.00649/2–3.
- ⁸⁷ Email, Douglas White to Richard Knapp and Stephen Ellis, 9 November 2010, INV.04.00691/3–4.
- ⁸⁸ Emails between Douglas White and Ted Botham, 15–18 November 2010, INV.04.00661/4–7 and INV.04.00733/1.
- ⁸⁹ See, for example, Tool Box Talk Safety Advisory notices issued on 31 March 2009 (DAO.001.11364), 15 December 2009 (DAO.001.11428) and 16 April 2010 (DAO.001.11947); and General Newflash notices on 5 January 2009 (DAO.001.08773), 30 April 2009 (DAO.001.08786), 17 September 2009 (DAO.001.08805) and 27 November 2009 (DAO.001.08820).
- ⁹⁰ In 2009 one of the first searches by an undermanager of 25–30 miners about to go on shift produced an estimated 18–20 restricted articles, including cigarettes, matches and lighters, cans and two cellphones. Pike also had instances of cigarette lighters left in the back of driftrunners, cigarette butts in the tunnel, a miner wearing a battery-operated watch underground, and other restricted items such as aluminium and glass vessels found underground: Reginald Matthews, witness statement, 29 November 2011, MAT0001/13, para. 77; Adrian Couchman, witness statement, 28 November 2011, COU0001/22, para. 119; Neville Rockhouse, transcript, p. 4247.
- ⁹¹ Pike River Coal Ltd, Contraband Searches Conducted, DAO.004.00002; Brett Murray, transcript, p. 4426.
- ⁹² Pike River Coal Ltd, Mine Manager's Rules, 13 September 2010, INV.03.25773/24–25.
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- ⁹⁴ David Reece, transcript, pp. 4668–69.
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- ⁹⁶ Police/DOL interview, 8 April 2011, INV.03.17556/1–22. (The commission decided, by majority, to withhold the name of the worker concerned. Commissioner Bell dissented.)
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- ⁹⁸ Reginald Matthews, witness statement, 29 November 2011, MAT0001/11, para. 68.
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- ¹¹⁷ Terence Moynihan, Police/DOL interview, 21 April 2011, INV.03.19308/25–33; Rem Markland, Police/DOL interview, 5 April 2011, INV.03.17730/31–34.
- ¹¹⁸ Neville Rockhouse, witness statement, ROCK0002/65–67, paras 253–55; Terence Moynihan, Police/DOL interview, 21 April 2011, INV.03.19308/25–33; Matthew Coll, Police/DOL interview, 20 April 2011, INV.03.19129/14–16; Pike River Coal Ltd, Corporate Safety Manual: Section 8.1, June 2008, DAO.001.08536/3.
- ¹¹⁹ *Ibid.*, DAO.001.08536/3.
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- ¹²⁴ Department of Labour, Investigation Report, DOL3000130010/264, para. 6.13.9; Simon Donaldson, Police/DOL interview, 11 July 2011, INV.03.24207/7–8; Shaun Whitau, Police/DOL interview, 4 February 2011, INV.03.12950/21–22.
- ¹²⁵ Rem Markland, Police/DOL interview, 5 April 2011, INV.03.17730/45; Craig Bisphan, Police/DOL interview, 12 July 2011, INV.03.24109/49.
- ¹²⁶ One contractor working at Pike River since 2009 said he was not instructed to and did not sign in at the control room; instead he believed that a microchip access button he was provided registered his whereabouts. He had lost his tag for the board about four months before the explosion and had not been given a new one: Phillip Smith, Police/DOL interview, 20 October 2011, INV.03.31617/33–34.
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Health and safety management

Introduction

1. Employers must take all practicable steps to ensure the safety of employees. In coal mining and other high-hazard industries best practice is to manage the significant risks involved through a health and safety management system that provides a mechanism for identifying hazards and the risks associated with them, and managing those risks.
2. This chapter introduces the systems concept and its basis in law and practice. It then discusses Pike's approach to planning, implementing, monitoring and reviewing its system.
3. The focus is on the people most involved in developing and managing the health and safety system and what was needed to put it into practice.
4. There is further analysis in other chapters on critical mine systems and organisational factors. Workplace safety is multi-faceted. In mining it is the product of good ventilation and gas control, effective hazard management, ongoing worker training and supervision, and a commitment by managers and directors to worker safety.

Health and safety management systems

5. A health and safety management system is 'that part of the overall management system which includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the OHS policy, and so managing the risks associated with the business of the organization'.¹ It integrates a range of safety management tools and functions including 'senior management commitment, hazard identification, risk management, safety reporting, occurrence investigation, remedial actions and education'.²
6. A health and safety management system provides a framework or structure for the development, implementation and review of the plans and processes necessary to manage safety in the workplace.³ The influences that shape the system and the main elements for an underground coal mine are illustrated in the following diagram.

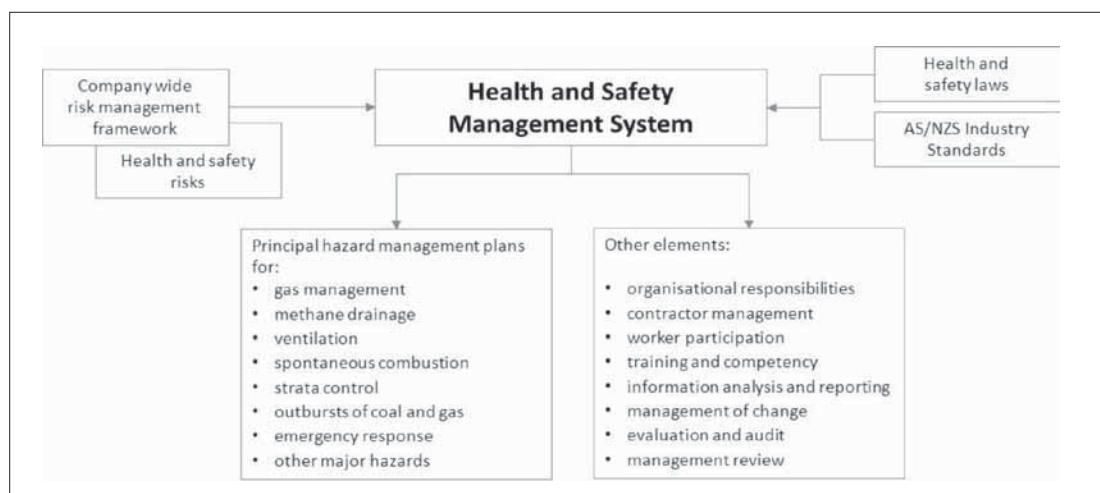


Figure 7.1: Elements of a health and safety system

Requirements of the Health and Safety in Employment Act 1992 (HSE Act)

7. The act's objective is to advance worker safety by 'promoting excellence in health and safety management, in particular through promoting the systematic management of health and safety'. Employers have a general duty to 'take all practicable steps to ensure the safety of employees while at work',⁴ through providing a safe environment, work facilities and plant and ensuring that workers are not exposed to hazards.⁵ Employers must identify and assess hazards,⁶ then implement a hierarchy of controls to eliminate, isolate or minimise those that might cause serious harm.
8. Other obligations on employers include informing employees about hazards to which they might be exposed and the steps to be taken to avoid being harmed by those hazards; ensuring worker health and safety representatives have access to information about health and safety systems; ensuring that employees are properly trained and supervised; and involving workers in health and safety matters.
9. Employees must take all practicable steps to keep themselves safe and not harm others.

The elements of a health and safety management system

10. Two Australasian industry standards provide guidance on health and safety management systems.⁷ These recommend that an organisation:
 - defines its health and safety policy and ensures commitment to the system through leadership and allocation of resources. This is a board and executive management function;
 - develops a management plan to control specific hazards;
 - implements the plan by involving people at all levels in the organisation. Implementation includes allocating resources, assessing training needs, making sure information is communicated, establishing incident/accident and hazard reporting systems, documenting the system and changes, and setting up procedures for continued assessment and control of hazards;
 - measures and evaluates health and safety performance, through inspections, monitoring, incident reporting, investigations and audits; and
 - reviews the system at the executive management level to ensure it is operating effectively and remains appropriate. 'Management review is the cornerstone of the system'.⁸
11. The design of a health and safety management system should be tailored to the circumstances of an organisation and its stage of development. Pike's system, for example, had to recognise that the company was in development and early production mode, mining in difficult conditions, reliant on a growing and diverse workforce, and planning to establish a high-production operation based on hydro mining. Hazard identification and control needed to take account of all these challenges.
12. The commitment of everyone in the organisation, from the chair of the board to trainee miners, is vital to a properly functioning health and safety management system. There must be attention to detail in all aspects of the operation, from design of the mine, procurement of plant and equipment to mining activities – all tasks that affect workplace safety, directly or indirectly.

The Pike approach

An integrated approach

13. Pike recognised the need for an organisation-wide, integrated approach to safety management. The corporate

health and safety policy stated that creating a safe work environment is 'both the individual and shared responsibility of all PRCL employees, management and board' and 'that people at all levels' must be committed to achieving high health and safety standards.⁹ Documentation shows that all aspects of the operation were seen as part of the health and safety management system and that responsibilities were dispersed across the organisation as depicted in this diagram.

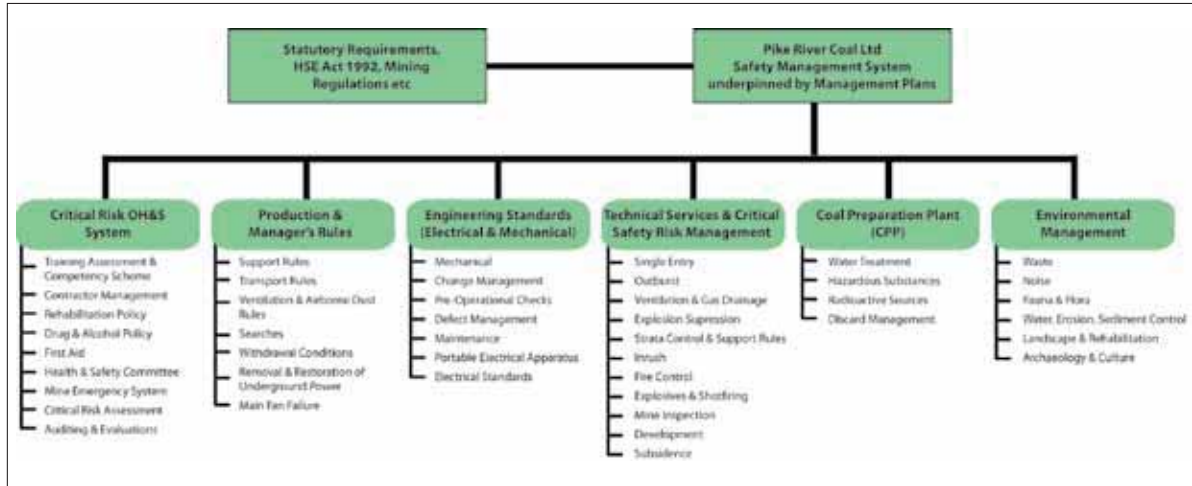


Figure 7.2: Pike safety management systems and management plan¹⁰

Role of the board

14. In its charter, the board's health, safety and environment (HSE) committee acknowledged that the board was ultimately responsible for health and safety and environmental policies and compliance with relevant laws. Responsibility for implementation rested with executive management. The actions of this committee and the board more generally are evaluated in Chapter 5, 'Governance and management'. The HSE committee and the board did not properly identify and manage the major health and safety risks facing the company.
15. Implementation of the health and safety management system was made more difficult because there were no clear objectives and targets during the development phase. Pike relied on having a fully externally auditable health and safety management system by the time 'steady-state production' was reached, which meant that 'virtually ... all of your infrastructure is in place, all of your plant and equipment has been ... fully commissioned and you are a coal mine producing coal'.¹¹
16. This goal was understandable if it meant the system would mature in pace with development of the mine. Workplace safety is a work in progress, and the identification and management of hazards ongoing. But it is critical that health and safety management begins at the planning, design and mine development stages and remains relevant to the stage the mine has reached. At Pike River the drive to produce coal in 2010 led to a view that management of some hazards could await the implementation of a long-term solution, when for example a suitable second egress and a usable fresh air base (FAB) should have been high-priority safety requirements.

The safety and training department

17. High-hazard and complex organisations generally employ specialist health and safety officers. Their existence does not remove the responsibility from directors or managers to manage health and safety in the same way as they manage other risks facing the organisation, such as those relating to production and finance.
18. The functions of Pike's safety and training department included developing the health and safety management system, developing and managing the incident and accident reporting system, conducting underground and medical equipment audits and inducting and training workers. Neville Rockhouse was the safety and training manager. He joined Pike in 2006. Mr Rockhouse had a post-graduate qualification and experience in health and

- safety and, earlier in his career, some mining experience. However, at the job interview he impressed upon Peter Whittall that his mining work experience was distant, was not in a gassy mine and did not extend to hydro mining.¹²
19. Mr Rockhouse twice gave evidence to the commission. This posed special difficulties for him: he lost one son in the tragedy and another was one of the two survivors who escaped from the mine.
 20. Mr Rockhouse had a heavy workload, sometimes working between 60 to 80 hours per week. He sought more staff for his department, but was largely unsuccessful.¹³ He found it difficult to get co-operation from other managers. Although Mr Rockhouse was the architect of most of the health and safety documents, he depended on technical input from the managers or staff of other departments. He had no authority over the managers and staff and there was no central oversight of the way departments managed health and safety other than Mr Rockhouse who was 'chasing them constantly to get stuff done'.¹⁴
 21. The commission is satisfied that Mr Rockhouse needed significant support and guidance in developing Pike's health and safety management system, and direction on priorities. This was lacking. And when Mr Rockhouse was vocal in raising safety concerns, for example the absence of a second means of egress and the need for a refuge chamber,¹⁵ his concerns were not addressed. Generally, his department struggled for credibility alongside the more production-focused departments.
 22. The resourcing of the safety and training department, including the staff members who assisted Mr Rockhouse, has been discussed in Chapter 6, 'The workforce'.

Implementing the system

23. Mr Rockhouse began in 2006 with 'pretty much a blank sheet of paper' and was told 'go for it'. He had previous experience in designing a system 'from scratch', but not for a coal mine. However, Mr Rockhouse saw it as 'an exciting project'.¹⁶ He drew on Australian and New Zealand industry standards and had access to management systems from other mines, mainly in Australia, which he adapted to Pike's circumstances. The system was to be computer-based, and was intended to be 'world class'.¹⁷

Documentation

24. The documented system was developed mainly by Mr Rockhouse.¹⁸ The main document was the *Corporate Safety Manual: Safety in the Pike River Coal Workplace*,¹⁹ which covered the employer commitment to safety management practices; planning, review and evaluation; hazard identification; information, training and supervision; incident/accident reporting and investigation; employee participation; emergency planning; and contractor management.
25. Beneath the manual was a hierarchy of documents, including departmental management plans, safe operating procedures (SOPs) to assist in managing known hazards, trigger action response plans (TARPs) to define the response to specific events, and job safety and environment analyses (JSEAs) for specific tasks.
26. A permit to work system operated to define the boundaries for specific work activities. Other documents included the mine manager's rules, an induction handbook, a SubbyPack™ (for contractors) and a hazard register.
27. By November 2010 there were over 398 documents in the electronic system.²⁰ Of these 227 were in draft as they were not signed off by two managers, although they were still used in the meantime. The number, and length, of the documents posed a challenge to the credibility of the system.
28. Although many of the documents were helpful, there were problems, not only with the sheer volume of material, but also with some of its content. For example, in 2010 two consultants and a Pike manager assessed the ventilation management plan and concluded it needed a complete review.²¹

Communication of health and safety issues

29. Informing workers, the board and the regulator about health and safety issues is an important component of any system.
30. Employees must be provided with a range of health and safety information, including about 'identified' hazards to which they may be exposed or that they may create. They may refuse to do work they believe is likely to cause them serious harm. That belief may be based on the advice of health and safety representatives, who must have access to sufficient health and safety information to enable them to perform their functions. Work cannot be refused because it carries an 'understood risk' of serious harm; the risk must have materially increased beyond the understood risk.²² These rights depend on access to accurate information.
31. Pike had a number of mechanisms for providing health and safety information to employees and contractors, including inductions, training, news flashes and tool box talk safety advisories. While these were no doubt of benefit, two problems are apparent.
32. First, it seems some known information, bearing on hazards and increased risk, was not widely published. For example in late October 2010 a high reading of methane occurred at the ventilation shaft. A ventilation expert, John Rowland, said 'I would assume that such an event would be of sufficient importance that subsequent investigations and remediation strategies would be widely publicised to at least all site personnel, as a matter of very urgent priority.'²³ Mr Rockhouse agreed but said 'I didn't even know about it so no, no it wasn't done.'²⁴
33. Prior to the tragedy Mr Rockhouse was not aware of methane readings of 5% reported by deputies during October 2010. When asked whether they received publicity or were notified to site personnel he stated 'No they didn't. You can't trust people can you.'²⁵ Methane readings were also not being properly reported in daily production or weekly operations meetings, nor through the health and safety system.²⁶
34. The hazard was not only that of a potentially explosive methane incident in the workplace, but also that the mine lacked the capacity to prevent that, and further potentially explosive methane levels.
35. Second, this and subsequent chapters identify hazards and risks, some at a systemic level, which it seems were not fully identified or assessed by Pike. Without Pike having accurately identified them and their nature, it is unlikely that workers were informed of them.
36. Board health and safety communication was mainly via executive management's monthly operations report. Direct contact between the safety department and the board was rare. There was a weak link between the board HSE committee and the safety and training department. The committee met Mr Rockhouse infrequently and he did not always receive its minutes.²⁷ There was what Mr Rockhouse termed 'a cursory look at what was going on' by the HSE committee.²⁸
37. Notification of health and safety information to the Department of Labour (DOL) was also inadequate. Employers must notify serious harm and other incidents prescribed by regulation 10 of the Health and Safety in Employment (Mining – Underground) Regulations 1999. These include an explosion or ignition of coal dust or gas, fire or spontaneous heating, unplanned outbursts of gas or water, loss of control of a vehicle, employees being trapped, structural failures, unplanned falls of ground, major collapses of part of the workings, uncontrolled accumulations of flammable or noxious gas, and failures of a main ventilation fan for more than 30 minutes.
38. Pike's incident and accident reporting procedure required serious harm notification, but did not capture and notify all matters required by regulation 10. Many notifiable incidents were not reported to DOL, including high methane readings of about 5% in October 2010.²⁹
39. To Mr Rockhouse's knowledge Pike did not review or take legal advice regarding whether it was notifying the matters it was required to notify.³⁰

The workers site health and safety committee

40. The site committee was of the kind envisaged in the HSE Act. It had the power to make recommendations about health and safety matters which an employer had to adopt, or give written reasons for not doing so.
41. The committee's function was defined as monitoring health and safety, but 'focused on injury prevention' and significant hazard identification and management because 'this process is the key to all of our injury prevention initiatives'. Its role was to gather information from workers, table that information and develop controls to 'manage risk and prevent harm'.³¹ The committee was to comprise an elected chair, a manager, a representative from each department and a union representative,³² although no union involvement eventuated.³³ The committee did not have a budget or authority over workers, although departmental managers had access to funds.³⁴ Later, membership of the committee was increased to include contractor representatives from McConnell Dowell Constructors Ltd and trucking company TNL Group Ltd.
42. The committee met monthly. Minutes were taken and widely circulated, including to the chief executive, general manager and Mr Rockhouse, who sometimes attended meetings. The minutes were also made available to workers by email and by placing copies on notice boards and on smoko tables. However, Adrian Couchman, the chair of the committee, said there was never any feedback from workers.³⁵
43. The committee maintained an 'action sheet' that recorded required actions, the person responsible for implementing them and an assignment and completion date. The sheets show that attention to completing actions varied. Ordinarily, simpler matters were attended to promptly, but actions assigned to some departments were routinely left unresolved. Mr Rockhouse stated, 'some department heads took little notice of action points arising from the meetings.'³⁶
44. Attendance at committee meetings was an ongoing problem. For example, only five of the 10 representatives attended the final meeting on 8 November 2010.³⁷ The engineering department was consistently unrepresented, and had still not appointed someone to the committee as at November 2010.³⁸ Sometimes, there were more managers than workers at meetings, which concerned Mr Couchman, given that the committee was intended to be a workforce forum for health and safety concerns.³⁹
45. Despite these problems the committee remained the voice of the workforce. Following the November 2010 meeting it raised numerous concerns, including the return to service of an unrepaired Jugernaut that had caused a back injury, poor underground management of fire hoses, the unavailability of a drifrunner underground at shift changeover periods and at other times when an evacuation could be declared, a shortage of fans and vent cans underground, the location of a toilet 1.2km away from the working faces, and the inability of miners to contact the control room by digital access carrier (DAC) or phone.⁴⁰ When Mr Couchman conveyed these concerns to Douglas White, Mr Rockhouse and Stephen Ellis, Mr White responded immediately, saying, 'my patience is wearing rather thin on some of these issues.'⁴¹ These were clearly recurrent problems.
46. The most significant obstacle the committee faced was its inability to make progress on the major issues it raised. On 3 March 2010 Mr Couchman, as chair, wrote to Mr Rockhouse asking 'if there has been any further progress made on reaching a resolution in regards to the 2nd means of egress.'⁴² On 17 March 2010 Mr Rockhouse replied, noting that, following a significant risk assessment, the Alimak section of the ventilation shaft would not be used as a second emergency egress if the drift was impassable. Instead a FAB was to be constructed in the slimline shaft stub. But a proper FAB was not completed by the end of June. There was only a pull-down brattice stopping to isolate the slimline shaft stub. This was an interim measure while the FAB was designed and ventilation surveys undertaken.⁴³
47. When the committee met on 13 September 2010, and noted that development of a second means of egress was planned 'sometime in the coming months', it resolved 'that this was not adequate and requested a firm plan be made available to identify when the 2nd means of egress would be actioned.'⁴⁴ Mr Couchman was designated to

action this. The matter was raised at the next meeting, on 11 October, when in the absence of any response from the company, it was reassigned to Mr Ellis to 'chase it up for us'.⁴⁵ At the November meeting it was noted that Mr Ellis would report 'next month'.⁴⁶

48. Hence, by the date of the explosion little progress had been made. There was a plan to establish a walkout second egress, but its construction was at least 12 months off. The interim safeguard of a proper FAB had not eventuated either. A fundamental concern of the workforce remained unaddressed – eight months after it was first raised.

Evaluation and monitoring

49. Ongoing evaluation of available information is an important component of a health and safety management system. It identifies emerging issues and risks and opportunities for improvements. This requires monitoring and reporting mechanisms, management analysis of the resulting information and a response to any warning signs, including effective feedback to the workforce.
50. As well as information from the site health and safety committee, numerous records and reports provided information about problems at the mine. Deputies and underviewers completed reports every shift. Control room operators prepared shift, daily and event reports. Engineers, electricians and machine operators regularly inspected and reported on diesel engines, fans, pumps, sensors and electrical equipment.⁴⁷
51. The safety and training department, assisted by the Mines Rescue Service, audited rescue and medical equipment; the New Zealand Fire Service undertook audits and prepared reports on surface facilities.
52. Later chapters consider the effectiveness of monitoring of specific systems such as those relating to methane, ventilation, strata and mining practices. This section looks at other reporting mechanisms and the company's general response to safety information from within the mine.

Incident/accident reporting and investigation

53. Pike had an incident/accident reporting and investigation system in place. Workers were required to report events on a report form.⁴⁸ These forms went to the safety and training department. Mr Rockhouse investigated some serious matters himself. Otherwise investigations were undertaken by a manager or staff member from the appropriate department. Some events were investigated by a team, which could include the mine manager.
54. The workers reported many incidents and accidents. The commission analysed 1083 reports and summarised a selection of 436 in a schedule.⁴⁹ The schedule groups events by type, including methane spikes, ventilation, strata, bypassing, equipment sparking and a number of others. The numbers suggest that the workforce, including contractors, were committed to reporting events, though the extent of non-reporting is unknown. The reports certainly contained a wealth of information which, if properly analysed, revealed much about the systems and conduct underground.
55. However, there were problems with the investigation process. Many reports were assigned to an investigator, but no investigation was completed. This was evident from the report forms filed with the commission. Mr Couchman described the extent of this problem. Some departments would have only a handful of investigations outstanding, while the engineering and production departments sometimes had up to 70 uncompleted investigations and some were over a year old. Measures to deal with the backlog were unsuccessful. When the backlog was discussed with Mr White in October 2010 he decided that they should be cleared and a fresh start made 'with a new management and a new mine manager'. This meant that the incidents were never properly investigated.⁵⁰
56. The site health and safety committee reviewed a selection of incident/accident reports at its monthly meetings. Approximately six of these were selected at random, and a committee member assessed whether stipulated remedial actions had been carried out.⁵¹ If not, the incidents were reopened and followed up.
57. There was some trend analysis of, and action was taken on, some issues, such as contraband. But because reports were not analysed systematically for recurring safety problems, or weaknesses in control measures, many matters

were not discovered. In this way potential information about safety and emerging risks was lost, and information that could have been obtained from completed investigations was not put to best use. The extent of this deficit was most apparent when Mr Rockhouse described his reaction to seeing the schedules prepared by the commission: 'Mr Wilding, when you spent that three days with me and you showed me that stuff you had me reduced to tears. I know there was no analysis like you've done with that [information] at Pike River.'⁵²

58. There was also a breakdown in providing feedback to the report writers. Mr Couchman considered there was no established system for providing feedback.⁵³ Mr Rockhouse understood that when an investigation was completed, there should have been feedback to the reporter but this 'didn't happen.'⁵⁴

Use of lead and lag data

59. An additional problem was the way overall safety performance was being measured at Pike. The health and safety management system and reporting to management and the board was based mainly on lag, rather than lead, data. Lead indicators 'are measures of pre-emptive actions or initiatives that assist in preventing workplace injury,'⁵⁵ for example, the percentage of hazards rectified and near miss investigations. They enable trends and weaknesses in processes to be identified before serious incidents occur. Lag indicators measure events and impacts after the event.
60. In the early days of the mine there was discussion of using lead indicators as key performance measures for managers,⁵⁶ though lag indicators (lost time injuries and later medical treatment injuries) were used.⁵⁷ Lag rather than a mixture of lag and lead data was also reported to the operations meetings and to the board.⁵⁸ There is no sign that the board of directors appreciated the importance of using both types of data.

Management review

61. Periodic management review of the health and safety management system is essential to ensure it remains relevant and to plan improvements. Beyond an audit of statutory compliance in early 2010,⁵⁹ there was no systematic attempt to review the health and safety management system initiated by Pike management.
62. The closest to a review was an insurance risk survey conducted by Hawcroft Consulting International. This established risk ratings that influenced the premiums Pike paid for insurance cover. The company's health and safety management systems were rated as average or above, save in one respect – risk management. This received an average rating in 2009, but a below average/low standard rating in 2010.⁶⁰ The commentary to the survey explained that 'Over the next 12 months Pike River Coal will be in a transition phase from development to steady state coal production from the monitor panels. A number of risks exist associated with methane (gas drainage efficiency), wind blast potential (monitor panels only), goaf falls in monitor panels and actual behaviour of the immediate massive strata.' And, as at July 2010, 'management had not conducted a broad brush risk assessment or formal operational risk assessments into these principal hazards, therefore some risks may remain unknown.'⁶¹
63. Mr Rockhouse was alive to this problem. Aware of Hawcroft's recommendation for a broad-based assessment, he raised the matter at various managers' meetings. Mr Whittall responded that the issue should be 'taken offline,' to be discussed 'at a later date outside of this forum.'⁶² There was no discussion and no broad assessment of risks before hydro mining began.
64. A review of the whole health and safety management system would have identified anomalies, many of which could have been readily rectified. For example, the mine manager's rules required people to go to 'a ventilated place' when gas concentrations exceeded 'safe levels,'⁶³ whereas regulations prescribe a 'flammable gas' level of '2% by volume, or more' as the trigger point for withdrawal.⁶⁴ Management plans referred to compliance with codes of practice, when these did not exist in New Zealand. These errors probably resulted from using overseas materials when drafting the Pike documents.
65. There was also a gap between the documented system and actual practices underground. The ventilation management plan provided a glaring example of this. In accordance with best practice it required the appointment

of a ventilation engineer, whose critical role was to oversee the ventilation system. But no one was appointed to this position (see Chapter 8, 'Ventilation', paragraphs 89–101). The plan also contemplated the installation of a tube bundle monitoring system, but the mine did not have one.

66. More generally, when referred to numerous examples of conduct and practices that were contrary to the procedures described in the documented system, Mr Rockhouse lamented that 'the purpose of their creation was to actually be used and be followed to keep everyone safe. Clearly that has not occurred across a lot of departments.'⁶⁵

Hazard recording

67. Pike had a suite of documents that enabled the reporting and recording of hazards and associated information. This included accident and incident forms and 'I am safe' booklets which workers could use to report hazards and a 'baseline risk assessment significant hazard register' (register), which listed hazards rated for their risk and probability and their controls. However, that system was not effective. Four examples illustrate why.
68. First, new information gathered by Pike was not always incorporated into the register. When hazards were reported on the accident and incident forms or in 'I am safe' booklets there would be a check to ensure those hazards were listed in the register. If not, they would be included. But multiple occurrences of the same hazard, and reporting of an accident or incident, did not result in re-evaluation of the probability and consequence of the hazard.⁶⁶ The concerns raised in the Hawcroft report did not flow into the register.⁶⁷
69. Second, the register dealt with hazards discretely, for example hazards relating to vehicles, water management, working at heights and ventilation management. The register did not reflect the increased risks resulting from a combination of hazards. Those risks should have become apparent had there been a broad brush risk assessment of the type raised by Hawcroft.
70. Third, many of the controls listed in the hazard register were dependent on compliance with Pike's management plans and operating procedures, and the proper training and assessment of, and operation of equipment by, workers. Yet, as seen elsewhere, there were significant problems with those aspects, which suggest that many of the 'controls' did not exist or could not be relied on.
71. Finally, to Mr Rockhouse's knowledge the register was not used for management-level operational planning.⁶⁸

Conclusions

72. The company did not have a clear strategy from the board that set out its vision, objectives and targets for health and safety management. It did not treat health and safety as a key corporate risk and prioritise the development of an integrated health and safety management system.
73. The executive management team therefore did not always prioritise safety matters. Mr Rockhouse, without a strong mandate, found it difficult to influence and involve others. The safety and training department at Pike appears to have been marginalised.
74. The Pike health and safety management system was never audited internally or externally. If it had been, deficiencies would have been identified, including the gap between the standards and procedures laid down in the Pike documents, and the actual mine practices. Examples of this are highlighted throughout Chapters 8 to 12, on the critical mine systems.
75. Pike generated a lot of information about the safety of critical mine systems and practices underground. This included information about contraband, bypassing of safety devices, ventilation problems, methane spikes, sensor

failures and information on numerous other topics. But much of the information was not analysed and responded to. If it had been, some of the problems discussed in this report would have been highlighted, and a number of warning signs that pointed to the risk of an underground explosion would have been noticed.

76. The appointment of a specialist health and safety adviser does not alleviate the need for an organisation-wide acceptance of responsibility for health and safety management.

ENDNOTES

- ¹ Standards Australia and Standards New Zealand, Occupational Health and Safety Management Systems – General Guidelines on Principles, Systems and Supporting Techniques, (AS/NZS 4804:2001), 15 November 2001, p. 4.
- ² Civil Aviation Authority of New Zealand, Safety Management Systems Policy, http://www.caa.govt.nz/SMS/SMS_Policy.htm
- ³ David Cliff, The Management of Occupational Health and Safety in the Australian Mining Industry, 2012, International Mining for Development Centre, p. 5, http://im4dc.org/wp-content/uploads/2012/01/UWA_1698_Paper-03.pdf
- ⁴ Health and Safety in Employment Act 1992, ss 5(a), 6.
- ⁵ To ensure there is broad coverage, and reflect the variety of workplaces, similar duties are imposed on those who control workplaces, the self-employed, principals to contracts and suppliers of plant.
- ⁶ The definition of hazards is broad. It can include 'physical, chemical, biological, psychosocial and mechanical factors': Kathleen Callaghan, witness statement, 31 October 2011, FAM00042/8, para. 23.
- ⁷ Standards Australia and Standards New Zealand, Occupational Health and Safety Management Systems – Specification with Guidance for Use (AS/NZS 4801:2001), 15 November 2001; Standards Australia and Standards New Zealand, AS/NZS 4804:2001.
- ⁸ Standards Australia and Standards New Zealand, AS/NZS 4801:2001, p. 40.
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- ¹² *Ibid.*, pp. 4197–98.
- ¹³ *Ibid.*, pp. 4340–41; Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/13, para. 30.
- ¹⁴ Neville Rockhouse, transcript, p. 4253.
- ¹⁵ *Ibid.*, pp. 4290–91.
- ¹⁶ *Ibid.*, pp. 4209, 4278, 4361.
- ¹⁷ *Ibid.*, p. 4365.
- ¹⁸ Before Mr Rockhouse began work, Pike had a documented system that he considered would not meet AS/NZS 4801: Neville Rockhouse, transcript, p. 4209.
- ¹⁹ See table of contents: Pike River Coal Ltd, Corporate Safety Manual: Safety in the Pike Coal Workplace, 2008, DOL7770030013/1–7.
- ²⁰ Department of Labour, Pike River Mine Tragedy 19 November, 2010: Investigation Report, [2011], DOL3000130010/235, para. 5.5.2.
- ²¹ Andrew Sanders, Pieter van Rooyen and John Rowland, see Chapter 8, 'Ventilation', paras 39–42.
- ²² Health and Safety in Employment Act 1992, ss 12, 28A.
- ²³ John Rowland, witness statement, 25 November 2011, ROW007/1, para. 4.
- ²⁴ Neville Rockhouse, transcript, p. 4244.
- ²⁵ *Ibid.*
- ²⁶ *Ibid.*, pp. 4224–25, 4244–45.
- ²⁷ *Ibid.*, p. 4235.
- ²⁸ *Ibid.*, p. 4366.
- ²⁹ *Ibid.*, pp. 4266–67.
- ³⁰ *Ibid.*
- ³¹ Pike River Coal Ltd, Corporate Safety Manual: Section 1.8, 26 November 2008, DAO.001.08360/1–2.
- ³² Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/37–38, paras 125–26.
- ³³ Adrian Couchman, transcript, p. 3811.
- ³⁴ Neville Rockhouse, transcript, pp. 4231–32.
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- ³⁹ Adrian Couchman, witness statement, 28 November 2011, COU0001/20, para. 109.
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- ⁴¹ Email, Douglas White to Adrian Couchman, Neville Rockhouse and Stephen Ellis, 9 November 2010, DAO.002.08157/1.
- ⁴² Email, Adrian Couchman to Neville Rockhouse, 3 March 2010, DAO.002.08049/1.
- ⁴³ Letter, Neville Rockhouse to Adrian Couchman, 17 March 2010, DAO.002.08049/2–3.
- ⁴⁴ Pike River Coal Ltd, Pike Health and Safety Committee, Meeting Minutes, 13 September 2010, DAO.002.08125/2.
- ⁴⁵ Adrian Couchman, transcript, p. 3817.
- ⁴⁶ Pike River Coal Ltd, Health and Safety Committee, Meeting Minutes, 11 October 2010, DAO.002.08138/2.
- ⁴⁷ Karyn Basher, witness statement, 10 November 2011, CAC0117.
- ⁴⁸ Pike River Coal Ltd, Incident/Accident Form for All Accidents, Near Accidents, Incidents and/or Property Damage Incidents, DAO.001.08685.
- ⁴⁹ Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, 7 November 2011, CAC0114.
- ⁵⁰ Adrian Couchman, transcript, pp. 3803–04.
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- ⁵² Neville Rockhouse, transcript, p. 4227.
- ⁵³ Adrian Couchman, witness statement, 26 November 2011, COU0001/17, para. 97.
- ⁵⁴ Neville Rockhouse, transcript, p. 4257.
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- ⁵⁶ Neville Rockhouse, transcript, p. 4207.
- ⁵⁷ Neville Rockhouse, witness statement, 13 November 2011, ROCK0002/28, para. 87.
- ⁵⁸ Neville Rockhouse, transcript, p. 4206.
- ⁵⁹ David Stewart, Pike River Compliance Audits, February–April 2010, STE0004.
- ⁶⁰ Hawcroft Consulting International, Pike River Coal Limited, Pike River Mine – Risk Survey – Underground, CPP & Surface Operations: Final Report, July 2010, DAO.003.08710/17, 21.
- ⁶¹ *Ibid.*, DAO.003.08710/11.

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Mine systems

- + Ventilation
- + Methane drainage
- + Gas monitoring
- + Electrical safety
- + Hydro mining

CHAPTER 8

Ventilation

Introduction

The purpose of mine ventilation

1. All underground coal mines require adequate ventilation. A mine's ventilation system must deal with the hazards of gas and dust, keep the temperature and humidity within acceptable limits, and ensure there is sufficient air for workers to breathe.¹ The ventilation system should form part of an overall gas management system, including gas monitoring, electrical safety procedures, measures to avoid sources of ignition and, in some cases, pre-drainage of methane.²
2. Poor ventilation is a serious hazard that creates a risk of a major explosion and loss of life. Multiple disasters over more than a century have shown the importance of robust ventilation, which has rightly been described as 'the life-blood of any operational mine'.³

Basic description of a ventilation circuit

3. The basic design of a ventilation system consists of an intake, which draws in fresh air, and a return, which expels contaminated air. This creates a ventilation circuit, with air flowing in, across a working face to collect gas and other contaminants, and out through the return. Mining consultant David Reece referred to the following diagram to explain the concept of a ventilation circuit:

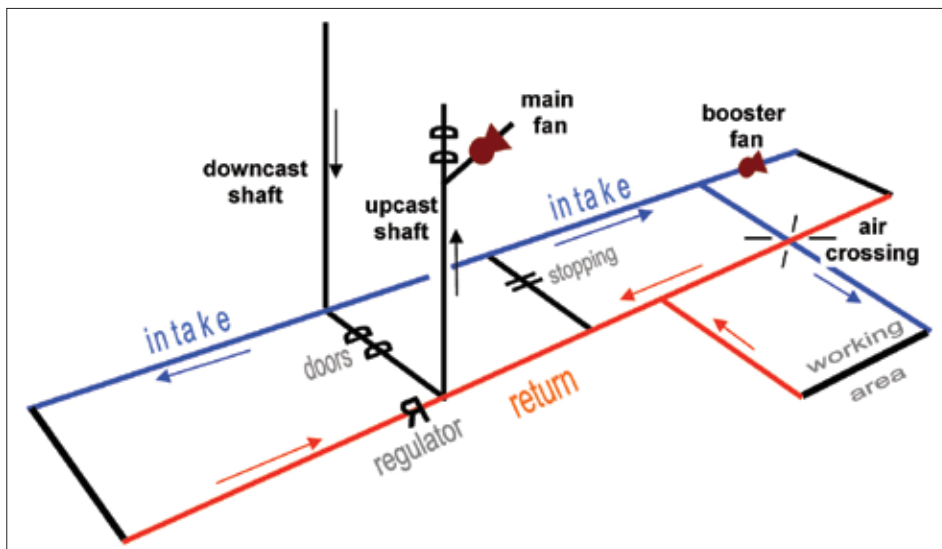


Figure 8.1: Typical elements of a main ventilation system⁴

4. Fresh air is drawn in through a downcast shaft, continues along the blue intake roadways, then across the mining faces shown in black. Contaminated air travels through the return airways, shown in red, and out the upcast shaft through the main fan. At Pike River, the intake was the 2.3km drift, and the main fan was at the base of the upcast shaft rather than on the surface, but the principle of a ventilation circuit was the same.
5. To create a ventilation circuit it is essential to direct air along the correct roadways and in the right direction. This is achieved with ventilation control devices. These consist of stoppings (solid barriers), overcasts or air crossings (which send air over a roadway) and other devices designed to direct or control the flow of air. Any leakage of air, through a poorly constructed stopping, for example, will make the ventilation circuit less effective.

6. The simplest ventilation circuit involves a U shape with the intake and return completely separated by solid walls. However, during development there will frequently be sections of one-way road, as well as dead-end stubs and other areas, that do not naturally fall within a circuit. One solution to ensure these areas are properly ventilated is to use an auxiliary fan, such as the one in the photograph.



Figure 8.2: Auxiliary fan

7. An exhausting auxiliary fan draws contaminated air away from the end of a stub or working face through a tube. A forcing fan may also help to send intake air in the correct direction towards the face. This is shown in the diagram, which shows an exhausting auxiliary fan drawing air away from the face through a ventilation tube, in red, with an additional forcing fan, in blue, on the right to help push fresh air up to the face.

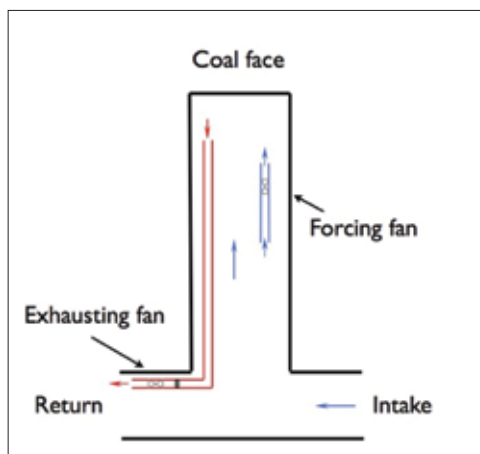


Figure 8.3: Right-hand diagram exhausting system with force overlap⁵

8. In order to function safely and effectively, an auxiliary fan must itself be located in sufficient air to keep it cool and to prevent recirculation of contaminated air. A standard requirement, which applied at Pike River, is that the main ventilation system must provide at least 30% more air to the auxiliary fan than the fan itself draws.

Who designed the Pike River ventilation system?

9. It was clear from an early stage that the Pike River ventilation system would need to deal with significant quantities of methane. As the next chapter describes in more detail, estimates of the methane content in the coal seam varied, and the Minarco Asia Pacific Pty Ltd ventilation report in June 2006 predicted a 'medium to high gas content throughout the resource area, particularly within close proximity to the Brunner fault.'⁶ As a result, Pike River was expected to need about twice the ventilation of a typical high-production longwall mine.⁷ Given the gassiness of

the coal seam, and the other challenges facing the design of the ventilation system, including the rugged surface terrain and complex geology, Pike should have had a dedicated ventilation officer⁸ to oversee the system's design.⁹

10. However, no one person assumed responsibility for designing the ventilation system. When Peter Whittall was asked who designed it, he referred to four different ventilation consultants providing specific advice at different times.¹⁰ It was appropriate for Pike to obtain advice from independent consultants, but the company did not establish clear responsibility and accountability for the overall design of the ventilation system.

Location of the main fan

Suggestions for an underground fan

11. On 31 October 2006 Pike invited four contractors to tender for the design, supply and installation of its main ventilation fans. The invitation stated that the fans were to be located on the surface. That is standard practice in the industry for a number of reasons, including the need for ready maintenance access, a secure power supply and access in an emergency. However, Pike faced significant challenges in installing fans on the surface. The proposed location was in mountainous conservation land, the only access was on foot by a bush track or by helicopter, there was no surface electricity supply and weather conditions on the surface were often harsh.
12. Two contractors ultimately proposed underground fans in addition to the conventional surface fans. It is unclear how the idea of underground main fans originated,¹¹ but Pike decided in favour of and developed the idea jointly with the preferred tenderer, Fläkt Woods Fan (Australia) Pty Ltd, in late 2006.¹²

Unique in the world

13. Pike ultimately decided to install its main fans underground, with a back-up fan on the surface. That situation is unique. Although underground booster fans are common in many countries, there is no evidence of any other coal mine in the world with a main fan underground.

The hazards of underground installation

14. Three main risks arise from locating a main fan underground.¹³ First, it is more difficult to re-establish ventilation after an explosion, which could compromise the survival chances for anyone underground. Second, an underground fan is more likely to be damaged by an explosion. Third, an underground fan is closer to explosive material such as methane and coal dust, and a malfunction of the fan or its motor can be a source of ignition.
15. No doubt for these reasons, legislation in other countries either expressly bans main underground fans in coal mines,¹⁴ or assumes they are installed on the surface and that only booster and auxiliary fans are installed underground.¹⁵ The International Labour Organisation (ILO) code of practice issued in 2006 also assumes main ventilation fans are installed on the surface.¹⁶ New Zealand law does not specifically prohibit the installation of main fans underground, and there is no mention of the location of main fans in the guidelines issued by the national health and safety council for the New Zealand minerals industry (MinEx), in October 2009.
16. Given the risks and the unique nature of the proposal, Pike should have insisted on a robust risk assessment and decision-making process to assess the proposal for an underground main fan. Three aspects of the process adopted by Pike are worthy of analysis: the risk assessment process, the level of oversight by Pike's board and the management's response to concerns raised.

Underground fan risk assessment

17. At the time of the tender process, Pike intended the ventilation shaft would be in stone measures, at a location east of the Hawera Fault. In February 2007 Pike held a professionally facilitated risk assessment into the placement of main fans underground. The risk assessment was led by two facilitators from Platinum Safety Ltd. Their role was specifically confined to facilitation of the assessment process as they had limited experience and knowledge of any

elements of mining.¹⁷ The expert group comprised Pike's engineering manager (Tony Goodwin), technical services manager (Udo Renk), mechanical co-ordinator (Robb Ridl), senior mine engineer (Guy Boaz) and health and safety manager (Neville Rockhouse). The group also included a representative from Fläkt Woods, and Jim Rennie, an Australian ventilation consultant engaged by Pike. Mr Whittall participated in scoping the risk assessment.¹⁸

18. The group noted that installing main fans underground required a rigorous risk assessment process because of the risks to employee safety and business continuity.¹⁹
19. The scope of the risk assessment was described as 'high level', and the facilitators described the process as 'very challenging' and difficult to maintain within the agreed scope and context because people continually left and returned to the meeting. A large number of 'unknown factors' required further analysis by Pike.²⁰

Problems with the underground fan risk assessment

20. In common with other risk assessments at Pike, the process rated the risks of various events and identified proposed controls. The risks were re-evaluated, and often reduced, in light of the controls.
21. For example, the hazard identified as '[b]oth main fans destroyed by explosion' involved the risks of 'destroyed fans', 'employee injury', 'business interruption' and 'suffocation from methane in the mine'. Two of these risks were initially rated as high in the 'red' or 'unacceptable' area, but revised into the 'green' or 'low' risk category in light of various controls, namely:
 - *design and layout of the installation with built in explosion proofing*
 - *protection of equipment by servicing and maintenance*
 - *design consideration of the doors*
 - *limit the sources of ignition*
 - *installation of blast panels to protect the surface fan*
 - *implement detailed Emergency Response Plans*
 - *require supervisors to monitor specific hazardous processes and the installation*
 - *install temperature and vibration sensing equipment*
 - *site in a solid rock housing.*²¹
22. Some of these proposed controls never eventuated. For example, Pike did not install explosion proofing for the main underground fan, did not site the fans in rock and the blast panels on the surface fan proved inadequate during the explosion.

Relocation of the ventilation shaft

23. In September 2007 Pike moved the location of the ventilation shaft from stone into coal, west of the Hawera Fault, as discussed in Chapter 3, 'The promise of Pike', paragraph 47. The fan site moved with it, and despite material changes in the risks, there was no further risk assessment. Commissioning engineer Andrew Sanders, who began work at Pike as a consultant, drew this to Pike's attention in March 2010,²² and listed three questions for the company:
 - Was the risk assessment report ever finalised?
 - Have resulting actions been followed up and signed off?
 - Would it be appropriate to conduct another risk assessment on the latest proposed design and installation?

Mr Sanders' questions were never answered.

24. The risk assessment report was not finalised. There were four versions of the draft report, but despite attempts by Platinum Safety between March and July 2007, Pike never finalised the report. In June 2007 Neville Rockhouse apologised to Platinum Safety for Pike's 'unprofessional conduct with regard to this project',²³ after a third version

circulated to management to provide content had not been completed. The fourth version was distributed to managers in early July 2007 for completion,²⁴ but Platinum Safety had no further communication with Pike.²⁵ Mr Renk described trying several times with Mr Rockhouse to finalise it, but said Mr Whittall disagreed 'with some of the risk ratings and wording of the report and we were not able to finalise it.'²⁶ Mr Whittall does not recall any such approaches. He said he was not on the risk assessment team and it could finalise the assessment without reference to him.²⁷

25. The failure to finalise the risk assessment, whatever the reasons, meant Pike had no adequate basis for deciding whether to proceed with the underground fan in light of the risks. That decision was critical, and should have been informed by a proper and final risk assessment.

Board oversight

26. Other than approving the expenditure required to enter into a contract with Fläkt Woods to manufacture and install the fans in July 2008,²⁸ neither the Pike board nor its health, safety and environment (HSE) committee took steps to ensure management had properly assessed the health and safety consequences of placing the main ventilation fans underground.
27. The board was informed in general terms of the underground fan risk assessment, but neither saw, nor asked for any audit of, the risk assessment report. The operations report to 23 February 2007 simply told the board there was 'no legislative or technical barrier to locating these fans underground with engineering solutions available to identified problems.'²⁹ From the board minutes, that advice appears to have been accepted without question.
28. Board chair John Dow was unaware of any other coal mine in the world with a similar arrangement,³⁰ but he said it was not a matter of particular concern for the board's HSE committee (which he chaired) to review the risks associated with having a main fan underground. He said he remembered having conversations about the location of the fan, but he saw it as a management issue.³¹

Management response to concerns

29. From early 2007, when the operational decision was made, numerous people at Pike raised concerns about locating the main fan underground.
30. In June 2007 Mr Rennie emailed Mr Whittall and proposed a forcing fan at the portal instead of an underground fan. He identified many advantages, including:
 - ease of installation;
 - immediate access to the fan for maintenance;
 - power to the fan would not have to be routed underground and no secondary fan/generator system was required;
 - minimal facilities would need to be maintained at the remote ventilation shaft surface with less environmental impact; and
 - the long-term escapeway via the ventilation shaft would not be needed.

Mr Rennie stated that while his proposal for a forcing fan was 'somewhat unusual', it was 'by no means rare'.³²

31. Mr Boaz was a participant in the February 2007 risk assessment. He left Pike later that year. He did not agree with the idea of putting fans underground and thought that the decision to do so was taken without full consideration of the risks involved.³³ Describing the concept as 'ground breaking', because he had not 'heard of it ever occurring in any other underground coal mine in the world', he raised his concerns with Mr Whittall.³⁴ However, Mr Whittall has 'absolutely no recollection' of this conversation.³⁵
32. Mr Renk, the technical services manager from January 2007 to May 2008, emailed Mr Whittall in October 2007 to say he 'strongly believe[d]' a forcing fan at the portal was preferable to an underground fan and quoted a number of economic arguments to support his case.³⁶ Mr Renk says he was told it was too late as the decision had already

been made.³⁷ Mr Whittall does not recall saying this and also said that in any event a forcing fan was ruled out as impracticable at Pike River.³⁸

33. Concerns continued to be expressed in 2009. Technical services manager Pieter van Rooyen recalled that in about February or March that year Mr Rennie expressed concerns about the placement of the main fans underground. Mr van Rooyen spoke to Mr Whittall, who said the decision had already been made, and one fan was already in New Zealand and the other partially constructed but on hold.³⁹

Oversight by the regulator

34. Michael Firmin, the Department of Labour (DOL)'s health and safety inspector responsible for liaison and inspections of Pike River mine from 2007 to mid-2008, recognised that an underground main fan was unusual and would give rise to more hazards than a surface installation.⁴⁰ Mr Whittall told him, at a meeting on 13 February 2007,⁴¹ that 'he looked at the regulations. And there was nothing that would stop Pike River doing this, and that's basically what he said.'⁴² Pike's risk assessment meeting on placement of the main fans underground occurred two days later.
35. Mr Firmin checked the New Zealand regulations and concluded they 'did not appear to prevent the main fan being installed underground.'⁴³ He was concerned enough to conduct internet research into the regulatory regimes in other countries but said he did not find any regulation preventing an underground installation.⁴⁴

The ventilation management plan

36. Pike had a ventilation management plan, which was signed off by mine manager Kobus Louw and Mr Rockhouse on 18 November 2008, soon after the main drift struck coal.⁴⁵ The ventilation management plan was a 78-page document, with 48 pages of appendices. It dealt with 11 major topics:
- ventilation design, plans and reports;
 - ventilation fans;
 - ventilation structures;
 - underground environmental monitoring;
 - mine inspections;
 - prevention of ignitions;
 - respirable dust;
 - management of heat underground;
 - wind blast;
 - administration of the ventilation management plan; and
 - responsibilities under the plan.
37. The plan required a ventilation engineer, a tube bundle system, explosion barriers, a permit to work system involving detailed sign-off by the ventilation engineer, and a full risk assessment to determine the non-restricted zone – none of which existed as contemplated by the plan.
38. The plan contained detailed and prescriptive responsibilities attached to 14 different roles at the mine. The mine manager was required to appoint a ventilation engineer,⁴⁶ and to receive reports from the ventilation engineer dealing with any defects in the ventilation or personnel.

Criticisms of the ventilation management plan

39. A number of staff members and contractors at Pike voiced concerns about the ventilation management plan. Mr Sanders produced a report dated 31 March 2010, which noted that the ventilation management plan was out of

date and contained numerous references to standard operating procedures that did not exist or had not been approved. He listed 54 items that required follow-up before the main ventilation fan was commissioned and hydro-monitor operations began. These included:⁴⁷

- the appointment of a ventilation engineer;
- the lack of a tube bundle system;
- the risk of wind blast due to hydro mining;
- clarifying the various responsibilities under the plan;
- ensuring consistency between the ventilation management plan, the emergency response management plan and other plans and procedures at the mine;
- addressing inconsistencies in the definition of the restricted zone;
- confirming assumptions underlying the plan;
- completing an annual ventilation audit by an independent ventilation engineer;
- reviewing the actions to be taken when methane levels rose above set limits;
- creating a hydro monitor panel gas management plan;
- establishing special controls during initial operation of the hydro monitor;
- planning for safe access to the surface ventilation fan in the event of an emergency;
- reviewing of the ventilation management plan;
- carrying out a risk assessment before monitor start-up; and
- training and communication on the ventilation management plan.

40. Mr White accepted that he received a copy of Mr Sanders' report,⁴⁸ although he said he was not aware of the list of 54 things to be addressed before hydro-monitor extraction.⁴⁹ There was no process to check whether the items had been completed,⁵⁰ and many of them were not.
41. Mr van Rooyen, who arrived at Pike in February 2009, realised the ventilation management plan would need to be reviewed because it contained information he considered irrelevant and was sometimes 'too detailed and impracticable'.⁵¹ As a result, he asked ventilation consultant John Rowland to review the plan.
42. Mr Rowland did so and reported: 'to be honest I don't like it either!!' He described it as an all-encompassing plan covering ventilation management, explosion suppression, monitoring and other topics. It was 'gargantuan to be blunt and far too specific in my opinion in a lot of areas'. It would be difficult for him to adjust the plan in isolation: he would need to review the other management plans to see how they dovetailed together, and he would need to see a risk assessment. In his view the plan should be split up into various documents and this would take considerable thought. He said, 'It is ugly and will require far more discerning thought from you guys than you possibly realise.'⁵² Mr Rowland received no further instructions in relation to this matter.

Compliance auditing

43. Australian and New Zealand Standard 4801 provides for safety management systems to be regularly audited.⁵³ There was no process at Pike to audit compliance with the ventilation management plan, and no external auditing.
44. Mr Rowland was not asked to audit compliance with the ventilation management plan.⁵⁴ When David Stewart of MinServ International carried out a series of compliance audits at Pike in February to April 2010, he did not look at the ventilation management plan. Indeed, he 'deliberately stayed away from looking at the documentation as such',⁵⁵ because he believed the plan was to be reviewed and updated. Mr Stewart said it is not easy for any mine to ensure that management plans are complied with, and he expected Pike was typical in this respect.⁵⁶

45. Mr Dow said the HSE committee did not consider asking to see evidence of compliance with the ventilation management plan.⁵⁷ He said those were 'onsite activities',⁵⁸ and he did not accept that the HSE committee of the board should have ensured that the things required by the ventilation management plan were in fact happening at Pike River.⁵⁹

The Pike ventilation system as built

46. Pike's early planning contemplated multiple intakes beyond the first year of development.⁶⁰ In November 2010 the Pike River ventilation system was still a one intake and one return system, as shown in the following diagram:

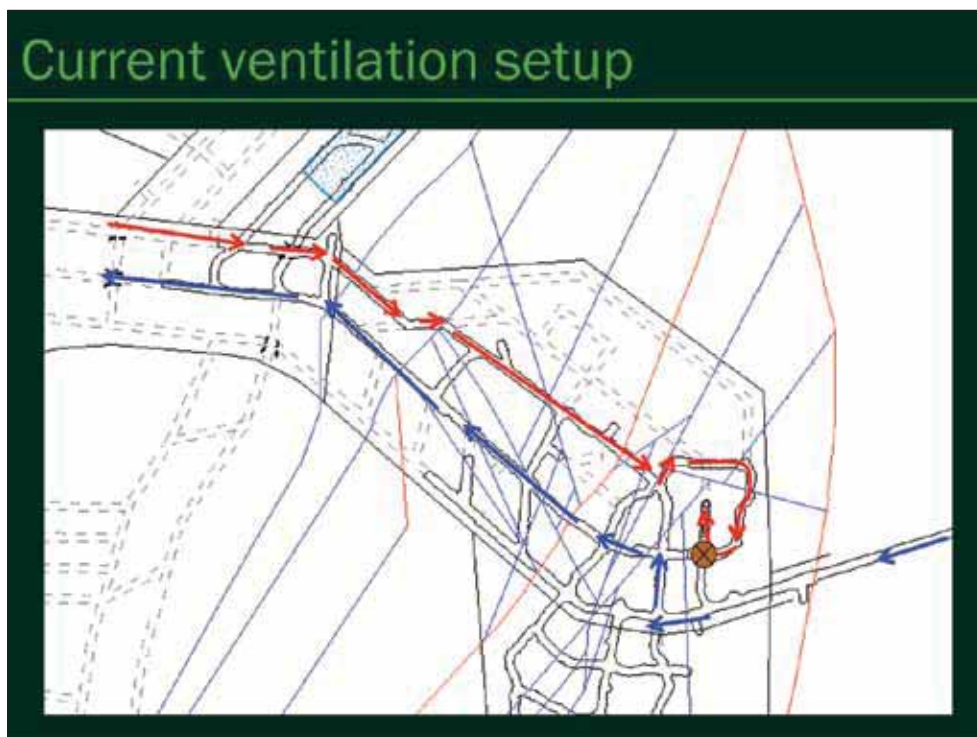


Figure 8.4 : Current ventilation setup⁶¹

47. The blue arrows depict fresh air entering through the intake (main drift), circulating through the workings and exiting through the return, shown in red. The main underground fan is depicted as a circled X towards the bottom right of the diagram, at the base of the ventilation shaft. Mr van Rooyen presented this simplified diagram of the Pike ventilation system to the Pike board in August 2010.
48. Mr Reece told the commission a single intake and return system is quite unusual for a mine with four or five working areas extending from it.⁶² The DOL experts' report states that a one intake and one return system is not uncommon in New Zealand coal mines but would not be considered acceptable for anything but initial development in Australia. The report notes that Pike did plan to establish a second intake but it appeared that the mine would always be restricted to a single return system. The report said this might be acceptable, given the difficult geographical environment, but from a ventilation perspective it left no room for error. Any compromise to the main return would become a very serious event.⁶³
49. The second intake was still planned. Mr van Rooyen presented the Pike board with a number of options in August 2010.⁶⁴ He estimated that it would have taken about a year for Pike to reach the recommended location of the second intake from the time he left in November 2010.⁶⁵

The surface fan

Design and installation

50. Pike installed the surface back-up fan at the top of the ventilation shaft in June 2009. The exhaust structure (evasé) for the surface fan is on the left in the photograph, and the larger evasé is for the main underground fan.



Figure 8.5: The surface back-up fan

51. Fläkt Woods designed, built and installed the surface fan. It was powered by a 132kW electric motor with a capacity of 90m³/s air flow at 0.4kPa (kilopascals) pressure.⁶⁶ The fan acted as the primary fan until the first main fan was commissioned underground.
52. The diagram below shows a bird's-eye view of the surface fan as installed. In the centre was the main underground fan evasé, designed to direct the air flow horizontally and prevent rain or snow entering the ventilation shaft.⁶⁷ The surface fan impeller (blades) and motor were to the right. To the left was an airlock entrance allowing access to the fan housing. Anyone climbing the ladder in the ventilation shaft would also exit through the airlock.

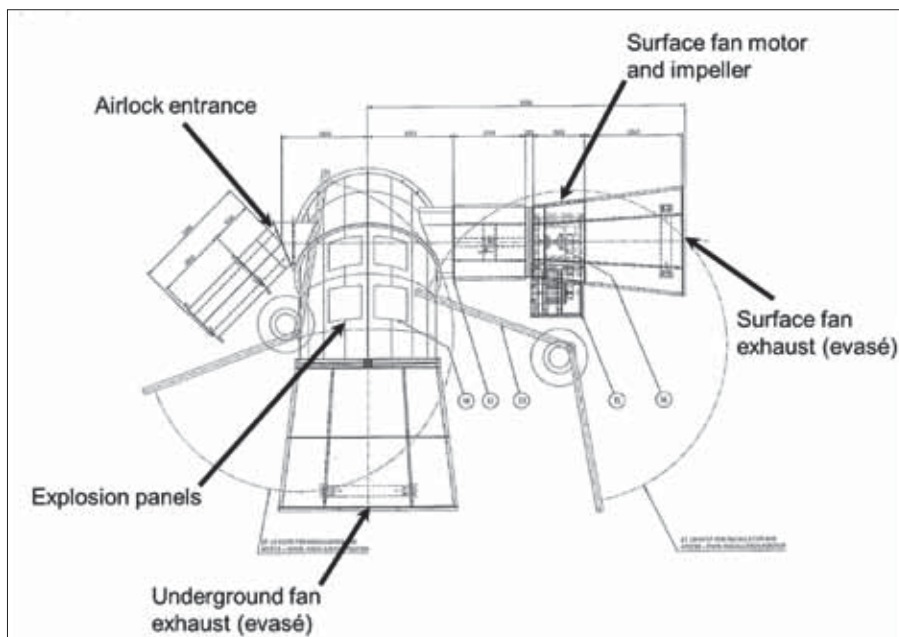


Figure 8.6: Surface fan as installed⁶⁸

53. On the top of the housing were four explosion panels, designed to allow a pressure wave of air and debris following an explosion to go straight through the top of the housing and minimise damage to the fan. The explosion panels are seen in black in Figure 8.5.
54. Because both the surface fan and main underground fan were connected to the same ventilation shaft, a system was needed to block off air flow through one or other easé, depending which was in use. Initially Fläkt Woods designed a butterfly damper for that purpose, but this was damaged and not repaired for 12 months or more.⁶⁹ During commissioning of the underground fan a few weeks before the explosion, Pike installed a set of louvres at the end of the main fan easé as shown below. These were designed to close if the main fan stopped and the surface fan started up to ventilate the mine.



Figure 8.7: Evasé showing louvres being installed

55. The surface fan was powered by electrical cabling that ran from the portal substation up the main drift and then to the surface via the shaft. This was unusual. It meant that if power was tripped to the main fan at the portal, for example because of methane in excess of 0.25% in the vicinity of the fan motor, power would also be unavailable to the surface fan. Accordingly, diesel generators were installed to start automatically if the main fan stopped, enabling the surface fan to operate.⁷⁰

Surface fan failures

56. On the evening of 5 October 2010, about three weeks before the commissioning of the underground fan, the surface fan failed after a blade sheared off.⁷¹ Methane levels rose, power tripped to the underground workings and all personnel underground were evacuated from the mine. The mine gassed out, and on 6 October drops in barometric pressure and temperature caused methane levels in pit bottom to rise to such a level that Pike was unable to send a Mines Rescue Service (MRS) team underground to degas.⁷² The daily volume of methane make peaked at 102,000m³ during degassing on 7 October.⁷³ Pike conducted a risk assessment together with MRS personnel,⁷⁴ and repaired and ran the surface fan using the damper door to 'gradually introduce ventilation underground diluting the gas levels until normal historical gas levels were reached'.⁷⁵
57. A similar event had occurred in July 2009 due to vibration.⁷⁶ Project manager Terence Moynihan believed that changes to underground ventilation and surface conditions meant the fan sometimes operated within the stall zone, leading to high levels of vibration and causing fan blade failure.⁷⁷ Given the changes from the original

ventilation shaft design, including the smaller Alimak raise installation, and based on an April 2010 ventilation survey conducted by Mr Rowland indicating high pressure losses between the shaft collar and the fan itself,⁷⁸ Mr Moynihan considered the surface fan was operating at significantly higher pressures than the instrumentation was recording. He felt that with the mine expanding, and increasing resistance, the surface fan would not have been able to meet its objective as a back-up ventilation fan.

58. Pike reviewed the surface fan failure in a meeting on 7 October.⁷⁹ The reason for the failure had yet to be determined by the engineering department,⁸⁰ and the review did not focus on preventing a repeat event. Rather, the meeting identified a number of improvements required to Pike's immediate response.⁸¹ It is unclear how many of the identified improvements had been achieved by 19 November 2010.⁸²
59. This failure occurred when the surface fan was about to take on a crucial back-up role to the underground main fan. Pike's ability to reventilate the mine in the event of a gassing out or an explosion underground was dependent on the surface fan, as the main ventilation fan could not be restarted in high methane levels. This incident was a near miss that should have led to more robust investigation and action.

The main underground fan

Installation of the fan

60. Pike's first main underground fan was installed in August and September 2010. Its size and configuration are shown in the photograph below. The fan motor (grey) is in the foreground, with the drive shaft (orange) connecting to the fan impeller (white).



Figure 8.8: Underground fan being assembled in factory

61. The bird's-eye diagram below shows the orientation and operation of the underground fan.

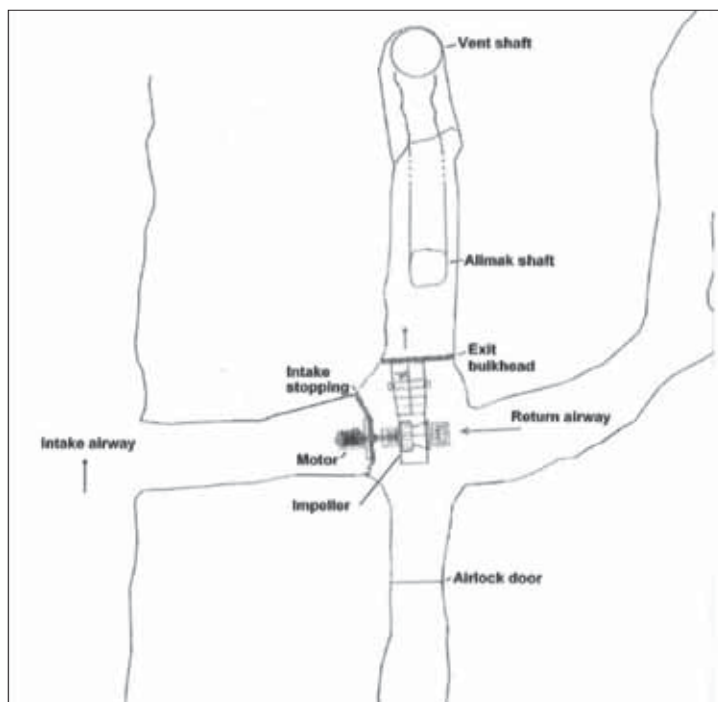


Figure 8.9: Orientation and operation of underground fan

62. Air entered from the return airway to the right of the diagram, then passed through the impeller and up the Alimak shaft. The non-flameproof motor was in fresh air on the intake side and sealed off from the fan impeller by a stopping, through which the drive shaft passed. The exit bulkhead was partly fitted with louvres, which were closed when the fan was working, but opened when it tripped. This enabled the surface fan to draw air more easily up the ventilation shaft to maintain mine ventilation. The airlock doors prevented return air from entering the mine intake system.
63. The main fan was designed to shut down in the event of a methane concentration in excess of 0.25% near the fan motor or when temperature or vibration cut-off points were reached, at which point the back-up surface fan was designed to start automatically.
64. The fan's maximum capacity was $128\text{m}^3/\text{s}$,⁸³ from the 375kW motor that was controlled by a variable speed drive (VSD) located about 94m away in pit bottom south.⁸⁴

Commissioning and operation of the fan

65. The main fan was first operated on 4 October 2010, but sparks came from the fan shaft at the junction with the intake stopping through which it passed.⁸⁵ To resolve the problem Pike removed a brass bush, which formed a seal between the drive shaft and the stopping.⁸⁶ This left a gap which Mr Sanders estimated was at least 20mm.⁸⁷ Mr White accepted there was potential for methane-contaminated air to leak through the gap if the fan was not operating.⁸⁸
66. Further testing continued and on 22 October 2010 the underground main fan came online and the surface fan switched to standby duty.⁸⁹ Almost immediately the main fan suffered problems associated with the VSD power supply and other issues. At first neither the supplier, Rockwell Automation (NZ) Ltd, nor the installer, iPower Ltd, could identify the problem. In late October Rockwell agreed to replace the liquid-cooled 700L VSD with an air-cooled and larger capacity 700H model.⁹⁰ Problems continued as the new model was installed in the same VSD cabinet but had a different thermal requirement, and to avoid rising temperatures tripping the power, the mine installed ducting to direct air over the VSD. An air conditioning unit was also ordered, but had not arrived at the time of the explosion.⁹¹

67. Testing of the fan was completed on 10 November 2010 and the fan was finally commissioned for operation.⁹² After installing the replacement 700H VSD, the main fan ran continuously until the explosion, apart from one problem caused by an auxiliary fan motor.⁹³

Explosion protection of the fans

The proposed explosion path and explosion proofing of the underground fan

68. In 2007 Mr Renk designed twin underground fans to be housed in a separate heading, offset at 90° from the main return.⁹⁴ This was an attempt to create an explosion path to mitigate the risk of damage to the underground installations in an explosion.⁹⁵
69. When the ventilation shaft was relocated into coal west of the Hawera Fault, Mr Renk redesigned the fans to remain offset from the shaft, with stoppings designed to fail in a pressure concussion event so a blast overpressure would bypass the fan and go directly into and up the shaft to the surface. He intended to install additional explosion-proof standard stoppings reinforced with steel to protect the fans.⁹⁶
70. After the collapse of the ventilation shaft and the installation of the Alimak raise, the technical services department had to review and redesign the underground fan installation, and Mr Renk's earlier explosion path design was no longer possible.⁹⁷ By that time he had left Pike and no one in the department, including the new manager Mr van Rooyen, had prior experience with the concept. In June 2009 Mr van Rooyen looked at trying to maintain an explosion path to protect the fan but, after some research,⁹⁸ that issue, and the decision over design of a second connection to join the ventilation shaft, were deferred until further geological information was available. It was noted the mine would be without an explosion path until the second connection to the shaft was completed, but the surface fan was considered to be a sufficient contingency, along with other methods, including installation of explosion barriers 'to reduce the potential damage of an explosion'.⁹⁹
71. Discussions in June 2009 (including with Jim Rennie and another consultant Steve Beikoff)¹⁰⁰ and again in September 2010 led to a consensus that explosion paths would not necessarily work as intended in an underground explosion,¹⁰¹ and were not proven to be effective.¹⁰²
72. The 2007 underground fan risk assessment had identified 'built-in explosion proofing' and protection as a control for placement of the main fan underground,¹⁰³ and Pike told insurance risk assessors in 2010 the underground fan would be located in 'explosion protected panels',¹⁰⁴ but no protection was in place.
73. This was described as 'somewhat deficient' by the joint investigation expert panel, who noted protection was a standard requirement in underground booster fan installations 'albeit in the form of a bypass mechanism'. Installation of explosion protection by means of a bypass in the underground workings near the fan 'may have contributed to reducing the extent or even the level of damage to the mine; as well as providing potential survivability of the ventilation system for later operation'.¹⁰⁵

Stone dusting

74. Stone dusting helps to mitigate the effect of an explosion by mixing an inert limestone dust, also known as stone dust, with the coal dust on the floor, roof and ribs of the mine.
75. New Zealand regulations require employers to take all practicable steps to ensure the roof, floor and sides of every accessible part of the mine were treated with stone dust so combustible matter did not exceed 30%.¹⁰⁶ Pike's ventilation management plan set out a stone dust monitoring plan, and required the production deputy and undermanager to ensure that stone dusting was maintained daily in all roadways to within 10m of any working heading.¹⁰⁷
76. Pike's stone dusting was inconsistent. When Mr White implemented a process in mid-2010 to test the standard of roadway dust, all samples failed the standard in Pike's draft standard operating procedure.¹⁰⁸ Although Pike was a

relatively wet mine, which would have mitigated the risk, the stone dusting was below standard and the problem had been raised during inspections and in writing twice by the DOL mines inspector in 2010.¹⁰⁹

Explosion barriers

77. Regulations also require employers to take all practicable steps to ensure water or stone dust barriers were erected at suitable sites to limit the effects of an explosion.¹¹⁰
78. The ventilation management plan stated that 'stone dust barriers of the bag type will be used',¹¹¹ and Pike advised the Hawcroft Consulting International insurance risk assessor, in 2009 and 2010,¹¹² that explosion barriers would be installed to 'provide added defences in the event of a gas ignition, preventing development of a coal dust explosion'. However, as at 19 November 2010, Pike had not installed any explosion barriers underground. The equipment had been purchased and was stored on site from mid-2009.¹¹³
79. Deputies were required to complete a report every shift, and answer the query 'Are explosion barriers in order?' Deputies regularly answered 'no' or 'N/A [not applicable]'. Some Pike employees were concerned about the lack of explosion barriers and said so.¹¹⁴
80. Mr Stewart noted the absence of stone dust or water barriers in any of the roadways, in contravention of the regulations. When he spoke to the engineering staff and underviewers he was told there were no plans for barriers to be erected and they were waiting for a stone dusting machine.¹¹⁵
81. The expert panel considered that stone dust explosion barriers would have been useful.¹¹⁶ Mr Reece accepted that stone dust barriers are not proven to extinguish a flame front from a methane ignition, but they can reduce the intensity of an explosion. Noting the common use of stone dust barriers within development panels of between 100 and 200m, and the relatively small size of the mine at the time of the explosion, Mr Reece said a stone dust barrier may have been appropriate in the main return to give some protection to the fan.¹¹⁷

The failure of explosion proofing of the surface installation

82. The surface fan failed in its vital back-up role. As shown in the photograph below, the explosion panels failed to divert the explosive air flow and debris from the first explosion, which damaged the fan, fan housing, shaft access doors, power generator and control infrastructure. Subsequent explosions propelled the fan and housing from their fixed positions.¹¹⁸



Figure 8.10: The surface fan after the first explosion

83. Gregory Borichevsky and an electrician examined the damage to the surface fan on 22 November 2010, before the second explosion on 24 November damaged it further. The airlock doors in the fan housing and the louvres installed on the evasé had been blown open and damaged. The fan was intact but three of the fan blades were damaged. The control panel had been blown over by the force of the blast coming out of the airlock doors and had fallen onto the emergency stop button of one of the generators.¹¹⁹ The DOL investigation report concluded that the surface fan did not start at all, but it appeared that at least one of the diesel generators had started, since some fuel had been used.¹²⁰
84. Mr Borichevsky believed the surface fan could and should have been restarted. Although damaged, his 22 November examination found the fan was intact, the second generator was running, the airlock doors could have been secured, the main cabling to the control panel appeared to be intact and could have been made safe to restart, the fan cowling, shutters and belts were slightly damaged but repairable, and the drive belts and motor on the fan appeared to be undamaged.¹²¹ He says he told the production manager, Stephen Ellis, of his inspection and his view that the fan could be repaired and restarted to ventilate the mine, but that did not occur. Mr Ellis does not recall this, but comments that effecting repairs would have been too dangerous and restarting the surface fan was a decision for the mine manager Mr White.¹²² Reventilating a mine following an explosion is an option that should always be available but can be dangerous and requires a risk assessment.
85. It is evident from the damage to the surface fan installation that the explosion panels could not cope with the explosion. The fan was too close to the ventilation shaft because of the limited space available at the site. The damage suffered meant the surface fan could not reventilate the mine.
86. Neither New Zealand or Australian mining legislation prescribes or provides guidance on the design of explosion panels. Pike provided no specifications to Fläkt Woods Fans. Fläkt Woods designed the explosion panels in accordance with a standard issued by the United States National Fire Protection Association (NFPA standard 68).¹²³ This standard requires complex calculations depending on analysis of several variables.¹²⁴ Fläkt Woods followed the design approach in this standard after it was specified for use by a Queensland mine for a surface fan installation Fläkt Woods completed in 2008, without comment from the Australian regulator.¹²⁵
87. The commission considers that best design practice is reflected in the United States Code of Federal Regulations for underground mining. These regulations require explosion panels to have a cross-sectional area at least equal to that of the area (in Pike's case the ventilation shaft) through which an explosion would pass.¹²⁶ Under that approach, Pike's explosion panels were less than half the size they should have been to operate effectively.
88. The US regulations also provide that a main fan must be 'offset by at least 15 feet [5m] from the nearest side of the mine opening unless an alternative method of protecting the fan and its associated components is approved in the ventilation plan'.¹²⁷ Although the Pike surface fan was a back-up fan, a similar level of protection was necessary. However, the surface installation site was congested and the fan blades were installed only approximately 2.3m from the edge of the ventilation shaft. This site layout made it much more likely they would be damaged by explosion overpressure and debris.

Responsibility for ventilation at Pike

A dedicated ventilation officer

89. Since 1999 it has been a requirement for underground coal mines in Queensland and New South Wales to have a dedicated ventilation officer. That requirement arose from a recommendation of the inquiry into the 1994 Moura No. 2 mine disaster. The officer's functions are defined by statute and by regulations. They include ensuring adequate ventilation in the mine, ensuring proper ventilation measurements are taken and ensuring all ventilation control devices at the mine are properly constructed and maintained.¹²⁸ In New Zealand, a committee headed by the chief inspector of coal mines reviewed the Moura No. 2 recommendations in 1996, but did not recommend the

creation of a statutory ventilation officer position in this country because at that time only the largest company, Coal Corporation of New Zealand Ltd, had the economy of scale, or need, for such a person.¹²⁹

90. In Australia, the ventilation officer's role is a full-time position. Queensland legislation does permit a ventilation officer to hold another role at the mine, but only if he or she can still carry out the functions of a ventilation officer. Mr Reece said a ventilation engineer would be 'constantly' looking into any methane issues in the mine and going underground every second or third day.¹³⁰
91. In New Zealand, there is no statutory requirement for an underground mine to have a ventilation officer. Non-binding industry guidelines established by MinEx recommend that the mine manager appoints someone to carry out certain functions concerning ventilation, but they are much less exacting than the Queensland requirements.¹³¹ Whereas in Queensland the ventilation officer must 'ensure' adequate ventilation and 'ensure' properly constructed ventilation control devices, the MinEx guidelines recommend that the relevant person carry out 'planning and design of ventilation systems and appliances' without reference to any particular standard.
92. From 2008 Pike's ventilation management plan required the mine to have a ventilation engineer, fulfilling the same role as a ventilation officer. However, no full-time ventilation engineer was ever appointed at Pike.
93. Mr Whittall said the role was subsumed within the mine manager's responsibilities. He thought Pike too small for a dedicated ventilation engineer and it might have been several years before the mine was large enough to merit a dedicated position.¹³² Mr Whittall also said that the mine manager's responsibility for ventilation was 'supplemented by having a full-time, on-call ventilation or a designated on-call ventilation consultant available to us and they acted in that capacity'.¹³³ In particular, he indicated that Mr Rowland filled that role.¹³⁴
94. However, Mr Rowland said he was never a 'full-time, on-call ventilation consultant' for the mine. He said he would not, under any circumstances, have accepted the ventilation engineer's responsibilities under the ventilation management plan as he was not permanently at the mine. Mr White accepted that Mr Rowland was not carrying out the role of ventilation engineer. He said it was never the intention to use Mr Rowland as a ventilation engineer but rather 'to seek his advice and have certain jobs done by him'.¹³⁵
95. Mr White said that when he started in February 2010 he did not think Pike required a ventilation engineer. However, he accepted in hindsight it would have been desirable to have had a full-time person in this role from an early stage, even from the design phase.¹³⁶

Concern at the lack of a ventilation engineer

96. A number of people at Pike raised the need for a ventilation engineer. Mr van Rooyen said that when he was appointed in February 2009 he assumed there would be a ventilation officer at the mine. He thought one was needed, particularly since he had very little ventilation experience. He suggested to Mr Whittall that Pike should send one of its engineers to New South Wales to complete a ventilation officer qualification. Mr Whittall said a ventilation officer was not required under New Zealand legislation, and not necessary owing to the size of the mine. Mr van Rooyen also raised this matter with Mr White.¹³⁷
97. Mr Sanders raised the lack of a ventilation engineer among the 54 matters in his March 2010 report.¹³⁸ The following month, he prepared another report documenting key aspects of the ventilation system and detailing how it was to be controlled and operated. The draft document contained dozens of queries and gaps on critical issues. No final document seems to have been created, and responsibility for the ventilation system and ventilation management plan was never clarified. Mr Moynihan wrote on his copy of the report, 'Who is the ventilation engineer?', 'Who "owns" the ventilation management plan?' and 'Who "maintains" the ventilation management plan and its requirements?'.¹³⁹
98. The subject was perhaps most stridently raised by Dene Murphy, one of the Pike deputies.¹⁴⁰ On 24 June 2010 he noted a problem with the ventilation system in an area containing two electrical substations. Mr Murphy filled out an incident form, noting, among other things, in capital letters, 'Who is the mine ventilation engineer?'. He went on to write, 'Ventilation engineer required', and 'Require immediate feedback within four days – or I will write a formal

letter to the mines inspector'.¹⁴¹ Mr White signed off the incident on 7 July 2010, with the comment, 'This has been discussed with Dene. Vent structures being organised to be made permanent.'

SECTION 4: Identify the Potential Root Causes			
Immediate Causes (tick and describe)		Basic Causes (tick and describe)	
Substandard practices <input type="checkbox"/> Operating equipment without authority <input type="checkbox"/> Unaware of hazard <input type="checkbox"/> Failure to secure <input type="checkbox"/> Operating at improper speed <input type="checkbox"/> Not following procedure <input type="checkbox"/> Removing safety devices <input type="checkbox"/> Using defective equipment <input type="checkbox"/> Failing to use PPE <input type="checkbox"/> Improper loading <input type="checkbox"/> Improper placement <input type="checkbox"/> Improper lifting <input type="checkbox"/> Improper position for task <input type="checkbox"/> Servicing equipment in operation <input type="checkbox"/> Horseplay <input type="checkbox"/> Under influence of alcohol/drugs <input type="checkbox"/> Making safety devices inoperable	Substandard conditions <input checked="" type="checkbox"/> Inadequate guards or barriers <input type="checkbox"/> Inadequate protective equipment <input type="checkbox"/> Defective tools, equipment or materials <input type="checkbox"/> Congestion/restricted action <input type="checkbox"/> Inadequate warning system <input checked="" type="checkbox"/> Fire & explosion hazards <input type="checkbox"/> Poor housekeeping, disorder <input type="checkbox"/> Noise exposure <input type="checkbox"/> Radiation exposure <input type="checkbox"/> High or low temperature exposure <input type="checkbox"/> Inadequate or excess illumination <input checked="" type="checkbox"/> Inadequate ventilation <input type="checkbox"/> Weather	Personal factors <input type="checkbox"/> Lack of knowledge/training <input type="checkbox"/> Lack of skill/inexperience <input type="checkbox"/> Lack of concentration <input type="checkbox"/> Stress <input type="checkbox"/> Misconduct <input type="checkbox"/> Language difficulties <input type="checkbox"/> Inadequate capability <input type="checkbox"/> Improper motivation	Job factors <input checked="" type="checkbox"/> Inadequate leadership/supervision <input checked="" type="checkbox"/> Inadequate engineering <input type="checkbox"/> Inadequate purchasing <input checked="" type="checkbox"/> Inadequate maintenance <input type="checkbox"/> Inadequate tools, equipment, materials <input type="checkbox"/> Inadequate work standards <input type="checkbox"/> Abuse <input type="checkbox"/> Wear and tear <input checked="" type="checkbox"/> Inadequate procedure <input checked="" type="checkbox"/> Safety rules not enforced <input type="checkbox"/> Insufficient staff numbers <input type="checkbox"/> Sub standard/no training <input checked="" type="checkbox"/> Substandard work practice
What was the ROOT CAUSE of this event? VERY INADEQUATE VENTILATION, POOR STOPPINGS: POOR VENTILATION MANAGEMENT. VENTILATION LEAKAGE HIGH PERCENTAGE			
SECTION 5: Remedial Actions Recommended, Including Any Injury Prevention & Training if Required			
Follow up of Event: What investigation/action has or will be taken to prevent a recurrence			
VENTILATION ENGINEER REQUIRED			
CONSTRUCT PERMANENT STOPPING ETC TO CONTROL VENTILATION	By Whom	By When	Date Completed
REQUIRE IMMEDIATE FEED BACK WITHIN 4 DAYS - OR I WILL WRITE A FORMAL LETTER TO THE MINES INSPECTOR			
New Hazard Identified - has this been added into the Hazard Register?			No <input type="checkbox"/>
New Controls Implemented - Have these been recorded in the Hazard Register?			Yes <input type="checkbox"/> No <input type="checkbox"/>

Figure 8.11: Extract from Dene Murphy's 24 June 2010 Incident/Accident Form

99. In the absence of a ventilation engineer, Mr White said he adopted the role of 'de facto ventilation engineer', adding he had 'no choice' because nobody else was available.¹⁴² The ventilation management plan allocated more than 90 duties to the mine manager and ventilation engineer, and Mr White could not have fulfilled those while working as general manager.
100. Hydro-mining consultant Masaoki Nishioka said that when he arrived at Pike in July 2010 he found that 'nobody' was really taking care of ventilation at the mine.¹⁴³
101. After Mr van Rooyen raised the lack of a ventilation officer with Mr White, it was agreed that Dean Jamieson, an underviewer, would be an appropriate person to train as a ventilation officer.¹⁴⁴ However, Mr Jamieson's training was delayed because of the resignation of another underviewer,¹⁴⁵ and he had not started formal training before November 2010.

Ventilation control devices

102. In any mine ventilation circuit it is essential that fresh air is delivered to the correct locations and in the right quantities, and that contaminated air is kept isolated from intake air and from any potential sources of ignition.¹⁴⁶ For that reason, ventilation control devices, including stoppings, overcasts, regulators and other devices, are used to ensure ventilation air continues on the correct path.
103. A stopping is a solid barrier that prevents air travelling through a roadway. A permanent stopping may be constructed from masonry, concrete blocks, fireproofed timber blocks or steel.¹⁴⁷ As a short-term measure, stoppings may be constructed from timber and brattice (a fire-resistant, anti-static cloth). The photograph below shows a low-pressure stopping constructed from timber and brattice.



Figure 8.12: Board and brattice stopping¹⁴⁸

104. Stoppings must be constructed to a suitable standard to avoid leakage, which can compromise the performance of the ventilation system. Stoppings should also be built to withstand the pressures that may follow a roof fall or windblast within the mine.¹⁴⁹

Construction standards

105. In Queensland and New South Wales the law requires stoppings to be 'rated', that is, built to withstand identified pressures. This followed a recommendation of the Moura No. 2 inquiry dealing with the design and installation requirements for seals. A seal is used to isolate a worked-out area of a mine from the rest of the mine infrastructure. It may consist of two or more stoppings, 5–10m apart, with the space between occupied by sand, stone dust or other non-flammable material.¹⁵⁰ The Moura No. 2 inquiry recommended that the chief inspector of coal mines should determine and enforce minimum requirements for the design and installation of seals.¹⁵¹
106. That recommendation is reflected in the current Queensland coal mining safety and health regulation, which requires the ventilation officer to ensure ventilation control devices are installed in compliance with specified ratings. For example, a stopping installed as part of the main ventilation system must be capable of withstanding an overpressure of 35kPa.¹⁵²
107. Neither New Zealand law, nor the industry guidelines produced by MinEx, provide for stoppings to be built to any rated standard. The guidelines suggest temporary ventilation stoppings can be as many as four cross-cuts or 250m backbye of development headings.¹⁵³ Mr Reece told the commission this was 'significantly less of a standard' than Queensland regulators would accept.¹⁵⁴

The ventilation control devices at Pike River

108. In 2006 the Minarco ventilation report noted there were no specific construction requirements in New Zealand for ventilation structures, except that they be constructed from non-flammable material. The ventilation devices nominated for Pike River included roadway stoppings of a 'nominal 14kPa rating'.¹⁵⁵ The suggested 14kPa rating was only 40% of the equivalent standard in Queensland and New South Wales of 35kPa. The 2006 report did not offer any justification for the proposed lower standard at Pike River. Ultimately, Pike did not implement even the lower standard.

109. Appendix 5 of the Pike ventilation management plan set out a procedure for the construction of ventilation structures.¹⁵⁶ The ventilation engineer was to advise the undermanager on standards for ventilation stopping construction, and stoppings were to be built to standards set out in the 'Pike River Mine Manager's Ventilation Rules'. Whereas Minarco's ventilation report in 2006 had contemplated stoppings with a nominal rating of 14kPa, the ventilation management plan left the issue of standards for ventilation control devices to the 'Pike Mine Manager's Ventilation Rules'. No such documentation was created.
110. When Mr Stewart carried out a statutory compliance audit in early 2010 he referred to stoppings being 'badly constructed and leaking hugely', contaminated air recirculating back into the ... working place and overcasts with 'significant leakage'.¹⁵⁷ Improvements were made as a result of the audit, including the rebuilding of some stoppings. One report noted that an underviewer had been asked to develop designs for all the stopping types to form part of a construction template for Pike River. Mr Stewart also spoke to mechanical engineer Matthew Coll about stopping standards and gave him a copy of design and procedures for stopping construction for training purposes.¹⁵⁸
111. When he left Pike in April 2010 Mr Stewart was not satisfied with the stoppings. Some had been improved, and he had done 'very basic things', for example, pushing stoppings to see whether they rocked.¹⁵⁹
112. Responsibility for advising on standards for the construction of stoppings and other ventilation control devices rested with the ventilation engineer. When he arrived at Pike Mr White recognised that there were no permanent ventilation control structures, and he began organising a standard for building temporary stoppings and 'set about starting to talk to contractors in Australia with respect to the supply of equipment for building permanent stoppings'. Mr White added that it was 'difficult to nominate positions for permanent stoppings' because the mine plan changed so frequently.¹⁶⁰
113. In May 2010 Pike issued a standard operating procedure document entitled 'Underground Standards', which set out the standard for both temporary and permanent stoppings.¹⁶¹ The basic construction method was the same for both, namely board and brattice construction, as depicted in the diagram below and in Figure 8.12.

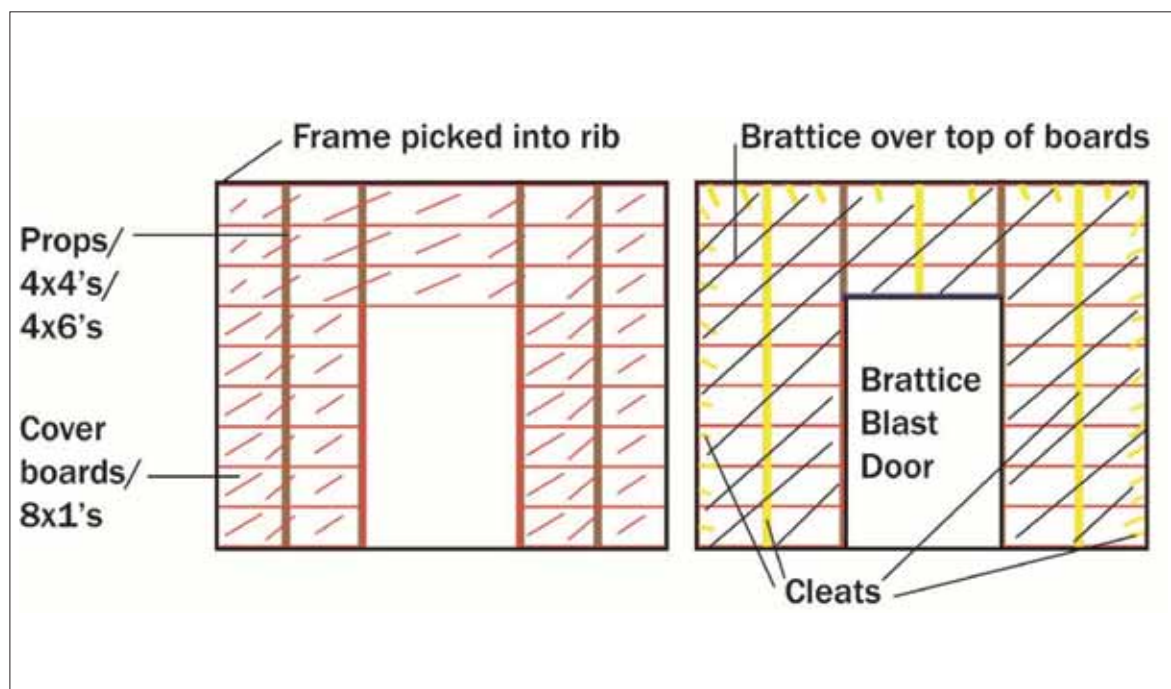


Figure 8.13: Board and brattice construction method¹⁶²

114. The construction method was essentially to use standard timber covered by brattice. The main difference with permanent stoppings was that these were covered in mesh and sprayed with shotcrete (this is concrete or mortar

projected through a hose at high velocity). The underground standards document made no reference to pressure ratings.

115. Despite the underground standards document, problems with stoppings continued. On 20 September 2010 Mr Nishioka noted repeated problems with methane levels in the hydro panel. The hydro operation was stopped, and on investigation it was discovered that the ventilation stopping in the hydro panel was leaking air so badly that recirculation of air was allowing methane to accumulate in the explosive range.¹⁶³ The board and brattice system used to construct the stopping was not robust enough to prevent leakage, and this was the type of issue that would have been raised with the ventilation officer if there had been one at Pike.¹⁶⁴

Roof fall on 30 October 2010

116. On 30 October 2010 there was a large roof fall in the goaf in the hydro panel. The roof fall generated a pressure wave that knocked over the stopping at cross-cut one in the hydro panel, marked in the diagram below.

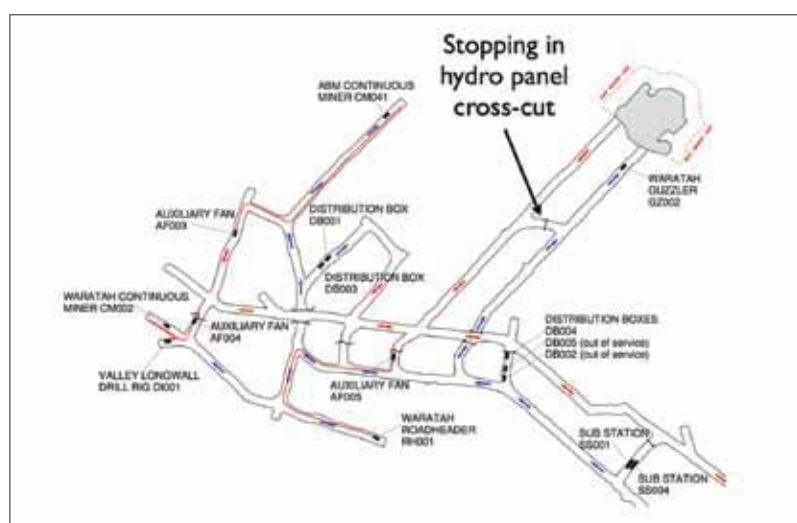


Figure 8.14: Stopping in hydro panel cross-cut¹⁶⁵

117. The incident occurred around 4:00am on 30 October 2010. Steve Wylie was the deputy on duty. Just before the roof fall the crew had been cutting to the left of a stump of coal in the goaf. Slabs of coal had been falling from the side of the stump, most likely as a result of downward pressure from the roof of the goaf. Mr Wylie heard the roof collapse and saw that it had fallen in, covering the front of the monitor.¹⁶⁶
118. He did not recall a significant windblast down the intake road, but the debris from the roof had blocked off the heading to the goaf and cut off ventilation. When he checked the stopping at cross-cut one he saw it had completely fallen over towards the intake roadway.¹⁶⁷ This indicated that a windblast had travelled down the return roadway and knocked the stopping over.¹⁶⁸ A gas reading showed greater than 5% methane in the return roadway at the intersection with cross-cut one.¹⁶⁹ Because his gas detector was not capable of reading greater than 5%, Mr Wylie could not tell the actual methane concentration, but there was clearly an explosive quantity of methane in the return.
119. Mr Wylie completed an incident report.¹⁷⁰ He attached a hand-drawn diagram showing the effects of the roof fall, including the blocked heading at the entry to the goaf and the damaged stopping in cross-cut one, with the words 'stopping blown over'.

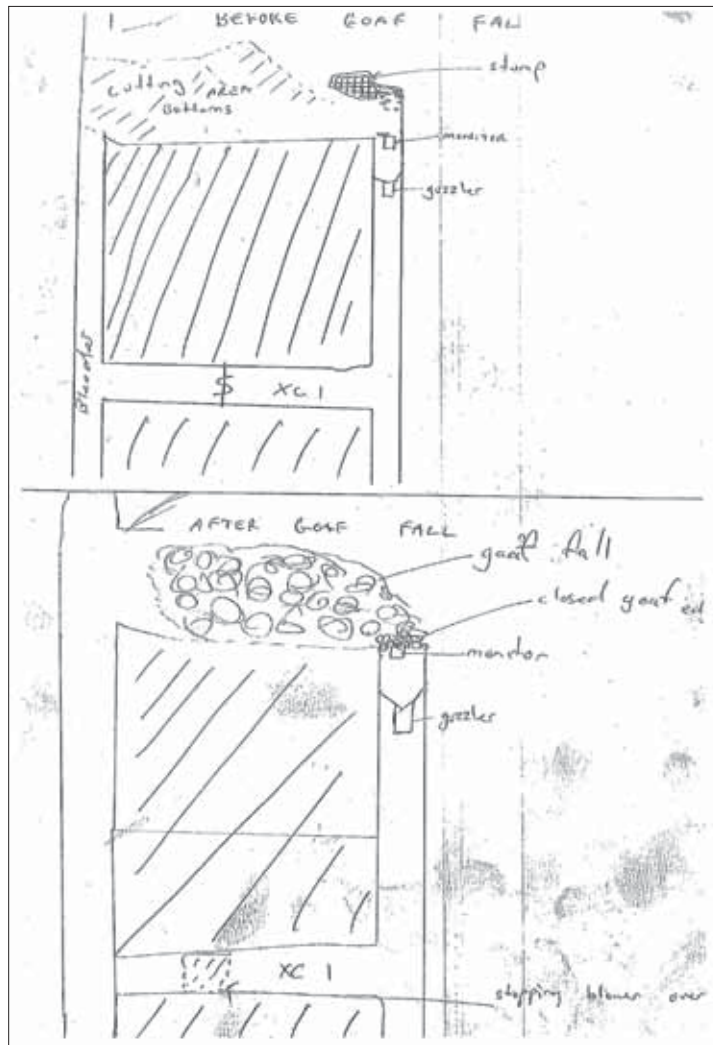


Figure 8.15: Effects of roof fall on 30 October 2010¹⁷¹

120. Mr Ellis signed off the incident form as 'closed' on 19 November 2010. The form stated the chance of this type of event happening again was 'occasional', and there had been 'extensive investigation and recovery'.¹⁷² The commission has not been able to locate any evidence of that investigation. Mr Ellis said he would have expected the investigation to have been carried out by Mr Wylie or George Mason, but neither can recall it.¹⁷³ In a supplementary statement to the commission, Mr Ellis said he searched the company's electronic and hard copy records but had not been able to locate any material relating to the investigation. He said he would not have signed off the incident as closed without reading a report.¹⁷⁴ There is no evidence of such a report, other than a short, five-sentence note prepared shortly after the event.¹⁷⁵
121. This incident provided a warning of a major hazard. It demonstrated the vulnerability of the mine's stoppings, as well as the potential for a roof fall in the hydro goaf to damage the ventilation system and lead to an explosive accumulation of methane.
122. Three aspects of the mine's response are significant. First, the incident was primarily categorised as property damage rather than as a safety issue. The original incident form noted that the incident had damaged a stab jack on the hydro monitor. The discussion at the weekly operations meeting focused on the cost of repair to the hydro monitor and the loss of production.¹⁷⁶ There is no indication that the broader significance of the event was discussed. When Mr Ellis signed off the incident on 19 November 2010 he did not answer the question whether any new hazard had been identified or new controls implemented, and he ticked the 'no' box in response to the question about a possible systematic failure.

123. Second, the incident highlighted the vulnerability at the mine caused by Pike's lack of a full-time ventilation engineer. The complete failure of a ventilation control device was a significant issue. Mr Rowland said he 'would expect the total failure of a ventilation appliance in a panel face area to be widely communicated to all persons on the site'.¹⁷⁷ Mr Reece agreed that, for a prudent mine operator, the roof fall would have signalled the urgent need to assess the integrity of all stoppings.¹⁷⁸ This task would have been the responsibility of the ventilation engineer, had there been one.
124. Third, the incident was not formally reported to DOL, despite the fact there was an uncontrolled accumulation of more than 5% methane. DOL inspector Kevin Poynter visited Pike three days after the roof fall, on 2 November 2010. Mr Ellis stated he discussed the roof fall with Mr Poynter, although he could not recall the specifics of the conversation.¹⁷⁹ Despite the seriousness of the incident, there was no formal notification and no investigation by the regulator.

The standard of ventilation control devices at Pike River in November 2010

125. The DOL investigation team carried out a detailed analysis of the ventilation control devices at Pike River, and concluded their quality was 'extremely variable'.¹⁸⁰ The stoppings near the main ventilation fan were made of steel and concrete, and rated to 35kPa. A number of stoppings were constructed using 'pogo sticks', expandable poles with an internal spring often used to hold up cables within the mine. Mr Reece described pogo sticks as 'very temporary arrangements',¹⁸¹ not intended for any type of permanent construction. The mine was attempting to achieve a number of permanent stoppings in the months leading up to November 2010, although these would not necessarily be rated.¹⁸² The stoppings in November 2010 would not have complied with Queensland standards.¹⁸³
126. The DOL investigation stressed the significance of the stopping at cross-cut 3, marked with an arrow below.

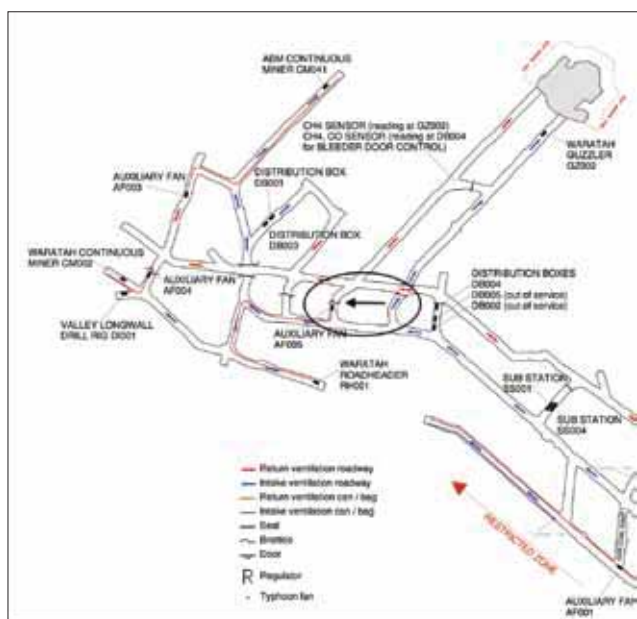


Figure 8.16: Hydro panel and cross-cut 3¹⁸⁴

127. That stopping was directly in line with the return from the hydro-monitor panel. Any significant roof fall in the hydro goaf would create an overpressure down the return, and the stopping would need to withstand that pressure.
128. Despite that risk, the stoppings at cross-cuts 3 and 4 remained in a temporary state on 19 November 2010. The collapse of the stopping at cross-cut 1 in the hydro panel on 30 October 2010 had served as a warning of this vulnerability, but Mr White said it was 'not likely' any consideration was given to the matter, even following the 30 October incident.¹⁸⁵
129. Mr van Rooyen agreed with the criticism of the stopping at cross-cut 3, and said it 'should have been made permanent preferably before or certainly early on in the excavation of the hydro panel'.¹⁸⁶ He agreed that the

increasing size of the goaf created a greater risk of a roof fall, resulting in damage to the temporary stopping in cross-cut 3, which could allow the short circuiting of air away from the inbye faces, and might also allow methane to enter the intake roadway.¹⁸⁷

130. Mr White said the intention was to make that stopping permanent after a panel move, which took place from Friday 12 November to Monday 15 November 2010, but this was not done.¹⁸⁸
131. There were three main problems with the ventilation control devices at Pike River in November 2010. First, there were too many temporary stoppings in light of the mining activity taking place. Second, with a few exceptions, the permanent stoppings that did exist were not rated to any particular standard. Third, there was insufficient oversight of the construction and maintenance of stoppings. The variable quality of stoppings at Pike River compromised the effectiveness of the ventilation system, and increased the risk of a catastrophic event. Rated stoppings may have assisted in an emergency, especially if combined with a functional surface fan, because they may have helped to re-establish a ventilation circuit to remove hazardous gases from the mine.

Sufficiency of ventilation at Pike River

132. Evidence before the commission indicated that Pike River had a 'serious lack of ventilation quantity for the number of faces being worked'.¹⁸⁹ At best the system was stretched to capacity, with no room for error.¹⁹⁰
133. Mr Ridl, by then the engineering manager, said the ventilation was 'pretty shit' before the main underground fan began operating in October 2010.¹⁹¹ Then 'there was a significant increase in ventilation and people were a lot happier'.¹⁹² However, Mr Rowland advised the mine in early November 2010 it needed more ventilation capacity 'relatively urgently' because the total amount of air available (120m³/s) was sufficient to run only four auxiliary fans on full speed while allowing standard margins for safety.¹⁹³ As at November 2010, the mine was running four auxiliary fans, with a fifth out of service. Mr Rowland's intention was to emphasise the importance of increasing the quantity of air available as soon as practicable and not 'resting on the apparent laurels of the new circuit capacity' provided by the underground fan.¹⁹⁴
134. The DOL investigation included detailed ventilation modelling of the mine based on the available data. That modelling indicated there was less than 25m³/s available for each place requiring ventilation, not allowing for leakage. That information, together with reports from mine officials, showed the ventilation system was struggling to cope with the gas quantity and the extent of mining operations.¹⁹⁵ DOL concluded that Pike had a ventilation shortfall, and should have been working one fewer place in the mine.¹⁹⁶ Pike considered the work was being managed within the limits of the ventilation system. As noted in paragraphs 139–144 methane problems persisted.
135. Ventilation inbye of the monitor panel was particularly fragile and struggling to cope with the extent of mining operations and gas load in the mine.¹⁹⁷ Those areas had a small amount of pressure (14Pa) and quantity (49m³/s) available to ventilate the three working places and two standing places inbye of panel 1. That area is shaded yellow in the following diagram.



Figure 8.17: Ventilation inbye of the monitor panel¹⁹⁸

136. DOL concluded that, given the gas make in the mine and the number of faces being worked, it should have been apparent that the ventilation system was stretched to its limit. Pike's approach allowed no factor of safety to deal with predictable hazards.¹⁹⁹
137. Mr Reece also noted other deficiencies with the ventilation system, for example, the placement of an auxiliary fan (AF003) immediately next to a stopping,²⁰⁰ which meant the fan did not have the necessary 30% of fresh air passing over it to ensure it did not overheat. The fan can be seen towards the left-hand side of the following diagram.

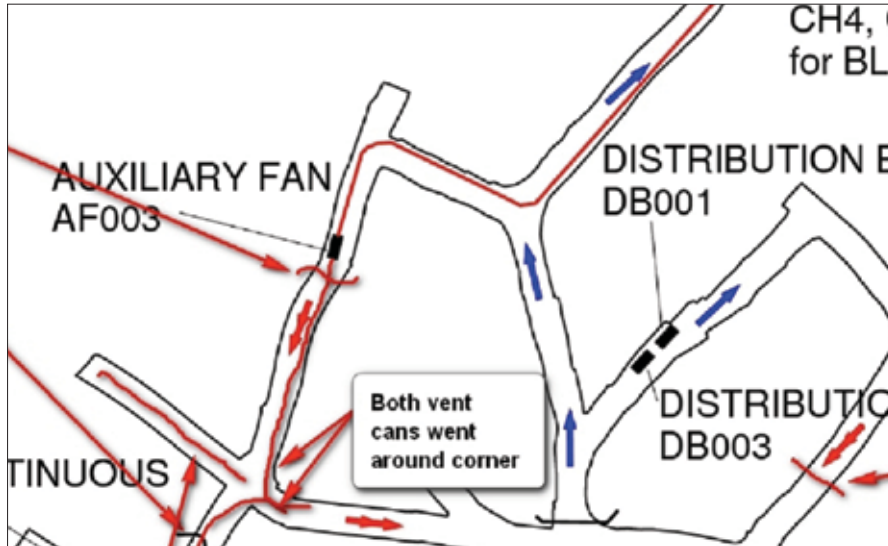


Figure 8.18: Location of the auxiliary fan²⁰¹

138. Mr White accepted that the evidence used by DOL in its modelling was correct, but considered that there was sufficient air to run the number of faces being mined.²⁰² He said Pike managed the amount of work done within the ventilation available and did not work all faces at the same time.²⁰³ However, Pike's own records, including incident reports and deputies statutory and production reports, show there were serious ventilation problems.

SPECIFIC PRODUCTION ISSUES, IMPROVEMENTS OR SUGGESTIONS						
IMPROVEMENT: GET THE DAM VENTILATION SORTED OUT SO WE CAN CUT COAL. THIS VENTILATION ISSUE HAS DRAGGED ON FOR 2 1/2 BLOODY YEARS!!!						
SHIFT ANALYSIS						
Shift start time: [] 14						
Shift	Target meters (hours into shift)	Actual meters	Out	Boat	Delay	Comments
1	7:00					<ul style="list-style-type: none"> ✓ PRE-SHIFT PACKING - TRAVEL - LOAD POGO STICKS BRATICE ✓ TRAVEL ✓ TRAVEL ✓ INSPECTION - UNLOAD GEAR FOUND DAMAGED AIR MANIFOLD
2	8:00					<ul style="list-style-type: none"> ✓ DEVELOPMENT HALLS SUGGONON NOT REPEATED ✓ TO PROVIDE VENTILATION TO MOUNTAIN HALL, WHEN ARE YOU GOING TO GET THIS SHIT SORTED!!! ✓ IF YOU RUN A PRIVATE MINE LIKE THIS YOU WOULD BE SHUT SO IN A WEEK!!!

Figure 8.19: Extracts from Dene Murphy's 21 October 2010 Deputies Production Report²⁰⁴

Recorded methane spikes

139. Evidence before the commission indicated a large number of methane spikes in the weeks and months before the explosion, many in the explosive range of greater than 5% methane. Mr White agreed that any instance of 5%

methane or more within a mine, even in the return, would be classified as a high-potential incident.²⁰⁵ The evidence indicates that methane greater than 2% were almost a daily event, both before and after the commissioning of the main underground fan.

Deputy statutory reports

140. Deputies' shift reports noted if they found greater than 1.25% methane in the general body of air. The reports between 3 October 2010 and 19 November 2010 contained recorded gas levels of 2% or higher on 48 occasions over 48 days. Concentrations of 5% were recorded within the mine 21 times during that period.²⁰⁶ The gas detectors used by Pike were not capable of reading higher than 5%, so it is not possible to know the actual level of gas on these occasions. Pike should have notified DOL of these events, but did not. This was supported by accident/incident reports.

Masaoki Nishioka's work record

141. Hydro consultant Masaoki Nishioka kept a daily work record. He noted methane levels on 14 days between 20 September and 15 October 2010, and on nine occasions methane levels exceeded 5% in the return airway.²⁰⁷ It was a safety hazard to continue monitor extraction with gas concentrations at that level.²⁰⁸ On 1 October Pike agreed to stop the hydro-monitor operation until the main fan became operational.²⁰⁹ During commissioning of the main fan, gas spikes in the hydro-monitor panel continued and Mr Nishioka's work record contained numerous references to methane levels above 5% and the 'poisoning' of the methane detectors.
142. When asked about these instances, Mr White said he believed the plugs of methane from the monitor panel would have been diluted below the explosive range in the main return.²¹⁰ Similarly, Mr Ridl's understanding was that the spikes of greater than 5% were present only in the hydro panel.²¹¹ However, the sensor at the top of the ventilation shaft was not capable of generating a reading higher than 2.96% methane, and it is not possible to be sure about levels in the main return. For that reason Mr White accepted that levels of methane may have remained in an explosive state all the way to the top of the ventilation shaft.²¹²

The gas monitoring system

143. DOL examined the records from the gas monitoring system for the period 25 October to 19 November 2010. Spikes over 1.25% were recorded 12 times. One of those spikes could be attributed to the calibration of the ventilation shaft gas detector, and a second to the restart of the main fan on 27 October 2010. Of the remaining 10, four events were of methane over 2.5% and a further two events were of methane over 1.8%. These were significant plugs of methane, and each one may have represented an explosive mixture if exposed to a source of ignition before dilution in the main return.²¹³ When asked about those conclusions Mr White said that number of spikes was a concern and, in hindsight, each should have been formally investigated.²¹⁴
144. In a report written shortly after the explosion, Gregory Borichevsky noted that potentially explosive levels of methane would have been present in the mine workings on a number of occasions, because methane levels in the ventilation shaft routinely exceeded 1%, regularly exceeded 1.5%, occasionally exceeded 2% and had exceeded 3% more than once in the weeks before the disaster.²¹⁵ Mr White was asked whether, in light of the number of methane spikes coming through the ventilation shaft, there was a risk that this situation had become normalised. He said he would hesitate to say 'normalised', but it was 'certainly something that was happening frequently, more frequently than would be desired'.²¹⁶

Accident/incident reports

145. Pike's accident and incident reports show other ventilation issues were reported often by workers. For example in October 2010 a typhoon fan ventilating a drill stub was not operating – the air hose had been disconnected and connected to other machinery. In June 2010 there was a higher pressure on the return side of a stopping near an electrical sub-station, leading to recirculation when the stopping door was open and the possibility of potentially flammable air in the presence of the substation. In January 2010 a blower fan was found on the floor 40 metres

from its original location, with the air hose disconnected. It was thought to have been hit by a passing vehicle. In April 2009 ventilation ducting was found damaged, resulting in an accumulation of flammable gas.

146. The reasons given for such incidents included lack of knowledge and training; lack of skill and experience; being unaware of hazards; inadequate work standards; safety rules not enforced; inadequate leadership/supervision, poor housekeeping and poor ventilation management.²¹⁷

Ventilation monitoring

147. The effectiveness of a mine's ventilation system should be measured in a number of ways, including manual pressure and quantity surveys. Pike used hand-held anemometers (Kestrels) to measure ventilation quantity. These instruments are necessary to verify ventilation speeds underground, and essential in the degassing process.²¹⁸
148. On at least 10 occasions during October 2010, deputies noted a lack of Kestrels underground. For example, on 20 October 2010 one deputy wrote: 'no Kestrel available for vent readings (5 wks now Hurry up and get em). Can't do job without the tools Bro'.²¹⁹
149. When asked about this, Mr White said that 'as far as I was aware we had an adequate supply of Kestrels',²²⁰ and that he would certainly have liked to have known this was an issue. He said it is not possible to start an auxiliary fan underground without measuring the air with a Kestrel, and he was disappointed to learn that someone had to wait five weeks to be given one.²²¹
150. The commission received further evidence that Pike lacked appropriate equipment for ventilation measurements. On 12 October 2010 the Pike project manager Mr Moynihan emailed the Spring Creek mine's ventilation officer Robin Hughes and invited him to come to Pike. Mr Moynihan wanted someone to check air flow and pressure measurements for the underground fan. He said, 'Pike still does not have a [hand-held] electronic manometer and a good quality anemometer'.²²² A manometer is a pressure measuring instrument that should be available at an underground coal mine.²²³

Three key decisions

151. The initial plan for the development of the Pike River mine envisaged a two-intake/single return ventilation system powered by two main forcing fans located on the surface. Three separate decisions put paid to this plan:
- In late 2006 a proposal was made to locate the main fans underground, but in stone measures to the east of the Hawera Fault, and this was decided on after a risk assessment in February 2007.
 - In late 2007, however, the location of the main ventilation shaft was moved from east of the Hawera Fault to its eventual position in pit bottom in coal. This meant also changing the location of the main fans so they would be adjacent to the shaft.
 - In early 2010 Pike obtained approval to locate a bridging panel near pit bottom, which meant that hydro mining began before the development of a second intake.

Hence, as at 19 November 2010, Pike had a single intake/single return ventilation system, powered by an underground main fan at a time when hydro coal extraction had begun.

Conclusions

152. The ventilation system at Pike River was inadequate:
- The ventilation management plan was incomplete, largely ignored in practice and required the appointment of a ventilation engineer to be responsible for the ventilation system. No one was

appointed to the role and the mine manager became the de facto ventilation engineer, without the time or resources to carry out the role adequately.

- The opportunity to improve ventilation capacity was lost when development of a second intake was deferred to accommodate the commencement of hydro mining in the bridging panel.
- The placement of the main fan underground was a major error, aggravated by the failure to adequately protect the fan motor against methane ingress.
- Aside from permanent stoppings erected at the location of the main fan, the mine stoppings were of variable quality and were not built to any rated standard. They compromised the effectiveness of the ventilation system, and created a safety hazard.
- The mine had a ventilation shortfall, with no factor of safety to meet foreseeable hazards, and one less mining or development area in the mine should have been worked.
- On 19 November 2010 the main and back-up fans were both damaged during the explosion, and the ventilation system failed. The mine was unventilated.

ENDNOTES

¹ MinEx Health and Safety Council, Guidelines for the Ventilation of Underground Mines and Tunnels, October 2009, MINEX0007/7.

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⁵ Ibid., CAC0158/110. (Labels added by the commission)

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⁷ Ibid., DAO.012.02277/27.

⁸ In this section, the terms 'ventilation engineer', as used in the Pike River ventilation management plan, and 'ventilation officer' are used interchangeably.

⁹ David Reece, transcript, p. 4563.

¹⁰ Peter Whittall, transcript, pp. 872–73.

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¹² Email, Ian Miller to Tony Goodwin, 16 November 2006, DAO.012.02253/3–4; Fläkt Woods Fans (Australia) Pty Ltd, Mine Ventilation Tender, 15 December 2006, DAO.025.27141.

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¹⁵ In Queensland: Coal Mining Safety and Health Regulation 2001, Part 11 Ventilation, Division 5, cls 353–58; in New South Wales: Coal Mine Health and Safety Regulation 2006, Part 4, Division 3, Subdivision 4, cls 118–22.

¹⁶ Clause 1.3.3. of the code of practice provides that in the absence of national laws and regulations on a particular occupational safety and health issue, guidance should be drawn from the code of practice, as well as from other relevant nationally and internationally recognised instruments. The ILO is a specialised agency of the United Nations of which New Zealand is a member state.

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¹⁸ Ibid., PSL0001/5, para. 16.

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²¹ Platinum Safety Ltd, Risk Assessment Report, DAO.012.02318/21.

²² Comlek Electrical Engineering Contracting Ltd, Report on Ventilation System – History and Current Status, 31 March 2010, DAO.003.05885/8.

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²⁶ Udo Renk, witness statement, 18 May 2012, RENK7770010001/9, para. 41.

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³⁷ Udo Renk, Summary of Telephone Conversation with Udo Renk, 4 October 2011, DOL3000150034/1.

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³⁹ Petrus (Pieter) van Rooyen, transcript, p. 5199; Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/33, paras 187–88.

⁴⁰ Michael Firmin, transcript, p. 2863.

⁴¹ Discussed further in Chapter 15, 'Regulator oversight at Pike River', paras 22–25.

⁴² Michael Firmin, transcript, p. 2898.

⁴³ Michael Firmin, witness statement, 19 October 2011, DOL7770040002/7, para. 26.

⁴⁴ Ibid., DOL7770040002/7, para. 29; Michael Firmin, transcript, p. 2899.

⁴⁵ Pike River Coal Ltd, Ventilation Management Plan, 2008, DAO.003.07114.

⁴⁶ Ibid., DAO.003.07114/54.

⁴⁷ Comlek Electrical Engineering Contracting Ltd, Report on Ventilation System, DAO.003.05885/13.

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- ⁴⁹ Ibid., p. 4879.
- ⁵⁰ Ibid., p. 4883.
- ⁵¹ Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/32, para. 179.
- ⁵² Email, John Rowland to Pieter van Rooyen, Terence Moynihan and Douglas White, 23 September 2010, INV.04.00238.
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- ⁵⁶ David Stewart, witness statement, 3 November 2011, STE0001/22, para. 42.2.
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- ⁵⁸ Ibid.
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- ⁶⁴ Petrus (Pieter) van Rooyen, transcript, p. 5207.
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- ⁶⁸ Ibid. (Extract with labels added by the commission)
- ⁶⁹ Masaoki Nishioka, work record, NISH0002/28.
- ⁷⁰ Department of Labour, Investigation Report, DOL3000130010/104, para. 3.8.20.
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- ⁸⁰ Pike River Coal Ltd, Review of Surface Aux Fan Failure, DAO.001.00359/17–26.
- ⁸¹ Ibid., DAO.001.00359/21. Including the need to establish an incident management team early on in an event. Mr White was allocated this issue and tasked to 'introduce this process to PRCL' by December 2010.
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Introduction

1. Knowledge and understanding of the basic principles of methane gas control is fundamental to a mine's ability to design effective controls and safe systems.
2. This chapter describes the hazard of methane in underground coal mines and summarises and assesses Pike's knowledge of its gas reservoir and its approach to managing methane.

Overview of best practice approach to methane drainage

Introduction

3. Methane gas occurs naturally in coal mines and is a natural by-product of mining. In the history of coal mining methane explosions have caused more loss of life than any other factor.¹
4. Increasing coal extraction rates often result in higher rates of methane emissions. However in modern mining, sustainable coal production should not be limited by a mine's inability to prevent gas concentrations from exceeding statutory safe limits, nor compromised by uncontrolled gas-related incidents that endanger life. Investment in effective gas drainage can ensure that mines meet production targets legally and safely.
5. Neither New Zealand's mining legislation nor MinEx Health and Safety Council (MinEx) guidelines specifically address the practice of methane drainage.
6. In February 2010 the United Nations Economic Commission for Europe published a best practice guidance on methane drainage,² and the following overview is sourced primarily from this.

Methane gas

7. Coal seam gases typically consist of 80 to 95% methane, with lower proportions of other gases, including carbon dioxide and nitrogen. Bag samples of gas tested by Pike in 2009 and 2010 showed the seam gas composition at levels between 95% and 99% methane.
8. Methane forms in coal seams as the result of chemical reactions taking place when the coal was buried at depth. Methane occurs in much higher concentrations in coal than other rock types because of the 'adsorption' process, which enables methane molecules to be packed into the coal interstices (gaps or spaces) to a density almost resembling that of a liquid. In a vertical sequence of coal seams like those at Pike River, the methane content of coal often increases systematically with depth and rank (maturity).
9. Methane and other gases stored in the coal seam and the surrounding strata can be released if they are disturbed by mining activity. The amount of gas and the rate of release or emission depend upon several factors, including the initial gas content of the coal, the distribution and thickness of the coal seams, the strength of the surrounding strata, the geometry of the mine workings, the rate of coal production and the permeability of the seam. The total gas flow varies proportionally to how much mining activity disturbs the strata and coal seam.
10. Coal seam gases become flammable and potentially explosive only when mixed with air. Methane is flammable when mixed with oxygen in a wide range of concentrations, but generally between 5 to 15% methane in air by volume. Gas released from mining activity inevitably mixes with the mine's ventilation air, is diluted and passes

through the flammable range. It is therefore critical that methane concentrations in the flammable range are limited in time and location as much as possible, to reduce the potential for exposure to ignition sources and the risk of explosion.

11. Methane is buoyant and rises in air, and layering of methane can occur in poorly ventilated areas underground. Concentrated methane tends:

*to collect in roof cavities and to layer along the roofs of airways or working faces. In level and ascensionally ventilated airways with inadequate airflow, the layer will stream along the roof in the direction of airflow, increasing in thickness and decreasing in concentration as it proceeds. Multiple feeders of gas will, of course, tend to maintain the concentration at a high level close to the roof.*³
12. Layering extends the area within which an ignition of methane can occur, and acts very effectively as a fuse along which the flame can propagate,⁴ with a risk of ignition of much larger accumulations of gas in roof cavities or goaf areas.
13. It is critical to reduce explosion risk by preventing occurrences of explosive mixtures wherever possible, and ensuring separation from potential ignition sources. It is essential to dilute high-purity methane by ventilation air to safe general body concentrations at the points of gas emission. This requires a well-designed ventilation system and knowledge of the seam's gas emission characteristics. Capturing high-purity gas in drainage boreholes at its source, before it can enter mine airways, and removing it from the mine, is another way of minimising the risks.

Gas emission characteristics

14. Peak flows of gas occur in a mine's return airways during the coal face cutting cycle and following roof caving. This is particularly the case with hydro mining, which is designed to quickly extract large quantities of coal from thick seams.
15. The volume of gas released from any coal disturbed by mining decreases over time, while continued mining activity adds new gas sources. When mining activity stops, gas continues to desorb from the coal seam and flow from rider seams and surrounding strata, but at a declining rate. Coal seams above and below the working seam may release methane that will migrate through the relaxed strata into the goaf.⁵ Unless methane drainage is carried out, this methane will also be emitted into the mine ventilation system.
16. When assessing gas flows and ventilation requirements, mine operators assume steady state coal production and uniform predictable gas emission characteristics. Although this approach suits most planning needs, other factors such as outburst and sudden emissions of gas from the floor create safety hazards and are not easily predicted, although the geological and mining factors indicating the risk of such events can often be identified.
17. Outburst is the sudden ejection of gas, coal and sometimes rock from a solid coal face into mine workings. Outburst hazards include asphyxiation, burial and impact injuries, and damage to mine equipment and systems. Outburst is a risk in certain mining situations where coal seams have a high gas content and low permeability. Structures in the coal seam, such as faulting, may increase the potential for outburst where they change gas migration or the gas drainage characteristics of the coal. Assessing the outburst risk for a coal seam requires collection, testing and analysis of gas data from core samples, and relating the results to other coal seams where outbursts have occurred. The use of such data for safety planning cannot be overstated. Management of the hazard typically involves pre-draining the coal, before mining begins, to reduce its methane content to below an identified critical gas content amount (m³/tonne).⁶

Pre-drainage

18. Pre-drainage of gas ahead of mining is done by drilling boreholes into the coal seam. Drilling can occur from the surface or within the seam from underground drill rigs.
19. Horizontal in-seam drilling for pre-drainage involves the drilling of boreholes from underground roadways into future mining areas. Moderate to high natural coal seam permeability is required to ensure significant decay of gas content over a reasonable period of time. A standpipe is installed at the collar of the borehole and connected to a

pipeline that removes the captured gas from the area. Problems with this method can include high water emissions pressurising the pipeline, borehole instability and directional control of drilling. Additional hazards are created if actively draining boreholes are later intersected by mining operations.

20. Coal permeability directly affects the time needed to drain gas to the required average gas content value. The lower the coal's permeability, the more time is necessary. The ultimate feasibility of pre-drainage depends on the available time for degassing the coal before mining and the cost of the drilling operation.
21. Modern directional in-seam drilling techniques and patterns can maximise the amount of gas removed from the seam. Patterns designed for pre-drainage purposes typically involve multiple boreholes about 20–30m apart drilled from one location in a fan, or parallel, orientation, and in a formation to ensure minimal intersection by future mine workings. Boreholes are designed to target the gas and drain the coal, with a sufficient lead time, typically more than six months, before there is intersection by mining.⁷
22. The flow rate of gas from a gas drainage borehole will vary with time. High initial flow occurs from the expansion and desorption of gas in the immediate vicinity of the hole. This may diminish fairly rapidly but then increase again as the surrounding strata are dewatered, which increases the relative permeability of the coal and also the flow of gas. This in turn is followed by further decay as the area of influence is depleted of gas.⁸ Structures in the surrounding strata, including faulting, can also affect gas emission and flow rates.
23. From a strictly regulatory perspective, only enough gas needs to be captured to ensure that a mine's ventilation system can adequately dilute the methane to a level below the permitted maximum. However, methane drainage also affects productivity, since the capacity of the ventilation system and the efficiency of a mine's methane drainage system will determine the maximum rate of coal extraction that can be safely achieved from a gassy coal face.
24. Introducing a gas drainage system, or increasing its effectiveness, is often cheaper than increasing ventilation air volumes. Investment in 'good practice' gas drainage systems therefore results in less downtime from gas emission problems, safer mining environments and the opportunity to reduce emissions and use more gas, which may have financial benefits under emissions trading schemes.

The need for gas data

25. Pre-planning of methane drainage is critical, and the design of gas drainage and ventilation systems to ensure safe mining requires knowledge of the amount of gas adsorbed in the coal (the gas content). Coal seam methane contents typically range from trace levels up to around 30m³/t.
26. To assess gas content (which should not be confused with specific emissions),⁹ core samples are taken from the coal seam, sealed in canisters in as fresh a state as possible, and maintained at near reservoir temperature while gas is allowed to desorb. The measured release rate allows estimation of the quantity of gas lost before sampling, and the gas remaining in the coal is also measured, by crushing the coal and measuring the amount released. An overall gas content assessment can then be made. The composition of the gas can also be established by chemical analysis.

Design of a gas drainage system

27. The design of a methane drainage system should reflect the maximum expected gas flows from all sources in the mine. The system must ensure that gas in the drainage pipeline is not diluted to less than 30% methane in air, safely above the explosive range. That requires quality borehole sealing, including proper installation of standpipes, the systematic regulation of individual boreholes and suction pressure from the surface to assist with the flow of gas from the holes and through the pipeline, if assistance is required. Water also needs to be controlled in the system to prevent pressure build-ups.
28. Underground drainage pipe systems are vulnerable to damage from mining equipment, blasting activities, strata movement and roof collapse. The drainage system should be designed to minimise these risks.

Monitoring of drainage systems

29. Gas drainage systems require continuous monitoring and management to determine effectiveness and performance. Mixture, gas flow and concentration, gauge pressure and temperature should all be monitored, with measurements made of individual boreholes, the gas drainage pipework and at the surface. Changes in barometric pressure affect gas flows and should also be recorded to assist in standardisation of flow data. The data obtained from monitoring these parameters is essential for safety planning.
30. Modelling of gas emissions can provide predictive information on the effects of increased coal production rates on gas flows. Modelling can also forecast the maximum controllable gas flow and the associated maximum coal production rate, depending upon methane limits and ventilation quantities.¹⁰

The need for pre-drainage at Pike River

Methane content of the seam

31. When Japanese company Mitsui Mining Engineering Co. Ltd carried out drilling at Pike River in 1993, methane was 'bubbling out' of drillholes close to the fault,¹¹ and reports from a series of consultants between 2000 and 2010 described Pike River's gas content levels as moderate to high.¹² Pike technical services co-ordinator Gregory Borichevsky described the mine as 'very gassy' because areas being mined were bounded by faults that had isolated blocks of coal. In these areas the coal had not been exposed to atmospheric pressure and gas remained adsorbed within the seam until intersected by mining activity.¹³ In Masaoki Nishioka's experience, high methane emission was generally to be expected near faulting in coal seams.¹⁴
32. The company's knowledge of the gas content levels within the coal seams was limited because of the relatively small number and wide spacing of vertical drillholes from the surface. Core sampling of vertical drillholes for gas content analysis began in 1999, and gas content results were available from 18 of the 33 surface holes drilled before the explosion (PRDH8 to PRDH40). These showed methane gas content levels varying from 1 m³/t to 10 m³/t, with the higher levels recorded close to the Hawera Fault.¹⁵
33. The company's knowledge did not improve to any significant degree once in-seam drilling began, as discussed further below. Few of the horizontal in-seam boreholes had core samples taken for gas content testing.¹⁶ The day before the explosion Pike received gas content results from sampling of its most recent borehole, GBH019,¹⁷ ranging between 2.80m³/t to 5.32m³/t.¹⁸ After the explosion Pike advised Queensland's Safety in Mines Testing and Research Station (SIMTARS) that the mine's coal seam gas content before drainage was approximately 8m³/t.¹⁹

Advice on the need for pre-drainage

34. In 2006 Pike was informed that the high (but variable) permeability and porosity of the Brunner seam meant gas control 'will not be able to be accomplished by ventilation means alone.'²⁰ Minarco Asia Pacific Pty Ltd recommended pre-drainage in areas of the mine, particularly to the north and for the initial development inbye from the stone drive.²¹ Minarco also recommended flanking boreholes in advance of development, and suggested the extent of pre-drainage required should be confirmed by further modelling of the gas reservoir. Investigation into likely emission rates was 'essential', and regular gas surveys were necessary particularly during the first period of development.²²

Pike's intended approach

35. Pike intended to use pre-drainage to reduce methane gas content in the Brunner seam before mining. General manager Peter Whittall described Pike's intended approach in a paper presented to a coal operators' conference in 2006:

Recent sampling has determined a seam gas content of 7.0-7.5 m³/t at the proposed seam entry location. This is at a depth of 85 m. This gas content is considered to be difficult to control by ventilation means alone and in seam gas capture (pre-drainage) will be used as part of the roadway development process. PRCL

will aim to reduce seam gas to $<3\text{m}^3/\text{t}$ prior to mining, however where insufficient lead-time is possible, a maximum content of $6.5\text{m}^3/\text{t}$ will be sought so as not to pollute the intake airways with rib emissions. In thick seam mining a more significant impact is content per square metre as the whole seam is removed during hydraulic extraction and the gas is liberated to the return airways.²³

In-seam drilling at Pike River

Purpose

36. Pike intended to supplement its limited geological knowledge from surface drillholes by the use of in-seam directional drilling for geological exploration.²⁴
37. The delays that plagued the initial development of the mine infrastructure, and the resulting pressures to produce coal, meant that all the in-seam boreholes drilled up to the time of the explosion were designed for exploration of the seam, rather than for the systematic reduction of methane gas content.²⁵
38. Some long boreholes, over 2000m with multiple branches, were drilled to delineate the seam. Although these holes would have provided some reduction in seam gas content in the areas drilled,²⁶ coverage was neither wide nor systematic and methane drainage was incidental. The boreholes did not serve to reduce methane gas content in the hydro panel down to Pike's planned $< 3\text{m}^3/\text{t}$ levels.

Valley Longwall International

39. In 2008 Pike contracted VLI Drilling Pty Ltd (VLI) to provide in-seam drilling services. The contract required VLI to drill directional in-seam boreholes with branches to the roof and floor of the coal seam to Pike's specifications, take core samples from the boreholes when requested, provide and maintain the specialist equipment and provide trained drillers and fitters/offsiders.²⁷ The contract was managed by geologist Jimmy Cory from Pike's technical services department.
40. VLI's crews generally comprised an experienced driller and at least one offsider. VLI had its own health and safety management documentation system relating to the contracted tasks, which it provided to Pike.²⁸ Site-specific documents were also created and VLI staff participated with Pike staff in a risk assessment on 14 November 2008 into the hazards arising from the drilling operations.²⁹

The drilling method used at Pike River

41. The directional drilling equipment used by VLI comprised an electro-hydraulic drill rig and a drill string, consisting of a down-hole motor and rotating drill bit, drill rods and an electronic drill guidance system.³⁰ The drill rig, shown below, was fitted with a gas monitor that alarmed at 1% methane and cut power to the rig when the sensor detected 1.25% methane.



Figure 9.1: Track-mounted Boart Longyear LMC75 drill rig³¹

42. The drilling method involved orientation of the down-hole motor (a 3m rod) to aim the slight bend in the tool towards the desired drilling direction. The down-hole motor (driven by a supply of water intensified by a pump on the rig) was fed in and out of the hole and rotated (to change orientation) using the rig's hydraulics. The electronic guidance survey tool (also approximately 3m long) relayed information back to a receiver unit with the driller, and was separated from steel rods by a copper rod to ensure no magnetic interference. The driller operated the drill rig, spinning rods onto the drill string and using a rotation unit to push the rods, the survey tool, the down-hole motor and the resulting hole to the required distance.³²
43. The photographs below show the drill bit, down-hole motor and assembly, and a close up of the rotating drill bit with high-pressure water forced through the assembly to provide rotation and torque to the bit.



Figure 9.2: Bit, down-hole motor and assembly³³



Figure 9.3: Rotating drill bit with high-pressure water³⁴

44. At Pike River, roof touches or coal seam roof intersections (branches) were drilled as a hole proceeded forward, normally at 40m intervals depending upon structural complexity in the area. When the borehole reached the planned limit, the drill string was progressively withdrawn and branches drilled down to the floor of the coal seam.³⁵
45. The directional guidance system controlled the borehole trajectory, which was pre-planned using 3D modelling software, guided by the geological model of the seam. Real-time survey information was obtained at 6m intervals and combined with logs kept by the drillers, enabling accurate mapping of the coal seam.³⁶

Installation of gas riser and pipeline

46. A risk assessment into in-seam drilling involving VLI and Pike staff and held in November 2008, before drilling began, identified the need for a 'gas discharge solution'. Three options were assessed,³⁷ and Pike adopted the second, installing a gas drainage system during December 2008 and January 2009.³⁸
47. Pike installed a 6" gas riser into an existing cased vertical drillhole, PRDH36, which was located close to the first VLI drill stub. A 4" fire-resistant anti-static (FRAS) pipeline (range) was connected to the three standpipes in place in the drill stub. Pike installed a flame arrestor on the surface for safety reasons,³⁹ but no pump or suction arrangement to assist with gas flow through the range.
48. Mr Cory prepared a memorandum to staff on the procedures required for underground connection of the gas drainage line and the necessity for water traps to be drained regularly. He also suggested that the engineering department start a maintenance schedule for the surface flame arrestor.⁴⁰ Many of these procedures were not followed consistently.⁴¹

Management of gas at the drill face

49. VLI established a gas management system at its drill sites in accordance with its own standard procedures, which included:
 - drilling through a standpipe – a gland driven into the wall face and grouted into position as a permanent access point to the borehole;
 - using valves connected to the standpipe to divert the flow of water and/or gas while drilling, and contain or divert the water and/or gas after drilling;
 - using a stuffing box, which prevents gas or water from the borehole from entering the mine's atmosphere, enabling it to be diverted to a gas/water separator; and
 - using a gas/water separator to assist with managing the flow of gas from the borehole and directing it through a T-piece into the mine's gas drainage line, or free venting the gas into the return ventilation system, in accordance with Pike's instructions.⁴²

Initial in-seam boreholes

50. Boreholes were assigned individual identifiers, from GBH (geological borehole) 001 up to GBH019 by the time of the explosion.
51. In-seam drilling began at Pike River in December 2008 from a drill stub in pit bottom, aimed at development around that area. The second in-seam borehole intersected the large stone graben (a down-thrust block of strata bordered by parallel faults), estimated at up to 220m wide in places, the significance of which Pike was unaware from its earlier geological exploration. By the time Pike got through the graben the focus was on roadway development and the ability to pre-drain the coal seam was limited.⁴³
52. No core samples for coal seam gas desorption testing could be taken from the first few in-seam boreholes, as the drilling method and the size of the graben meant samples would have a 'coal to canister' time exceeding one hour, giving unreliable results.⁴⁴

The slimline shaft

53. The collapse of the ventilation shaft on 2 February 2009 severely limited mine ventilation. To recover air capacity, Pike drilled the slimline shaft from the same surface drill pad location it had recently used to install the gas drainage system. Figure 9.4 below shows the gas riser (yellow) with flame arrestors, and the brown pipe is connected to the top of the slimline fresh air shaft.



Figure 9.4: Gas riser and slimline shaft⁴⁵

54. The bottom of the 6" riser is shown below connected to the 4" gas drainage line labelled in yellow, at the entrance to what became the fresh air base (FAB) in mid-2010.⁴⁶



Figure 9.5: Bottom of gas riser at entrance to the FAB

55. To drill the slimline shaft the flame arrestors at the surface had to be disassembled and removed and the gas drainage line temporarily decommissioned, which resulted in suspension of the drilling programme. VLI's crews left Pike and returned to Australia.
56. The three active boreholes were temporarily closed at the collar, and boreholes GBH001 and GBH002 were soon intersected by development and became inactive for gas flow monitoring.⁴⁷

Commencement of drilling and extension of the drainage pipeline

57. VLI returned to Pike River in May 2009 and continued the drilling programme, completing GBH003 and drilling six more holes by the end of 2009.⁴⁸
58. Very limited gas flow data was obtained from these boreholes. Three were quickly intersected by roadway development and only initial flow measurements were taken,⁴⁹ and no gas flow measurements could be taken from the other three.⁵⁰ Nor were core samples obtained during the drilling of any of these holes to permit gas content analysis.
59. In October 2009 the gas drainage range was modified and extended by the installation of a 4" Victaulic pipeline dedicated to the in-seam drilling programme, and installation of a water trap at the riser.⁵¹ The pipeline continued to extend as new borehole drilling locations were established.⁵²

60. Four more boreholes were drilled between December 2009 and March 2010 and connected to the gas drainage line.⁵³ All had initial high gas and water makes, but subsequent gas flow measurement was hampered by those factors and by poor management of the drainage line.

Problems with Pike River's gas drainage system

System at full capacity

61. By April 2010 the gas drainage line was at full capacity. High water capture in recent boreholes, and ineffective dewatering of the drainage line and at the drill rig,⁵⁴ resulted in resistance and regular flooding of the line, impeding the drainage of gas from the holes and making the system ineffective and highly pressurised. Accurate measurement of gas flows was impossible.

Warnings from workers

62. On eight occasions in March 2010 Pike deputies completed statutory reports noting their concerns with the overpressurised gas drainage system.⁵⁵ VLI's drilling co-ordinator Gary Campbell also voiced his concern that the gas drainage system was inadequate for the gas make, which was affecting their ability to continue drilling some holes.⁵⁶
63. On 11 April 2010 Brian Wishart, an experienced underviewer, sent this email to Mr Cory:

Attention Jimmy Cory

General Concerns Methane drainage system PRCL 11/4/2010

I would like to bring to your attention again the inadequacy of our Methane Drainage system.

1 – The running of a gas drainage system in intake airways is of concern to me as any trouble that we have with water traps, which is very regularly causes methane to vent into our intake roadways this scenario would not happen in NSW or QLD as this kind of arrangement would not get past a risk assessment process and would not be allowed, we should also not allow this practice.

2 – The positioning of this system in 3ct also leaves it venerable to damage from jugos ect.

3 - We now also have a fresh air base with a methane riser in the middle of it.

4 – Over the weekend we had to reposition a water trap at the FAB as it was installed in such a way that the FAB door could not be dropped down in an emergency?

5 – On numerous occasions I have found methane free venting in the old drill stub, while we are drilling there is so much pressure in the line that this stub does not actually discharge any methane into the system.

6 – Water traps are continuously filling with water at a rate faster that they can be drained.

7 – The first trap in the line is that inundated with water while drilling that the trap tube is by bull hose draining straight into the flumes which also surges gas into the return.

8 – "There is a definite problem when we are pushing water up the riser".

9 – This is all due to the line being too small for the sheer volume of methane we are trying to force downhill then up the riser.

10 – My list goes on... but by now I'm sure you get the picture.

It is my opinion that the VLW drill program should be suspended until the line is renewed with larger pipes installed out of the intake. I am well aware of the pressures we are under as a company but this should not be the pressure that possibly one day causes us a serious incident.

Last night the surges in the system were so violent that I was concerned it could blow of the rubber pipe which connects to the trap in the 3/B intake position. This would be very dangerous, if this happened with nobody in the vicinity to close the valve at maddock cribo which is not easily accessible we would have full flow methane directly into the intake and in turn across maddock headings I'm sure with that flow the methane would be in the 5 – 15% range with plenty of Oxy not a nice scenario.

Just to bring to your attention the suspected findings of the American pit that recently exploded was centered around an inadequate methane drainage system.

History has shown us in the mining industry that methane when given the write environment will show us no mercy. It is my opinion that it is time we took our methane drainage here at PRCL more seriously and redesigned our entire system.

Regards

Brian Wishart

Figure 9.6: Email from Brian Wishart to Jimmy Cory⁵⁷

64. Some issues with the system were already known,⁵⁸ but this email provoked an immediate response.⁵⁹ Mr Cory showed it to Pieter van Rooyen, who took it to the next production meeting where 'various actions' were discussed.⁶⁰ Short-term remedies were implemented, and Pike engaged an Australian gas drainage consultant, Miles Brown of Drive Mining Pty Ltd.⁶¹

Insufficient planning and design

65. At the time it was installed Mr Whittall 'fully expected' that the 4" pipeline would eventually become inadequate, but the small diameter pipeline was chosen because 'it was easiest to start with'.⁶²
66. In these circumstances, close management of the pipeline and monitoring of gas concentrations, pressure and flow was essential. Yet no manual measurement or monitoring processes were established when the system was installed, and commonly used sensors (measuring real-time flow and pressure and reporting to the control room) were not installed on the system.⁶³
67. Pike's gas drainage system was designed with insufficient information on gas flows or the mine's future drainage requirements. David Reece considered that the gas drainage system was clearly inadequate for the methane levels predicted and experienced.⁶⁴

Location of pipework and gas riser

68. Gas drainage pipelines carrying high-purity methane under pressure should be located in a mine's return airway to minimise the risk of damage from blasting and mining equipment.
69. At the time of the explosion, the whole pipeline ran downhill to the riser, working against the natural inclination of methane to rise.⁶⁵ Significant pressure was required to force the gas along the 4" pipeline and to the top of the riser, and the pressure peaked at the highest point on the pipeline, at the drill stub. This led to difficulties for the drilling crews in managing water and gas from boreholes.⁶⁶
70. The pipeline was installed primarily in the return airways leading from connected boreholes outbye to the riser (as shown below in green), but it also ran for about 100m in the intake airway (shown in pink) from the overcast near the underground fan through Spaghetti Junction before turning left and then right to the gas riser located at the entrance to the slimline shaft/FAB. This created a significant hazard.

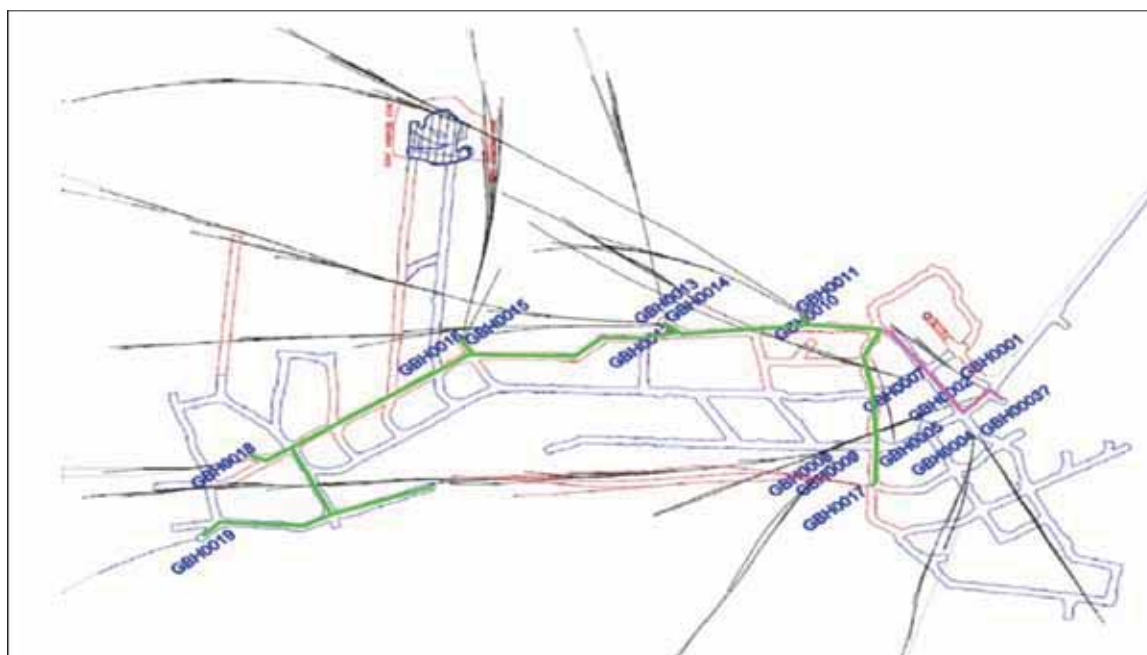


Figure 9.7: Gas drainage line and in-seam boreholes⁶⁷

71. During a risk assessment into the operation of the ventilation fans held on 14 October 2010, an action plan recorded the need to move the methane drainage lines into a better area, away from the methane sensor at the main fan motor.⁶⁸ This had not occurred by 19 November 2010.
72. Staff from the technical services department disagreed with the decision to establish an FAB near the gas drainage line and riser, but the design decision was not theirs.⁶⁹ Mr Reece also criticised the decision:

*you wouldn't have something of a hazardous nature like that in that sort of a location, you'd want to keep them significantly separated. ... A different roadway, you wouldn't have them anywhere near each other.*⁷⁰

The intersection of boreholes

73. Also not ideal was the frequent intersection of boreholes by the mining process. Intersections create a risk of frictional ignitions and the potential for release of large volumes of gas at the face. Intersections also reduce the effectiveness of gas drainage since boreholes must have a pipe connection to the drainage line to remain useful for that purpose.⁷¹
74. A safe operating procedure for borehole intersection was in place,⁷² but it appears the procedures were not necessarily followed.⁷³ Pike commissioned a review and received expert advice in July 2010 on changes required to its safe operating procedure.⁷⁴
75. A more structured approach to advising operational crews about upcoming intersections, via borehole warning zones marked on permits to mine,⁷⁵ was implemented but crews sometimes remained unaware of imminent intersections with gas boreholes. An example occurred in August 2010 when the ABM crew mined 3m past the indicated 'stop' point in the permit to mine for the intake in panel 1, intersecting in-seam boreholes and with the roof strata unsupported.⁷⁶
76. Intersections with boreholes sometimes occurred shortly after the holes were drilled.⁷⁷ This meant little time for reduction of methane levels in the area drilled, and did not allow the technical services department to obtain gas flow and content data from the holes for planning purposes.
77. Pike's accident and incident reports show gas drainage issues were reported by workers. For example in August 2010 a butterfly valve was found partially open, which allowed flammable gas to enter the fresh air intake. In July 2010 a worker found a borehole hose that was incorrectly connected. In February 2010 there was back pressure in the gas drainage range. In August 2009 there was a report that:

*The gas drainage holes in C/2-1 stub are all in floor & branching into multiple holes. This is making it very dangerous & hard to try & plug these holes which are producing large amounts of methane. To try & plug these holes requires people to be working in an explosive/very high CH₄ atmosph [sic]. Tech Services need to plan these holes & intersecting points better to avoid repeats of this situation.*⁷⁸

78. Vehicle collisions were sometimes reported. For example in July 2009 a buried gas pipe was hit by mistake, puncturing it and releasing methane into the workings. Also in July 2009 a worker was:
- using the roadheader to trim corner for vale fan the head caught some rib mesh pulling it down along with the gas drainage hose cutting it, releasing gas and water from the drainage line, 3-4% CH₄.*⁷⁹
79. Causes identified in the reports include not following procedure, lack of knowledge and training, lack of skill or experience, congestion and substandard work practices.⁸⁰

Expert advice on gas drainage

Drive Mining Pty Ltd

80. New South Wales mining engineer Miles Brown,⁸¹ engaged to advise Pike on its gas drainage system,⁸² conducted three site visits in 2010, each involving underground inspections and consultation with staff from the technical

services department. He gave Mr Cory training, including on gas flow measurement, and provided lengthy technical reports supplemented by email advice when required.

81. Mr Brown requested information on Pike's gas reservoir before he arrived. No gas content data was available as up until then Pike had not taken any core samples during its in-seam drilling programme.⁸³

Miles Brown's first site visit

82. When Mr Brown visited Pike River on 28–29 April 2010 he found Pike's drainage system under significant pressure and inadequate for the gas flows experienced from the thick Brunner seam. There was inadequate maintenance of the pipeline and no method for measuring gas flows. Mr Brown recommended the VLI drillers not to force any further gas into the pressurised pipeline, to reduce the risk of gas emissions around their drill site.
83. Mr Brown suggested the design of flanking drainage holes as a minimum for all development headings, including the proposed hydro bridging panels, and gas content core sampling at 200m spacing. A lack of data meant he was unable to properly design a gas drainage system and had to make assumptions about the gas reservoir. He provided a gas drainage schedule for Pike, noting:

This schedule highlights the fact that draining such a thick seam without a large lead time or enough data to quantify an accurate decay curve leads to the conclusion that if there is 8 m³/t of gas then development rates will be affected. The solution will be to gain more knowledge quickly and if high levels of gas are found introduce a smaller spacing of drainage holes. This will increase costs, however will assist with increasing development rates.⁸⁴

84. Mr Brown advised Pike to improve its gas drainage system by:
- installing a new gas riser inbye of current development within three months, with a minimum 10" internal diameter to service the current and future drainage needs; and
 - upgrading all current and future underground drainage pipes to 10" pipes to lower frictional resistance and pipeline pressure, increase drainage capacity and water control, and improve the ability to maintain the system.
85. Mr Brown also urged an assessment of the outburst risk of the Brunner seam, and cautioned that if the gas content was 'confirmed above 8m³/t or a GeoGas DRI of 900, then development should be stopped until a risk assessment for continuation has occurred'.⁸⁵ The DRI900 method has been universally accepted by the mining industry for determining outburst threshold limit values.⁸⁶

86. Mr Brown described the need for data collection over the next three months as a 'key' recommendation:

Gas Content Cores must be taken to not only allow the assessment of an area but to determine the drainage parameters. These core results also determine if the coal seam is liable to Outbursts. . . . Hole flow data assists in the determination of pipeline and riser design. This flow data along with virgin core results help create the decay curve for drainage which is the backbone of a drainage model. This allows for the development of hole spacing requirements.⁸⁷

87. Pike accepted that recommendation, noting 'no historical gas-flow data has ever been collected from in-seam drill-holes and the gas reservoir content is therefore unknown'.⁸⁸ Collection of gas flow data and information on the gas reservoir began in mid-June 2010 when Mr Cory began recording some weekly gas data measurements.⁸⁹ Pike took one core sample on completion of in-seam borehole GBH014,⁹⁰ but the sample was compromised and no gas desorption testing or analysis was possible.⁹¹ From August 2010 Mr Cory began to measure and monitor essential flow data from all individual holes, after measuring sets were installed at the borehole standpipes and at the bottom of the 6" riser.⁹²

Outburst management plan

88. Pike created a draft outburst management plan in July 2009, although no signed or final version was available to the commission.⁹³ It aimed to reduce and minimise the risks associated with outbursts in development panels by

draining in-seam gas content to below agreed threshold limits, and by implementing a system of measurement and risk assessment before authorisation of mining, via the permit to work process.⁹⁴

89. Parts of the plan reflected Australian documents,⁹⁵ and had no relevance to Pike River.⁹⁶ Other parts were simply not followed or ignored in practice, for example:

Prediction, in the form of comprehensive data acquisition and extensive in-seam drilling, and prevention by way of effective gas drainage coupled with gas flow monitoring, and regular core sampling so that the Mine Manager is always aware of the seam gas and structure environment into which the Mine is about to develop or extract, are the two prime components of The Plan. These form the input into the Authority to Mine process which, upon completion, will determine the mining methodology to be used to develop each roadway or sequence of roadways and extraction panels.⁹⁷

90. The plan also stated, as a basic operating principle, 'that no mining will take place when the gas content of the coal is above the established Outburst Threshold Level'.⁹⁸ A risk assessment into ventilation and gas monitoring on 7 September 2010 also recorded 'propensity testing' as an existing control of the outburst risk.⁹⁹
91. The outburst threshold level for the Brunner seam was still unknown at the time of the explosion.

Miles Brown's second site visit and Pike's decision to free vent methane

92. Mr Brown returned to Pike River from 28 June to 1 July 2010. During his underground inspection he became concerned about the imminent uncontrolled intersection of GBH012, a highly pressurised borehole, by a development mining machine. After discussion, Douglas White made an operational decision to 'free vent' the borehole into the main return, by releasing gas directly into the mine atmosphere via a valve on the borehole standpipe. Free venting occurred over several days in a controlled manner and methane levels were kept within a target maximum of 1% in the main return. GBH012 was then intersected on 7 July 2010 with reduced gas make and limited impact on mining.¹⁰⁰
93. Free venting released large quantities of methane and allowed Pike to 'make full use of the existing dilution capacity in the main returns to relieve this pressure on the gas drainage line and to actively manage gas from the Panel 1 area in advance of mining'.¹⁰¹ This was a more attractive alternative than relying on an inadequate drainage system. In early July 2010 Pike decided to free vent all three boreholes in the hydro panel to the return before they were intersected by development of the panel headings, to avoid 'possibly days of lost development' while the holes were depressurised at the face.¹⁰² Large quantities of methane were free vented from these holes,¹⁰³ and methane levels were closely monitored.¹⁰⁴
94. Free venting became part of a new gas management strategy, although no formal procedure existed. In July 2010 the technical services department prepared a draft gas drainage management plan,¹⁰⁵ and issued operational advisory notices setting out the strategy.¹⁰⁶ Deputies, underviewers and surface controllers were to manage the process so the level of methane at the main fan remained below a maximum of 1.25%, with a target level of 1% in the return. Intersected boreholes required installation of standpipes and hosing into the return.
95. Mr Brown's second report, finalised on 22 July 2010 after discussions with Pike, recorded the continuing struggle to maintain the gas drainage system. Gas make was greater than the system's capacity, and the pressure at the bottom of the riser was considerably greater than the flow of gas up the riser.¹⁰⁷ Overall the system was highly restrictive.¹⁰⁸ Mr Brown made a number of short-term suggestions and advised Pike to plan for a suction unit on the upgraded system.
96. Mr Brown stated that beginning hydro extraction before the underground fan was commissioned would increase methane levels in the return and have a negative effect on the available ventilation. He doubted the desired extraction rates were achievable without an upgraded gas drainage line.¹⁰⁹
97. Mr Brown calculated production scenarios, but noted a number of assumptions,¹¹⁰ including the unknown effects of the surrounding strata on gas emission calculations for panel 1, and increased methane levels from the ABM20 development miner. Although his calculations indicated a more manageable situation once the main underground

fan was commissioned, he had 'major' concerns about predicted methane levels in the hydro panel return and advised that additional air would be required for panel 1.¹¹¹

98. Mr Brown suggested replacing the 4" pipeline with a 12" diameter line, and that Pike use the slimline fresh air shaft as the gas riser until a new 12" riser could be drilled and installed inbye.¹¹² He urged Pike to start 'vital' weekly gas flow and emission measurements, and create a database to inform future gas flow estimations and for emissions trading legislative requirements.¹¹³
99. By this time three core samples had been taken from GBH16,¹¹⁴ a borehole flanking the hydro panel. One worrying gas content result of 8.29m³/t fell just below the outburst threshold limit of 9m³/t identified for the Bulli coal seam in Australia. Mr Brown repeated his advice that additional gas cores must be taken from new boreholes drilled ahead of development, and cautioned:

*If ever the DRI900 limit is exceeded then development must not mine this area until drainage has occurred and a new core sample has been taken and found to be below this value. As Pike River is approaching outburst threshold limits additional drilling should be conducted to both drain the coal of gas but to [sic] understand the gas reservoir.*¹¹⁵

100. There was no additional in-seam drilling to reduce the gas content levels in panel 1, although one of Mr Brown's assumptions was pre-drainage down to 3m³/t in that area.

Mechanical Technology Ltd

101. Pike also engaged mechanical engineer Chris Mann, of Mechanical Technology Ltd in Auckland, to report on gas utilisation options and to address Mr Brown's recommendations for upgrading the drainage line.¹¹⁶ In his multi-purpose report to Pike in August 2010,¹¹⁷ Mr Mann agreed that Pike's gas drainage system was inadequate for the gas levels experienced and required upgrading. He described Pike's gas flow measurements as 'rudimentary' and dismissed the mine's historic predictions of gas drainage flows of 300l/s, estimating peak flows of up to 1400l/s for the next 10 years as multiple panels were drained.¹¹⁸
102. The system's borehole pressure was high and Mr Mann suggested that, before the pipeline upgrade, Pike should install a temporary blower at the top of the gas riser to provide suction on the system. He estimated this would approximately double the flow of gas from the boreholes and through the pipes.¹¹⁹ Mr Mann agreed that Pike should upgrade the current pipeline to a 12" diameter range, pre-drain the seam to a methane content of 2–3m³/t and install a temporary flare to flare gas out of the drainage system if that could be achieved safely.¹²⁰ He, too, suggested Pike consider using the slimline fresh air shaft as a temporary gas riser.

Miles Brown's third site visit

103. Mr Brown made a third visit to Pike River from 13 to 17 September 2010. Panel 1 roadways were completed, equipment was being installed for the monitor panel and Pike was about to begin hydro extraction. There had been no upgrade of the gas drainage infrastructure, the underground fan had not been commissioned and free venting was still occurring. Lack of certainty in mine planning and the fact that inadequate gas data had not been obtained for a sufficient period of time meant Mr Brown could not provide a drilling design for pre-drainage. His third report dealt primarily with short-term tasks.¹²¹
104. Mr Brown found improved control of the gas drainage holes and no water in the pipeline as a result of Pike's better management of the system, although only three non-critical holes were connected and only approximately 40l/s of gas was flowing up the riser.¹²²
105. Mr Cory was continuing with weekly gas drainage measurements and spreadsheets had been set up for recording data from each borehole.¹²³ Pike also planned, but had not yet begun, weekly gas emission measurements to identify where gas was being emitted and its effects on production.¹²⁴
106. Mr Brown also suggested the VLI drilling crews required greater direction to manage the gas at their stubs in a more regimented way, as their next drill site was at the highest elevation yet and at the end of the pipeline range, so

would be the most pressurised. He suggested continued free venting to the ventilation system with connection to the pipe range once a hole was completed.

107. An outburst threshold value had still not been estimated. Mr Brown described core sampling as 'the single most important task' that needed to be regimented, as results were vital for estimating an outburst threshold rating, estimating gas hole flows and for the creation of a decay curve for the Brunner seam. This in turn would assist Pike in estimating pipeline and riser requirements for the future. He suggested 'all efforts' should be made to obtain a DRI900 level for safe mining.¹²⁵
108. The evidence of further borehole core sampling provided to the commission is of samples taken from boreholes GBH018 in September 2010 and GBH019 in November 2010,¹²⁶ both located in the south-west corner of the workings as shown in Figure 9.7. Pike received results of gas desorption testing from those samples just before the explosion on 19 November, but no outburst threshold limit had been established.

Pike's approach to methane management

Insufficient pre-drainage of panel 1

109. The following diagrams show the proposed production area of the hydro panel, and the expected gas emission area for gas flows from the surrounding strata.¹²⁷ Long in-seam boreholes intersect the panel,¹²⁸ and faulting to the east of the panel is shown.

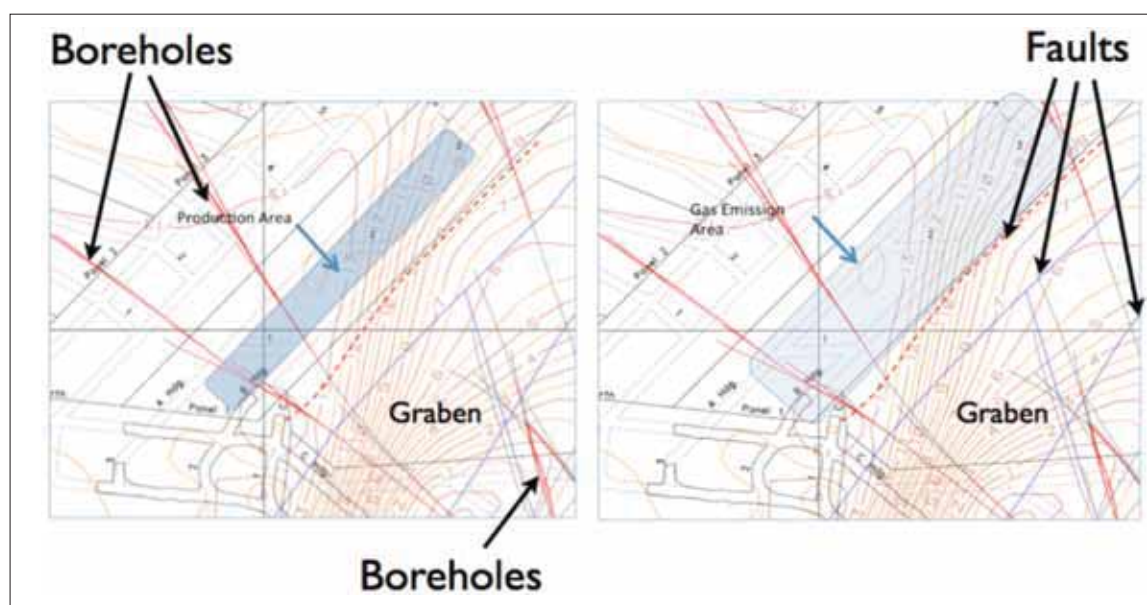


Figure 9.8: Panel 1 production area and panel 1 area of interest for gas emissions¹²⁹

110. Borehole GBH016 was subsequently drilled 'flanking' the eastern boundary of panel 1, but no drainage holes were drilled within or to the west of the panel. GBH016 and the intersected boreholes were designed primarily for exploration of the seam, not for systematic pre-drainage of methane from the panel before mining.¹³⁰
111. The gas content core sample result of 8.29m³/t from GBH016 underlined the need for further drainage of the area, particularly given the use of an untried hydro-extraction method in a thick seam with the likelihood of high methane release. However, coal extraction from panel 1 began without pre-draining the seam down to safer gas levels.

The hazard of free venting

112. Free venting created an additional hazard by increasing the level of methane within the mine's return, removing (up to) a 1% buffer and putting pressure on the ventilation system. It required close monitoring and effective management.

113. In practice, free venting involved staff opening a borehole until gas levels in the return got to around 1%, which allowed sufficient capacity for 'little peaks' to go up to a maximum of 1.25%, 'with the idea being that they could go, always go and turn it back down again if they needed to'.¹³¹
114. Mr Borichevsky monitored gas levels and trends and reported these to the daily production meetings until the new production manager, Stephen Ellis, took over running the meetings about mid-September 2010. Messrs Borichevsky and Ellis gave conflicting evidence about the change of focus in the production meetings, but the daily review and reconciliation of gas levels and trends did not occur regularly from that point on.¹³²
115. Although more air was available to the mine from October 2010, when the main underground fan came online, the ventilation system was almost immediately at capacity and at times struggled to cope with the high methane levels experienced from hydro and development mining.
116. Expert evidence before the commission was that the practice of free venting is only a 'stop-gap' measure and no longer a common or preferred practice for dealing with problem amounts of methane. Mr Reece described reliance on free venting as 'not done these days'.¹³³
117. Pike had initially described free venting as an interim measure when dilution capacity in the return permitted,¹³⁴ until the (then imminent) drainage system upgrade. Given anticipated high methane levels, it was not expected to continue once hydro panel extraction began.¹³⁵ But the practice did continue up to the time of the explosion.

Deferral of the system upgrade

118. Mr Mann had investigated the scope and cost of upgrading the drainage system, and budgetary approval had been given to install a bigger pipeline and riser.
119. The technical services department considered it was impractical to upgrade the current 4" pipeline or the 6" riser in the existing locations. It also rejected the suggestion that the larger slimline fresh air shaft be used as a temporary gas riser, given the stub was, by then, designated as the FAB. Instead a location inbye to the north-west was identified as suitable for installation of a new larger gas riser, which would then be connected to a new 12" pipeline installed from that location to the active drill stubs. Roadway development to this location was estimated to be three months away.¹³⁶
120. Mr van Rooyen explained that his department was concentrating on finding a longer term solution to Pike's problems, and installing a new larger capacity gas drainage system was part of that plan. Otherwise, 'trying just to solve a short term problem creates other problems that's not always foreseen when you try and solve the problem'.¹³⁷ Mr van Rooyen estimated installation of the new gas drainage infrastructure would have taken a further six months from the time he left Pike in early November 2010.¹³⁸ A temporary blower/pump arrangement on the surface to increase the flow of gas from the boreholes and through the pipes was not installed. Pike continued to extend the 4" pipeline to newly drilled in-seam boreholes.¹³⁹

Failure to assess the risks

121. The free venting programme successfully reduced the hazard created by the overpressurised drainage line. Yet the effect was the release of large quantities of methane into the mine's returns, extending the duration and location of potentially explosive mixtures underground. High methane levels continued, particularly after panel 1 extraction began, but there is no evidence of a risk assessment of the free venting practice.
122. In August 2010 both Hawcroft Consulting International and Zurich Financial Services Australia Ltd,¹⁴⁰ during annual insurance assessments, noted the need for Pike to conduct a risk assessment of the methane hazard in the mine. Hawcroft recommended Pike should 'expedite' a risk assessment into gas and ventilation, and 'implement suitable measures to ensure the methane in the underground workings remains at management, risk free levels'.¹⁴¹
123. The 7 September 2010 risk assessment report into ventilation and gas monitoring assessed the hazard of 'gas drainage',¹⁴² but made no mention of free venting. Some controls did not exist, or were ineffective in addressing the actual hazard. For example, the existence of a safe operating procedure for gas drainage was listed as an existing

control, although it was not finalised until 5 November 2010.¹⁴³ The risk of high methane levels from exploration holes in development headings referred to the 'specification of new drainage system' as an existing control,¹⁴⁴ but it did not exist. The assessment did not recognise the use of pre-drainage as a control measure to reduce in situ gas content to safer levels. Nor did it identify Pike's limited knowledge of the characteristics of its gas reservoir as a hazard in itself.

Lack of oversight by the Department of Labour

124. Kevin Poynter, the DOL mines inspector dealing with the company in 2010, was unaware that Pike's gas drainage system was inadequate for the gas levels encountered. He did not know of the reliance on free venting or the lack of gas data, and he did not audit the systems Pike used to measure and monitor gas flow and emission rates. He acknowledged that the department did not know whether Pike's methane drainage system met health and safety standards.¹⁴⁵ The location of the gas riser at the FAB should also have been an issue of concern to the regulator.¹⁴⁶

The gas drainage system at November 2010

125. A few weeks before the explosion, VLI had begun drilling GBH019, and several in-seam boreholes were free venting to the mine's atmosphere. Problems with management of the gas drainage system continued with gas flow from borehole GBH018 backing up and restricted by the 4" pipe.¹⁴⁷ Les Tredinnick, McConnell Dowell's underground superintendent, advised Pike staff in October of a 'whistling' standpipe and methane being emitted through the stone floor in A heading in pit bottom north. This had not been addressed by 19 November 2010.¹⁴⁸

126. The following graph prepared by the joint investigation expert panel¹⁴⁹ summarises the total daily methane volumes (m^3/day) for the drainage system gas from July 2010 until the explosion. The red line depicts the volume of methane measured at the bottom of the gas riser, which decreases from the beginning of July when the practice of free venting began with GBH012 disconnected from the range. The blue line shows the volume of methane free vented to the mine's atmosphere for dilution by ventilation; and the grey line shows the total methane flow from all boreholes. These measurements began on 20 August 2010, the start of gas flow measurement from individual boreholes. The green line shows the total methane volume flowing into the range from September 2010 when weekly gas drainage measurements commenced.

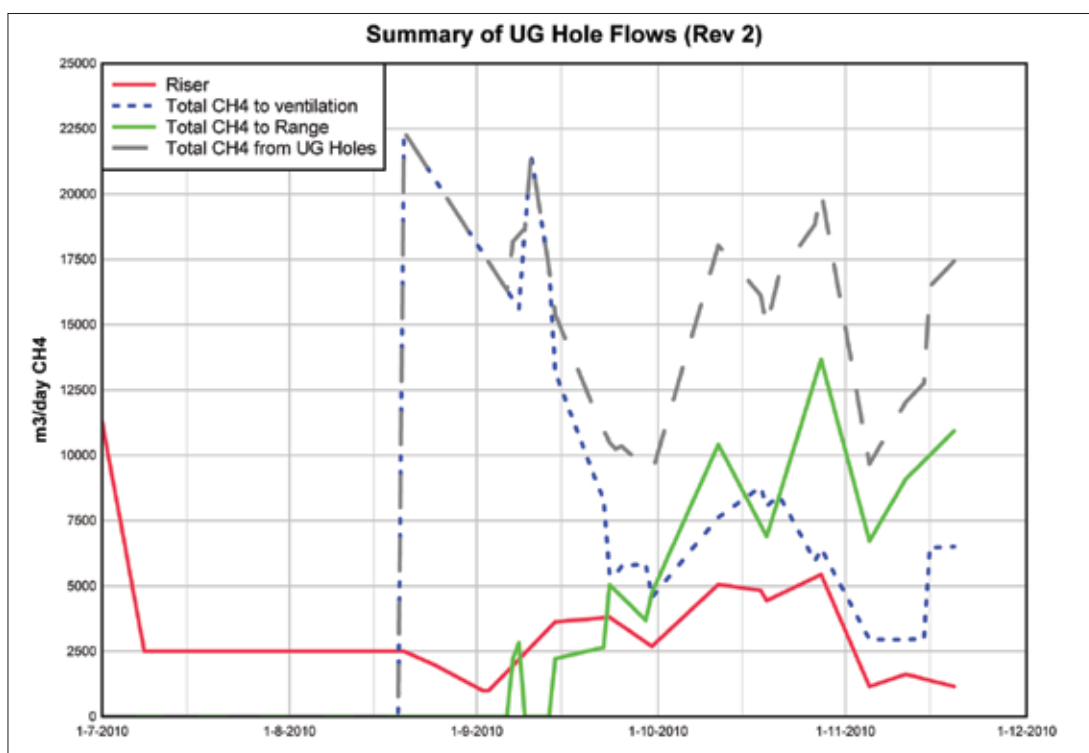


Figure 9.9: Graph summarising total daily drainage system gas flow measurements¹⁵⁰

127. The noteworthy features are the high volume of methane free vented when compared to the volume of gas entering the range, and the difference between the volumes entering the range and reaching the bottom of the riser. For example, on the day of the explosion the measured gas flow into the range was 126.4l/s but only 13.3 l/s was measured at the gas riser. Such discrepancies dated back to the beginning of October. Various explanations for the difference have been suggested including leakage, methane back-feeding into other areas, a blockage in the range or incorrect measurements at the gas riser.¹⁵¹
128. As late as 27 October 2010, there was no accurate recording of methane emissions and no comprehensive system in place to capture, record and store all data permanently.¹⁵²
129. The expert panel criticised Pike's gas management approach:

*Significantly, there was a lack of specific gas drilling design and implementation for adequate in situ gas reduction; a particularly inadequate gas drainage system with substandard pipeline dimensions and lack of evacuation (pumping); and little determination of in situ gas content (cores) linked with an authority to mine.*¹⁵³

Conclusions

130. The following key features marked the management of methane drainage at Pike River:
- In-seam drilling undertaken from December 2008 was designed to explore and delineate the coal seam. Pre-drainage of the coal seam was a secondary purpose of the drilling and was often prevented by intersection of boreholes before gas levels could decay.
 - A limited gas drainage system was installed in 2009 which, by early 2010, was inadequate to service the gas flows experienced from in-seam boreholes and was poorly managed. Management of the system improved, but the system capacity was not upgraded.
 - Free venting of methane into the mine return began in July 2010 to relieve pressure on the range in the interim, and continued to the time of the explosion.
 - Adequate gas data was not gathered until August 2010. Knowledge of the gas reservoir remained limited.
 - Gas management continued to be a problem into November 2010 even after the main fan improved the ventilation capacity.

ENDNOTES

¹ Malcolm J. McPherson, *Subsurface Ventilation Engineering*, CAC0158/389, ch. 12.1.

² United Nations, Economic Commission for Europe, *Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines* (ECE Energy Series No. 31), 2010, http://www.unece.org/fileadmin/DAM/energy/se/pdfs/cmm/pub/BestPractGuide_MethDrain_es31.pdf

³ Malcolm J. McPherson, *Subsurface Ventilation Engineering*, CAC0158/412, ch. 12.4.2.

⁴ Ibid.

⁵ Ibid., CAC0158/410, ch.12.4.1. The author suggests a range of methane migration from some 200m above to 100m below the working horizon.

⁶ Volume of gas contained per mass of coal substance in situ.

⁷ David Reece, transcript, pp. 4502–03.

⁸ Malcolm J. McPherson, *Subsurface Ventilation Engineering*, CAC0158/421, ch. 12.5.1.

⁹ Specific emissions represent the total volume of gas emitted per tonne of coal mined over any given period. Gas from all sources is measured, i.e. not just from the coal that is being extracted, but all the strata that is disturbed

and becomes relaxed as the void left by the mining process collapses.

¹⁰ Modelling requires adequate data collection that includes seam gas contents, mechanical properties of the rock and coal strata, mining geometry and coal production rates.

¹¹ Masaoki Nishioka, transcript, p. 3481.

¹² AMC Resource Consultants Pty Ltd, *Pike River Coal Company Final Feasibility Study – Project Summary*, 23 June 2000, NZOG0007/10, 18; Minarco Asia Pacific Pty Ltd, *Pike River Coal Company – Ventilation Report*, June 2006, DAO.001.04505/5; Hawcroft Consulting International, *Pike River Coal Limited, Pike River Mine – Risk Survey – Underground, CPP & Surface Operations: Final Report*, July 2010, DAO.003.08710/60; Zurich Financial Services Australia Ltd, *Pike River Coal Ltd – Risk Assessment and Improvement Report*, 18 August 2010, INV.04.00868/15.

¹³ Gregory Borichevsky, Police/DOL interview, 26 April 2011, INV.03.18954/7–8; Gregory Borichevsky, witness statement, 26 June 2012, BOR0001/9, para. 57.

¹⁴ Masaoki Nishioka, transcript, p. 3481.

¹⁵ Pike River Coal Ltd, *Summary Tables of Drillhole Gas Measurements*, June

2008, DAO.025.42433; CRL Energy Ltd, CSG Canister Desorption Results (PRDH037), 2009, DAO.025.36396.

¹⁶ Pike River Coal Ltd, Monitor and Report on In-seam Gas Levels and Flow Rates from the In-seam Holes, 14 October 2010, DAO.025.44571/3.

¹⁷ Shown in Figure 9.7.

¹⁸ For example: CRL Energy Ltd, CSG Canister Desorption Results, 18 November 2010, DAO.025.34092, DAO.025.34090 and DAO.025.34094.

¹⁹ Safety in Mines Testing and Research Station, Review of Gas Data Following Pike River Explosion on 19 November 2010 for New Zealand Police, 7 April 2011, SOE.001.00004/8.

²⁰ Minarco Asia Pacific Pty Ltd, Ventilation Report, June 2006, DAO.001.04505/27.

²¹ *Ibid.*, DAO.001.04505/27, 6.18. However as discussed below no pre-drainage of the area between the stone drive and the connection to the shaft occurred – Peter Whittall, transcript, pp. 878–79.

²² Minarco Asia Pacific Pty Ltd, Ventilation Report, June 2006, DAO.001.04505/6, 15.

²³ P. Whittall, 'Pike River Coal – Hydraulic Mine Design on New Zealand's West Coast', in N. Aziz (Ed.), *Coal 2006: Coal Operators' Conference*, University of Wollongong & the Australasian Institute of Mining and Metallurgy, 2006, pp. 161.

²⁴ Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/39, para. 230.

²⁵ *Ibid.*, PVR001/43, para. 253; P. Whittall and J.J. Cory, 'In-seam Directional Drilling at Pike River Coal Mine – An Essential Planning Tool', in AusIMM New Zealand Branch Annual Conference 2009, CAV0001/705.

²⁶ David Reece, witness statement, 2 February 2012, DOL3000150001/21, para. 92.

²⁷ David Carter, witness statement, 9 August 2011, VLI0001/4, paras 8–10.

²⁸ The documentation included risk assessments, critical work procedures, JSEAs and work method statements on its directional drilling procedures and for coring and gas testing from underground exploratory drillholes: Valley Longwall International Pty Ltd, Standard Work Method Statement, 15 August 2008, DAO.032.03294.

²⁹ Pike River Coal Ltd, Risk Assessment Report – In-seam Directional Drilling Provided by Valley Longwall Drilling, 14 November 2008, DAO.032.00244.

³⁰ P. Whittall and J.J. Cory, 'In-seam Directional Drilling at Pike River Coal Mine', CAV0001/710.

³¹ Peter Whittall and Jimmy Cory, In-seam Directional Drilling at Pike River Coal Mine: An Essential Planning Tool – AusIMM conference – Queenstown, August 2009, DAO.007.25198/6.

³² David Carter, witness statement, 9 August 2011, VLI0001/5, paras 16–22.

³³ Peter Whittall and Jimmy Cory, In-seam Directional Drilling at Pike River Coal Mine, DAO.007.25198/4.

³⁴ P. Whittall and J.J. Cory, 'In-seam Directional Drilling at Pike River Coal Mine', CAV0001/709.

³⁵ *Ibid.*, CAV0001/710.

³⁶ *Ibid.*

³⁷ Pike River Coal Ltd, Risk Assessment Report, DAO.032.00244/11–12.

The first option was to 'utilise existing gas drainage pipeline', which was (described as a 4" polypipe non-FRAS pipe) installed as a control measure when Pike mined through the Hawera Fault. Further details of this pipeline are unknown from documentation filed with the commission.

³⁸ Memorandum, Jimmy Cory to Peter Whittall, 29 January 2009, DAO.003.16304; Memorandum, Jimmy Cory to Kobus Louw, 12 February 2009, DAO.003.16311.

³⁹ Petrus (Pieter) van Rooyen, transcript, p. 5229.

⁴⁰ Memorandum, Jimmy Cory to Kobus Louw, 12 February 2009, DAO.025.53172.

⁴¹ John (Jimmy) Cory, witness statement, 18 June 2012, COR0001/12–13, paras 53–60.

⁴² David Carter, witness statement, 9 August 2011, VLI0001/7, para. 33.

⁴³ Peter Whittall, transcript, p. 879.

⁴⁴ Pike River Coal Ltd, Monitor and Report on In-seam Gas Levels and Flow Rates from the Inseam Holes, 14 October 2010, DAO.025.44571/3.

⁴⁵ Photograph sourced from Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report, 22 July 2010, DAO.001.04909/5.

⁴⁶ Mechanical Technology Ltd, Pike River Coal – Methane Gas Drainage and Utilisation Concept Design Report, August 2010, MED0010070099/22.

⁴⁷ Pike River Coal Ltd, Monitor and Report, 14 October 2010, DAO.025.44571/5.

⁴⁸ *Ibid.*, DAO.025.44571/6. Boreholes GBH04-05 and 07-10. There was no borehole labelled GBH006.

⁴⁹ *Ibid.* GBH003 (greater than 50l/s), GBH004 (greater than 50l/s), and GBH008 (135l/s)

⁵⁰ *Ibid.* No measurements could be taken from GBH005 (as the borehole was abandoned as the area was required for development), GBH007 (due to a recovery operation for drilling rods lost down the borehole), or GBH009 (which was grouted on completion to allow a drill and blast crew to develop a heading through stone).

⁵¹ Memorandum, Jimmy Cory to Pieter van Rooyen, 21 October 2009, DAO.003.16400/2; Pike River Coal Ltd, Operations Report, 16 November 2009, DAO.019.00568/6; Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/43, para. 257.

⁵² *Ibid.*, PVR001/40, para. 236.

⁵³ GBH010 to GBH013: Pike River Coal Ltd, Monitor and Report, 14 October 2010, DAO.025.44571/6–7.

⁵⁴ *Ibid.*, DAO.025.44571/4.

⁵⁵ Simon Donaldson on 5 March (DAO.003.15146) and 6 March (DAO.003.15150), Stephen Wylie on 13 March (DAO.003.15197), Simon Donaldson on 14 March (DAO.003.15199), Boyd Molloy on 18 March (DAO.003.15215), Simon Donaldson on 22 March (DAO.003.15252), Russell Smith on 24 March (DAO.003.15261) and Simon Donaldson on 30 March (DAO.003.15304).

⁵⁶ Gary Campbell, Police/DOL interview, 13 January 2011, INV.03.08182/12–18.

⁵⁷ Email, Brian Wishart to Jimmy Cory, 11 April 2010, DAO.025.32975/1.

⁵⁸ Emails between Jimmy Cory and Lunagas Pty Ltd, 26 March 2010, INV.03.29639/3; John (Jimmy) Cory, witness statement, 18 June 2012, COR0001/20, para. 102.

⁵⁹ *Ibid.*, COR0001/20, paras 97–100.

⁶⁰ Petrus (Pieter) van Rooyen, transcript, p. 5230.

⁶¹ Pike River Coal Ltd, Operations Report, 19 April 2010, DAO.019.00616/7; Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/44, paras 260–62.

⁶² Peter Whittall, transcript, pp. 913, 910.

⁶³ David Reece, transcript, p. 4537.

⁶⁴ *Ibid.*, p. 4536.

⁶⁵ Department of Labour, Pike River Mine Tragedy 19 November, 2010: Investigation Report, [2011], DOL3000130010/93, para. 3.5.1.

⁶⁶ Drive Mining Pty Ltd, Pike River Coal Ltd – Gas Drainage Assessment, 15 May 2010, DAO.001.04811/9.

⁶⁷ Department of Labour, diagrams, DOL3000150025/1. (Diagram modified by the commission)

⁶⁸ Pike River Coal Ltd, Main and Standby Fans Operation and Control: Risk Assessment V2 (Draft Document), 14 October 2010, SOE.024.00333/11.

⁶⁹ Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/40–41, paras 239–42.

⁷⁰ David Reece, transcript, pp. 4542–43.

⁷¹ David Reece, witness statement, 2 February 2012, DOL3000150001/21, para. 93.

⁷² Pike River Coal Ltd, Mining Towards Boreholes not Fully Cemented: Safe Operating Procedure (Final Document), 6 January 2010, DAO.001.04188.

⁷³ Department of Labour, Investigation Report, DOL3000130010/90, para. 3.4.17.

⁷⁴ Memorandum, Jimmy Cory and Gregory Borichevsky to Peter Whittall, Pieter van Rooyen, Douglas White and Michael Lerch, 2 June 2010, DAO.003.16495/5; Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report, 22 July 2010, DAO.001.04909/21–22.

⁷⁵ Memorandum, James Wimbridge to Bernard Lambley, Brian Wishart, Lance McKenzie, Martin Palmer, Dean Jamieson, Jan Joubert and Peter O'Neil, 19 July 2010, DAO.003.16345; Pike River Coal Ltd, Risk Assessment – Intersection of In-seam Borehole GBH0008 along 1West CT AB6, 29 October 2010, DAO.025.34614.

- ⁷⁶ Memorandum, James Wimbridge to Douglas White, Bernard Lambley and Grant MacLean, 17 August 2010, DAO.025.41497.
- ⁷⁷ Gary Campbell, Police/DOL interview, 13 January 2011, INV.03.08182/18–19.
- ⁷⁸ Simon Donaldson, Incident/Accident Form, 30 August 2009, DAO.002.09069/2.
- ⁷⁹ D. Murphy, Incident/Accident Form, 31 July 2009, DAO.002.08933/2.
- ⁸⁰ Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, November 2011, CAC 0115/10–20.
- ⁸¹ Mr Brown was interviewed during the joint investigation by DOL and the police, and also by counsel assisting the commission in 2011, but subsequently declined to sign a witness statement for the commission.
- ⁸² Email, Jimmy Cory to Miles Brown, 13 April 2010, DAO.001.05060/1.
- ⁸³ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Drainage Assessment, 15 May 2010, DAO.001.04811/16.
- ⁸⁴ *Ibid.*, DAO.001.04811/8.
- ⁸⁵ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Drainage Assessment, 15 May 2010, DAO.001.04811/17. GeoGAS DRI 900 is a method developed by GeoGAS Pty Ltd to define outburst threshold limits for coal seams other than the New South Wales Bulli seam. The method requires measuring the volume of gas emitted from a coal core sample after crushing for 30 seconds. The result is related to the total gas content of the full core sample in order to calculate a figure which, if above 900, indicates there is a risk of an outburst of coal and gas if a geological structure (such as faulting) is present.
- ⁸⁶ D. Black, N. Aziz, M. Jurak and R. Florentin, 'Outburst Threshold Limits – Are They Appropriate?', in N. Aziz (ed.), *Coal 2009: Coal Operators' Conference*, University of Wollongong & the Australasian Institute of Mining and Metallurgy, 2009, pp. 185–92.
- ⁸⁷ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Drainage Assessment, 15 May 2010, DAO.001.04811/17.
- ⁸⁸ Memorandum, Jimmy Cory to Gregory Borichevsky, 24 May 2010, DAO.003.16501/2.
- ⁸⁹ Email, Jimmy Cory to Miles Brown, 20 June 2010, DAO.001.05096/1.
- ⁹⁰ Pike River Coal Ltd, Operations Meeting Minutes, 16 June 2010, DAO.002.14622/4.
- ⁹¹ Pike River Coal Ltd, Operations Meeting Minutes, 30 June 2010, DAO.002.14672/3.
- ⁹² Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report #2, 20 September 2010, DAO.012.02524/13; Pike River Coal Ltd, Monitor and Report on In-seam Gas Levels and Flow Rates from the In-seam Holes, 14 October 2010, DAO.025.44571.
- ⁹³ Pike River Coal Ltd, Outburst Management Plan: Management Plan (Draft Document), 7 July 2009, DAO.003.06920.
- ⁹⁴ *Ibid.*, DAO.003.06920/4, 8.
- ⁹⁵ For example see University of Wollongong's website on outburst hazards: <http://www.uow.edu.au/pdfs/OMP.pdf>
- ⁹⁶ For example, the plan states that 'PRCL has a long history of mining the Bulli Seam' – a coal seam in New South Wales: DAO.003.06920/9, 11, 37.
- ⁹⁷ *Ibid.*, DAO.003.06920/13.
- ⁹⁸ *Ibid.*, DAO.003.06920/12.
- ⁹⁹ Pike River Coal Ltd, Formal Risk Assessment – Ventilation and Gas Monitoring, 7 September 2010, DAO.011.00025/4.
- ¹⁰⁰ Memorandum, Gregory Borichevsky and Jimmy Cory to Pieter van Rooyen, 5 July 2010, DAO.001.04572/1–2.
- ¹⁰¹ *Ibid.*, DAO.001.04572/1.
- ¹⁰² *Ibid.*
- ¹⁰³ When the target level of 1% methane was achieved in the main return, daily methane volumes peaked at 67,514m³ with typical daily volumes of 62,000 to 63,000m³ from GBH012 and GBH013: Pike River Coal Ltd, Operational Advisory – Gas Drainage Management Plan – Panel 1 Degassing and Borehole Intersections, 27 July 2010, DAO.001.04566.
- ¹⁰⁴ Gregory Borichevsky, notes, July 2010, INV.03.29202/9–18.
- ¹⁰⁵ Pike River Coal Ltd, Gas Drainage Management Plan (Draft Document), undated, DAO.002.03631.
- ¹⁰⁶ Memorandum – Operational Advisory, Gregory Borichevsky to Pike River operational staff, 8 July 2010, DAO.001.04569; Memorandum – Operational Advisory, Gregory Borichevsky to Pike River operational staff, 27 July 2010, DAO.001.04566.
- ¹⁰⁷ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report, 22 July 2010, DAO.001.04909/4.
- ¹⁰⁸ *Ibid.*, DAO.001.04909/8: The drainage system showed a flow of approximately 135l/s of methane, and the flame arrestors at the surface of the gas riser were highly resistant due to coal fines and water emitted through the drainage pipelines.
- ¹⁰⁹ *Ibid.*, DAO.001.04909/10–11.
- ¹¹⁰ *Ibid.*, DAO.001.04909/10. Including a 20m-wide extraction panel and pre-drainage of the area down to a level of 3m³/t of methane, shown in a table.
- ¹¹¹ *Ibid.*, DAO.001.04909/10–11.
- ¹¹² *Ibid.*, DAO.001.04909/12.
- ¹¹³ *Ibid.*, DAO.001.04909/23.
- ¹¹⁴ Pike River Coal Ltd, Q1 Sheet – GBH0016, 19 July 2010, DAO.025.34058; VLI Drilling Pty Ltd, Inseam Drillhole Report – GBH0016, 30 July 2010, DAO.025.45024/23.
- ¹¹⁵ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report, 22 July 2010, DAO.001.04909/28.
- ¹¹⁶ Emails between Chris Mann, Gregory Borichevsky, Miles Brown and James Cory, 1–15 July 2010, DAO.001.05008.
- ¹¹⁷ Pike was interested in reducing its liability under New Zealand's Emissions Trading Scheme by capturing methane and converting it to carbon dioxide using a flare, and in future options for the generation of electricity. Mr Mann's report also addressed these options.
- ¹¹⁸ Based upon known flows from boreholes and an assumed decay curve prepared by Miles Brown: Mechanical Technology Ltd, Pike River Coal – Methane Gas Drainage and Utilisation: Concept Design Report, August 2010, MED0010070099/17–18.
- ¹¹⁹ *Ibid.*, MED0010070099/23: He suggested the blower could be installed on the concrete pad at the current gas riser site subject to addressing safety issues with the flame arrestor.
- ¹²⁰ *Ibid.*, MED0010070099/16–25.
- ¹²¹ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report #2, 20 September 2010, DAO.012.02524/3.
- ¹²² *Ibid.*, DAO.012.02524/4: Mr Brown was concerned that connected borehole GBH008 appeared to be blocked at the intersection point, meaning the gas flow make may only have been from a newly drilled hole.
- ¹²³ *Ibid.*, DAO.012.02524/6.
- ¹²⁴ Mr Brown suggested these should be taken from the same locations at which a ventilation survey had been recently conducted with Pike's ventilation consultant John Rowland.
- ¹²⁵ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report #2, 20 September 2010, DAO.012.02524/7, 11.
- ¹²⁶ Pike River Coal Ltd, Q1 Sheet – GBH0018, 27 September 2010, DAO.025.34088; Q1 Lost Gas Desorption Sheets – GBH0019, 8–10 November 2010, DAO.025.34782/2–4.
- ¹²⁷ The Rider and Paparaoa seams above and below the hydro panel may also contribute to the gas emissions.
- ¹²⁸ Some of the in-seam boreholes are marked in red and black, used to represent drilling through coal and stone respectively.
- ¹²⁹ Drive Mining Pty Ltd, Pike River Coal Limited – Gas Management Primary Report, 22 July 2010, DAO.001.04909/10. (Labels added by the commission)
- ¹³⁰ Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/42, para. 253.
- ¹³¹ Gregory Borichevsky, Police/DOL interview, 7 June 2011, INV.03.20410/73.
- ¹³² Gregory Borichevsky, witness statement, 26 June 2012, BOR0001/37, para. 257; Douglas White, transcript, pp. 4917–21; Petrus (Pieter) van Rooyen, transcript, p. 5215; Stephen Ellis, witness statement, 14 March 2012, DAO.041.00042/3–4.
- ¹³³ David Reece, transcript, p. 4541.
- ¹³⁴ Memorandum, Gregory Borichevsky and Jimmy Cory to Pieter van Rooyen, 5 July 2010, DAO.001.04572/1.
- ¹³⁵ Pike River Coal Ltd, Gas Drainage Management Plan (draft document), DAO.002.03631/4. Although undated or signed off, it must have been created in early July 2010. See also: Hawcroft Consulting International, Pike River Mine

– Risk Survey, DAO.003.08710/57.

¹³⁶ Petrus (Pieter) van Rooyen, witness statement, 27 January 2012, PVR001/46, 50, paras 271, 294. Subsequently a design review based upon further geological information resulted in a change of direction and development to the west (towards the proposed location of the second intake, return and egress), and another location for the new riser was identified.

¹³⁷ Petrus (Pieter) van Rooyen, transcript, p. 5235.

¹³⁸ *Ibid.*, pp. 5233–35.

¹³⁹ Gregory Borichevsky, notes, 3 August 2010, INV.03.29202/19; Gregory Borichevsky, witness statement, 26 June 2012, BOR0001/35, para. 240.

¹⁴⁰ Zurich Financial Services Australia Ltd, Pike River Coal Ltd – Risk Assessment and Improvement Report, 18 August 2010, INV.04.00868/9.

¹⁴¹ Hawcroft Consulting International, Pike River Mine – Risk Survey, DAO.003.08710/58.

¹⁴² Pike River Coal Ltd, Formal Risk Assessment – Ventilation and Gas Monitoring, 7 September 2010, DAO.011.00025/11.

¹⁴³ Pike River Coal Ltd, Management of the Gas Drainage Line: Safe Operating Procedure (Draft), 5 November 2010, DAO.025.34471/3.

¹⁴⁴ Pike River Coal Ltd, Formal Risk Assessment – Ventilation and Gas Monitoring, 7 September 2010, DAO.011.00025/5.

¹⁴⁵ Kevin Poynter, transcript, pp. 3095–96.

¹⁴⁶ David Reece, transcript, p. 4543.

¹⁴⁷ Emails, Jimmy Cory to Miles Brown, 9 November 2010, DAO.001.05057/1.

¹⁴⁸ Leslie Tredinnick, Police/DOL interview, 15 December 2010, INV.03.03263/19–29, and map INV.03.03382.

¹⁴⁹ Keith Stewart, witness statement, 16 August 2012, MBIE3000010012; Email, Tim Harvey to Jane Birdsall, David Reece and Keith Stewart, 16 August 2012, MBIE3000010016.

¹⁵⁰ Graph, 16 August 2012, MBIE3000010017/1.

¹⁵¹ David Cliff, David Bell, Tim Harvey, Anthony Reczek and David Reece, Pike River Coal Mine Explosion: Investigation for Nature and Cause (DOL Investigation Report, Appendix 6), October 2011, DOL3000130007/43, para. 9.3.

¹⁵² Email, Gregory Borichevsky to Danie du Preez, Pieter van Rooyen and Jimmy Cory, 27 October 2010, INV.04.01375/1.

¹⁵³ David Cliff et al., Investigation for Nature and Cause, DOL3000130007/12, para. 6.1.

Introduction

1. All underground coal mines require gas monitoring to detect and help prevent explosive accumulations of gas. There are three main forms of gas monitoring: remote gas monitoring systems, machine-mounted sensors and hand-held sensors.¹ The first two systems may be used to isolate or 'trip' electric power if the concentration of flammable gas exceeds safe levels.²

Remote gas monitoring

2. Remote gas monitoring usually consists of tube bundle and/or real-time systems.³ Industry practice in Australia is to have both in place, and in Queensland it is also standard to have a gas chromatograph at each mine.⁴ A gas chromatograph provides the most comprehensive analysis of mine gases, and is particularly suited to manage spontaneous combustion events.⁵
3. Real-time or telemetric monitoring systems rely on underground electronic sensors that send a signal to the surface in real time. They provide rapid feedback to the control room about the underground conditions and are the best method for identifying a sudden event such as a methane plug or a fire. However, they require underground power, and the sensors must be located in underground conditions, which may be damp or dusty. The sensors tend to have limited measuring ranges; for example, methane can usually be detected only up to 5%. They are also prone to being 'poisoned', or shutting down when exposed to gas beyond their maximum level. They are not as useful as tube bundle systems for long-term trending or in oxygen depleted locations, and they require frequent recalibration. In addition, despite providing 'real-time' feedback, the signals are not instant. Energy New Zealand calculated the two systems at Pike River had lag times of up to 29 and 44 seconds each before results were reported to the control room.⁶ There was also a lag time of eight to 13 seconds before power was tripped underground following a high gas reading.⁷
4. A tube bundle system uses plastic tubes that run from within the mine to the surface. A vacuum pump draws gas samples to the surface, where they are analysed for a range of gases – usually carbon monoxide, carbon dioxide, methane and oxygen. The advantages of a tube bundle system include the ability to measure several different gases from a single sample, the fact the system does not rely on underground power, and the ability to use more sensitive analysis equipment on the surface. A tube bundle system is also more likely to remain functional after an underground explosion. The surface analysis and pumping equipment should always survive, and if underground tubing is damaged, new tubes may be lowered into the mine and connected to the system. Because of its greater accuracy and flexibility, the system is ideally suited to long-term trending, as well as monitoring oxygen depleted goafs and sealed-off areas that are not suitable for real-time equipment. The main downside of a tube bundle system is the time taken to retrieve a sample from underground, which may be 20 minutes or more, depending on the distance the gas sample must travel. This delay is not relevant when monitoring trends.

The Pike monitoring system as planned

5. Consistent with Australian practice, both the Minarco Asia Pacific Pty Ltd ventilation report in 2006 and the ventilation management plan in 2008 proposed real-time and tube bundle systems for Pike River.⁸ Under the ventilation management plan, the real-time and tube bundle systems were to run continuously.⁹ The ventilation engineer was to identify the location of all sampling points, and ensure these were marked on a plan,¹⁰ establish

12. The five sensors circled in blue were all located within the intake roadways, in areas expected to be ventilated by fresh air. These sensors were located at or near electrical equipment in an area Pike designated as the 'non-restricted zone'. Regulations require the non-restricted zone to contain no more than 0.25% flammable gas. The sensors in this area at Pike River were set to trip power at 0.25% methane.

Sensors in the return

13. The three sensors circled in red were in the return of the ventilation system, and were intended to measure the concentration of methane in the contaminated air removed from the mine workings.²³
14. The sensor at L11 stopped working on 4 September 2010,²⁴ and the sensor at L20 stopped working on 13 October 2010,²⁵ leaving Pike with no gas sensors reporting to the surface from further into the return than the ventilation shaft. This did not give the mine adequate information about the location, source and quantities of flammable gas within the mine. Surface controller Barry McIntosh said the controllers had raised the issue of the location of gas sensors, and in his view the gas sensors 'weren't up far enough' in the mine.²⁶
15. By way of comparison, consultant David Reece provided on request a plan showing where Pike would have typically required gas sensors under Queensland legislation. His plan was not absolute and was subject to a number of technical qualifications including the proximity of other detectors, but on the basis of the plan, Pike would probably have required seven fixed sensors (marked in red) reporting to the surface from inbye of the ventilation shaft. As at 19 November Pike did not have any fixed gas sensors reporting to the surface in these areas. The only functioning sensor reporting to the surface from the return was at the position marked in green on the plan.

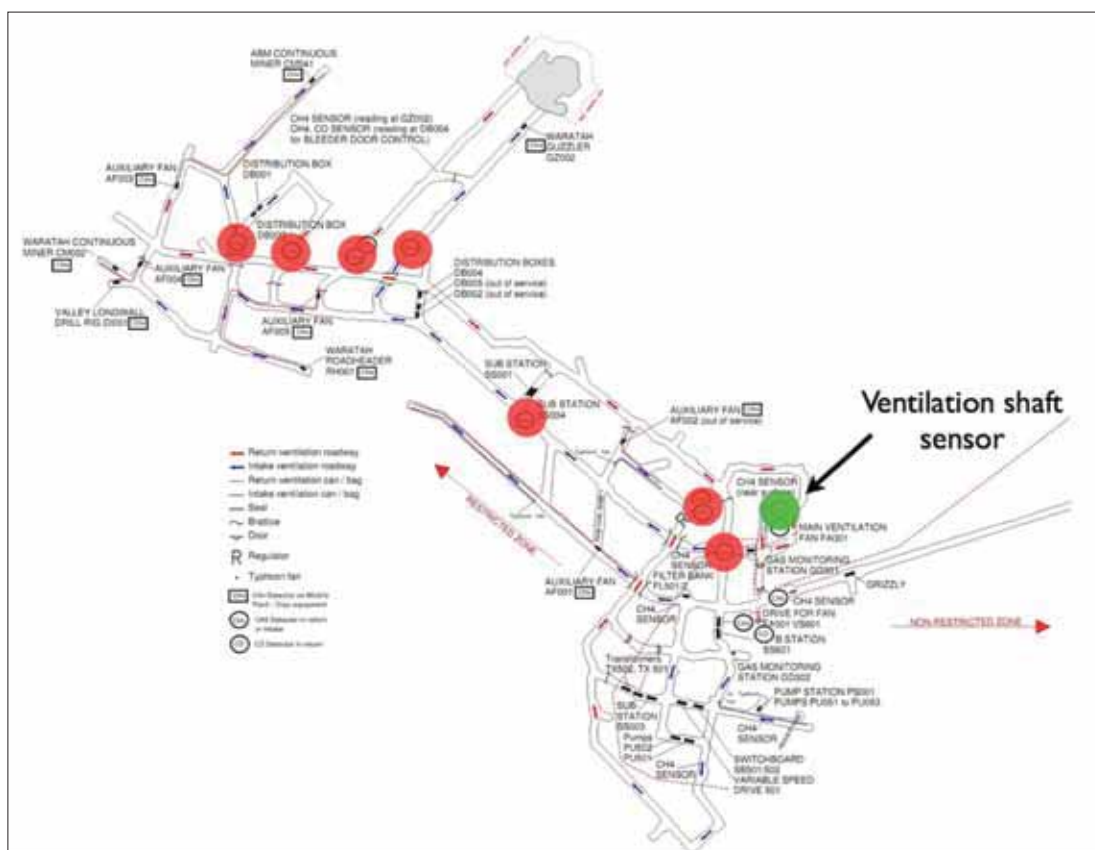


Figure 10.2: Plan of required gas sensors at Pike River under Queensland legislation²⁷

16. The joint investigation expert panel said that the mine 'should not have operated' without at least two sensors in the return, connected to an alarm and set to trip the power supply for the underground fan.²⁸

Hydro-panel sensors

17. There were two methane sensors located in the return from the hydro panel, circled in black on the diagram below.



Figure 10.3: Location of hydro-panel sensors²⁹

18. One provided a reading at the guzzler near the hydro monitor, but did not report to the surface or result in any permanent record of gas levels. The other sensor had been exposed to methane concentrations above 5%, and did not work after 13 October 2010.³⁰

Problems with the sensors in the ventilation shaft

19. There were several problems with the gas sensors in the ventilation shaft. First, the sensor at the bottom of the ventilation shaft stopped working on 4 September 2010, nearly 11 weeks before the explosion, and was never repaired or replaced.³¹ Indeed, the control room operator's screen on the Safegas system was permanently annotated to say the sensor was 'faulty' and 'waiting for spare'.

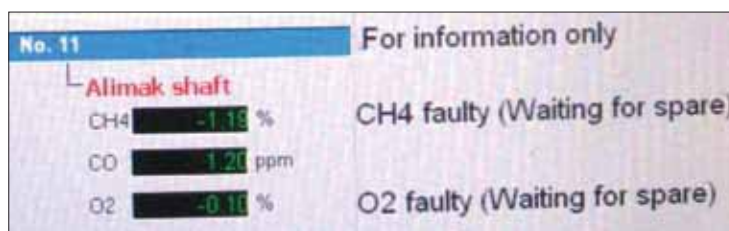


Figure 10.4: Control room operator's screen on the Safegas system³²

20. Mr White was not aware the sensor was not working and could not explain why the sensor was broken for two and a half months without his knowledge.³³ The problem appears to have been discussed at the review of the surface fan failure on 7 October 2010, at which Mr White was present.³⁴ It was resolved to 'Set up Gas Monitoring [at] shaft bottom',³⁵ but was still to be done at the time of the explosion.
21. With the bottom sensor broken, there was just one sensor in the return reporting to the surface. The expert panel described this situation as 'hard to comprehend' in a gassy mine.³⁶
22. Second, the sensor at the top of the ventilation shaft was incorrectly installed and unreliable. The sensor was hanging on a 2m piece of rope at the top of the shaft, and was wet and muddy when inspected on 4 November 2010.³⁷ A gas sensor is a sensitive instrument that should not be blocked or obstructed, much less covered in mud.

23. Further, Energy New Zealand concluded the sensor was installed in such a way that 5% methane (the upper limit of the sensor) would have reported as 2.96%.³⁸ This problem was not detected at the mine. Mr White said he was not aware of it,³⁹ and he agreed it raised serious issues about the reliability and accuracy of the sensor.⁴⁰ The sensor did go through a calibration exercise on 4 November 2010,⁴¹ but this was carried out with a concentration of 2.5% methane, 'which was within the functional operating range of the system.'⁴² Accordingly, the issue was not uncovered during the calibration process.
24. The ventilation shaft sensor also 'latched' or was poisoned on a number of occasions, causing a flat line to show on the surface controller's system. The flat line phenomenon indicated the sensor had been exposed to greater than 5% methane. This occurred during the 'gassing out' of the mine on Wednesday 6 October 2010, after the failure of the surface fan.

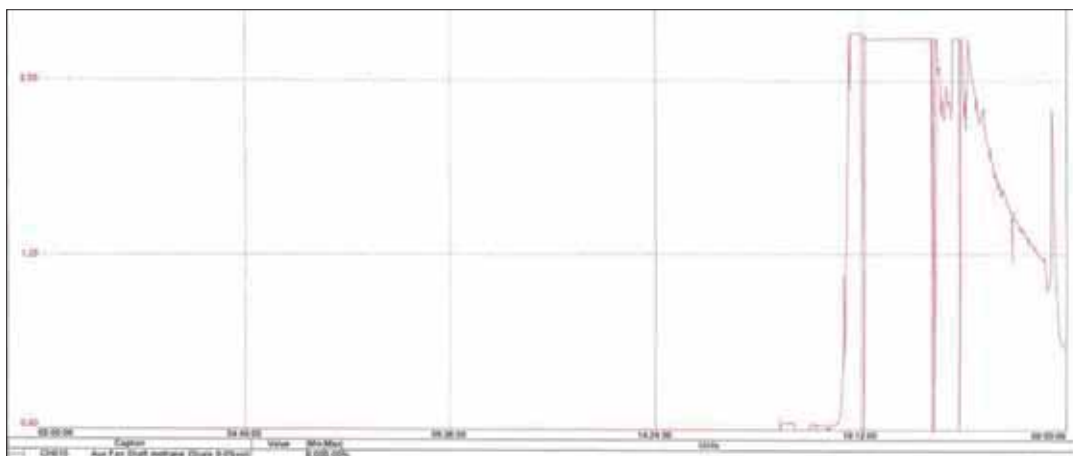


Figure 10.5: Auxiliary fan shaft methane – 6 October 2010⁴³

25. There was no data from the sensor from the time of the fan failure on 5 October. The control room system then showed a flat line around 2.5% during the evening of 6 October. Despite a review and a notification to the Department of Labour (DOL) about the incident, nothing was done about the flat line issue.
26. There was then a second flat line that started late on Thursday 7 October and continued through to Friday 8 October 2010 during the degassing procedures.

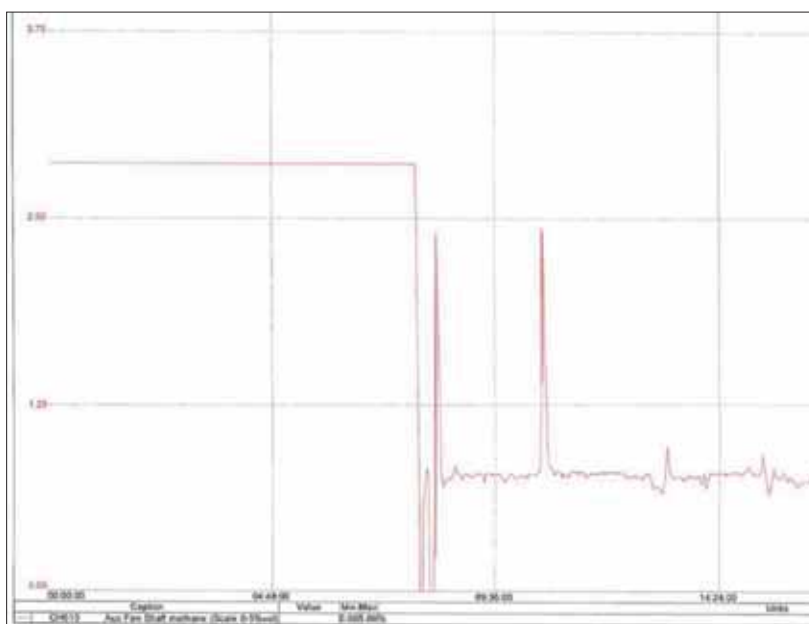


Figure 10.6: Auxiliary fan shaft methane – 8 October 2010⁴⁴

27. Mr White told the commission he was not aware of any flat lines, and if he had been, it would have been a cause for investigation.⁴⁵ However, he accepted that he signed a ventilation survey dated 7 October 2010 that said in red capital letters 'Had a spike of 2.8% at vent shaft – monitor stuck on this reading.'⁴⁶
28. Third, while the sensor at the bottom of the shaft was operational, there was an obvious discrepancy between the readings at the top and bottom of the shaft. The discrepancy is shown in the following graph prepared by DOL, which shows the reading from the top of the shaft in red, and the reading from the bottom of the shaft in blue.

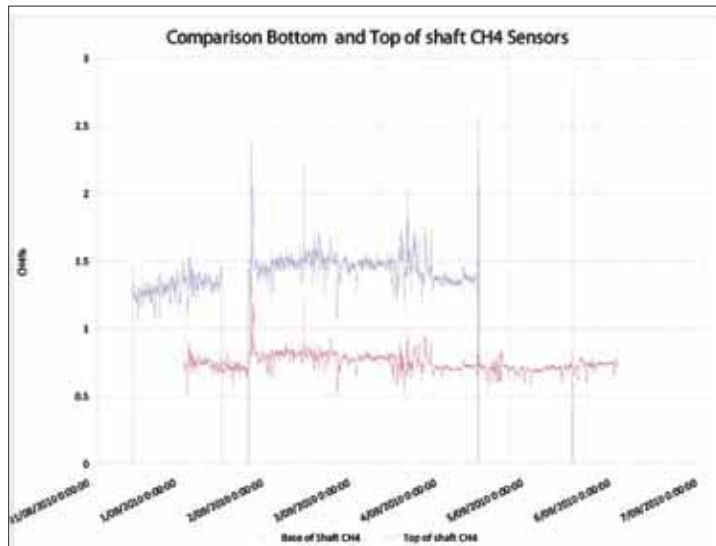


Figure 10.7: Comparison bottom and top of shaft CH₄ sensors⁴⁷

29. There was an obvious question to be answered given that two sensors in the same air stream were reading so differently.⁴⁸ The discrepancy was not investigated.⁴⁹
30. Fourth, the sensor at the top of the ventilation shaft was not connected to the Safegas monitoring system.⁵⁰ Safegas includes a control room operator's screen, multi-level alarms and an audit trail of all actions taken. It requires the operator to acknowledge all alarms, and helps to ensure that the appropriate actions are taken.
31. Pike installed Safegas in 2008 and the mine's remote gas sensors were connected to it. On 8 October 2010 the engineering manager, Nicholas Gribble, emailed Mr White and said that the mine should use Safegas for all gas monitoring, because 'when we get alarms Safegas requires the alarm to be accepted and [instructs] what action has to be taken.'⁵¹ Mr White agreed. By 19 November 2010 the gas sensor at the top of the ventilation shaft was still not connected to Safegas.

Maintenance and calibration of gas sensors

32. In November 2010 underground electrical co-ordinator Michael Scott took over responsibility for the fixed gas sensors following a reorganisation of engineering roles at the mine. He found the fixed sensors were not being calibrated on a regular basis as they should have been, and responsibility for the sensors in the ventilation shaft was 'falling through the cracks.'⁵² He said it was 'kind of a haphazard... maintenance programme',⁵³ and although six-monthly calibrations were done, the more frequent weekly or monthly calibrations were not being completed.⁵⁴ The detector at the top of the ventilation shaft was calibrated in early November, but the other sensors were due to be looked at the weekend after the explosion.⁵⁵ Mr Scott did not know whether the management level above him was aware of the problem.
33. On 22 September 2010 Robb Ridl wrote to Mr White stating that the Pike engineering department was 'currently unable to meet the needs of the business',⁵⁶ and fixed plant was 'not being proactively maintained due to lack of supervisory resources.'⁵⁷ He noted that three members of the engineering team had been seconded to the hydro project, and 'the maintenance of fixed and mobile plant is currently insufficiently covered due to the absence of these individuals.'⁵⁸

34. Mr White was asked whether he looked at maintenance or calibration records as a lead indicator of safety. He said he did not check the preventative maintenance programme; it was a matter he delegated to the maintenance department. He did take steps to encourage better maintenance of equipment.⁵⁹

Control room monitoring

35. The role of the surface controller is critical to the operation of a mine's gas monitoring system. Following recommendations from the Moura No. 2 inquiry,⁶⁰ Queensland regulations require standard procedures for acknowledging gas alarms.⁶¹ The control room operator is the first to respond to a gas alarm, and it is essential that person is well trained and able to perform the role.
36. Under Pike's ventilation management plan, surface controllers were required to acknowledge and record all gas alarms and notify the production deputy of any active alarms.⁶² However, Pike did not train the controllers adequately, ensure they were aware of their responsibilities, or keep them informed of developments in the monitoring system. There had been a meeting shortly before the explosion, when the control room officers requested training in gas monitoring and Safegas.⁶³ Mr McIntosh told investigators it was 'pretty bloody difficult' in the control room, because 'we were never given any training.'⁶⁴ He described the meeting with management and said the controllers 'spelt out a lot of things that we weren't happy about', including the way the controllers were treated, the lack of training and paucity of information.⁶⁵ Mr White said that after the meeting Mr Ellis was asked to organise training for surface controllers in the gas monitoring system.⁶⁶ No training had occurred before the explosion.
37. Pike had a TARP dealing with gas alarms,⁶⁷ which was signed off by the mine manager on 5 December 2008. The TARP was not in use or known to key people and the document itself was confusing and internally inconsistent. The first part dealt with three trigger levels, but the section relating to methane identified four, making it unclear which responses applied to methane. The plan referred to gas accumulations at 'lower levels' and 'higher levels', but these terms were not defined. A level three trigger was a gas accumulation at high levels over a 'prolonged period',⁶⁸ but that was not defined. These ambiguities undermined the purpose of a TARP, which is to give clear and precise rules.
38. In October 2010 Pike was in the process of drafting a standard operating procedure (SOP) to deal with methane alarms in the return.⁶⁹ The draft relied on several things that did not exist, including a ventilation officer, an underground text messaging service and a gas alarm log book. Although a log book was being drafted in October 2010,⁷⁰ neither this, nor the methane alarm SOP, had been introduced by 19 November 2010.
39. There was no effective process to make sure that gas alarms were monitored and then acted upon within the control room.⁷¹

Management oversight of gas monitoring

40. Although the mine manager and ventilation engineer were responsible for gas monitoring under the ventilation management plan, there was no reliable process to ensure that the results from the gas monitoring system, or problems with the system, were communicated to them.
41. Mr White said he 'made [himself] available every day at the start of the shift for the process of passing on information.'⁷² However, relying on informal feedback of that sort is a flawed approach, as demonstrated by the fact that Mr White remained unaware that a critical gas sensor was broken for 11 weeks before the explosion. Mr Ridl was also unaware of the broken sensor and the problems with the sensor at the top of the ventilation shaft.⁷³ Effective oversight requires an active system to make sure information is identified and passed on, rather than a passive system relying on senior managers being 'available'.
42. The company did make a concerted effort to record and communicate gas results to ensure compliance with the Emissions Trading Scheme (ETS). An email from technical services co-ordinator Gregory Borichevsky in October 2010 noted the ETS requirements were 'mandatory' and had 'significant commercial implications.'⁷⁴ He said 'because of our statutory compliance requirements for an accurate measure of methane emissions, it is critical that you put in place an accurate measure of ... the volume of methane produced.'⁷⁵

43. Because of the ETS, and the need to monitor methane levels during the free venting of gas drainage lines,⁷⁶ Mr Borichevsky paid attention to the gas monitoring results in the control room.⁷⁷ After the explosion he produced a document that said methane levels at the ventilation shaft 'routinely exceeded 1 per cent,' 'regularly exceeded 1.5 per cent,' 'occasionally exceeded 2.0 per cent' and 'had exceeded 3 per cent on more than one occasion in the weeks prior to the disaster.'⁷⁸ He said 'methane levels at the face would be expected to be at least 2 to 3 times those measured in the main return ventilation shaft due to the dilution factors involved', and that, on that basis, 'potentially explosive levels of methane would have been present in the active mine workings on a number of occasions.'⁷⁹ Mr White could not argue with Mr Borichevsky's observations.⁸⁰
44. Mr Borichevsky said at one stage he reported on methane spikes to morning production meetings.⁸¹ To do so, he obtained printouts of methane records, made a note of any spikes, reviewed the deputies' reports and other documents to try to establish the cause, and discussed the spikes in the meetings. However, Mr Borichevsky maintains that when Mr Ellis took over the morning meetings the agenda changed to focus on production, and Mr Ellis was not interested in methane spikes.⁸²
45. Mr Ellis rejected Mr Borichevsky's comments and said that although he did not recall Mr Borichevsky discussing gas levels at the production meetings, there was nothing to prevent him doing so.⁸³ What is clear is that methane spikes were no longer discussed at production meetings from late 2010. Coal extraction from the hydro panel had started, and there was an increased need to discuss and resolve high methane levels.
46. The failure of the surface fan on 6 October 2010 should have alerted senior managers to problems with the gas monitoring system. The review on 7 October 2010 noted, among other things, a need to '[s]et up/review Gas Monitoring procedures as per QLD,' '[d]efine ownership of ... gas monitoring,' address 'gas monitoring spares and procedures,' and '[s]et up Gas Monitoring [at] shaft bottom.'⁸⁴ Both Mr White and Mr Ellis were present at the review, and received the report. This should have alerted management to the need for urgent action.⁸⁵

Inappropriate equipment

47. Five of the six functioning fixed gas sensors were located within the non-restricted zone. These sensors were required to establish there was no more than 0.25% methane, in order to comply with the Health and Safety in Employment (Mining – Underground) Regulations 1999. However, the sensors had a margin of error of plus or minus 0.25%. Accordingly, they were not fit for purpose.⁸⁶
48. The sensor in the hydro return was not capable of reading greater than 5%⁸⁷ methane, although concentrations above that occurred frequently in the return. This should have been capable of reading greater than 5%. Such a need was recognised in October 2010.

No tube bundle system

49. Another deficiency was the lack of a tube bundle system. Mr White made it clear he wanted such a system installed, plus a gas chromatograph.⁸⁸ He exchanged correspondence with the Safety in Mines Testing and Research Station (SIMTARS) in Queensland to investigate leasing a tube bundle system in 2010.⁸⁹ But in October 2010 Mr Whittall told the bank, who were to provide lease finance, that a decision about the tube bundle system was 'some way off',⁹⁰ January 2011 being a possible purchase date for the system.⁹¹
50. Pike River should have had a tube bundle system before coal mining began. Such a system would have provided important gas information and highlighted the serious problems with methane control.

Machine-mounted and hand-held gas monitoring

Machine-mounted sensors

51. A number of mining machines at Pike River were fitted with gas sensors. These were set to cut power to the machines if they detected methane concentrations above 1.25%. None of the sensors reported to the surface. The

sensors underground on 19 November 2010 had been maintained and calibrated appropriately.⁹² The sensor on the VLI Drilling Pty Ltd (VLI) drill rig was faulty and was scheduled for replacement.

52. The records of deputies underground noted numerous examples of gas trips activated by machine-mounted sensors. For example, the ABM production report for the day shift on 19 November 2010 referred to three individual gas trips, then 'continuous CH₄ trips', apparently caused by mining over a gas drainage hole. The references to gas trips are highlighted in the following image.

Shift start time: 7:00 am		SHIFT ANALYSIS		0359					
Hours into shift	Target meters	Actual meters	Cut	Rel.	Down	Comments	Downtime Codes		
							Resp.	Group	Type
1						Conc Meeting Travel up Active fall 7:30 Tidy up place - gear off floor			
2			x			Cutting / Means Gas trips - high CH ₄ - Gas bag in tunnel drainage hole.			
3			x			Cutting Gas trips			
4			x			Gas trips - High CH ₄ - hard to move. Fleet to rock - waiting for gas to active Recal ABM - Power up Machine & Complete mega bolts.			
5			x			Cutting - Continuous CH ₄ trips Ctly seems to be coming from floor. Mega bolting			
6						Flume water down for rest of shift Stone dust by hand - No dusts available			
7			x			Walks down to McDowell / Shot fire place. Change over with Back shift.			
8						Travel end.			

Figure 10.8: References to gas trips⁹³

53. Machine-mounted sensors have an important role in an underground mine. However, workers may continue working in the face of gas trips, or be tempted to bypass the detectors, particularly under significant production pressure. Such behaviour defeats the purpose of the sensors.
54. The joint investigation revealed many reports of underground workers at Pike bypassing machine-mounted sensors by various means. One worker admitted he covered a gas sensor with a plastic bag.⁹⁴ He did that 'just to save it tripping and havin' to wait around for an electrician ... and save the boys' legs.⁹⁵ He heard of gas detectors being covered on other machines including loaders, and he thought every miner knew how to do it.⁹⁶ Another miner saw compressed air being blown onto gas sensors to keep the machine cutting, and miners using metal clips to override machine-mounted sensors.⁹⁷ He saw machines overridden following gas trips 'quite a few times illegally.'⁹⁸ Indeed, 'it happened so often' that he would come on shift and find the previous shift had left the metal clip in place, because 'everyone - not everyone, but a lot of people did it.'⁹⁹ He said in his view workers bypassed gas detectors 'out of frustration' because of the poor standard of equipment at Pike River and the need to get the job done.¹⁰⁰
55. Unless there is a concerted effort by management to collect, monitor and respond to information about gas trips and safety bypassing, that information is likely to be lost or overlooked. Senior managers did not have an adequate system to identify and respond to the bypassing of sensors. One worker told investigators that written reports of sensors being bypassed would just 'disappear' without any response from management.¹⁰¹
56. Pike's incident/accident reporting system did contain at least 14 reports of gas sensors being bypassed.¹⁰² One such report in March 2010, shown here, was a plea to the mine manager to 'stop people from overriding safety circuits'.

What was the ROOT CAUSE of this event? <i>Someone has deliberately bypassed the CH₄ system</i>			
SECTION 5: Remedial Actions Recommended, Including Any Injury Prevention & Training if Required			
Describe event: <i>Attempt to find out how and why and stop people from overriding safety circuits (PLEASE)</i>	By Whom <i>White</i>	By Whom <i>Manager</i>	Date Completed <i>ASAP</i>
New Hazard Identified – has this been added into the Hazard Register?		Yes <input type="checkbox"/>	No <input type="checkbox"/>
New Controls Implemented – Have these been recorded in the Hazard Register?		Yes <input type="checkbox"/>	No <input type="checkbox"/>

Figure 10.9: Plea to stop overrides of safety circuits¹⁰³

57. In many cases there was no management sign-off, and in other cases the solution was to speak to deputies and undermanagers, or issue a tool box talk. For example, Mr White signed off three incidents involving bypassing on 23 and 24 June 2010.¹⁰⁴ In each case the response was that Mr White had 'spoken to' statutory officials.
58. Given the heightened production pressure in 2010, and problems with safety culture, it was not enough to assume that talking to staff and officials would result in proper compliance. That lesson has emerged clearly from other disasters, which have shown that instructions to comply are no substitute for auditing and enforcement.¹⁰⁵
59. Previous disasters have also shown the importance of setting up systems to ensure managers are regularly informed of non-compliance.¹⁰⁶ The incident/accident system did not achieve that, and managers were not adequately informed of the scale and frequency of the problems at Pike River. For these reasons the effectiveness of machine-mounted gas sensors as a control against the risk of an explosion was compromised.

Hand-held sensors

60. Deputies and underviewers at Pike were given hand-held personal gas monitors. These were used to take gas readings for the deputy statutory reports, and to inform the miners underground. However, there were frequently shortages of hand-held gas detectors at Pike. Hydro-mining consultant Masaoki Nishioka said 'almost all [the] time' there was no methane detector for him to take underground.¹⁰⁷ The lack of gas detectors featured several times in incident reports.

SECTION 3: Description and Investigation of Accident/Incident and Immediate Actions			
Describe event: Give all details			
<input type="checkbox"/> Ask what happened, where, how and who (if not enough) room, attach additional sheets of paper) <input type="checkbox"/> Include a diagram to better explain what you are saying, if that is required. <input type="checkbox"/> Ask why? Five times to really get to potential Root Cause. Remedial actions need to occur at this level to prevent recurrence.			
<i>LACK OF GAS DETECTORS AVAILABLE IN CONTROL ROOM - AT 14:00 SHIFT change over there is only 2 left ARVO IT IS NOT fully charged - THERE IS 13 IN THE STORE TO BE SENT AWAY AND 4 TO COME BACK FROM CHECK</i>			
Was plant/equipment involved? If so, describe including the ID/regno number of it e.g. CM1, MT004, Light vehicle rego number:			
FORM COMPLETED BY: <i>Dan Dugga</i>	SIGNATURE: <i>Dugga</i>	POSITION: <i>Control</i>	DATE: <i>2/06/2010</i>
(Sections below to be completed by Supervisor/Department Manager/or Safety & Training Manager):			

Figure 10.10: Report of lack of gas detectors¹⁰⁸

61. Mr White said he was not aware of any shortage and said, 'We'd actually just increased the number of gas detectors quite significantly.'¹⁰⁹ Given the frequency with which the issue featured in written reports at the mine, Mr White should have been aware of the problem.¹¹⁰ The fact he was not emphasises a weakness in the information management system.
62. Because methane is lighter than air and accumulates in the roof areas within a mine, it is important that deputies and underviewers are able to use methane detectors anywhere likely to contain gas. Pike did not have extension probes available, which would have given deputies a better understanding of the extent of methane layering in the higher areas of the mine.¹¹¹
63. Detection of methane with gas detectors was not necessarily comprehensive. DOL noted that high levels of gas were recorded in the ventilation shaft in the period 11 to 13 November 2010.¹¹² However, the deputies' statutory

reports did not record correspondingly high readings anywhere in the mine in that period. The expert panel noted there would have been levels greater than 5% somewhere in the mine to get the concentrations seen at the main ventilation shaft.

64. Miners are required by law to withdraw from the mine if flammable gas reaches 2% or more in the general body of air.¹¹³ One miner encountered methane over 2% 'quite a lot', and more than 5% on two occasions.¹¹⁴ One occasion involving over 5% was approximately two weeks before 19 November, after the commissioning of the main fan. He informed his deputy, who said, 'We'll be right, just quickly get [the job] done.'¹¹⁵ They remained working in the explosive atmosphere for at least 10 minutes,¹¹⁶ and there was no investigation because I never reported it.¹¹⁷ He said there were times when they continued working in 2% methane contrary to the regulations.¹¹⁸ On another occasion, three contractors were found working in the ventilation return without gas detectors.¹¹⁹ These examples demonstrate the vulnerability of any system that simply assumes workers will comply with procedures, even those of such importance.
65. Mr White was asked whether he had any system to make sure that significant information from the deputies' statutory reports was being identified by undermanagers and filtered up to him as mine manager. He said he would 'on occasion' read the deputies' reports, and he had regular contact with the deputies and undermanagers which gave opportunity for feedback from them.¹²⁰ He said he did not see all the written reports, but 'relied on the face-to-face transfer of information.'¹²¹ For someone in Mr White's position, burdened with numerous responsibilities beyond the ventilation system, reliance on 'being available' meant he was not properly informed of the gas results recorded by the deputies. Mr White acknowledged that a more systematic approach to analysis of the deputies' statutory reports 'may well have helped',¹²² but reiterated that he made himself available to be informed of issues at the mine. Mr White acknowledged it was 'absolutely certain' that a ventilation officer, if the mine had one, would have looked at the information contained in the deputies' reports.¹²³

Deputies reports

66. The commission prepared a number of summaries of events, drawn from the deputy statutory reports and the deputies production reports, for each shift. A list is contained in Chapter 15, 'Regulator Oversight at Pike River' (see the footnote for paragraph 73). In relation to gas monitoring, one schedule compares readings of methane at the ventilation shaft with methane levels contained in the reports of the deputies. See Appendix 8 for an extract from that schedule, limited to November 2010.¹²⁴ It gives an insight into some of the issues that the deputies were managing in the 19 days before the tragedy.

Conclusions

67. Pike's gas monitoring system was deficient in several respects at the time of the explosion:
- There was only one working fixed methane sensor reporting to the control room that measured contaminated air in the ventilation return. This was not capable of showing a methane level above 2.96%, and did not report to the main Safegas system.
 - The mine should not have operated without multiple methane sensors located throughout the main return.
 - The maintenance and calibration of the fixed methane sensors was inadequate, at least in November 2010.
 - Machine-mounted sensors, which were well maintained and calibrated, were sometimes bypassed, resulting in men working in unsafe conditions.
 - Reporting by underground workers disclosed significant methane management problems, and there was no effective system to respond to this.

- The mine lacked a tube bundle system and was short of hand-held gas monitors.
- The poor standard of gas monitoring at the mine was a very serious problem throughout the period leading up to the explosion.

ENDNOTES

- ¹ The purpose of gas monitoring systems is discussed in: David Cliff, David Bell, Tim Harvey, Anthony Reczek and David Reece, *Pike River Coal Mine Explosion: Investigation for Nature and Cause* (DOL Investigation Report, Appendix 6), October 2011, DOL3000130007/18, para. 7.2 and John Rowland, witness statement, 22 October 2011, ROW001/3, para. 10. Douglas White agreed with Mr Rowland's comments: Douglas White, transcript, p. 4892.
- ² Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 58, requires electricity to be disconnected if the concentration of flammable gas exceeds 1.25% in the general body of air.
- ³ Darren Brady, 'The Role of Gas Monitoring in the Prevention and Treatment of Mine Fires', in N. Aziz (Ed.), *Coal 2008: Coal Operators' Conference*, University of Wollongong & the Australasian Institute of Mining and Metallurgy, 2008, pp. 202–08.
- ⁴ *Ibid.*, p. 202.
- ⁵ *Ibid.*, p. 204.
- ⁶ Department of Labour, *Pike River Mine Tragedy* 19 November, 2010: Investigation Report, [2011], DOL3000130010/64, para. 2.39.1; Energy NZ Ltd, Department of Labour – Pike River Coal Audit Report for November 19, 2010, 25 January 2012, DOL3000140001/52.
- ⁷ Department of Labour, Investigation Report, DOL3000130010/140, para. 3.26.17.
- ⁸ Minarco Asia Pacific Pty Ltd, *Pike River Coal Company: Ventilation Report*, June 2006, DAO.012.02277/21, para. 5.2; Pike River Coal Ltd, *Ventilation Management Plan*, 2008, DAO.003.07114/33, para. 6.1.
- ⁹ *Ibid.*, DAO.003.07114/34–35, paras 6.2.1.1–6.3.2.
- ¹⁰ *Ibid.*, DAO.003.07114/78–79, para. 282.
- ¹¹ *Ibid.*, DAO.003.07114/38, para. 48.
- ¹² *Ibid.*, DAO.003.07114/59, para. 136.
- ¹³ *Ibid.*, DAO.003.07114/38, para. 54.
- ¹⁴ *Ibid.*, DAO.003.07114/38 para. 55.
- ¹⁵ *Ibid.*, DAO.003.07114/59, para. 135.
- ¹⁶ Douglas White, transcript, p. 4894.
- ¹⁷ Michael Donaldson, Police/DOL interview, 14 April 2011, INV.03.17838/17, 32.
- ¹⁸ Pike River Coal Ltd, P&ID Gas Monitoring, 5 June 2010, DOL7770050005/4.
- ¹⁹ Douglas White, witness statement, 24 May 2012, WHI004/3, para. 15.
- ²⁰ Pike River Coal Ltd, *Mine Ventilation & Gas Drainage: PB-Vent-024*, 10 March 2010, DAO.032.00163. (Plan annotated by Michael Lerch)
- ²¹ Energy NZ Ltd, *Coal Audit Report*, DOL3000140001/55.
- ²² 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 based on source information from Energy NZ Ltd, *Coal Audit Report*, DOL3000140001, Robb Ridl, witness statement, 14 March 2012, DAO.041.00009 and Keith Stewart, witness statement, 9 August 2012, MBIE3000010011.)
- ²³ This was accepted by Douglas White: Douglas White, transcript, p. 4899.
- ²⁴ Department of Labour, Investigation Report, DOL3000130010/124 para 3.16.2; Pike River Coal, *Trend Friday*, 3 September 2010–Saturday 4 September 2010, DAO.001.03907/1.
- ²⁵ Keith Stewart, witness statement, 9 August 2012, MBIE3000010011/2, para. 6.
- ²⁶ Barry McIntosh, Police/DOL interview, 2 August 2011, INV.03.28697/6.
- ²⁷ David Reece, plan annotated with gas sensor locations, MBIE3000010009/1.
- ²⁸ David Cliff et al., *Investigation for Nature and Cause*, DOL3000130007/48.
- ²⁹ 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)
- ³⁰ Department of Labour, Investigation Report, DOL3000130010/139, para. 3.26.7; Keith Stewart, witness statement, 9 August 2012, MBIE000010011/2, para. 6.
- ³¹ Department of Labour, Investigation Report, DOL3000130010/124, para. 3.16.2; Pike River Coal Ltd, *Trend Friday*, 3 September 2010–Saturday 4 September 2010, DAO.001.03907/1.
- ³² David Cliff, *An Evaluation of Elements Relating to the Cause of the First Explosion at Pike River Coal Mine: Draft*, 16 September 2011, DOL3000140009/12.
- ³³ Douglas White, transcript, p. 4902.
- ³⁴ Pike River Coal Ltd, *Review of Surface Aux Fan Failure 05/10/10*, 7 October 2010, DAO.001.00359/17–25.
- ³⁵ *Ibid.*, DAO.001.00359/21. (The entry reads 'Set up Gas Monitoring and shaft bottom', but presumably 'and shaft bottom' should read 'at shaft bottom'.)
- ³⁶ David Cliff et al., *Investigation for Nature and Cause*, DOL3000130007/48.
- ³⁷ Department of Labour, Investigation Report, DOL3000130010/145, para. 3.32.12.
- ³⁸ Energy NZ Ltd, *Addendum 1: Surface Methane System Report, Version 1.1*, January 2012, DOL3000140002/6.
- ³⁹ Douglas White, transcript, p. 4899.
- ⁴⁰ *Ibid.*, p. 4901.
- ⁴¹ Department of Labour, Investigation Report, DOL3000130010/145, para. 3.32.12.
- ⁴² Energy New Zealand, *Surface Methane System Report*, DOL3000140002/7.
- ⁴³ Pike River Coal Ltd, *Auxiliary Fan Shaft Methane*, CAC0112/7. (Gas reports compiled by the commission)
- ⁴⁴ *Ibid.*, CAC0112/9.
- ⁴⁵ Douglas White, transcript, p. 4898.
- ⁴⁶ Pike River Coal Ltd, *Mine Ventilation & Gas Drainage: PB-Vent-028*, 7 October 2010, DAO.001.05378.
- ⁴⁷ Department of Labour, Investigation Report, DOL3000130010/146.
- ⁴⁸ David Reece, transcript, p. 4573; Douglas White, transcript, p. 4897.
- ⁴⁹ Douglas White, transcript, p. 4897.
- ⁵⁰ Safegas is a system designed by Queensland's Safety in Mines Testing and Research Station (SIMTARS) for underground coal mines.
- ⁵¹ Email, Nicholas Gribble to Douglas White, 8 October 2010, INV.04.00676/1.
- ⁵² Michael Scott, Police/DOL interview, 3 October 2011, INV.03.28829/4–5.
- ⁵³ *Ibid.*, INV.03.28829/5.
- ⁵⁴ *Ibid.*, INV.03.28829/4, 30.
- ⁵⁵ *Ibid.*, INV.03.28829/6–7.
- ⁵⁶ Memorandum, Robb Ridl to Douglas White, 22 September 2010, DAO.043.00004/1.
- ⁵⁷ *Ibid.*
- ⁵⁸ *Ibid.*
- ⁵⁹ Douglas White, transcript, pp. 4988–4989.
- ⁶⁰ Queensland Warden's Court, *Wardens Inquiry: Report on an Accident at Moura No 2 Underground Mine on Sunday, 7 August 1994, 1996*, CAC0152/1.
- ⁶¹ *Coal Mining Safety and Health Regulation 2001*, ss 224–26.
- ⁶² Pike River Coal Ltd, *Ventilation Management Plan*, DAO.003.07114/74, paras 250–51.
- ⁶³ *Ibid.*
- ⁶⁴ Barry McIntosh, Police/DOL interview, 2 August 2011, INV.03.28697/33.
- ⁶⁵ *Ibid.*, INV.03.28697/34.
- ⁶⁶ Douglas White, transcript, p. 4924.
- ⁶⁷ Pike River Coal Ltd, *Acknowledgement of Gas Alarms: TARP (Trigger Action*

Response Plan), 5 December 2008, DOL7770030078.

⁶⁸ Pike River Coal Ltd, Acknowledgement of Gas Alarms, DOL7770030078/1.

⁶⁹ Email, Nicholas Gribble to Douglas White and Stephen Ellis, 19 October 2010, SOE.024.00323.

⁷⁰ Grey Star–James Print, Proof Sign-off: Control Room Gas Log Book, 21 October 2010, DOL5000010018.

⁷¹ Douglas White, transcript, p. 4915.

⁷² *Ibid.*, p. 4925.

⁷³ Robb Ridl, witness statement, 14 March 2012, DAO.041.00009/18–19, paras 70–76.

⁷⁴ Email, Gregory Borichevsky to Danie du Preez, 27 October 2010, INV.04.01375/1.

⁷⁵ *Ibid.*

⁷⁶ Petrus (Pieter) van Rooyen, transcript, p. 5151; Email, Gregory Borichevsky to Danie du Preez, 18 June 2010, INV.04.00354; Memorandum, Gregory Borichevsky to Pike River operational staff, 27 July 2010, DAO.001.04566.

⁷⁷ Petrus (Pieter) van Rooyen, transcript, p. 5151; Gregory Borichevsky, witness statement, 26 June 2012, BOR0001/33–34, paras 225–29; Email, Gregory Borichevsky to Danie du Preez, 18 June 2010, INV.04.00354/1–2; Memorandum, Gregory Borichevsky to Pike River operational staff, 27 July 2010, DAO.001.04566.

⁷⁸ Gregory Borichevsky, Pike River Coal Mine Disaster, 19 November 2010, INV.04.00001/7.

⁷⁹ *Ibid.*

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⁸¹ Gregory Borichevsky, Police/DOL interview, 26 April 2011, INV.03.18954/87.

⁸² *Ibid.*, INV.03.18954/89–91.

⁸³ Stephen Ellis, witness statement, 14 March 2012, DAO.041.00042/3–4, paras 8–13.

⁸⁴ Pike River Coal Ltd, Review of Surface Aux Fan Failure, DAO.001.00359/19–21.

⁸⁵ Email, Nicholas Gribble to Douglas White, Stephen Ellis, Neville Rockhouse, Peter Sinclair, Chris Coetzer, Danie du Preez and Robb Ridl, 7 October 2010, SOE.024.00287.

⁸⁶ Department of Labour, Investigation Report, DOL3000130010/137, para. 3.24.8.

⁸⁷ *Ibid.*, DOL3000130010/142, para. 3.28.7.

⁸⁸ Douglas White, Operation PIKE Investigation: Summary of Interview, 5 May 2011, INV.03.17891/10.

⁸⁹ Email, Paul Harrison to Douglas White, 28 October 2010, EXH0042/1.

⁹⁰ *Ibid.*

⁹¹ Douglas White, transcript, p. 1294.

⁹² Department of Labour, Investigation Report, DOL3000130010/141, figure 45.

⁹³ Pike River Coal Ltd, Pike River Coal Mine: Deputies Production Report, 19 November 2010, DAO.001.02568/1.

⁹⁴ Police/DOL interview, 8 April 2011, INV.03.17556/15–16. (The commission decided, by majority, to withhold the name of the worker concerned. Commissioner Bell dissented.)

⁹⁵ *Ibid.*, INV.03.17556/16.

⁹⁶ *Ibid.*, INV.03.17556/16–17.

⁹⁷ Police/DOL interview, 29 April 2011, INV.03.20794/3. (The commission decided, by majority, to withhold the name of the worker concerned. Commissioner Bell dissented.)

⁹⁸ *Ibid.*, INV.03.20794/7.

⁹⁹ *Ibid.*, INV.03.20794/8.

¹⁰⁰ *Ibid.*, INV.03.20794/10.

¹⁰¹ *Ibid.*, INV.03.20794/4.

¹⁰² Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, November 2011, CAC0114/20–24.

¹⁰³ Pike River Coal Ltd, Incident/Accident Form, 2 March 2010, DAO.002.09871/2.

¹⁰⁴ Pike River Coal Ltd, Incident/Accident Forms: DAO.001.00754/2 (10 June 2010); DAO.001.00746/2 (9 June 2010); DAO.001.00777/2 (6 June 2010).

¹⁰⁵ Andrew Hopkins, Failure to Learn: The BP Texas City Refinery Disaster, 2008, CCH Ltd, p. 15.

¹⁰⁶ *Ibid.*, pp. 107–20.

¹⁰⁷ Masaoki Nishioka, transcript, p. 3546.

¹⁰⁸ Pike River Coal Ltd, Incident/Accident Form, 2 June 2010, DAO.001.00826/2.

¹⁰⁹ Douglas White, transcript, p. 5000.

¹¹⁰ See the following Pike River Coal Ltd incident/accident forms: DAO.001.00359/28 (11 October 2010); DAO.001.00682 (13 July 2010); DAO.001.00826 (2 June 2010).

¹¹¹ Department of Labour, Investigation Report, DOL3000130010/142, para. 3.29.5.

¹¹² David Cliff et al., Investigation for Nature and Cause, DOL3000130007/39.

¹¹³ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 21.

¹¹⁴ Police/DOL interview, 8 December 2010, INV.03.01747/13–15. (The commission decided, by majority, to withhold the name of the worker concerned. Commissioner Bell dissented.)

¹¹⁵ *Ibid.*, INV.03.01747/43.

¹¹⁶ *Ibid.*, INV.03.01747/47.

¹¹⁷ *Ibid.*, INV.03.01747/43.

¹¹⁸ *Ibid.*, INV.03.01747/47–48.

¹¹⁹ Pike River Coal Ltd, Incident/Accident Form, 7 May 2010, DAO.001.00885/2.

¹²⁰ Douglas White, transcript, p. 4994.

¹²¹ *Ibid.*, p. 4995.

¹²² *Ibid.*, p. 4999.

¹²³ *Ibid.*, p. 5002.

¹²⁴ Royal Commission on the Pike River Coal Mine Tragedy (Karyn Basher), Instances of Methane Recorded in 'CH610 Aux Fan Shaft Methane' Graphs, Deputy Statutory Reports and Deputies Production Reports (30 September – 19 November 2010), February 2012, CAC0145/7–11.

Introduction

1. This chapter considers the underground electrical system at Pike River. The integrity of parts of that system, and its potential to be a source of ignition for the first explosion, have been the subjects of conflicting evidence.
2. Relevant evidence and submissions have been received from many sources, including the Department of Labour (DOL); Anthony Reczek, an electrical expert engaged by DOL and the New Zealand Police; Rockwell Automation (NZ) Ltd, the supplier of key electrical components called variable speed drives (VSDs); and certain Pike directors, employees and contractors.
3. Because it has not been possible to access the underground parts of the mine in which significant electrical equipment is located, its installation and functioning, and its potential contribution to the explosion, cannot be determined. That is still being investigated by the health and safety regulator. Accordingly, the commission is compelled to limit its analysis.

Electrical systems at Pike River

4. Underground electrical systems are critical to mine safety and production. They must be designed, sited, installed and maintained so that they do not create hazards, including the risks of electric shock and sparking, which may provide an ignition source for flammable gas or material. These systems are complex, and use specialised equipment requiring expertise beyond that of a generalist electrician.
5. Their functions include powering the ventilation system of a mine, the monitoring and communications systems (including those for use in an emergency) and mining equipment. At Pike River that included the ABM, continuous miners and roadheader, the VLI Drilling Pty Ltd drill rig and the water pumps for the hydro monitor and coal transport systems. Although some parts of the electrical system, for example the surface fan, had back-up power supplies, those were often of limited duration.
6. Pike River's underground power supply came from two substations. One, at Logburn, stepped the voltage down 110kV to 33kV. It fed power to another substation near the portal entrance, which stepped that 33kV down to 11kV. From that substation, three 11kV lines delivered power into the mine through the main drift, two to the main electrical distribution board located in pit bottom in stone, identified as SB001 in Figure 11.1. Through that board power was supplied to much of the underground equipment. The third line delivered power to the main ventilation fan distribution board pit bottom south, at location SS601 in Figure 11.1. Pit bottom south extended to the coal reserves of the mine.
7. Those two areas, pit bottom in stone and pit bottom south, contained more substations to further step down the voltage, from 11kV to either 1kV, 690V or 400V, to power underground electrical equipment. Those areas also had the greatest concentration of fixed electrical equipment.
8. Generally, fixed electrical equipment could be controlled and monitored from the surface control room. Some of the equipment had methane sensors and safety cutouts, including in the event of overheating.¹
9. The red line in Figure 11.1 marks the boundary between two underground zones, the restricted zone, which is to the left of the line and includes the coal workings, and the non-restricted zone to the right. That non-restricted zone includes Spaghetti Junction and much of pit bottom south. The zones are explained below.

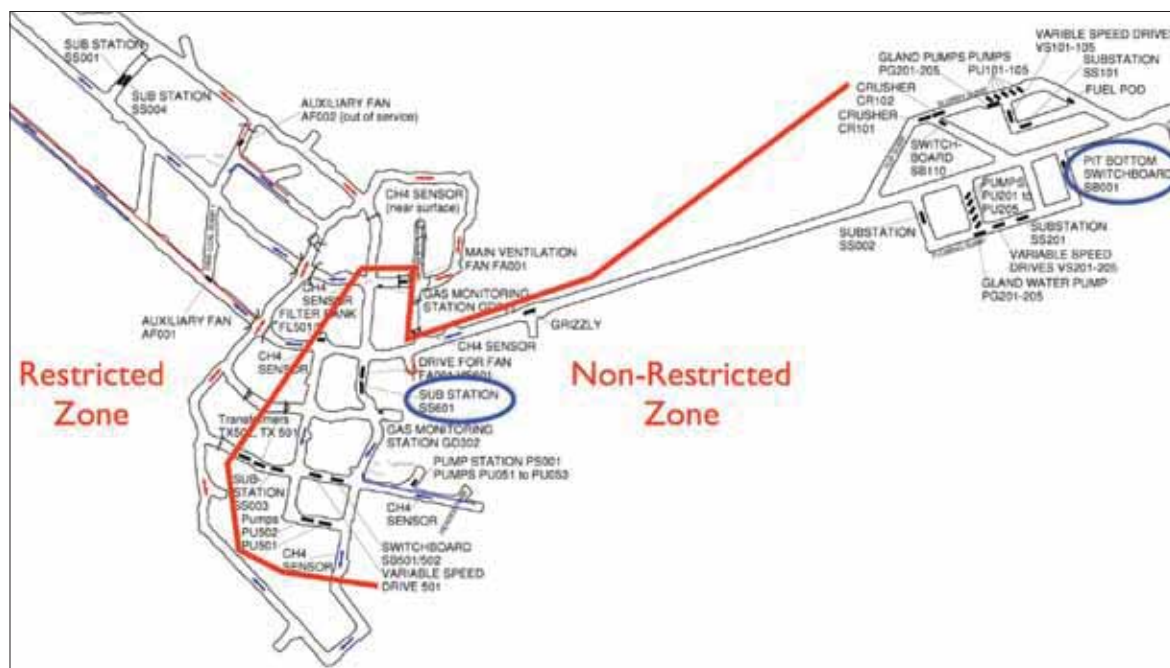


Figure 11.1: Main electrical area and zones underground²

The restricted and non-restricted zones

10. Because of the risk of an electrical system being a source of ignition, the Health and Safety in Employment (Mining – Underground) Regulations 1999 provide for restricted and non-restricted zones in gassy coal mines.
11. In gassy mines the restricted zone includes the working faces, the return, any area where flammable gas is likely to be 2% or more in the general body of air and any area containing electrical equipment that has not been shown to be free from flammable gas. Free from flammable gas means there is no more than 0.25% flammable gas in the general body of air.³
12. All practicable steps must be taken to ensure electrical equipment used in a restricted zone meets certain safety standards, so that it is not a source of ignition. Essentially, it must be intrinsically safe or flameproof.⁴ Intrinsically safe equipment operates at such a low energy level that it is incapable of igniting methane. Flameproof equipment is enclosed in a special housing to ensure any ignition of methane is safely contained inside the enclosure.⁵
13. These requirements were reflected in Pike’s detailed ventilation management plan. It contemplated that an ‘electrical supervisor’ would define any non-restricted zones, following a risk assessment. The zones were to be shown on a plan kept in the surface controller’s office.⁶ Electrical equipment had to meet legislative standards. Inspections were to occur with a frequency that differed according to the equipment.
14. The restricted and non-restricted zones were defined in August 2010, but the process outlined in the management plan was not followed. There was no risk assessment to define the location of the restricted zone.⁷
15. By then Pike had already installed a large amount of electrical equipment, some of which was neither intrinsically safe nor flameproof, in the pit bottom south and Spaghetti Junction areas of the mine. The motor for the main fan, numerous pumps and VSDs fell within that non-restricted zone as defined.⁸
16. Some electrical equipment was tested on the surface before being installed underground. In addition, before underground electrical equipment in pit bottom south was powered up, gas samples were taken in the vicinity over three days to ensure there was less than 0.25% methane. Methane sensors were placed at various parts of the non-restricted zone.⁹

17. Despite those precautions, the non-restricted zone in pit bottom south extended to the coal measures in the gassy mine and was close to the return. Michael Scott, an underground electrical co-ordinator at Pike, noticed that some of the methane sensors in the non-restricted zone in 'pit bottom south near switchboard SB501 would trip. This was because the tunnel where the header tank is located is a non-free ventilated stub, or dead end, and we did have methane coming out there in small amounts ... very low concentrations, maybe 0.3%.¹⁰ The sensor was moved and ventilation of the area improved. Methane greater than 0.25% in the non-restricted zone was reported through the accident and incident reporting system on at least one occasion.¹¹
18. The location of the non-restricted zone did not go without comment at the mine. One deputy said:
- I asked one of the electrical engineers what [the main fan] motor was doing up there, right next to the main return and fan. He just said it was a non-restricted zone. I can't understand how it could be a non-restricted zone when it was within 10m of a temporary stopping into the main return where all the gas was leaving the mine.*¹²
19. A stopping failure or ventilation fan failure (which may be followed by the reversal of ventilation) could result in methane being introduced into the pit bottom south non-restricted zone.¹³ Because some equipment in that zone was not intrinsically safe or flameproof, methane sensors and the associated safety cutouts had to be relied on if methane entered the area.
20. The location of the non-restricted zone concerned Mr Reczek, the electrical expert engaged by DOL and the police. In his view it did not make logical sense and the whole area inbye of the main drift should have been a restricted zone.¹⁴ He stated that 'despite the fact that the presence of methane was possible, there was no explosion protection technology used on the major items of electrical equipment located in the designated "unrestricted" area of the mine's inbye workings at the end of the stone drift entry.'¹⁵
21. A risk assessment would likely have led to the view that the non-restricted zone, and thus non-flameproof or non-intrinsically safe equipment, ought not to be located within or so near to the coal measures of a gassy mine or, if it was, very good protection would be needed to prevent methane coming into contact with electrical equipment.
22. Such a risk assessment is not expressly required by the underground mining regulations. This contrasts with the Queensland legislation in which a risk assessment is required to define three types of zones, those with a negligible explosion risk (methane likely to be less than 0.5%), explosion risk 1 (methane likely to be 0.5 to 2%) and explosion risk 0 (methane likely to be greater than 2%).¹⁶

Proximity of non-restricted zone and electrical equipment to utility services

23. The inclusion of pit bottom south and Spaghetti Junction in the non-restricted zone led to another hazard. These areas contained roadways and significant utility services – water pipes, compressed air pipes and gas drainage pipes. To those were added 11kV lines. The sheer quantity, and lack of separation, of utility services at Spaghetti Junction is shown in Figure 11.2. The high-voltage cables are red.
24. Of that configuration mining consultant David Reece said:
- This is quite unusual to have pipes like this, this sort of configuration in a mining situation. The other thing is the high-tension cables that are also interspersed with all these services in that particular area. So this is potentially an area where these could be hit by a diesel vehicle or something of that nature ... it's certainly hazardous and the combination of services that you've got there with high-tension cables, and we're talking about 11,000 volts in those cables, if you damaged that at the same time as the pipeline, it is highly likely that you would get an ignition at that point.*¹⁷



Figure 11.2: Spaghetti Junction¹⁸

25. Consultant Comlek Electrical Engineering Contracting Ltd had raised the proximity of electrical cabling and equipment to other utility services and the roadways in a 30 October 2009 electrical audit report commissioned by Pike. Its purpose was to assess the compliance of electrical equipment located in a potentially explosive atmosphere with relevant Australian and New Zealand standards and to make corrective recommendations.
26. Comlek was concerned that high-voltage lines 'crossing the mine access road is considered dangerous due to it not specifying clearance heights by signage and not having indication of aerial location' and that standards of electrical equipment and location of storage needed 'major improvement'. An example was an item of electrical equipment (a starter) being located under water pipes, on the floor and without barrier identification.¹⁹
27. High-voltage cabling and electrical equipment should not be located close to gas, water and compressed air utility services. Where this is unavoidable, protective housing should be used, including protection against vehicle impact.

The variable speed drives

28. Pike used VSDs to allow the fixed speed motors for the main fan and underground pumps to operate at variable speeds. The VSDs do this by varying the frequency of the power supply to the motors.²⁰ This enables a softer start-up process and also allows the operating speeds of a motor to match its output demand, resulting in cost savings and improved performance.
29. Pike had 12 VSDs underground, at the locations circled in red in Figure 11.3. There were five VSDs in each of the locations to the top right of the plan and one at each of the locations to the bottom left of the plan.
30. There were concerns about the use of VSDs. Mr Reczek was aware of the use of VSDs underground elsewhere, but they were 'explosion protected. They're in flameproof enclosures and they're confined to the body of machinery'.²¹

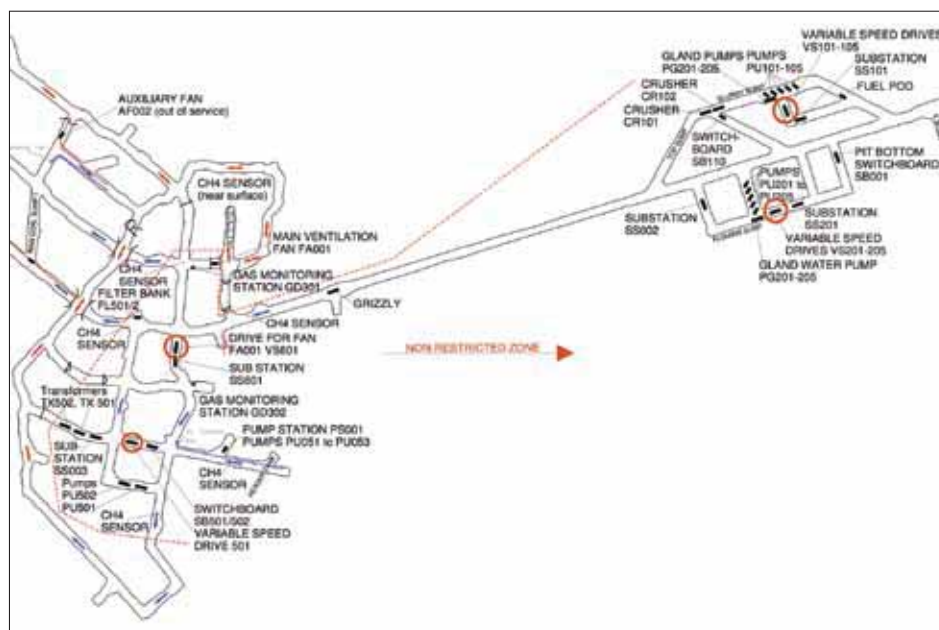


Figure 11.3: Plan showing VSDs underground at Pike River²²

He had never seen a configuration such as that at Pike River, which was essentially a significant number of fixed VSDs underground.

31. Mr Reczek and Mr Nishioka gave evidence that VSDs need to be placed in a very clean, dust-free environment with a consistent temperature. Mr Reczek thought that 'unless you have a totally enclosed room which is dust free and filtered and separately ventilated, I don't think you could provide a satisfactory environment' underground in a coal mine.²³ Evidence indicates that Pike created, or sought to create, such an environment.²⁴
32. VSDs have the potential to cause enough harmonic distortion to generate sparking within the earth system of the power supply. The extent to which harmonics occur depends on many matters, including the type of VSD, the manner in which it is installed and the cabling type, length and connection. The installation and cabling details at Pike River remain unclear.²⁵ There is conflicting evidence from Mr Reczek and Rockwell, the supplier of VSDs, about the extent and effect of harmonics. This is referred to in more detail in Chapter 14, 'The likely cause of the explosions'.
33. There were other problems associated with the use of VSDs. There was an overvoltage in the power supply to at least one VSD, affecting its performance; this was rectified on about 9 November 2010. Five VSDs failed and were removed. In one case a power structure exploded. On several occasions pre-charge resistors failed. This problem was to be solved by changing the ratings of protective fuses. New fuses had been ordered but not replaced by the time of the explosion.
34. During commissioning of the main underground fan there were intermittent and difficult problems with the associated VSD. On 27 October 2010 the VSD was replaced with an air-cooled model, which was placed within an enclosure to provide protection. It seems this led to overheating. Pike took steps to correct that, including leaving open the doors to the enclosure and installing ducting to direct air into it. On about 9 November 2010 Pike ordered an air conditioner to improve the cooling. It had not arrived by the time of the explosion.²⁶
35. In summary, despite Pike's efforts and those of external experts, there was a range of problems associated with the use of VSDs, not all of which had been addressed by the time of the explosion.

Regular electrical inspections

36. Documents filed with the commission show that, as with much other plant, there were frequent inspections of and written reports on electrical plant and equipment. The frequency varied, but some were daily.²⁷ Despite containing information relevant to health and safety, those reports did not make it as far as the safety and training department.²⁸

37. The timing of tests and inspections does not always seem to have been consistent. The October 2009 Comlek audit report shows, at that stage at least, no weekly and monthly tests on certain electrical equipment. A selection of work orders from October 2010 shows that daily electrical checks on some equipment were not always done. The reasons are unclear or not explained.²⁹
38. Comlek also pointed out that there was no single line diagram of the underground and above-ground electrical reticulation and that reporting of events and transfer of information at shift handovers needed improvement.³⁰

Electrical staffing at Pike River

39. Pike contracted in expert electrical advice,³¹ and had its own electrical staff, usually including electrical engineers,³² within the engineering department. Mr Scott, the underground electrical co-ordinator at the time of the explosion, noted '[w]e had trouble getting good electricians as they needed to be industrial electricians, but the majority of the electricians were up to standard in my view. A couple were beyond the standard.'³³ In October 2009 Comlek identified the lack of procedures for sign-off of electricians at Pike River as having certain certificates of competence.³⁴
40. Mr Reczek envisaged an electrical engineer with an overview of the management and operation of electrical equipment and responsibility for the implementation of risk controls as part of an electrical management plan. The relationship with the mine manager would be close.³⁵
41. Two early documents of Pike, a draft management plan of September 2008 and a draft electrical engineering management plan of November 2008,³⁶ contemplated an electrical engineer of some seniority. The final electrical engineering management plan dated 30 April 2010 provided for an electrical co-ordinator.³⁷ This appears to be a lesser, more maintenance orientated, position than that described by Mr Reczek. It is reflected in the structure of the engineering department before 24 August 2010 (Figure 11.4).

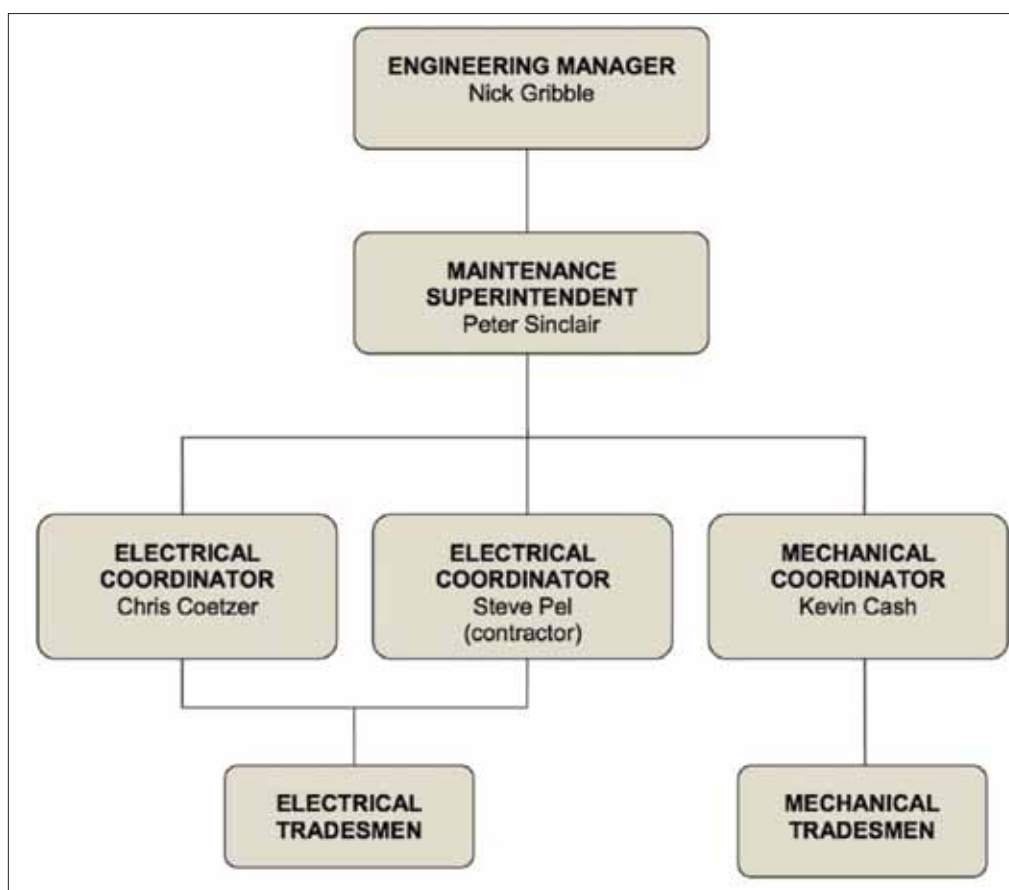


Figure 11.4: Structure of Pike engineering department before 24 August 2010³⁸

42. In September 2010 that structure was reviewed by Robb Ridl, the engineering manager for Pike from 24 August 2010 to 30 September 2011.³⁹ A memorandum from Mr Ridl dated 22 September 2010 records the reasons for the review and resulting recommendations:

The current Pike River Engineering Department is currently unable to meet the needs of the business and a new engineering organisational structure has been developed to provide for the maintenance requirements of the business in an operational phase.

... The current structure does not have clearly defined areas of responsibility and fixed plant is not being proactively maintained due to lack of supervisory resources.⁴⁰

43. A new structure with increased staffing was proposed and was approved by Douglas White and Peter Whittall (see Figure 11.5).⁴¹ It included the position of electrical engineer.
44. This was not as senior as the position suggested by Mr Reczek but did include responsibility for many aspects of the electrical system, including risk management, ensuring maintenance in accordance with statutory requirements, electrical inspections and continuous improvement.⁴²

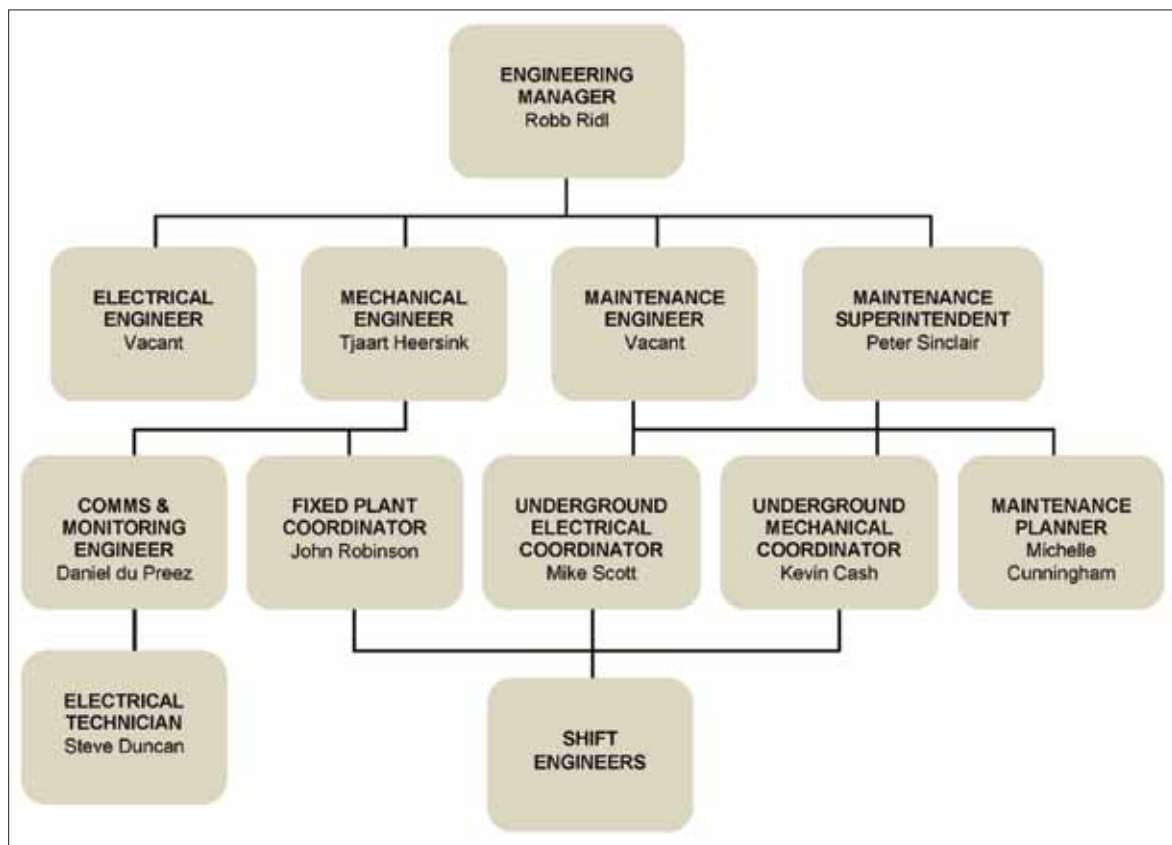


Figure 11.5: New structure for Pike engineering department⁴³

45. By 19 November 2010 an electrical engineer, a contractor who had been an electrical co-ordinator, had been appointed but he had not started in the new position.⁴⁴

Overall management of electrical safety at Pike River

46. All of the above issues call into question the extent to which Pike was properly managing electrical issues. The DOL investigation report states:

Taken together, it appears that [Pike] was experiencing an excessive number of issues with its electrical system and especially with its VSD operation. Each issue seems to have been explained and dealt with on an

*ad hoc basis, as and when it occurred. However, given the high risk environment [Pike] was operating in, and the number of unknown reasons for the electrical failures [Pike] management should arguably have approached the issues first and foremost as a safety matter. From this perspective, it may have been reasonable for [Pike] to have ceased operations and sought further third party expert advice to determine the causes of the electrical issues and the appropriate controls necessary. [Emphasis in original]*⁴⁵

47. The DOL investigation report also states that Pike had:

*four departures from conventional electrical arrangements for an underground coal mine. These were the placement of the main fan underground, the use of VSDs to drive key infrastructure systems, the long single entry (the Drift) and use of non-hazardous zones and equipment. These four unconventional arrangements individually and together created an increased level of risk because they were largely untested and unusual.*⁴⁶

Given the importance of a safe and efficient electrical system, Pike should have introduced 'compensatory processes to mitigate the higher risk.'⁴⁷ Those would include carrying out sufficient research to understand the risks those unconventional arrangements created in a hazardous environment, obtaining independent expert advice on the use and installation of VSDs underground, and a risk assessment.

48. Pike obtained significant advice about the VSDs. Experts were involved in designing and maintaining its electrical system. Assessments were undertaken for certain electrical equipment and there was some above-ground testing before installation. However, problems still occurred.
49. There does not appear to have been a comprehensive assessment of the potential risk of the electrical system. Mr Ridl thought such an assessment necessary but in the short time between his starting employment and the explosion he did not become aware of one.⁴⁸ Mr Scott thought the risk assessment process at Pike was more extensive than at other places he had worked, but did not recall an overall risk assessment concerning the use of electrical equipment underground.⁴⁹ Mr White was not sure of the extent of electrical risk assessments, and it was outside of his expertise.⁵⁰ The Pike board's health, safety and environment committee did not seek confirmation that the underground electrical systems were correctly installed and safe.⁵¹
50. A comprehensive risk assessment, in mid- to late 2010, would have taken into account the individual and cumulative risks raised by DOL and the problems with important components of the electrical system. The risks should have been considered in the context of Pike's move to hydro mining. This would have indicated the desirability of halting, or at least restricting, hydro-mining operations (because of its introduction of significant accumulated methane in the goaf), until all the electrical problems had been fixed.

Electrical inspections

51. Mr Reczek considered that the underground Pike electrical system warranted 'a significant amount of attention' from a regulator, because of its location in a hazardous area and its unconventional nature. The focus would be on the measures undertaken to assure safety.⁵²
52. However, regulator oversight was limited. On 13 February 2007 Richard Davenport, from the Electrical Safety Service of the Ministry of Economic Development (MED), and Michael Firmin of DOL, inspected the electrical system. They approved the then installation, but at that stage the drift was still being developed and the underground electrical cabling and system had not been installed.⁵³
53. On 26 November 2008 Mr Davenport, with Kevin Poynter of DOL, conducted another electrical inspection.⁵⁴ This concluded that all electrical installations were compliant.⁵⁵ At that stage the underground electrical equipment had not been installed.
54. From January 2009 MED no longer conducted electrical inspections in underground coal mines and DOL did not have the expertise to carry them out.⁵⁶ As a result, key underground electrical systems installed in 2010 were not scrutinised by an electrical expert from or on behalf of DOL.

Conclusions

55. The underground electrical system at Pike was unconventional in a number of ways:
- the main fan was underground;
 - the non-restricted zone, which contained some non-flameproof and non-intrinsically safe electrical equipment, extended to the coal measures in this gassy mine;
 - there was significant use of VSDs underground to drive key infrastructure and a range of problems was associated with their use; and
 - high-voltage cables and utility services were intermeshed at Spaghetti Junction.
56. Individually, and in combination, these unconventional arrangements introduced significant risks to the underground environment. The location of the non-restricted zone, and the overall electrical system, ought to have been subject to comprehensive risk assessment, followed by any necessary actions. Within the overall context of the mine's development and operation in mid- to late 2010, that may have led to a halting or restriction of hydro-mining operations while electrical problems were being corrected.
57. A risk assessment conducted before creating the non-restricted zone at pit bottom south would likely have led to the view it ought not to be located in or near the coal measures in this gassy mine.
58. Pike had both external and internal electrical expertise, but did not have a sufficiently senior electrical engineer with responsibility for the whole electrical system.
59. There was inadequate regulatory oversight of the electrical system from 2009 onwards, owing to a lack of expertise within the DOL mines inspectorate.
60. The commission has significant concern about the electrical system and whether it played a role in the explosion.

ENDNOTES

¹ For example the VSD for the main ventilation fan: Robb Ridl, witness statement, 14 March 2012, DAO.041.00009/28, para. 116. See also: Pike River Coal Ltd, Incident/Accident Form, 12 October 2010, DAO.001.00359/3–5.

² 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)

³ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 2.

⁴ *Ibid.*, reg 55.

⁵ Anthony Reczek, witness statement, 7 February 2012, DOL3000160001/5, para. 16.

⁶ Pike River Coal Ltd, Ventilation Management Plan, 2008, DAO.003.07114/72, para. 242.

⁷ Douglas White, transcript, p. 4971.

⁸ Michael Scott states the electrical equipment for the hydro monitor was installed between June and August 2010: Michael Scott, witness statement, 30 May 2012, SCO7770010001/17, paras 64–66.

⁹ Michael Scott, witness statement, 30 May 2012, SCO7770010001/18, paras 68–69; Douglas White, transcript, pp. 4968–70.

¹⁰ Michael Scott, witness statement, 30 May 2012, SCO7770010001/36–37, para. 150.

¹¹ Pike River Coal Ltd, Incident/Accident Form, 12 October 2010, DAO.001.00359/3–5; Douglas White, transcript, p. 4972.

¹² Dene Murphy, witness statement, 2 December 2011, FAM00057/12, para. 60.

¹³ Michael Scott, witness statement, 30 May 2012, SCO7770010001/37, para. 151 (stopping failure); Dene Murphy, witness statement, 2 December 2011, FAM00057/11, para. 58 (ventilation fan failure).

¹⁴ Anthony Reczek, transcript, pp. 4774–75.

¹⁵ Anthony Reczek, witness statement, 7 February 2012, DOL3000160001/28, para. 108.

¹⁶ Coal Mining Safety and Health Regulation 2001, cls 286–91.

¹⁷ David Reece, transcript, p. 4485.

¹⁸ DR12 – Photo of Spaghetti Junction, DOL3000150019/1.

¹⁹ Comlek Electrical Engineering Contracting Ltd, Audit Report of Electrical Management Systems at Pike River Coal NZ, 30 October 2009, DAO.025.26626/6–7, paras 1.14–1.15.

²⁰ Anthony Reczek, witness statement, 7 February 2012, DOL3000160001/16, para. 55.

²¹ Pike River Coal Ltd, Plant Location and Ventilation Plan, DAO.010.13140/1 (extract of the plan modified by the commission).

²² Anthony Reczek, transcript p. 4760. In a memorandum, Mr White referred to a VSD unit that he said was 'the only one of its kind on site, and, we are lead to believe, the only one of its kind in the Southern Hemisphere [sic]': Memorandum, Douglas White to Peter Whittall, 22 March 2010, DOL3000160011/1.

²³ Anthony Reczek, transcript pp. 4760–61; Masaoki Nishioka, transcript, p. 3494.

²⁴ Gregory Borichevsky, Police/DOL interview, 7 June 2011, INV.03.20410/30.

²⁵ Department of Labour, Report on Electrical System Evidence, 8 June 2012, DOL7770050017.

²⁶ Michael Scott, witness statement, 30 May 2012, SCO7770010001/26–28.

²⁷ Karyn Basher, witness statement, 10 November 2011, CAC0117/3.

²⁸ Neville Rockhouse, transcript, p. 4234.

²⁹ Pike River Coal Ltd, Work Order No 17075, 26 October 2010,

DAO.004.05509/1; Pike River Coal Ltd, Work Order No 16856, 19 October 2010, DAO.001.07114/1; Pike River Coal Ltd, Work Order No 15936, 27 September 2010, DAO.001.07211/1; Kevin Poynter, transcript, pp. 3018–28.

³⁰ Comlek Electrical Engineering Contracting Ltd, Audit Report, DAO.025.26626/5, paras 1.7–1.9.

³¹ Anthony Reczek, transcript pp. 4823–29.

³² Douglas White, transcript, p. 4965.

³³ Michael Scott, witness statement, 30 May 2012, SCO7770010001/7, para. 20.

³⁴ Comlek Electrical Engineering Contracting Ltd, Audit Report, DAO.025.26626/4, para. 1.1.

³⁵ Anthony Reczek, transcript, pp. 4771–73.

³⁶ Pike River Coal Ltd, Roles and Responsibilities: Management Plan (Draft Document), 9 September 2008, DAO.002.00960/67; Pike River Coal Ltd, Electrical Engineering Management Plan: Management Plan (Draft Document), 2 November 2008, DAO.002.00662.

³⁷ Pike River Coal Ltd, Electrical Engineering Management Plan, 30 April 2010, DAO.003.07228/9.

³⁸ RJR1: Engineering Structure Before 24 August 2010, DAO.041.00006/1.

³⁹ Robb Ridl, witness statement, 14 March 2012, DAO.041.00009/3, para. 2.

Mr Ridl had also been a mechanical co-ordinator at Pike from August 2006 to May 2007.

⁴⁰ Memorandum, Robb Ridl to Douglas White, 22 September 2010, DAO.043.00004/1.

⁴¹ Robb Ridl, witness statement, 14 May 2012, DAO.043.00050/12.

⁴² Pike River Coal Ltd, Engineering Department Areas of Responsibility, DAO.043.00001.

⁴³ Pike River Coal Limited Organisation Chart as at 19 November 2010, PW23a/1. (Extract with 'Note 2' removed from beside Robb Ridl's name by the commission)

⁴⁴ Pike River Coal Ltd, Manager's Promotion Recommendation, 4 November 2010, DAO.043.00049/1; Douglas White, transcript, pp. 4965–68.

⁴⁵ Department of Labour, Pike River Mine Tragedy 19 November, 2010: Investigation Report, [2011], DOL3000130010/161, para. 3.37.10.9.

⁴⁶ Department of Labour, Investigation Report, DOL3000130010/151, para. 3.37.4.6.

⁴⁷ Ibid., DOL3000130010/151, para. 3.37.4.7.

⁴⁸ Robb Ridl, witness statement, 14 May 2012, DAO.043.00050/9–10, paras 50–51.

⁴⁹ Michael Scott, witness statement, 30 May 2012, SCO7770010001/41, paras 169–170.

⁵⁰ Douglas White, transcript, p. 4967.

⁵¹ John Dow, transcript, p. 4033.

⁵² Anthony Reczek, transcript, p. 4770.

⁵³ Richard Davenport, Inspection Audit Report, 13 February 2007, DAO.025.42883/2–3.

⁵⁴ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/17, paras 84–86.

⁵⁵ Ministry of Economic Development, Energy Safety, ES Audit Report, 4 December 2008, MED3000010002/2–4.

⁵⁶ Michael Firmin, transcript, pp. 602–04, 684.

Introduction

1. This chapter summarises the hydro-mining systems used at Pike River, and assesses the management, safety and effectiveness of the company's hydro-mining operation.

The hydro-mining technique

2. Hydro mining is particularly suited to the West Coast, where coal seams are thick and geologically disturbed. Seams have steep variable gradients and are often severely faulted, which means the coal seam can be completely displaced, as shown in the simplified diagram of Pike River's Brunner seam below.¹ Minor faults are often present within areas separated by major faults, creating further variation. Such steeply dipping coal seams are unsuitable for conventional mining methods such as longwall mining, which may be unable to extract the full seam thickness.²

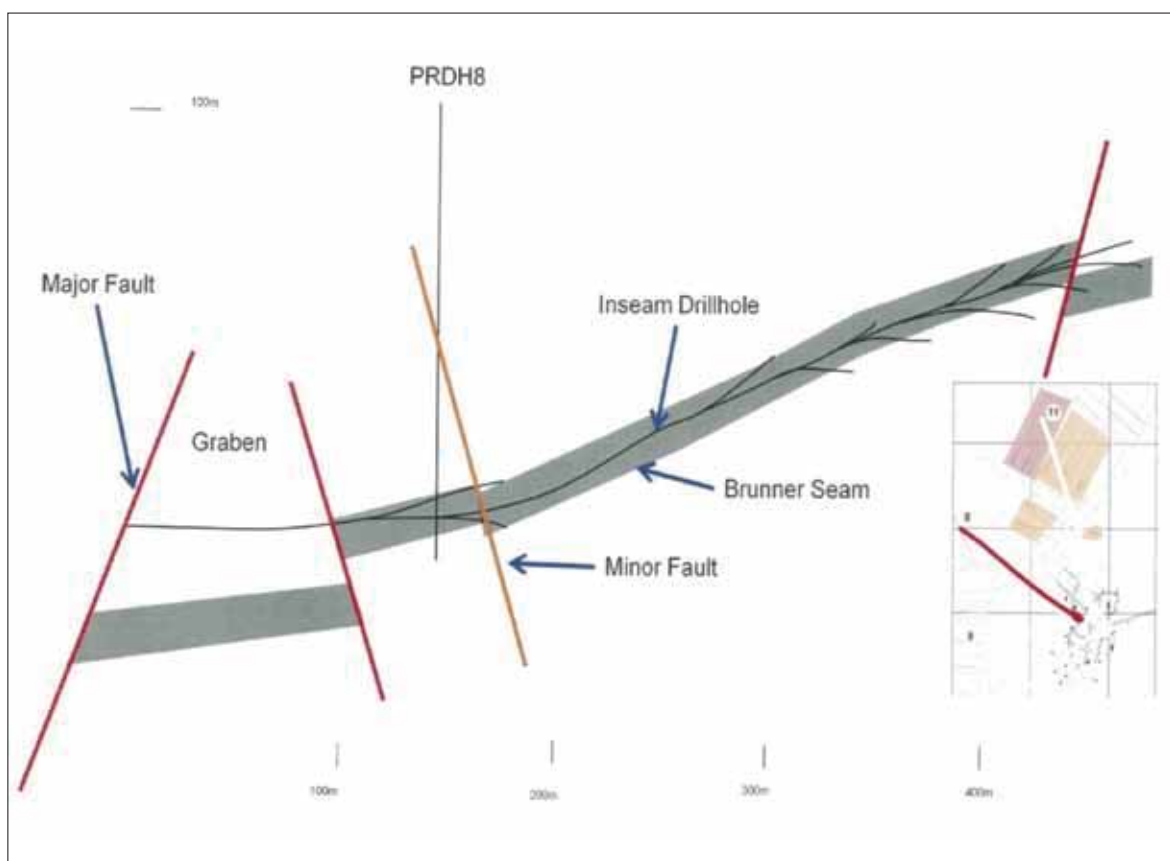


Figure 12.1: Pike River's Brunner seam

3. Hydro mining uses a high-pressure water jet from a hydro monitor to cut coal:



Figure 12.2: Hydro monitor at work³

4. The first hydro panel at Pike River followed a simple design: it had one intake roadway and one return roadway, with the hydro-monitor unit located at the top of the intake roadway under a supported roof. The hydro panel sloped uphill, with the return roadway higher than the intake roadway, as shown in the three-dimensional sketch below. Water from the hydro monitor flowed naturally downhill, carrying the extracted coal.

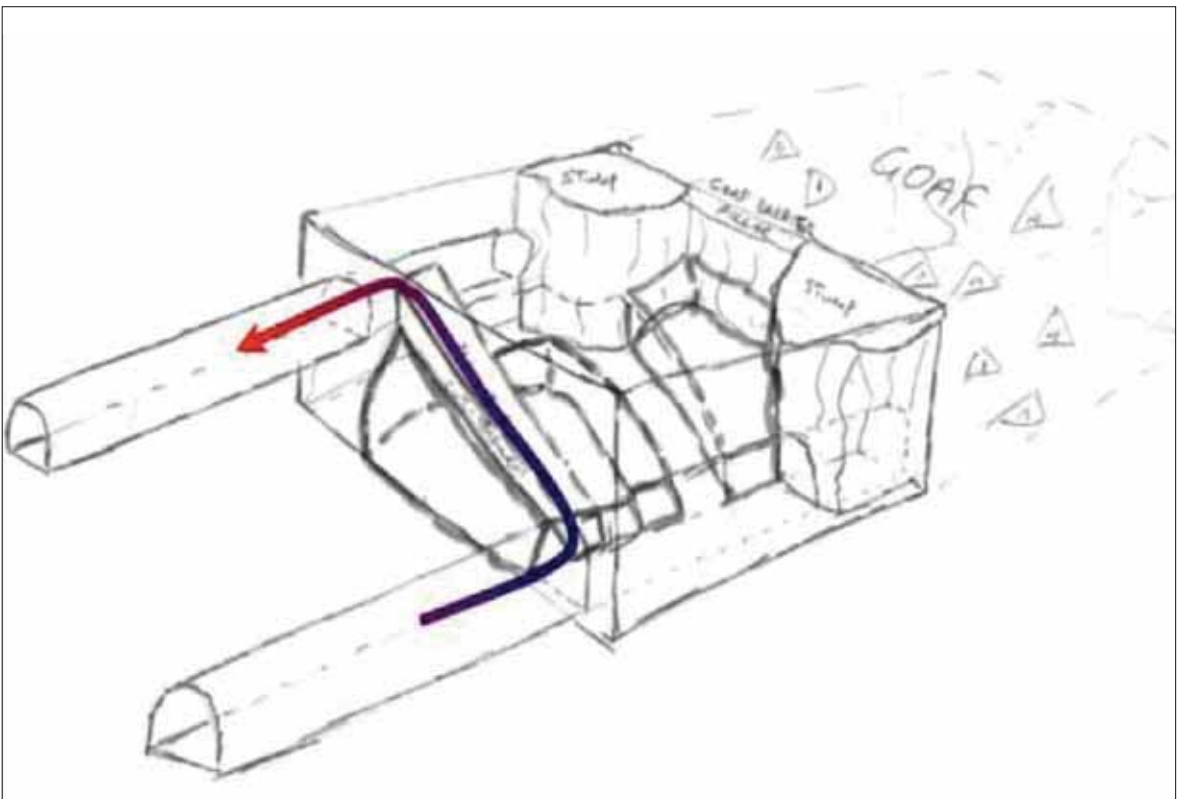


Figure 12.3: Three-dimensional sketch of hydro panel showing height difference between intake and return and ventilation path when panel idle⁴

5. At Pike River a machine called a guzzler was located 18m behind the hydro monitor, and directed the mixture of coal and water into the roadway flume system. The guzzler also crushed any large lumps of coal.⁵ It is shown in the photograph with its 'wings' open ready to gather and direct the coal/water mixture.



Figure 12.4: Guzzler ready to gather and direct water/coal mixture⁶

6. Having passed through the guzzler, the coal and water slurry was flumed under gravity to the crushing station at pit bottom, where it was pumped down the 2.3km drift and on to the coal preparation plant approximately 10km away.⁷
7. Miners operated the hydro monitor from a series of controls at the guzzler. It was a cold, tedious job,⁸ given the long periods spent operating levers to direct the water jet. Operators extracted coal in blocks of coal called lifts, following a set cutting sequence. After lifts were extracted across the full panel width, the monitor and guzzler retreated to a new position further in the intake roadway, and the process was repeated.⁹
8. The following diagram shows a bird's-eye view of the coal cutting sequence in place at November 2010 for each lift. The monitor position is marked M and operators cut coal in the areas defined as A to F, in that order, using the water jet within parameters bounded by the 'clock' numbering, i.e. for lift A the operator directed the water jet between 9 and 10 o'clock. Extracting coal first from A and B created the ventilation cut through between the intake and the return roadways. Areas X, Y and Z were designed to be temporary support pillars, called stumps, to keep the roof up until they, too, could be safely extracted and the roof allowed to fall.

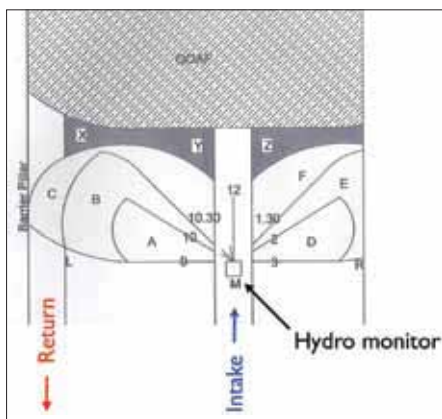


Figure 12.5: Bird's-eye view of the coal cutting sequence at Pike River¹⁰

9. The diagram below shows a cross-section of the seam in panel 1. The squares depict the return (left) and intake (right) roadways, with the return driven higher in the coal seam. Operators used the water jet to cut coal from the tops and bottoms of the seam as the hydro monitor was retreated, but were to avoid cutting into the rock in the roof and floor.

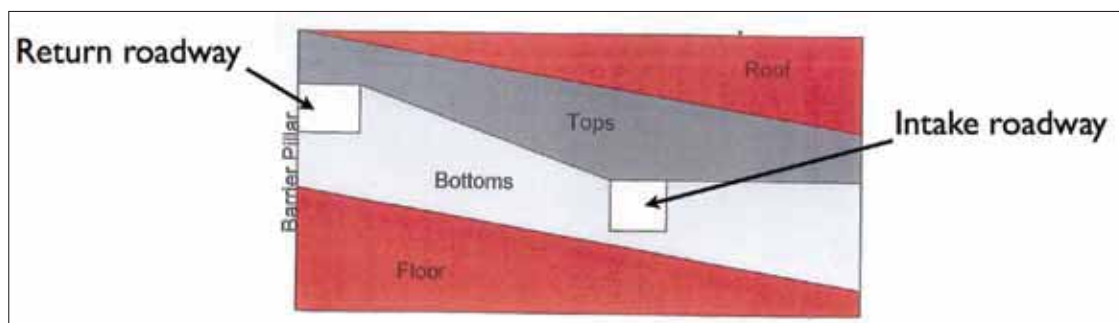


Figure 12.6: Cross-section of the seam in panel 1¹¹

Hazards associated with hydro mining

10. Hydro mines must deal with specific risks and challenges, particularly in gassy West Coast conditions. Gas management can be particularly challenging. Hydro mining releases high volumes of methane as a result of extracting the full height of thick coal seams. That methane tends to build up in the goaf (the empty space left behind after coal extraction). The force of the water jet can disturb gas in the goaf and a roof fall can displace large amounts of gas. Rapid falls in barometric pressure can also draw methane out of the goaf.
11. Hydro-monitor operators face the risk of a windblast or high-velocity wind either injuring them directly, or surrounding them with irrespirable gas. Large volumes of coal slurry may also overwhelm the guzzler where the operator stands.¹²
12. A massive roof fall in the goaf is a major hazard. Such a fall may generate a blast of air that can injure people, damage stoppings and equipment, and send out a large plug of flammable gas. Panels should therefore be designed so the goaf collapses progressively after the coal has been cut.¹³ If necessary, the roof can be made to fall by deliberately aiming the water jet at it in a controlled way. It is important to manage the risk by obtaining as much information as possible about the characteristics of the roof in the goaf, in order to avoid the creation of a large goaf and the potential for a massive roof fall.
13. For all these reasons, hydro mining calls for particular skill, experience and judgement on the part of the operator and management team. It is important that the operator can see the monitor nozzle to gauge the angle of the water jet when cutting, and to control the jet, so large amounts of methane are not displaced from the goaf. To cut coal productively and safely, an experienced operator relies on a constant assessment of factors, including the noise of the monitor jet, the size of the coal lumps in the slurry, changes to the water flow coming from the face, the noise of falling coal and stone, and gas readings in the return. There is little room for error unless all the back-up safety systems are well established.¹⁴

Development and production stages

14. Hydro mining is a two-stage process. The first stage involves development of the roadways and panels and the installation of infrastructure. The second stage is production – the extraction of coal using the hydro monitor. Development work generates some coal from the driving of roadways, but it is the production phase that produces large volumes of coal.¹⁵

The development of hydro mining at Pike River

15. Pike River was planned as a hydro mine from the early 1990s.¹⁶ Later feasibility studies confirmed the proposal to use hydro mining,¹⁷ and no other mining method was ever seriously considered.

The bridging panel

16. In 2004 Pike agreed with the Department of Conservation (DOC) that it would mine trial panels before beginning full hydro production. This was to enable monitoring of surface subsidence and roof caving characteristics underground.¹⁸
17. By late 2007 delays with the main drift had cost tens of millions of dollars, and Pike proposed the development of a 'commissioning panel' in advance of the trial panels. It was hoped that this would realise an additional \$15 to \$20 million for the company.¹⁹
18. In response to continuing delays,²⁰ the technical services department was told in May 2009 to locate coal for earlier production.²¹ Pike identified six bridging panels that could be mined before the commissioning panel. These were designed with a narrow extraction width (30m) in order to test mining techniques in a controlled panel with 'low risk to the surface'.²² In November 2009 DOC approved the concept and altered the access arrangement accordingly.²³
19. In May 2010 DOC approved another variation for Pike to reduce the number of bridging panels and move the first panel closer to pit bottom.²⁴ This became known as panel 1 and is shown in Figure 12.7, as 'Bridging Panel'.

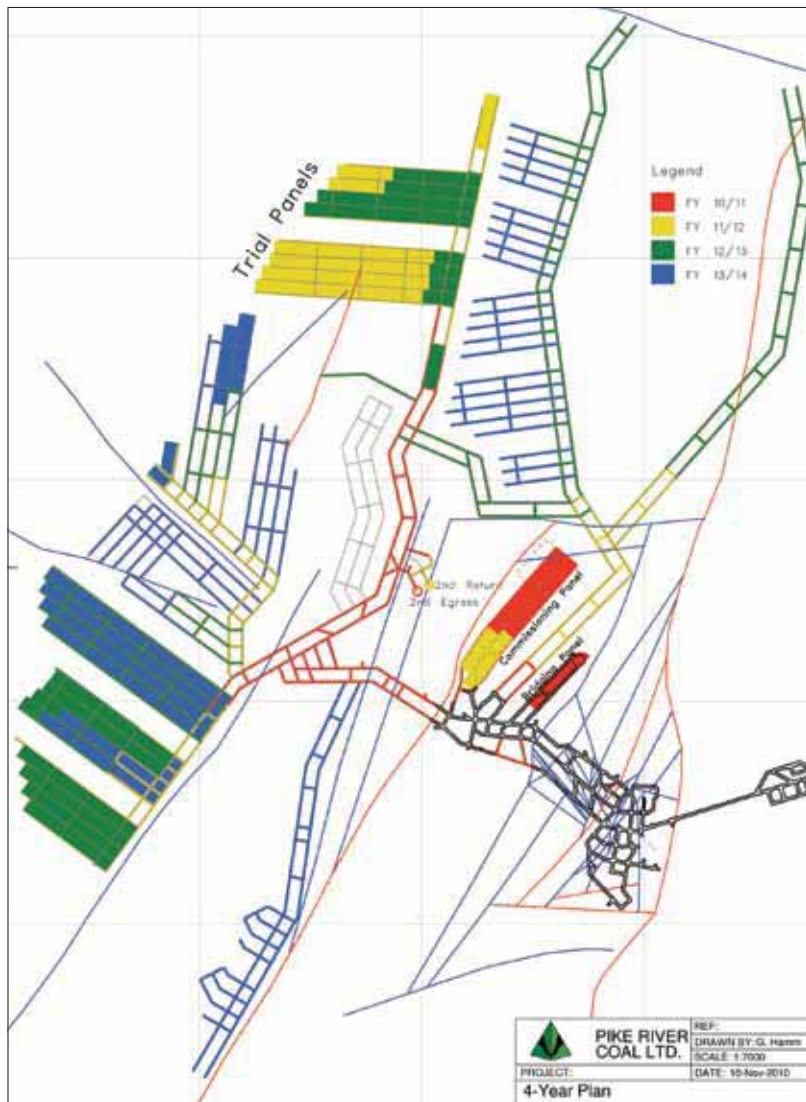


Figure 12.7: Pike's Four-year Plan for 2010–2014²⁵

Ongoing delays

20. At the initial public offering in 2007, investors were told that hydro mining was scheduled to start in the first quarter of 2009.²⁶ By early 2010 the overall project was well behind schedule, and the planned start of the hydro monitor had been pushed out to at least July 2010.²⁷

21. Problems with the design, manufacture, delivery and commissioning of equipment accounted for a major part of the delay in 2010. In 2004 and 2005 Pike had engaged Japanese company Seiko Mining and Construction Ltd (Seiko) to advise on the necessary equipment for hydro mining.²⁸ That advice was largely provided by Masaoki Nishioka, a world expert in hydro mining with more than 40 years of hydro-mining knowledge, including considerable experience on New Zealand's West Coast, and who had intermittent involvement with Pike.²⁹ Mr Nishioka said that although he had not been given proper design criteria, he provided Pike with a comprehensive quotation for all necessary hydro-mining equipment.³⁰ Seiko supplied some of the hydro-mining equipment, including the slurry pipeline.
22. Pike obtained other core hydro-mining equipment, including the track mounted monitor unit, from Australian companies who lacked expertise in hydro mining. Some of the equipment was essentially at the prototype stage.
23. Pike engaged a range of external consultants to assist with the development of the hydro-mining system.³¹ In February 2010 a review of some of the equipment by external consultants found that the commissioning time frame for the equipment had been underestimated, software issues had plagued the commissioning stage, there was a significant problem with track clearances, re-engineering was required in part because of a contractual misinterpretation and there were insufficient trained service people available.
24. Against that background, Peter Whittall asked Mr Nishioka to come to Pike River in June 2010 to assist with the commissioning of the hydro-monitor system. Mr Nishioka arrived at Pike on 25 July and he soon had concerns about many aspects of the mine.
25. Mr Nishioka considered Pike's ventilation system insufficient for the hydro-monitor operation to begin before the commissioning of the main fan. He believed it was poor planning to have a large hydro goaf located so close to pit bottom and the Hawera Fault.³² He was critical of Pike's equipment, including the monitor unit, which he thought was unwieldy and did not provide easy visibility for the operator.³³ The guzzler unit was also too big, heavy and complicated, and the pump units and high pressure pipe joints were unsuitable.³⁴
26. Mr Nishioka also had other concerns. The hydro panel was too wide for the monitor jet; the proposed approach to roof caving was not good practice; there was a substandard work and safety culture underground; the workforce was inexperienced; and the mine was under obvious financial pressure. He said the system was generally not well engineered and not fit for a hydro-mining operation.³⁵

The hydro bonus

27. In response to the increasing delays, in July 2010 the Pike board authorised the payment of a hydro-production bonus to staff when hydro extraction began. The bonus started at \$13,000 if hydro production (defined as 1000 tonnes of coal) was achieved, together with 630m of roadway development, by 3 September 2010. After that date the amount of the bonus reduced each week, as shown in the following table that was presented to staff.

Hydro Mining Bonus Table

- In the event that hydro is achieved earlier than 24 September this rate will increase and in the event that we do not achieve it until after 24 September, the amount will decrease as set out in the table below:

Date Achieved										
Date	3 Sep	10 Sep	17 Sep	24 Sep	1 Oct	8 Oct	15 Oct	22 Oct	29 Oct	6 Nov
\$	13,000	12,000	11,000	10,000	7,500	5,000	2,500	1,000	1,000	0
Metres	630	680	735	790	790	790	790	790	790	790

- The scheduled date for hydro start-up is 3 September 2010.

Figure 12.8: Hydro-mining bonus table³⁶

28. The bonus, budgeted to cost Pike \$2.3 million,³⁷ came when the board acknowledged internally it was facing credibility problems because of overpromising and underdelivering.³⁸ In April and May 2010 Pike had raised a further \$50 million from the market,³⁹ but by 24 June 2010 it was forecasting a \$5.8 million cash shortfall. In an email to directors on 5 July 2010, board chair John Dow said it was 'worth paying [the hydro bonus] to retain short-term market credibility'.⁴⁰
29. At the commission's hearings, Mr Dow suggested the bonus was a response to poor work practices and in particular a lack of productivity and efficiency by workers. He said workers were not showing up for shifts, not looking after equipment and forgetting to fuel vehicles, and the bonus was 'about making sure people were thoughtful before they came to work'.⁴¹ The board did not consider the potential impact of the hydro bonus on health and safety, but 'would have considered ... There would be no reason why there'd be any relaxation in health and safety attention'.⁴² Mr Dow believed the targets were 'modest enough and readily achievable'.⁴³
30. Three points arise from the board's decision to implement the hydro bonus. First, the board did not give sufficient consideration to the ventilation requirements of the hydro monitor. Hydro mining began on 19 September 2010, two weeks before commissioning of the main fan started on 4 October 2010.⁴⁴ Because of the large amount of methane generated by the hydro monitor, Pike should have established robust ventilation from the main fan before starting hydro mining. Several people at Pike expressed that view.⁴⁵ Problems with methane recurred and on Friday 1 October, following the achievement of the hydro bonus, Pike agreed to stop monitor operations until the main fan became operational in booster mode the following week.⁴⁶
31. Second, the board failed to address the risk that the bonus would place undue focus on production at the expense of safety.⁴⁷ Following the bonus, the mine pulled out 'all stops' to start hydro mining as quickly as possible.⁴⁸ Mr Nishioka reported that workers made 'strenuous effort' to produce 1000 tonnes of coal by midnight on 24 September, the due date for the \$10,000 bonus,⁴⁹ although methane levels rose to explosive levels in the return twice in the days leading up to this deadline. It was hazardous to continue extraction in those conditions, and Mr Nishioka recommended that the operation stop until the main fan became operational.⁵⁰ This did not happen until the bonus had been achieved.
32. Although production bonuses are common in the coal mining industry, the hydro bonus at Pike created particular risks. Pike offered the bonus when there were known problems with equipment, ventilation, staff inexperience, and a lack of effective monitoring systems.
33. Third, the bonus was introduced when the board and senior management had not been assured that Pike's systems were ready for hydro mining. In early July 2010 the company had not undertaken the appropriate risk assessments, and it did not properly complete them before beginning hydro extraction.

Haste to begin hydro extraction

34. By mid-2010 Pike was committed to starting hydro production as soon as possible. The mine went through a number of exercises that identified major weaknesses in the mine's systems. These exercises identified that some critical systems were not yet in place, and others were not yet working properly.

Operational preparedness gap analysis

35. This exercise occurred during the third week of August 2010 (a month before the start of hydro mining), facilitated by Bob Dixon of Palaris Mining from New South Wales.⁵¹ He prepared a report of the exercise in the following format:

Operational Preparedness Gap Analysis					
Specific Area	Plan, Policy, Procedure	Priority	Status / Action	Who	When
Ventilation					
Spon Com		2	yes – exists and needs reviewing to encompass hydro mining	Doug	
Degassing procedure review			In place		
Gas plug		1	no procedure exists	Doug	
Sealing off panel			plan needs to be developed	Doug	
Ventilation network			plan needs to be developed	Doug	
Panel ventilation plan		1	plan needs to be developed	Doug	
Broad brush risk assessment		1	windblast, ventilation and gas, hydro mining, and fire fighting risk assessments to be reviewed or completed	DW	
Gas monitoring manual and automatic		1	plan needs to be developed	Doug/ Nick	
Ventilation TARP – operator requirements		2	needs to be reviewed	Doug	
Safety critical systems include dilution doors, CH ₄ protection, emergency stops, guarding,	Risk Assessment	1	need to be identified, checked, and implemented	Doug / NG / MC	
Mining plan		2	needs to be completed	PVR/Doug	
Hydro extraction plan - ATM		2	needs to be completed and updated with geotechnical, geological, strata control, and operating requirements	Doug /PVR	
Start-up strategy e.g. Day shift only		2	needs to be finalised	Doug/ Bernie	

Figure 12.9: Operational preparedness gap analysis⁵²

36. The full document identified 15 'priority 1' actions, including creating or finishing plans for critical hazards such as gas plugs, panel ventilation and gas monitoring. The mine needed to complete risk assessments for windblast, ventilation and gas, hydro mining and fire fighting. Safety critical systems, including dilution doors (a mechanism to dilute large volumes of methane), gas protection and emergency stops needed to be identified, checked and installed.
37. The gap analysis provided a vital 'to do' list for the mine and a stocktake of the project's readiness, but was of little use without a mechanism to make sure these things were actually done before hydro start-up.
38. Pike supplied this document to external insurance risk assessor Jerry Wallace of Hawcroft Consulting International. On 23 August 2010 Mr Wallace emailed Mr Whittall to express concern about 'the lack of formal risk assessments [one] month out from the start-up of the first monitor panel'.⁵³ He was particularly concerned that so many priority 1 actions were unresolved in relation to ventilation and gas management, and that a risk assessment into windblast was yet to be conducted.⁵⁴ He considered it 'unfortunate' that Pike was beginning hydro mining 'with many controls currently being developed but not yet implemented'.⁵⁵
39. In the 10 days following Mr Wallace's email, Pike did complete two risk assessments regarding hydro extraction, and ventilation/gas monitoring. Many other actions on the gap analysis list remained unaddressed, and were not completed even by the time of the explosion on 19 November 2010.

Panel 1 risk assessment

40. This risk assessment took place on approximately 3 September 2010, although the document filed with the commission is undated and in draft. The treatment of windblast and ventilation, and the risk of explosive mixtures in the return, are all significant.
41. Windblast is caused by a sudden plate-like roof fall in a goaf. This can push air and gas out of the goaf at high speed, and a windblast is technically defined as generating an air velocity greater than 20m/s. Such velocities can injure people by knocking them over or hitting them with airborne objects. They can also damage the mine and mining equipment, seriously disrupt ventilation and create potentially explosive mixtures. Wind velocities of less than 20m/s are not technically considered windblasts, but can still cause significant damage and displace large plugs of methane from a goaf into mine roadways.⁵⁶
42. Pike's risk assessment report recorded a number of hazards arising from windblast, including a change in ventilation pressure, which was considered to have only relatively minor consequences because of four 'existing controls'.⁵⁷

Hazard	Existing Controls	Assessment			
		Consequence	Likelihood	Risk Score	Risk Rankin
Change in ventilation pressure due to windblast	Ventilation	2	A	16	
	Rated vent structures				
	Dilution doors				
	Windblast investigation (PRCL 2010)				

Figure 12.10: Hazards arising from windblast

43. However, it was not correct to refer to these four matters as ‘existing’ controls. The generic label ‘ventilation’ was not a meaningful control since ventilation in the hydro panel was not robust enough to deal with the effects of a windblast, particularly as hydro extraction started before the main fan was working. As noted in Chapter 8, ‘Ventilation’, Pike did not have rated ventilation structures, and the structures around the hydro panel were some of the weakest in the mine – as shown by the failure of the stopping in panel 1 after the roof fall on 30 October 2010. Similarly, dilution doors were never operational at Pike River, and the windblast investigation was, at best, a work in progress. The four ‘existing controls’ amounted to little or no protection, and the risk should have been rated ‘high’ or ‘unacceptable.’
44. The risk assessment also considered the hazard of an explosive mixture of gas in the return/through the fan.

Explosive mixture through return / through fan	Fan design (electric installation on intake side)	5	C	22	Restricted access into return	5	D	19
	Dilution doors				Ventilation management plan review (TARP)			
	Monitoring				Ventilation procedures			
	Fan design (anti-spark)							
	Ventilation quantities							

Figure 12.11: Hazard of an explosive mixture of gas in the return/through the fan⁵⁸

45. That hazard initially received a high (red) rating, but that was downgraded to medium because of three proposed additional controls. Neither the existing nor the additional controls were accurately described.
46. The planned dilution doors were not operational, and the monitoring system was not an effective control for the reasons set out in Chapter 10, ‘Gas Monitoring’. The ‘anti-spark’ fan design did not stop sparks coming from the fan on 4 October 2010,⁵⁹ and ‘restricted access into the return’ did not stop contractors and employees working in the return, even in explosive range methane, on several occasions.⁶⁰ Moreover, the review of the ventilation management plan never took place, and the generic description ‘ventilation procedures’ did not translate into anything meaningful. This hazard should also have been rated ‘high’ or ‘unacceptable.’
47. The remainder of the document contained similar problems. Although tasks were assigned to individuals, no dates were set for completion and none were signed off as completed. The exercise was an inaccurate and incomplete assessment of the existing risks and the effectiveness of Pike’s proposed controls. It may have identified problems at the mine, but they were not properly addressed.

Ventilation and gas monitoring risk assessment

48. The third exercise was a ventilation and gas monitoring risk assessment dated 7 September 2010.⁶¹ This also suffered from reliance on non-existent controls and relied on the ventilation management plan as a control for many risks. Yet, as discussed in Chapter 8, the company largely ignored this plan and it was not an effective risk control.

49. The risk assessment generated a list of actions, including some fundamental requirements, such as:
- *Specify construction requirements for [ventilation control devices];*
 - *Ensure [gas] monitors are installed to a standard;*
 - *Determine the capabilities of real time monitoring ;*
 - *Control room operators to be trained in SafeGas; and*
 - *Ensure regular auditing of ventilation system.*⁶²
50. These actions were not allocated to individuals until 16 September 2010, three days before hydro extraction began. In emailing the list to key personnel, Mr White stated 'None of these issues are show stoppers and some will take time to implement.'⁶³ It is a revealing insight into the thinking at the mine that such fundamental requirements were not seen as 'show stoppers'. Many of these requirements had still not been attended to before the explosion on 19 November 2010.

The start of hydro extraction

51. On 19 September 2010 Pike operated the hydro monitor for the first time, and extracted approximately 140 tonnes of coal.⁶⁴ Over the next two months the hydro team encountered a catalogue of problems, including equipment issues, gas and ventilation problems, a lack of hydro experience, the departure of Mr Nishioka and continuing difficulty cutting coal. The hydro team did not achieve the targets it had been set.
52. Neither the hydro project manager (Terence Moynihan) nor the hydro co-ordinator (George Mason) had any hydro-mining experience.⁶⁵ Most of the crew lacked operational hydro-mining experience, and one study by Gregory Borichevsky indicated that operators were not following the cutting sequence up to a third of the time.⁶⁶ In particular, workers were spending too long mining the roof and the floor, diluting the coal with ash and stone.⁶⁷
53. To help address its inexperience in hydro mining, Pike hired Mr Nishioka to help with the commissioning process. During a commissioning stage some teething issues can be expected, but in addition there were equipment and design issues.
54. Mr Nishioka's work record during the monitor's first week of operation noted that:
- the guzzler was too large and complicated;
 - it was hard for the operator to see the direction of the monitor nozzle, because vision was blocked by the housing;
 - methane in the return exceeded 5% as soon as the monitor began cutting;
 - loose stoppings caused methane levels to rise above 5% on several occasions;
 - every hour to hour and a half the monitor clogged up and stopped working;
 - the slurry pipeline became blocked;
 - the 30m panel was too wide for the water jet; and
 - the flume leaked in many places.⁶⁸
55. In mid-October Mr Nishioka left Pike. This was the scheduled time for him to depart, but he told the commission he did not feel comfortable staying.⁶⁹

24-hour production

56. The original aim for the bridging panel was to have a single-shift operation conducting technical investigations and ensuring the equipment was fully operational and effective. However some weeks after hydro mining started, Pike moved to a 24-hour production cycle in the hydro panel, incorporating two 12-hour shifts. The change also required more hydro crews, which exacerbated the problems with operator inexperience.

Strata control in the hydro panel

57. Strata control is critical to ensure the roof and walls of a mine do not collapse. Within a goaf, roof collapse is often desired, in which case it must be managed in a controlled way. Good strata control requires a management plan, adequate geotechnical knowledge and a variety of techniques to manage and monitor underground stability. The three main hazards to be avoided are unplanned roof collapse, unwanted surface subsidence and windblast.

Pike's strata control management plan

58. MinEx produced guidelines in 2009 for the management of strata control in underground mines. The guidelines state that an employer is responsible for the development of a strata management plan. This outlines procedures for safe excavation of strata, for monitoring the effects and for managing strata control issues; it also defines the roles and responsibilities of personnel. Section 3.3 provides that a 'formal documented technical risk assessment ... shall be performed for strata and geological hazards for all excavations prior to development' of its strata management plan.⁷⁰ Such risk assessments 'shall' consider a number of geological and geotechnical factors including the adequacy of the mine's exploration data and its interpretation of the data. The guidelines note that design of adequate strata control requires a geotechnical assessment of many factors, including assessment of the method of extraction, void or caving characteristics, in-situ stress and gas drainage and exploration data.⁷¹
59. There is no evidence of a risk assessment into strata and geological hazards before panel 1 excavation. In October 2010 Pike had a draft strata control management plan based on three stated principles: prediction, prevention and protection. Prediction required the mine to collect, analyse and maintain detailed geotechnical information, and set out the design process for planning strata control, support and pillar design. Prevention required regular evaluation and monitoring, with responsibilities assigned to a 'hydro-mining undermanager' and 'Strata Management Team'. Protection required permits to mine, a trigger action response plan (TARP) and staff training in strata control.⁷²
60. Pike did not fully comply with these principles. It had insufficient geotechnical information on the strata in panel 1 and undertrained hydro crews. There was some monitoring and evaluation,⁷³ but no strata management team and no qualified hydro-mining undermanager. None of the qualified undermanagers at Pike had responsibility for the panel.⁷⁴

Subsidence

61. Minimising surface subsidence was particularly important at Pike River because of DOC requirements under the access arrangement.
62. Consultant geotechnical engineer Dr John St George was Pike's principal adviser on subsidence. He prepared reports supporting the proposed designs of Pike River's bridging and commissioning panels, to ensure minimal surface subsidence and compliance with its access arrangement with DOC.⁷⁵ These reports focused largely on surface effects, rather than the underground safety of Pike's proposals.

Windblast

63. In July 2010, as part of its annual insurance risk assessment, Hawcroft Consulting 'strongly recommended' Pike undertake a thorough risk assessment into the potential for windblast before coal extraction began in panel 1.⁷⁶
64. On approximately 3 September 2010 Pike carried out the 'panel 1' risk assessment, which dealt with many aspects of windblast. However, Pike had inadequate information to assess the likelihood of windblast occurring and, as noted above, many of the 'existing controls' relied on in the risk assessment did not exist or were ineffective.
65. There was no vertical borehole in the area of the hydro panel, so the only geotechnical data available was from vertical drillholes PRDH8 and PRDH37. These were some distance apart to the south and north of panel 1, as shown below circled in red. PRDH47 (shown below circled in blue) was not drilled until after the explosion.

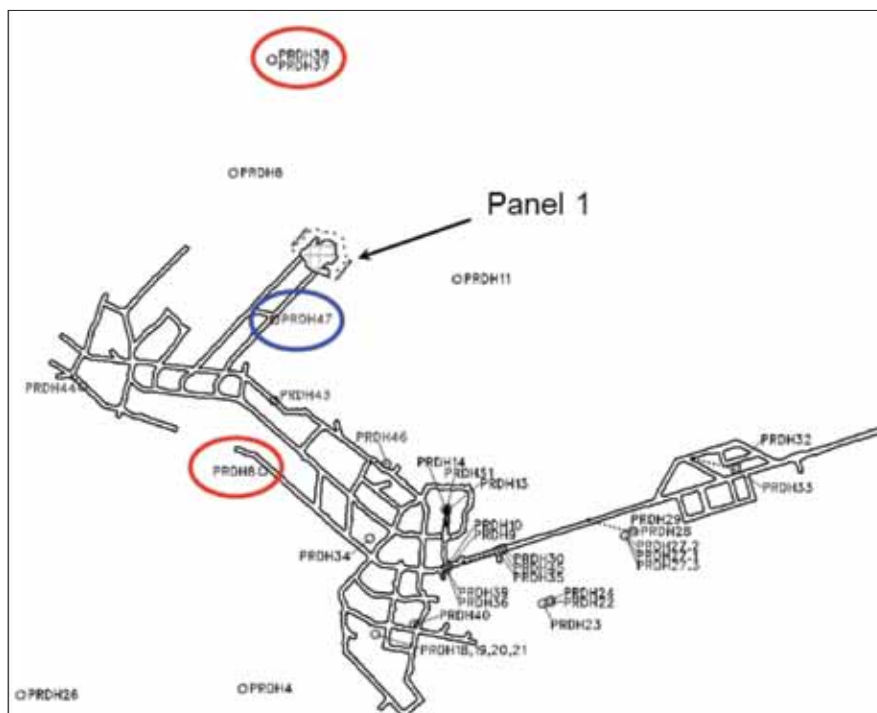


Figure 12.12: Drillholes in the vicinity of Panel 1⁷⁷

66. Consultants Strata Engineering used information from drillholes PRDH8 and PRDH37 to provide Pike with windblast advice on 29 August 2010, and Pike relied on this advice repeatedly in the risk assessment. The advice noted that Pike River's bridging panels were planned to be 31m wide in the first instance, but might increase to 50m in the future, with an extraction height in the 10–13m range.⁷⁸ Pike generally took Strata Engineering's advice, based on modelling, as encouraging about the windblast hazard. The island sandstone was considered likely to bridge over panel widths of up to 30m, and although it might fail over larger distances, this was likely to be progressively in smaller blocks rather than a large plate-like fall associated with windblast.⁷⁹
67. However, Strata Engineering tempered its advice, noting the areas of uncertainty, and emphasised the desirability of 'ongoing collection of structural data ... to assess the structural environment on ... a panel by panel basis'.⁸⁰ Moreover, Strata Engineering later stated that although it knew the Hawera Fault was to the east of panel 1, its advice to Pike would have been different if it had been asked about extending extraction 15m closer to the edge of the fault.⁸¹ However, this was disputed by Mr van Rooyen. He noted Strata Engineering personnel were on site in September and October providing further advice on strata control issues for panels 1 and 2, had seen plans of the extension of panel 1 to the east, and had not altered their advice to Pike.⁸²

Core logging

68. Pike had two main options to obtain more geological information. First, it could have drilled another vertical borehole from the surface above the hydro panel. This would have been expensive and further delayed the start of hydro extraction. Pike did not pursue this option.
69. As an alternative, Pike planned to use core logging. This involved drilling holes in the roof and floor and taking a core sample for geotechnical logging. The technical services department wanted to complete core logging to assess the risks identified by Strata Engineering, and to assess such things as the spontaneous combustion potential of the rider seam, the depth of the interburden layer and its characteristics and capabilities, whether there were weak zones in the strata, and the layering of the sandstone structure. Pike also wanted to develop a correlation between what was cored and the strata behaviour recorded before, during and after panel 1 was mined.⁸³
70. Dr St George also supported core logging of all extraction zones. He emphasised it was essential that caving of the roof strata was 'monitored and managed since it presents a safety hazard as well as an influence on subsidence'.⁸⁴

71. Pike did not achieve core logging before hydro mining began. On 10 September 2010 Pieter van Rooyen expressed his frustration in an email to Mr White and others, writing in capital letters 'CAN THIS ISSUE PLEASE BE ADDRESSED ASAP', noting the information was required to 'ensure the assumptions in strata control designs, windblast and caving characteristics is correct (or at least acceptable).'⁸⁵
72. The main obstacle was Pike's inability to supply enough air pressure to run the required drill rig. Despite the engineering department suggesting another option, that did not occur and extraction began in panel 1 without core logging being done.⁸⁶
73. There was bore scoping done in panel 1 roadways, where holes were drilled and a bore scope inserted allowing the operator to view and log the strata and its geology.⁸⁷ But the results were of poor quality and Strata Engineering advised that they should be treated with some caution.⁸⁸
74. Starting coal extraction in panel 1 before geotechnical core logging could be done meant the opportunity to obtain vital geotechnical data was lost. The importance of data from this area of the coalfield should not have been underestimated.

Further advice, and the widening of the panel

75. In early September 2010 Pike engaged an Australian geotechnical engineering consultant, Dr William Lawrence of Geowork Engineering Pty Ltd, to assist with strata issues. Among other tasks,⁸⁹ he was asked to consider and review work already done on the effects on the overlying strata of varying the proposed widths of bridging panels.⁹⁰
76. On 27 September, a week after hydro extraction began, Pike asked Dr Lawrence to assess the ability of the island sandstone to form a bridging beam across both panels 1 and 2.⁹¹ Dr Lawrence faced the same difficulties as Strata Engineering with the lack of data from Pike, and requested information that was not available.⁹²
77. On 6 October 2010 the technical services department recommended widening panel 1 by up to 15m to the east to extract more coal. Pike estimated this would increase the recoverable coal by 50%.⁹³ This was authorised on 15 October 2010,⁹⁴ although Mr White did not formally sign off on widening panel 1 until 18 October 2010.⁹⁵
78. On 25 October 2010 Dr Lawrence gave Pike his report summarising the characteristics, behaviour and spanning capability of the island sandstone. As with the earlier report by Strata Engineering, Pike drew comfort from Dr Lawrence's views. However, the report emphasised that the lack of data to date meant 'critical parameters have been assumed, which does result in some uncertainty.'⁹⁶

A warning – roof fall on 30 October 2010

79. Five days later, on 30 October 2010, part of the roof in the panel 1 goaf collapsed. The resulting rush of air was strong enough to knock over the stopping in the hydro panel cross-cut, and result in an explosive accumulation of methane.⁹⁷
80. There was no formal investigation into the roof fall, but visual examinations of the rubble found larger blocks of white stone had fallen but no coal, and there were different views on whether the roof collapse had extended up to the rider seam.⁹⁸
81. Pike did not want a recurrence of stumps of coal left in the goaf that were unreachable by the monitor water jet. A 'best practice' monitor cutting technique was designed, directing the hydro crews to create only temporary stumps in the goaf, to be extracted last. This was intended to ensure a more controlled roof fall in future.⁹⁹

Further assessment of risks

82. After receiving advice from Strata Engineering and Geowork Engineering that windblast and large goaf falls could not be excluded, given the lack of geotechnical data, Pike did not reconsider the potential for these hazards and the effectiveness of its possible controls and did not suspend hydro extraction to enable further data collection from panel 1. The unexpected large roof fall on 30 October also failed to trigger any further review, despite the methane plug released and the destruction of the panel ventilation stopping.

Ongoing problems

83. Pike's problems with the hydro-monitor production continued, and on 19 October 2010 Pike downgraded its production forecast for the period to 30 June 2011 from 620,000 tonnes to between 320,000 and 360,000 tonnes.¹⁰⁰
84. By late October Pike internally described the lack of hydro output as 'untenable'.¹⁰¹ Mr Mason instigated a productivity review group and Mr White sought advice by email from Mr Nishioka.¹⁰²
85. Pike considered that the difficulties arose from the hardness of the coal, technical issues with the hydro monitor cutting performance and inconsistent operating standards. The first retreat of the monitor was authorised on 22 October 2010, meaning a month was spent attempting to extract its first lifts of coal.¹⁰³
86. In its search for answers, the review group considered panel design issues, including extraction pillar dimensions, viable monitor cutting distances and repositioning of monitor and water jet orientation; the need for systematic collection of operational data; changes to management responsibilities; greater insistence on cutting sequences and standards from monitor operators; use of drill and blast methods within the panel to loosen up the coal; and the need for more testing, given the lack of raw data gathered to characterise the coal that we are cutting.¹⁰⁴ The group identified changes to the process, but the explosion intervened.¹⁰⁵
87. On 15 November 2010 Mr Whittall told Pike's annual general meeting:

*I am very pleased with the way the process has gone. There have been no significant issues and the hydro system cuts and flows through the Coal Preparation Plant as it is supposed to.*¹⁰⁶

Conclusions

88. Delays in achieving coal production resulted in a change of location for the hydro panel. This change was hurried and poorly managed in a number of respects:
 - Geotechnical knowledge of the bridging panel strata conditions was limited and the risks arising from hydro extraction were inadequately assessed.
 - The board initiated a staff bonus scheme based on reaching a coal production target promptly, with the bonus then reducing from week to week.
 - Hydro production was affected by equipment, crew inexperience, ventilation and methane problems. Coal production levels remained very low.
 - On 30 October a roof fall in the hydro panel goaf expelled a large volume of methane and damaged a nearby stopping, but there was no adequate management review and response to this event.
 - Generally, the hazards of hydro mining were not sufficiently understood and coal extraction at Pike River should have been suspended until a second egress and strata, ventilation and gas management problems were resolved.

ENDNOTES

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⁴ David Reece, DR3 and DR4 Hydro Panel – Goaf Diagram, DOL3000150011/1. (Extract of diagrams modified by commission to remove caption from image)

⁵ George Mason, witness statement, 31 October 2011, MAS0001/9–11, paras 36–43.

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⁷ Peter Whittall, witness statement, 22 June 2011, PW0/12, para. 45.

⁸ Stephen Wylie, transcript, pp. 3715–16.

⁹ Pike River Coal Ltd, Monitor Extraction Guidelines, 10 November 2010, DAO.010.00399/1–8; Craig Smith, transcript, p. 3405.

¹⁰ *Ibid.*, DAO.010.00399/8. (Diagram modified by commission)

¹¹ *Ibid.*

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- ¹⁴ David Stewart, transcript, p. 3339.
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- ²⁹ *Ibid.*, pp. 3476–77. Mr Nishioka was involved with Mitsui Mining Engineering Co. Ltd in the Spring Creek proposal in the 1980s, as well as the successful trial of hydro mining at the old Strongman mine in the 1990s, and the early exploration phase for Pike River mine: Report of the Ministry of Energy for the Year Ended 31 March 1983, MED0010040007/31.
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- ³³ Masaoki Nishioka, transcript, p. 3487; Masaoki Nishioka, work record, NISH0002/21.
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How did it happen?

- + Pike's safety culture
- + The likely cause of the explosions
- + Regulator oversight at Pike River

Workplace culture

What is safety culture: is it tangible?

1. In considering safety culture, Neil Gunningham and David Neal, in their 2011 review of the Department of Labour (DOL)'s interactions with Pike River, stated that it was 'exceptionally difficult for the inspectors to address issues of safety culture', since their occasional visits provided only a snapshot and 'they were not equipped to investigate complex issues of safety culture (or the lack of such a culture), which are largely intangible and do not lend themselves to ready investigation.'¹ Dr Kathleen Callaghan strongly disagreed with the latter part of this statement. In her view the published literature shows that safety culture is not intangible, and that it may be evaluated. Moreover, she believed that for the commission 'to dismiss safety culture as too complex and intangible [would be] to ignore a core element of the disaster at Pike River.'²
2. This difference of opinion suggests the need to define what is meant by culture. The commission has found a discussion by Andrew Hopkins helpful.³ He suggests that two common understandings about culture centre on 'mindset', and on 'the way we do things around here.' 'Mindset' involves a focus on individual values, while 'the way we do things' concerns collective behaviour. There is no conflict between the two ideas; rather they reflect a difference of emphasis. Both, in fact, go to make up culture – the way in which people both think and act.
3. Hopkins, however, stresses the importance of organisational practices because individual attitudes are more difficult to determine and unlikely to be capable of modification in a workplace unless the environment is conducive to change. James Reason suggests that the key may be conscious attention to safety systems and practices, in particular 'a safety information system that collects, analyses and disseminates the knowledge gained from incidents, near misses and other "free lessons"'.⁴

What organisational practices measure culture?

4. Operators in a high-hazard industries must establish structures that enable a response to the unexpected. These structures include safety, reporting, auditing, training and maintenance systems.⁵ They require resources, which should be allocated at governance level. This essential leadership from the top begins to set the cultural tone.
5. A safety conscious organisation needs to involve people at all levels: management, supervisors and workers at the coal face. Take methane control, a critical safety concern in an underground coal mine. Methane levels must be monitored throughout a mine on every shift. This requires the input of many people, from miners using portable gas detectors to control room operators who receive periodic methane readings from fixed sensors. Management must establish systems to assess this data to determine whether there is a hazardous trend and, if so, decide on the appropriate response.
6. The methane readings, however, are backward-looking indicators. Equally important are forward-looking indicators, which test the worth of the monitoring regime itself. There must be verification that portable detectors are readily available and accurate, and that there are enough fixed sensors in appropriate positions and that their calibration and accuracy are assured. This requires the involvement of operational planners, managers, electricians and technicians, who test and report on the monitoring system. Ongoing review and verification of the system's adequacy are also necessary as the mine grows and develops.

7. An assessment of the methane monitoring systems and practices, including the resourcing provided, the level of reporting, the response to data, the testing of devices, and the ongoing review and oversight of the system as a whole, will provide a valuable insight into the organisational culture.

A number of cultural influences

8. Organisational culture is not one-dimensional. A mixture of behaviours and attitudes is to be expected in a workplace, and particularly in a large and diverse organisation like Pike. Nor will the cultural influences be consistent, or all point in a single direction. Other chapters identify a number of cultural strands that existed at the mine.

An environmental culture

9. Pike had a strong environmental culture. When the company received an award from the Department of Conservation (DOC) in September 2008, the minister of conservation shortly afterwards described the mine as a 'showcase development'.⁶ Pike not only met the environmental requirements of its access agreement with DOC, but also initiated predator control programmes over and above its contractual obligations.

Production before safety

10. Coal production is, of course, the core objective of a mining company. But this imperative remains subject to an employer's statutory obligation 'to take all practicable steps to ensure the safety of employees'.⁷ The commission considers that the way in which hydro mining began at Pike indicates a culture that put production before safety.
11. Chapter 12, 'Hydro mining', discusses the reasons for this conclusion. They include locating the panel next to pit bottom, beginning coal production before a second outlet from the mine was developed, introducing hydro mining without completing a comprehensive risk assessment process, not adequately understanding the roof strata, proceeding before the ventilation fan was commissioned, widening the panel despite a geotechnical deficit, and failing to reassess the operation in light of methane issues and the collapse of the goaf on 30 October 2010.
12. In addition, Pike had no previous experience in hydro mining, and used a largely inexperienced workforce and a co-ordinator who was neither qualified nor confident in the role. The Pike board approved a hydro-mining bonus payable to workers if a production target was met by a defined date, after which the bonus reduced progressively each week. These factors, in combination, compel the commission to conclude that, in September 2010 as hydro mining began, the pressure for production overrode safety concerns.

Recklessness underground

13. Chapter 6, 'The workforce', considers workforce matters, including the inexperience of many of the miners and the low ratio of experienced to inexperienced men in the crews. A witness with almost 40 years' mining experience, who was trained in an English colliery, recounted safety incidents at Pike that he attributed to a gung-ho attitude underground. Inexperienced workers could be overconfident, failed to understand how their actions endangered others and did not treat mining with respect.⁸ He attributed these problems mainly to the experience ratio, saying that there were too few experienced miners to set and maintain the required standards.⁹
14. The commission accepts this opinion. It is supported by the evidence of contraband and bypassing incidents, conduct that seems inexplicable if viewed in isolation. There was clearly an attitude of recklessness in at least some quarters of the workforce.

The response to safety information

15. Many catastrophic accidents are preceded by situations in which warning signs are normalised, dismissed as intermittent or simply ignored.¹⁰ At Pike, however, a lot of safety information was not assessed at all. It simply remained unnoticed in the safety management system.

16. These aspects are discussed in Chapter 7, 'Health and safety management'. Throughout the commission's hearings, witnesses disavowed knowledge of methane spikes, ventilation problems and a host of other signs that suggested all was not well underground. A repeated refrain from witnesses was that no one drew this or that report or data to their attention. Pike's safety management system lacked an essential component – procedures that made specific people responsible for collecting, assessing and responding to safety information. Nor was there a functioning process for communicating information to everyone on a need-to-know basis.

Was health and safety management taken seriously?

17. As Pike's health and safety manager told the commission, his brief from the company was to develop a world-class health and safety management system. Much time and effort was devoted to putting in place what was seen as a best practice system. Documents were drawn up, systems were prescribed and training programmes established.
18. But, as discussed in the chapters on health and safety management and the critical mine systems, commitment from others was lacking. The board and executive management did not lead the process. Most documents remained in draft, and many were not followed anyway. Systems were set up, but were not used as intended. Safety information was not well monitored, and internal and external review of the system was very limited.
19. Ultimately, the worth of a system depends on whether health and safety is taken seriously by everyone throughout an organisation; that it is accorded the attention that the Health and Safety in Employment Act 1992 demands. Problems in relation to risk assessment, incident investigation, information evaluation and reporting, among others, indicate to the commission that health and safety management was not taken seriously enough at Pike.

The risk of an explosion

20. Did culture affect the ability of decision makers at Pike to appreciate the risk of an explosion? A culture that put short-term production before safety as hydro mining began could well affect the ability to appreciate an explosion risk as well. The following aspects are also relevant to this question.

The emergency response management plan

21. This plan was prepared in 2009, and signed off by Peter Whittall as general manager. Section 6.5 of the plan described emergency response actions with reference to six emergency situations: earthquake, flood, pipeline rupture, major slope failure, underground fire, and explosion and outburst.
22. The risk posed by explosion and outburst was described at 6.5.6 in these terms:
- The risk of outburst is considered as being low at PRCL [Pike River Coal Ltd] and gas build up is minimised via ensuring that ventilation is maintained at a level considered to be of sufficient quantity to dilute the methane content to more acceptable levels. Gas drainage is also conducted via in-seam drilling to pre-drain ahead of workings to further reduce the potential of outburst occurring and to reduce the gas make in active workings. Stone dusting practice is also maintained to reduce the risk of coal dust explosion potential. The use of hydro-extraction will minimise the risk of frictional ignition in the main coal extraction panels.¹¹*
23. This is an optimistic assessment of the risk posed by an underground explosion. It assumes that good ventilation and in-seam drilling to reduce the gas make will prevent a methane accumulation. It anticipates only one potential ignition source, frictional ignition, an unlikely source during hydro mining. Given that Pike River was a gassy mine located in a region with a history of methane tragedies, the commission regards the description of the risk profile as understated.

An indifference to methane spikes

24. Chapter 10, 'Gas monitoring', contains a review of methane monitoring at the mine, including reference to the prevalence of methane spikes in the period from 1 October to 19 November.¹² Employees must be withdrawn from

a mine when the volume of flammable gas in the general body of air is 2% by volume,¹³ and methane becomes explosive at a level of 5% in air.

25. Despite a paucity of well-positioned fixed methane sensors at Pike River, there were still numerous methane readings that provided ample warning of regular high methane accumulations in the period before the explosion. Deputies using hand-held detectors reported readings of 2% or higher on 48 occasions in 48 days, and 5% concentrations on 21 occasions. Readings of 5% were also routinely recorded in the hydro panel return, and the mine's remote monitoring system logged four methane readings of 2.5% or more in the final 26 days.¹⁴ Together, these readings provided a graphic illustration of the extent of this problem.
26. The mine manager, Douglas White, was asked whether this evidence indicated that the occurrence of methane spikes had become 'normalised' at Pike River, to which he responded not normalised but 'certainly something that was happening frequently, more frequently than was desired.'¹⁵

Disbelief on 19 November 2010

27. The explosion occurred at 3:45pm. All reporting and communications from the mine ceased immediately. At 4:26pm, 41 minutes after the explosion, Mr White finally authorised a call to emergency services. By then, Mattheus Strydom had been into the mine and had confirmed that an explosion had occurred.
28. In Chapter 16, 'Search, rescue and recovery', the commission finds that the loss of power and of telemetric reporting from underground, and the absence of response to calls from the control room, were unprecedented and indicated a serious situation that should have been recognised straightaway.

Witness accounts of the perception of risk

29. In giving evidence Messrs White, Stephen Ellis and Whittall each indicated their perception of the risk of a methane explosion. Mr White, questioned about using the vent shaft as an escapeway and whether this was of concern, replied, 'I think it's fair to say that having never actually considered the possibility of the mine blowing up ... it was not a matter that overly concerned me.'¹⁶
30. Mr Ellis, asked about confusion in the first few hours of the emergency response, responded, 'I've heard various statements around chaos, people running around and so on, and I would certainly argue against that ... [but] it was hectic, it was busy. We don't expect an explosion of that magnitude at a mine site.'¹⁷
31. Finally, Mr Whittall was asked whether he had ever contemplated an explosion. He gave a long answer, which included these words: 'you always hope for the best and plan for the worst. ... What I would say is that the – I would not expect rather than contemplate an explosion occurring ... So to say that it wasn't contemplated, not at all. The emergency response management plan was there for that. I had managed mines that had had explosions in them. I was familiar with explosions, Moura, many others.'¹⁸
32. In fact the emergency response management plan essentially discounted the risk of an explosion. The plan and the responses by the witnesses indicate a lack of appreciation of the explosion risk at Pike River, despite the history of methane explosions in mining and methane issues at Pike River.

Conclusions

33. The commission considers that as at November 2010, the emphasis placed on short-term coal production so seriously weakened Pike's safety culture that signs of the risk of an explosion either went unnoticed or were not heeded.

ENDNOTES

- ¹ Neil Gunningham and David Neal, Review of the Department of Labour's Interactions with Pike River Coal Limited, 4 July 2011, DOL0100010001/131, para. 471.
- ² Kathleen Callaghan, witness statement, 31 October 2011, FAM00042/55, para. 205.
- ³ Andrew Hopkins, Failure to Learn: The BP Texas City Refinery Disaster, 2008, CCH Australia Ltd, p. 141.
- ⁴ James Reason, 'Achieving a Safe Culture: Theory and Practice', *Work and Stress*, 1998, Vol. 12, No. 3, p. 302.
- ⁵ Andrew Hopkins, Failure to Learn, p. 145.
- ⁶ Pike River Coal Ltd, Activities Report: Quarter ended 31 December 2008*, DAO.008.04847/1.
- ⁷ Health and Safety in Employment Act 1992, s 6.
- ⁸ Albert (Alan) Houlden, witness statement, 14 November 2011, FAM00053/8, para. 39.
- ⁹ Ibid., FAM00053/11–12, paras 58–61.
- ¹⁰ Andrew Hopkins, 'A Culture of Denial: Sociological Similarities between the Moura and Gretley Mine Disasters', *Journal of Occupational Health and Safety – Australia and New Zealand*, 2000, Vol. 16, No. 1, pp. 29–36.
- ¹¹ Pike River Coal Ltd, Emergency Response Management Plan, 20 February 2009, DAO.001.08110/39.
- ¹² Chapter 10, 'Gas monitoring', para. 43.
- ¹³ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 21.
- ¹⁴ Chapter 8, 'Ventilation', paras 140–141, 143.
- ¹⁵ Douglas White, transcript, p. 4945.
- ¹⁶ Ibid., p. 1259.
- ¹⁷ Stephen Ellis, transcript, p. 2228.
- ¹⁸ Peter Whittall, transcript, p. 2791.

The likely cause of the explosions

Introduction

1. The commission is required to report on the cause of the explosions at Pike River on and after 19 November 2010. Because the mine has not been re-entered, the cause of the first, and subsequent, explosions can be based only on the evidence available without a scene examination.
2. The commission accessed work undertaken by a team of investigators and a panel of experts established by the Department of Labour (DOL).¹ The panel was co-ordinated by David Reece, a Brisbane-based mining consultant with a wealth of experience in mine management, mine inspection and advising the mine industry. The other panel members are Professor David Cliff, an expert in gas analysis and mine explosions, Dr David Bell, a mining geologist, Tim Harvey, a ventilation engineer, and Anthony Reczek, an electrical engineer. In October 2011 the panel provided the department with a report on the nature and cause of the first explosion. In February 2012 the investigation team leader, Brett Murray, and Messrs Reece and Reczek gave evidence at a commission hearing. The commission acknowledges DOL's co-operation in making the main investigation and the expert reports available and also in providing oral evidence.
3. Determination of the cause is complex. As will be seen, the commission is confident that the explosions were caused by the ignition of methane. But to determine why and where they occurred required expert analysis and assumptions. One of the most important estimates the experts had to make was the volume of methane that ignited; this then allowed the circumstances surrounding the explosion to be inferred. Estimates of the amount of methane varied depending on the assumptions adopted.²
4. The following discussion about the causes of the explosions is not intended to be definitive. If, and when, the mine is re-entered, any conclusions about the causes of the explosions will need to be re-evaluated.

The cause of the first explosion

Activities in the mine on the day

5. The DOL investigation report contains a close description of the mine workplaces and an intricate analysis of all known events that occurred during the morning shift and into the afternoon shift on 19 November.³ The following discussion does not replicate this level of detail, but reviews the essential facts.
6. On the afternoon of 19 November there were eight places in the mine where workers were engaged in different activities. These areas are best explained by reference to a mine map drawn to indicate the last-known position of all the men underground at 3:45pm.

The ABM20

7. The ABM20 continuous miner was driving a roadway at the north-west extremity of the mine. An eight-man morning crew cut 3m of new roadway during the shift. Progress was slow because branches of an in-seam borehole were intersected, resulting in methane emissions that caused the continuous miner to trip out. Readings of up to 3.5% methane were recorded in the general body of air, until the gas was dispersed using a typhoon fan and the transected branches of the borehole were plugged.

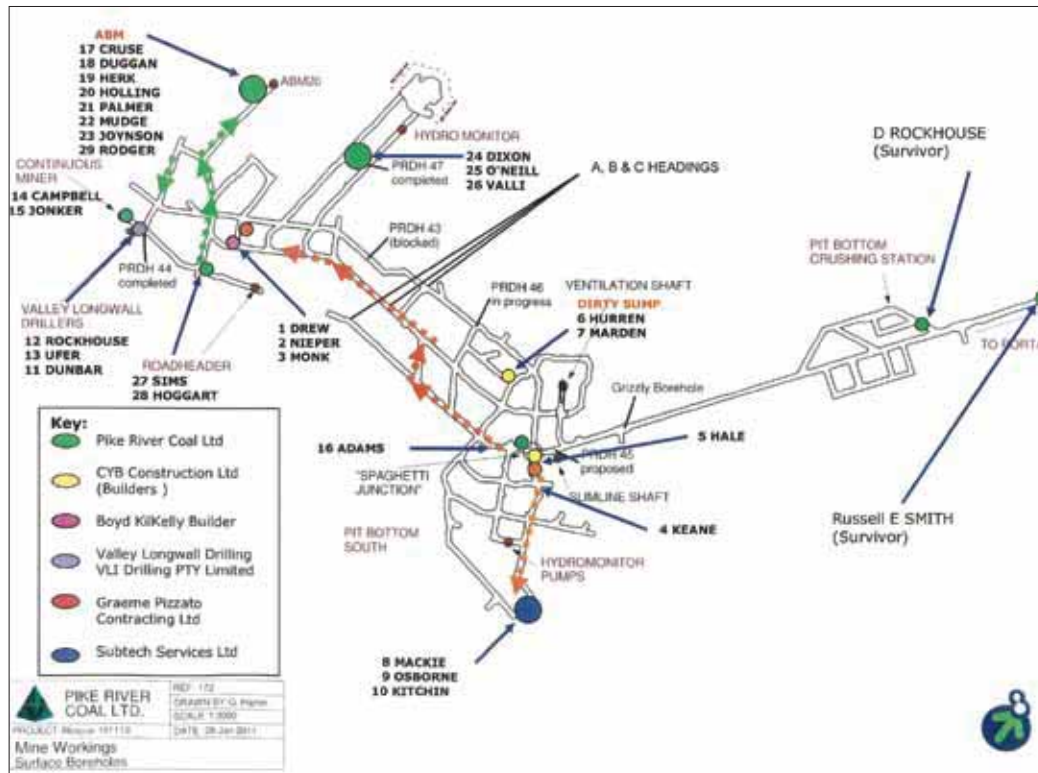


Figure 14.1: Last known position of the 29 deceased and two survivors⁴

The three main roadways running in parallel from pit bottom in a north-westerly direction are known as headings A, B and C from the bottom of the plan, with A heading still incomplete.

8. At 12:20pm mining ceased because fluming water to carry coal from the face was lost owing to a planned shutdown. The afternoon crew reached the face about 2:00pm, and were stocking up the ABM20 and carrying out roadway maintenance while waiting for mining to recommence. Some men may have begun stone dusting or been on a crib break at 3:45pm. Mining could not have resumed because the fluming pumps were still in start-up mode at the time of the explosion.

The roadheader

9. The roadheader was located in A heading, mining in an easterly direction to link up the two branches of this heading. The morning shift experienced some methane layering, although the air readings were steady at 0.8% up to 1:00pm. A fan was operated to control the methane level.
10. The afternoon crew was undermanned, so the roadheader was not scheduled to work until Monday 22 November. Two men moved the roadheader back from the face to ready it for operation after the weekend. It is unclear whether they were still at the roadheader at the moment of the explosion.

Continuous miner CM002

11. This machine was located in a stub at the western end of A heading, but had not been operational for some time and was being serviced on 19 November. Two men, an engineer and a fitter, were working on the machine during the afternoon. Daniel Duggan, the control room operator, was speaking to Malcolm Campbell, the engineer, at the time of the explosion. Gas readings taken at this location during the day were unremarkable.

VLI Drilling Pty Ltd drilling rig

12. This in-seam drilling rig was at drill stub 3 near the western end of A heading. The two-man crew began a day shift at 7:00am. The night shift experienced a malfunction with the drilling rig, as a result of which the connection to 16 drilling rods in the borehole was lost. The day shift endeavoured to reconnect to the rods and retrieve them. Whether they succeeded is not known. An observer, who was to start work the next week, was also with the crew that afternoon.

13. Gas readings, and a measure of the methane flow rate from the borehole taken during the morning, were normal for a drilling rig stub.

Cross-cut 4, B–C headings

14. Three contractors were working a day shift in an inbye cross-cut between B and C headings. They were constructing a board and brattice stopping required for ventilation control. Comparatively little was observed of their progress during the day. By 3:45pm they may have finished work in preparation for catching the 4:00pm taxi out of the mine from Spaghetti Junction.

The hydro-monitor panel

15. The three-man hydro-mining crew began a 12-hour shift at 7:00am. The night shift had experienced a water leak while operating the monitor. However, the day shift used it to cut coal until 12:20pm, when the supply of fluming water to the mine was halted. Little was seen of the crew throughout the day, but they likely used the downtime to undertake maintenance work, including fixing the monitor leak. The three men were probably in the hydro panel at the time of the explosion. Video footage obtained via a drill hole into the hydro panel cross-cut (PRDH47) confirmed the presence of one body in that location.

The dirty water sump heading

16. Two contractors were working in this heading using a bucket excavator, known as a brumby, to excavate an area in readiness for the construction of a concrete sump. This machine did not have a fixed methane detector or an automatic shutdown system, and nor did the men remember to take a portable gas detector with them into the mine. At 3:45pm the men may still have been at work in the heading, or preparing to leave on the 4:00pm taxi.

Pit bottom south

17. Four contractors were working a day shift installing a water pipeline at this location in the southern extremity of the mine. The contractors used a dump loader to cart and dump excavated material at the grizzly. The machine broke down several times during the day and was last seen at Spaghetti Junction where the operator, Riki Keane, was working on it. It is not known whether the other three contractors remained at their workplace at 3:45pm or were en route to catch the taxi.

Four workers in transit

18. An interviewer, Conrad Adams, drove a drifrunner into the mine at 3:15pm and was last seen near Mr Keane's broken-down dump loader. The taxi driver, John Hale, was also in the Spaghetti Junction area ready to take miners and contractors out of the mine at 4:00pm.
19. Daniel Rockhouse was a member of the ABM20 afternoon crew, but at the time of the explosion he was parked at pit bottom in stone, refuelling a vehicle. Russell Smith was late for work and driving inbye up the drift at the time of the explosion.

The fuel consumed in the first explosion

What was the fuel type?

20. An explosion is a violent release of energy resulting from a rapid chemical reaction, which produces a pressure wave, substantial noise, heat and light. An explosion requires an explosive fuel source, oxygen and contact with an ignition source.
21. Methane occurs naturally in coal seams and is released by mining activity. It is explosive in the range of 5–15% methane in air. The coal measures at Pike River had a gas content of approximately 8m³/tonne of coal. The gas composition of the seam was at least 95% methane, with small quantities of carbon dioxide and ethane.⁵ Methane

was the suspected fuel source as soon as the explosion occurred.

22. The other possible fuel type was airborne coal dust, although wet mining conditions at Pike River suggested it was not likely to be the primary fuel source. It could, however, have been a minor contributor to a methane-fuelled explosion.
23. Professor Cliff analysed the results of gas samples obtained from about 9:00pm on 20 November, principally from the top of the fan shaft. The ratio of gases found in these post-explosion samples is 'consistent with methane being the primary cause of the first explosion.'⁶
24. The only potential evidence that implicated coal dust as a contributor to the explosion was some coking located at the exhaust infrastructure at the top of the vent shaft. Samples were sent to the University of New South Wales for analysis, specifically to establish if coking had occurred. If it had, this would indicate the conversion of coal dust into coke as a result of explosion temperatures. Only a very small percentage of coked particles were found, consistent with a minor involvement of coal dust, if any. Coal dust explosions are extremely violent and the first explosion at Pike River was sluggish. The joint investigation expert panel concluded that it was a methane explosion.⁷

What quantity of methane?

25. To determine the source of the methane consumed in the explosion, the panel first assessed the likely volume of methane required to produce an explosion of the kind recorded on the portal closed circuit television (CCTV) footage. This footage was the starting point from which to work back and endeavour to extrapolate the initial methane volume.
26. The blast exited the portal for approximately 52 seconds,⁸ with most energy expended in the first 30 seconds. The cross-sectional area of the stone drift at the portal was approximately 22m². To estimate the velocity of the blast, the speed at which debris passed through the 7.5m field of vision of the camera was calculated. The camera recorded four frames per second and debris cleared the field of vision in less than one frame. This indicated a blast velocity greater than 30m/s (metres per second) and within a range up to 70m/s.⁹
27. The expert panel's analysis of the blast enabled the volume of gas ejected at the portal to be estimated. Then followed the extrapolation process:

Explosion products ejected at the portal	30–70,000m ³
Double this for a similar volume of products ejected at the vent shaft	60–140,000m ³
Divide by 5 (the assumed expansion factor of the explosion) to establish the volume of mine atmosphere which exploded	12–28,000m ³
Reduce explosive mine atmosphere volume to 5% (the lower limit of the explosive range of methane) to establish the minimum volume of methane consumed in the explosion	600–1400m ³ .

28. However, the expert panel concluded that the methane consumed in the explosion was more likely to be at least 1000m³, and possibly a much higher amount. This reflected the high concentration of carbon monoxide in the post-explosion gases, as confirmed by the two survivors' prolonged loss of consciousness and the analysis of early samples from the vent shaft. High post-explosion concentrations of carbon monoxide indicate a fuel rich explosion.¹⁰

Some revised thinking

29. In light of points raised in the cross-examination of Mr Reece, and following subsequent discussions between experts, Professor Cliff revised some aspects of his explosion calculations. He discussed these aspects in a transcribed telephone conference on 13 March 2012, to which an expert adviser to the commission, Darren Brady of Queensland's Safety in Mines Testing and Research Station (SIMTARS), contributed.

30. The first change related to the methane content of the first explosion. After discussion and consulting experts from the United States, Professor Cliff (supported by Mr Brady) concluded that it was likely the explosion consumed even more than 1000m³ of methane. Although the pressure wave at the portal was significantly long, the explosion was not particularly powerful; rather it was slow and weak. It was also described as a 'deflagration' (explosive burn), rather than a 'violent detonation'. This supported a methane rich mixture greater than 10%, and perhaps approaching the upper limit of the explosive range, 15%.¹¹
31. The previously adopted expansion factor of five was also revised. Discussion with other experts led Professor Cliff and Mr Brady to conclude that the expansion factor could have been as low as two and was not likely to be as high as five. A lower expansion factor indicated that the volume of the explosive atmosphere in the mine was likely to be larger than previously thought, in order to still produce the gas volume.
32. The combination of the two factors, a higher methane concentration and an increased volume of explosive atmosphere, pointed to an even larger methane volume than the previously favoured 1000m³. In the course of the discussion, Professor Cliff favoured 2000m³ of methane as the upper end of the likely range.¹²

Possible sources of the methane

The goaf

33. The expert panel concluded that there were few potential locations within the mine capable of producing the required volume of methane. One possible location was the hydro panel goaf.
34. Hydro mining at Pike River had created an irregular goaf approximately 30m wide, 40m deep and up to 9m high. The void volume was approximately 6000m³. The goaf was not ventilated. Methane would have continued to bleed from the coal seam into the goaf.¹³ It also contained an in-seam borehole drilled to explore the limits of the seam and also pre-drain methane. The borehole had been intersected during hydro mining, and therefore provided an additional potential source of methane.¹⁴ The diagram below illustrates the area of the goaf (top right corner) and the intersecting borehole. The gas drainage lines are marked in red.

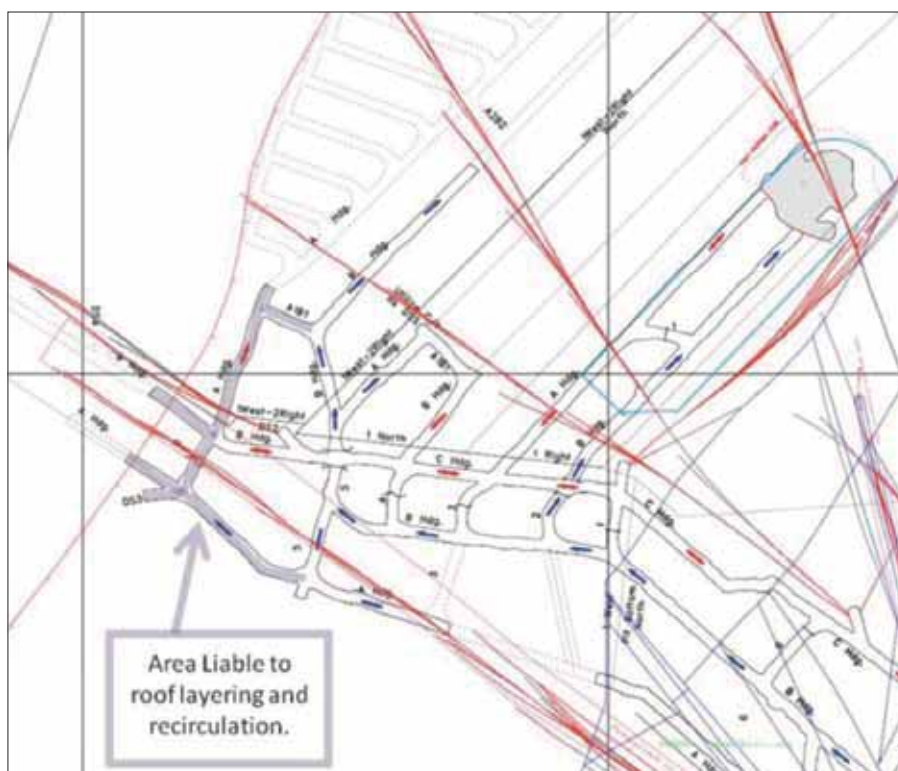


Figure 14.2: The area of the goaf and the intersecting borehole¹⁵

There was also a rider seam above the goaf which, after disturbance of the roof strata during mining activity, could leach further methane into the goaf.

35. The panel considered that up to 5000m³ of methane could have built up in the goaf.¹⁶ Methane is buoyant and would not move unless disturbed and flushed out during mining or expelled by a significant roof fall. The goaf was unsupported, so strata failure and roof falls were to be expected. Indeed, the mine had experienced a large goaf fall in October, and a flushing out of methane by the monitor during mining on 17 November. Both events expelled significant volumes of methane into the adjacent roadways.¹⁷
36. In cross-examination, Mr Reece was asked whether a drillhole into the goaf would confirm the occurrence of a roof collapse large enough to have expelled the required volume of methane, but his answer demonstrated that this is a highly problematic issue.¹⁸
37. The expert panel favoured the goaf as the most likely source of the methane and a roof fall as the likely expulsion mechanism.¹⁹

Three explosion scenarios

38. The expert panel suggested three potential ways in which an explosive atmosphere of between 5 and 15% methane in air may have formed to become the fuel source consumed in the explosion. Scenarios one and two implicated the goaf, with methane emitted by a goaf fall as the initiating event, but with different transmission paths outside the hydro panel as the methane was diluted to within the explosive range. The difference between these scenarios was one of degree. The third scenario, however, envisaged a layered accumulation of methane in the western working areas of the mine.
39. Scenarios one and two are best explained by reference to the following diagram.

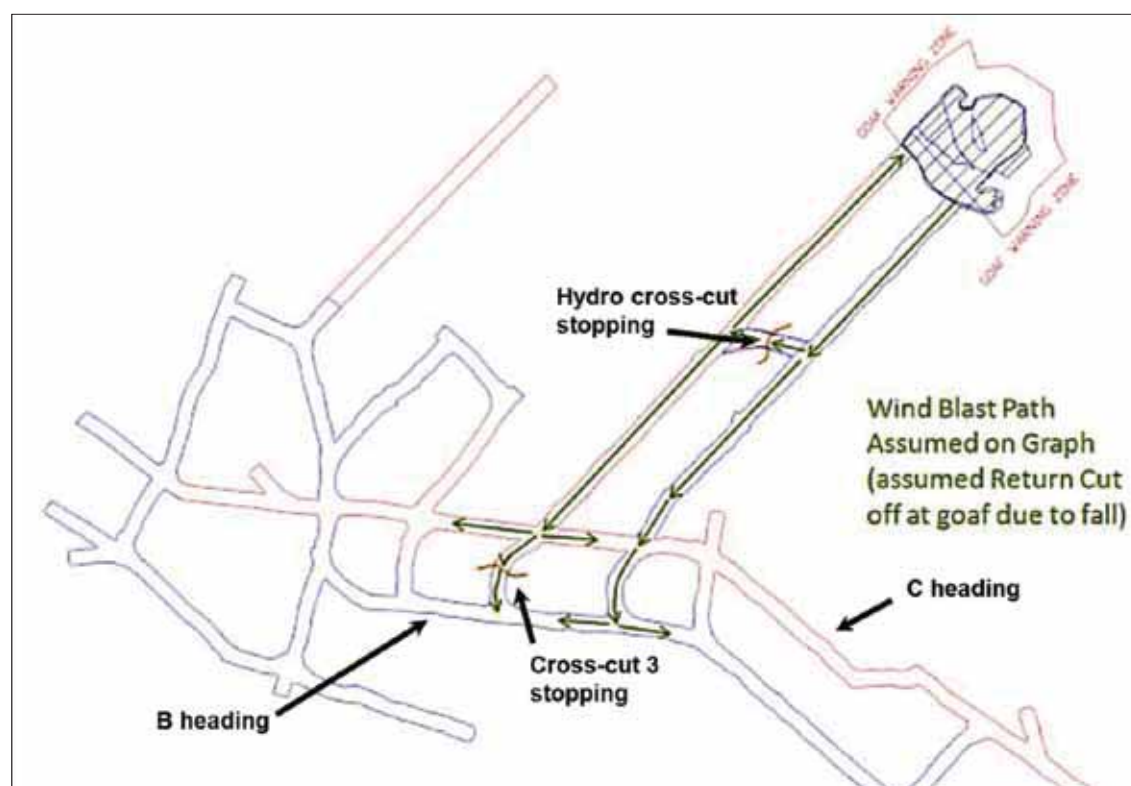


Figure 14.3: Gas flow path due to goaf fall²⁰

40. The expert panel assumed that the return roadway from the hydro panel (left side of the diagram) would have been 'cut off at the goaf due to (the roof) fall'. Hence, the diagram depicts only methane expelled along the intake roadway (right side of the diagram) as far as B heading, and then flowing both inbye and outbye. In addition, it was thought that methane would be forced into the hydro panel cross-cut, would breach the stopping in this cross-cut

and travel in both directions along the return (left-hand) roadway. The southern flow was assumed to have crossed heading C, then breached the stopping in cross-cut 3 to reach B heading.

41. The difference between the two scenarios appears to lie in the extent of the methane spread. In scenario one the methane was more localised, while scenario two contemplated a greater spread of methane, including inbye towards the working areas of the mine.²¹

An inbye gas accumulation

42. The third, and 'less likely,' scenario was a gas accumulation centred in the most inbye and western area of the mine, where the two continuous miners, the roadheader and the in-seam drilling rig were located. This area is depicted in Figure 14.2 and labelled 'area liable to roof layering and recirculation'. There had previously been ventilation and gas management problems in this area, which triggered the shutdown of machinery and the initiation of various methane control measures. In giving evidence, Mr Reece said scenario three was considered less likely because of the significant volume of methane required, which experienced workers, and statutory officials, should have detected and reacted to.²²

Difficulties concerning the possible sources of the methane

43. The commission considers that there are some contentious issues relating to the source of the methane.
44. First, the CCTV footage showed that the blast at the portal was variable, being at its strongest for only the first 30 seconds. This variation, however, was not taken into account in calculating the volume of gas emitted. Mr Reece explained that the fall off in the pressure wave could affect the calculation of methane consumed in the explosion.²³ Second, in arriving at the total volume of gas expelled by the explosion it was assumed that equal volumes were emitted from the portal and up the vent shaft. Again, Mr Reece explained that a lesser volume may have been ejected from the vent shaft, given its smaller dimensions and the absence of video evidence at this location.²⁴
45. In a working paper dated 16 September 2011 Professor Cliff included a schedule of times recorded on various of the mine's systems in relation to the explosion, including a time reference: '15.45.36–15.46.22, explosion visible at portal for this duration – 47 seconds.'²⁵ Although only a difference of five seconds, this shortening of the duration of the blast would still reduce the methane volume required to produce the explosion. It is apparent, when viewing the CCTV footage, that assessment of the exact duration of the blast is no easy matter; a value judgement is required.
46. Lastly, Mr Brady pointed out that the standard dimensions of the mine roadways were 5m by 3.5m,²⁶ although these exact measurements were not consistently achieved. An explosive atmosphere volume of 12,000m³, for example, would occupy between 686 and 1600m of standard roadway. This represents a significant distance in a small mine, which may suggest that the explosive atmosphere consumed in the explosion was not as voluminous as the panel calculated.

The source of ignition

The amount of energy required

47. Mr Reczek described methane as 'very easily ignited' by an ignition source that is 'intimately engaged', or comes into contact, with the fuel source.²⁷ The actual energy requirement to ignite methane at its most explosive point (9.8% of methane in air) is 0.29 millijoules. This means that a wristwatch battery has 'many times the amount of energy' required to ignite methane (hence the prohibition on using battery-powered watches underground).²⁸
48. The expert panel identified a range of potential ignition sources. The most favoured was an electrical ignition at any one of numerous points in the mine's electrical infrastructure.

A timing coincidence

49. The supply of fluming water to the mine was cut about 12:20pm on 19 November owing to a planned service shutdown at the surface coal preparation plant. Very shortly before 3:45pm the plant advised Daniel Duggan, the control room operator, that the water supply was back on. He switched on the number one fluming pump and made a call to the working faces, using the digital access carrier (DAC) system. Malcolm Campbell, the shift engineer who was repairing a continuous miner at the most western inbye point of the mine, answered the call, but communication to the mine was lost as the two men were speaking. Simultaneously, all telemetric reporting from the mine to the control room also stopped.²⁹
50. Data subsequently obtained from the mine electrical system confirmed that the start-up signal from the control room initiated the number one fluming pump start-up sequence at between 3:45:14pm and 3:45:18pm (GPS time). Seconds later, at 3:45:26pm, all power to the mine was lost when circuit breakers at the portal substation tripped.³⁰ The coincidence of the switching on of the pump followed so soon by an explosion persuaded the expert panel that an electrical cause was the most likely ignition source.

Potential electrical sources

51. The timing coincidence, coupled with some operational problems in the lead-up to 19 November, resulted in a focus on variable speed drives (VSDs) installed in the mine. VSDs enable fixed speed motors to operate at continuously variable speeds. By varying the frequency of the power supply to a motor, VSDs can achieve a softer start-up process with a consequent power saving. And by varying the operating speed of the motor to match its output demand, further savings and improved performance are achievable. VSDs were installed underground at Pike River in conjunction with the main ventilation fan, and pump, motors.
52. However, in varying the frequency of the power supply, VSDs can cause an electrical waveform distortion, termed harmonic distortion. Harmonics are a normal characteristic of a VSD's operation. The distorted waveform can flow back into the power supply grid and into the motor, and from there into the mine earthing system.³¹ Harmonics may also flow into metal works, such as a pipeline, that are connected to electrical equipment powered by a VSD.³²
53. Mr Reczek considered that 'harmonic currents flowing in the earth circuits of the underground power supply would be capable of generating incendive sparking across any mechanical surface connection in the earth circuit.'³³ This incendive sparking, also termed arcing, could 'basically light the entire electrical system up like a Christmas tree' and produce sufficient energy to ignite an explosive methane mixture, should there be one at the point of an arcing.³⁴ Mr Reczek stated the phenomenon of arcing occurred in many underground coal mines when machines made contact, causing shocks to men who were in contact with mobile machinery and the ground.³⁵ This risk extended to metal infrastructure connected to a VSD-powered motor, and could, in Mr Reczek's view, have caused arcing anywhere on a pipeline, for example, particularly at a joint.
54. Mr Reczek was supplied with correspondence and other documents relating to the underground electrical installations at Pike River. He considered that technical issues raised in the documents indicated a heightened risk from harmonics.
55. Loadflow studies suggested to Mr Reczek that the main power supply to the mine was insufficient to meet the demands of the underground fans, pumps and other electrical installations. A soft power supply may cause motors to achieve less than their specified output, leading to overheating, 'hot joints' at connections to conductors and drive instability.³⁶ In these circumstances, VSDs also produce higher currents in an attempt to compensate for the inadequate power supply, and higher currents are a cause of increased harmonics.³⁷
56. Documentary evidence confirmed that overheating and instability had affected the main fan and the monitor pump at Pike River.³⁸ Mr Reczek also highlighted harmonic analysis reports,³⁹ which showed high levels of waveform distribution and in areas of the mine where this should not have been found.⁴⁰
57. He also relied on photographs that he concluded showed physical evidence of arcing.⁴¹ These depicted pitting caused by arcing to the metal surface of a component of the methane sensor located near to the surface in the vent shaft, but connected to the underground power supply.

58. Before the explosion, the VSD driving the motor of the main fan was replaced because of a circuit breaker problem that caused intermittent tripping of the fan.⁴² Other VSDs were also to be replaced by the supplier at a cost of \$140,000 because of various failures, including the failure of pre-charge resistors.⁴³
59. Although his evidence contained a considerable emphasis on harmonics, Mr Reczek considered that arcing was only a 'potential' ignition source at Pike River. He acknowledged that the lack of access to the VSD units in the mine, limited information about the way electrical equipment was installed and the non-availability of information following the forensic analysis of the failed resistors in the United States all limited the weight that should be placed upon his opinions.⁴⁴ Indeed, in another answer, Mr Reczek described his report as 'incomplete' because it involved 'drawing conclusions or inferences, if you like, based on information which is available [but] which isn't conclusive.'⁴⁵

Rockwell Automation (NZ) Ltd

60. This company supplied the Powerflex 700L model VSDs installed at Pike River, and the replacement 700H model for the main fan. The company filed an institutional statement with the commission in which it strongly disputed Mr Reczek's views concerning harmonics. Although Rockwell sought and was given interested party status at an early stage, it did not actively participate in the inquiry until the commission drew its attention to Mr Reczek's witness statement.
61. Rockwell described Mr Reczek's conclusions as 'implausible'.⁴⁶ It maintained that he had not taken account of modern VSD technology, which ensures:
- VSD Input voltage and current waveforms contain very little low frequency harmonics due to active wave shaping of the line current with embedded AC line filters. Modern VSD input voltage and current waveforms meet IEEE [Institute of Electrical and Electronics Engineers] standards which therefore cannot create hot joints and possible resulting methane ignition.*⁴⁷
62. Further, Rockwell conducted a simulation study based on the actual specifications for the number one fluming pump, a 700L model VSD and any associated componentry, including the cabling between the pump motor and the VSD. The essential conclusions reached were that a 700L model VSD generates only low-level harmonic currents, that these are contained in the cabling system and that the energy level of any stray currents going into the earthing system would be insufficient to ignite methane. Rockwell also contended that the overheating of motors at Pike River was caused by defective resistors, and that it was incorrect to attribute the overheating problem to a soft power supply, which could lead to hot joints as a potential ignition source.⁴⁸
63. Since March 2012, when Rockwell filed its institutional report with the commission, there has been ongoing communication between it and the DOL investigation team resulting in a number of outcomes:
- DOL accepts that 'the simulation work in the Rockwell report is detailed and thorough for the cases it considers'.⁴⁹
 - However, DOL draws attention to the substitution of a 700H model VSD at Pike to power the main fan,⁵⁰ while its investigations have not revealed a sample of the actual cable used at Pike River,⁵¹ but have confirmed the cable termination arrangements used in connecting VSDs to electric motors at the mine.⁵² DOL asked Rockwell to undertake further simulation work based on a 700H model VSD, the actual Pike cable termination arrangements and, if possible, cabling of the kind described by Pike's underground electrical co-ordinator.⁵³ The cable and termination arrangements can affect harmonics.
 - Rockwell responded that the scenarios it was requested to simulate were 'speculative', would not be of assistance and it declined to undertake them.⁵⁴
64. There have also been four developments of relevance to the evidence Mr Reczek gave to the commission. He had understood that the number one fluming pump motor was very large, 10 times the size of the main fan motor.⁵⁵ This was not the case, meaning that the VSD starting this pump would not have generated a very high level of harmonics. In addition, it is now 'less certain' whether the VSD had actually started, or whether it remained in

start-up mode, at the time of the explosion.⁵⁶ If the latter, the scope for harmonic generation is removed, or at least minimised. Thirdly, investigators are now unsure whether there is a 'direct pipework' connection between number one fluming pump and the inbye area of the mine. The number one pump replenished the fluming water supply before another pump in the sequence pumped water inbye. This may eliminate pipework as a connection route, leaving the mine earthing system as the only path for harmonics to travel from pit bottom in stone to an inbye ignition location.⁵⁷ Finally, Mr Reczek's view that the power supply to the mine was soft has been contested by Pike's electrical co-ordinator.⁵⁸

65. In June 2012 DOL observed that it had 'not been able to confirm or to rule out' harmonics generated by a VSD as the ignition source of the explosion. Its investigation was described as 'continuing'. When he gave evidence, Mr Reczek acknowledged the constraints he was under. The wisdom of his warning has been borne out by subsequent developments.

Other potential ignition sources

66. In addition to an electrical cause, the expert panel considered a range of different, 'less likely' potential ignition sources. These alternatives included spontaneous combustion, frictional ignitions (from metal on rock, or metal on metal, sparking), a conveyor belt heating or fire, diesel vehicle 'hot surface' ignition and ignition from the introduction of contraband into the mine.
67. Some of these potential sources were discounted for lack of evidence. For example, testing indicated that the Pike River coal seam was not prone to spontaneous combustion and there was no history of its occurrence, and that the conveyor belt was not in service at 3:45pm.

A diesel engine 'hot surface' ignition

68. The expert panel concluded that a fault in the protection system of a diesel engine could not be ruled out as the ignition source. The diesel-powered vehicles and machines used underground at Pike River were fitted with flameproof enclosures designed to prevent an overheated engine from becoming an ignition source. But component failure, incorrect settings and poor maintenance can compromise these safety systems.⁵⁹
69. In addition, throughout Pike River's short history there were instances of the deliberate bypassing of various safety devices designed to counter the risk of methane explosions. Some incidents of this kind were recorded in statutory reports, which were subsequently summarised in a schedule compiled by the commission.⁶⁰ The schedule included several instances of interference with vehicle shutdown systems, so that an engine would not cut out in the event of an overheating.
70. This history also influenced the panel in concluding that an engine hot surface ignition remained a potential ignition source.

Contraband

71. Regulations prohibit taking any device or material likely to cause a spark or flame into an underground coal mine.⁶¹ Devices powered by a battery (including wristwatches or cameras) must not be used underground, unless the device is fitted with an intrinsically safe battery system. Matches and cigarette lighters are also banned and smoking is of course prohibited. Aluminium cans are another contraband item, because contact between aluminium and other metals can produce sparking.
72. Again, there had been instances at Pike River of contraband both taken and used underground.⁶² In particular, aluminium cans, cigarette butts and unsafe battery-powered devices featured in incident/accident reports that covered the period from August 2008 to October 2010. Although management had taken significant steps to deal with contraband, the expert panel concluded it remained a potential ignition source.

Frictional ignition

73. Although there was no mining activity at the time of the explosion, maintenance and building work was taking place. Machines, including scrapers and diggers, were being used, as were vehicles to transport workers. Frictional ignition from these activities, such as a spark caused by a metal to metal contact, cannot be ruled out. Machinery related sparks had previously been reported.⁶³

The main fan

74. The main fan was located underground with its non-flameproofed motor in fresh air in the intake airway and the fan impeller in the return airway. As explained in Chapter 8, 'Ventilation', there had been sparking problems with the fan, and changes had been made, but there was an increased potential for contaminated air to reach the motor.

The site of the ignition

Introduction

75. Pike River was still in a development phase at the time of the explosion. The area of the workings was small, by comparison with a mature mine. Developed mines typically have a number of sections where coal extraction has finished, plus current working sections. Despite the small size of the mine, the information available to the expert panel was limited, meaning it could offer only an indicative conclusion about the likely ignition site.

Some indicative factors

76. The panel concluded that three factors indicated the most likely site: the absence of a reflective explosion wave, the temperature levels experienced by the survivors in the drift and the duration of the explosion wave at the portal.⁶⁴
77. Only one pressure wave was discernible from the CCTV portal footage. Had the explosion occurred close to the inbye western side of the mine, a reflective wave at the portal would have been expected. An initial explosion wave would be transmitted through the workings and down the drift, followed soon after by a reflected wave that had hit and rebounded from the western parts of the mine.⁶⁵
78. An explosion that emanated in the middle of the mine workings, or even outbye of this point, would not be expected to produce a discernible reflective wave. Any such effect would be absorbed or weakened by the web of roadways, intersections and cross-cuts that make up the mine workings.⁶⁶
79. Neither of the survivors, Daniel Rockhouse or Russell Smith, experienced significant ill effects from excessive heat when the pressure wave struck them in the drift. Had the explosions occurred near to the inbye end of the drift, the expert panel expected the hot post-explosion atmosphere would have expanded well along the drift, to the point 800m outbye where Mr Smith was hit by the pressure wave. By contrast, in the panel's view, gases and heat generated by an explosion significantly inbye of the drift would be dissipated and cooled before reaching the survivors, particularly in a wet mine.⁶⁷
80. The third factor was the duration of the explosion pressure wave at the portal. The duration of about 52 seconds was more than twice the duration of the pressure waves generated by the three subsequent explosions, all of which were more likely to have occurred at pit bottom than further inbye. The panel therefore concluded that the longer duration of the first explosion was consistent with a more inbye location, although there were other possible explanations.⁶⁸

Explosion modelling

81. In order to verify that the explosion probably occurred inbye of pit bottom, computational fluid dynamic modelling undertaken by engineering consultant BMT WBM was used to test the panel's assumption. The model replicated the layout of the entire mine, and testing was then conducted using different figures for the volume, and the methane concentration, of the explosive atmosphere consumed in the explosion.⁶⁹

82. Two ignition site locations were chosen: an auxiliary fan next to the intake roadway to the hydro panel and the main fan.⁷⁰
83. The modelling suggested that an explosion located at the main fan was 'less likely', while a location further into the mine appeared 'plausible'. The modelling also indicated that a 10% methane concentration and an explosive atmosphere volume of about 25,000m³ best matched the explosion footage. These parameters were also considered consistent with the heat exposure experienced by, and the survival of, Messrs Rockhouse and Smith, but less consistent with a blast duration of 52 seconds.

Conclusions concerning the first explosion

84. Based on the evidence available to date, and without a scene examination, the commission finds that:
- methane fuelled the explosion, with no or very little contribution from coal dust;
 - the volume of methane consumed in the explosion was substantial;
 - the actual volume can only be estimated, but could have been as high as 2000m³;
 - the hydro goaf probably contained approximately 5000m³ of methane;
 - a roof fall in the goaf could have expelled sufficient methane to have fuelled the explosion;
 - a layered accumulation of methane in the roof of the western workings of the mine was another possible methane source, either alone or in combination with methane from the goaf;
 - the ignition source remains contentious, but a number of possible sources exist, including:
 - an electrical cause, given the timing coincidence between the switching on of the fluming pump and the explosion
 - a diesel engine hot surface ignition
 - contraband taken into the mine
 - frictional ignition from activities that were continuing in the mine
 - sparks from the non-flameproofed underground fan; and
 - the possible site of the ignition, and resulting explosion, was in the centre area of the mine workings.
85. Despite the level of uncertainty surrounding several aspects of this exercise, there is no doubt that a large explosive methane atmosphere existed in the mine at the moment of the explosion. This shows that methane control at Pike was not adequate. Ultimately, all explosions are a manifestation of the failure of an organisation's health and safety management system.⁷¹

The subsequent explosions

Introduction

86. The commission received less detailed evidence concerning the three subsequent explosions, but there was also less conjecture about their nature. Their occurrence was predicted by many of the experts gathered at the mine, who stressed the need to seal the mine to avoid further damaging explosions.
87. There were three subsequent explosions. The second occurred on Wednesday 24 November at 2:37pm, five days after the first explosion. The next explosion was on Friday 26 November at 3:39pm, after a gap of only two days. The fourth explosion was on Sunday 28 November at 1:50pm, also after a two-day gap.

88. The later explosions differed from the first. The second and third explosions had a duration of 30 and 23 seconds at the portal, respectively. Both caused a much more forceful pressure wave than that from the first explosion. Following the pressure wave, air was initially drawn into the drift and then there was a reversal or expulsion of air.⁷²
89. The fourth explosion was different again. It caused a billow of black smoke, followed by a fire ball out of the vent shaft and, subsequently, flames that diminished over time, but continued to be visible until 8 December.⁷³



Figure 14.4: Fire coming from the ventilation shaft following the fourth explosion⁷⁴

The fuel type and source

90. It is clear that all three explosions were fuelled by methane. A build-up of methane in the workings was expected as soon as the ventilation system was disabled on 19 November.
91. Mr Brady provided a comprehensive overview of gas data gathered at the mine between 20 November 2010 and March 2011.⁷⁵ Samples obtained at 4:00pm on 22 and 23 November contained an explosive gas mixture, and there was a methane concentration of over 6% before the explosion on 24 November. The methane concentration rose and fell depending on the time of day, changes Mr Brady considered were related to the natural ventilation flow between the portal and the vent shaft. Predominantly the flow was up the vent shaft, but there were reversals driven by a variable pressure differential that changed according to the temperature and barometric pressure.⁷⁶
92. In the two-day gap before the third explosion there were similar fluctuations in the methane concentration, which climbed to a high of almost 12% at one point. Following the third explosion, few samples were collected owing to damage to the sampling lines and the danger involved in re-establishing them.⁷⁷
93. However, it can be inferred that there was a similar build-up of methane, which ebbed and flowed with ventilation changes, until an ignition source and an explosive fringe coalesced to cause the fourth explosion on 28 November.

The ignition source and the ignition site

94. The most likely ignition source for each of the subsequent explosions was 'hot coal'.⁷⁸ Following the heat generated in the first explosion, conditions in the mine were ripe for coal fires or for spontaneous combustion to occur and

provide an ignition source, leading to an explosion once an explosive atmosphere gathered and came into contact with that source.

95. The expert panel concluded that the ignition site of each of the subsequent explosions was probably close to, or a little inbye of, the vent shaft. Logically, there would be an accumulation of methane within the workings and the development of a fringe where oxygen from the natural ventilation circuit mixed with the methane rich atmosphere to reduce it to within the explosive range. When a hot coal ignition source and an explosive atmosphere combined, each of the further explosions occurred.

ENDNOTES

¹ This work was part of the joint investigation, but DOL led the explosion analysis aspect.

² Including (1) the estimated velocities and quantities of gas ejected at the portal; (2) the volume of gas ejected through the ventilation shaft; (3) the percentage of methane (somewhere between 5 and 15%) in the air when ignition occurred; (4) the expansion factor of 5, being how many times the volume of flame was greater than the original explosive mix; (5) the assumed location of the ignition; (6) the dimensions, area and resistance of the mine's roadways; and (7) the path taken through the mine by the explosion.

³ Department of Labour, Pike River Mine Tragedy 19 November, 2010: Investigation Report, [2011], DOL3000130010, pt. 2, sections 3–4.

⁴ Department of Labour, Last Known Position of Deceased and Two Survivors. Final Version, 28 January 2011 (DOL Investigation Report, Appendix 3), DOL3000130004/2. ('A, B, & C headings' locations added to the map by the commission).

⁵ Darren Brady, Review of Gas Data Following Pike River Explosion 19th November 2010: For New Zealand Police – Operation Pike, 5 May 2011, SOE.008.00001/14.

⁶ David Reece, witness statement, 2 February 2012, DOL3000150001/8, paras 29–30.

⁷ David Reece, transcript, pp. 4454–56.

⁸ See para. 45 for discussion concerning the accuracy of this time duration.

⁹ The upper limit of the range was viewed as consistent with the evidence of Russell Smith, who survived the blast 1500m inbye of the portal and suffered significant deafness, but not ear drum damage: David Reece, witness statement, DOL3000150001/10, para. 36.3.

¹⁰ David Reece, transcript, pp. 4458–60.

¹¹ Notes from Pike River Discussion, 13 March 2012, MEM0001/8, 11, 17–19.

¹² Ibid., MEM0001/9.

¹³ David Reece, transcript, p. 4467.

¹⁴ Ibid., pp. 4467–68.

¹⁵ Department of Labour, Investigation Report, DOL3000130010/74.

¹⁶ David Reece, witness statement, 2 February 2012, DOL3000150001/11, para. 41.

¹⁷ David Reece, transcript, pp. 4465–66.

¹⁸ Ibid., pp. 4616–18.

¹⁹ David Cliff, David Bell, Tim Harvey, Anthony Reczek and David Reece, Pike River Coal Mine Explosion: Investigation for Nature and Cause (DOL Investigation Report, Appendix 6), October 2011, DOL3000130007/7.

²⁰ David Reece, DR5 – Gas flow Path Due to Goaf Fall, DOL3000150012/1. (Plan modified by the commission)

²¹ David Reece, witness statement, February 2012, DOL3000150001, paras 20–22.

²² David Reece, transcript, p. 4478.

²³ Ibid., p. 4604.

²⁴ Ibid., pp. 4604–05.

²⁵ David Cliff, An Evaluation of Elements Relating to the Cause of the First Explosion at Pike River Coal Mine: Draft, 16 September 2011, DOL3000140009/33.

²⁶ Darren Brady, witness statement, 2 April 2012, SIM0003, para. 2.5.

²⁷ Anthony Reczek, transcript, pp. 4706, 4835.

²⁸ Ibid., pp. 4732–33.

²⁹ Daniel Duggan, transcript, p. 1581.

³⁰ Anthony Reczek, transcript, p. 4733.

³¹ David Cliff et al., Investigation for Nature and Cause, DOL3000130007/76.

³² Anthony Reczek, transcript, p. 4792.

³³ Anthony Reczek, witness statement, 7 February 2012, DOL3000160001/17, para. 60.

³⁴ Anthony Reczek, transcript, p. 4737.

³⁵ Anthony Reczek, witness statement, 7 February 2012, DOL3000160001/14, para. 45.

³⁶ Anthony Reczek, transcript, pp. 4742–45.

³⁷ Ibid., p. 4746.

³⁸ Anthony Reczek, transcript, p. 4731; Rockwell Automation service records, iPower Ltd, Australia Rockwell Automation to Pike River June 2009–October 2010, DOL3000160006.

³⁹ Email, Cosmin Cosma to Mike [no surname], 13 October 2010, DOL3000160012.

⁴⁰ Anthony Reczek, transcript, p. 4727.

⁴¹ AAR10 (photographs), DOL3000160013.

⁴² Michael Scott, witness statement, 30 May 2012, SCO7770010001/26–27, paras 101–06.

⁴³ Energy NZ Ltd, Department of Labour – Pike River Coal Audit Report for November 19, 2010, 25 January 2012, DOL3000140001/27.

⁴⁴ Anthony Reczek, transcript, pp. 4765–67.

⁴⁵ Ibid., p. 4785.

⁴⁶ Rockwell Automation (NZ) Ltd, Institutional Report of Rockwell Automation (NZ) Ltd in Response to the Statement of Anthony Arthur Reczek for Phase Three (Dated February 7, 2012), 15 March 2012, ROC.001/2, para. 8.

⁴⁷ Ibid., ROC.001/22, para. 67.

⁴⁸ Ibid., ROC.001/4, 6–8.

⁴⁹ Department of Labour, Department of Labour Report on Electrical System Evidence, 8 June 2012, DOL7770050017/4, para. 6.

⁵⁰ Ibid., DOL7770050017/4, para. 6.1.

⁵¹ Ibid., DOL7770050017/8–9, paras 17–23.

⁵² Ibid., DOL7770050017/9–10, paras 24–30.

⁵³ Rockwell Automation (NZ) Ltd, Memorandum (Second) Regarding the Institutional Report of Rockwell Automation (NZ) Limited and Further Enquiries Received from the Department of Labour, 23 July 2012, ROC. M40001. (Department of Labour letters annexed to memorandum)

⁵⁴ Ibid., with Rockwell Automation letter annexed.

⁵⁵ Anthony Reczek, transcript, p. 4737.

⁵⁶ Department of Labour, Report on Electrical System Evidence, DOL7770050017/7, para. 14.2.

⁵⁷ Ibid., DOL7770050017/10, para. 33.

⁵⁸ Michael Scott, witness statement, 30 May 2012, SCO7770010001/39, para. 161.

⁵⁹ Mine Safety, New South Wales, recently issued a safety warning on the

failure rate of explosion-protected diesel engine systems. A lengthy study indicated that, although reliability had improved, the annual failure rate probability for each system was 23%, meaning it was 90% certain that about six failures per annum coincided with a reportable methane accumulation in a mine: NSW Trade and Investment, Mine Safety Operations Branch, Safety Bulletin: In-Service Failures of Explosion Protected Diesel Engine Systems During 2010 and 2011 (Mine Safety Report No. SB12-01), 19 March 2012, http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/428614/SB12-01-ExDes-report1.pdf

⁶⁰ Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, November 2011, CAC0114/20–24.

⁶¹ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 35.

⁶² Royal Commission on the Pike River Coal Mine Tragedy, Summary of the Reports, CAC0114/29–30.

⁶³ *Ibid.*, CAC114/27–28.

⁶⁴ David Reece, witness statement, DOL3000150001/27–28, para. 118.

⁶⁵ Department of Labour, Investigation Report, DOL3000130010/76, para. 2.49.1.

⁶⁶ David Reece, transcript, pp. 4453–54.

⁶⁷ *Ibid.*

⁶⁸ David Reece, witness statement, 2 February 2012, DOL3000150001/28, para. 118.5.

⁶⁹ *Ibid.*, DOL3000150001/27, para. 117.

⁷⁰ Department of Labour, Investigation Report, DOL3000130010/76–77, para. 2.49.3, figure 24.

⁷¹ United Nations, Economic Commission for Europe, Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines (ECE Energy Series No. 31), 2010, p. 3, http://www.unece.org/fileadmin/DAM/energy/se/pdfs/cmm/pub/BestPractGuide_MethDrain_es31.pdf

⁷² New Zealand Police, Sequence of Events: Search, Rescue and Recovery, SOE.014.00001/76, 88, 104.

⁷³ Darren Brady, Review of Gas Data, SOE.008.00001/81.

⁷⁴ New Zealand Police, Pike River Coal Mine – Sequence of Events: Search, Rescue and Recovery, SOE.014.00118/64.

⁷⁵ Darren Brady, Review of Gas Data, SOE.008.00001.

⁷⁶ *Ibid.*, SOE.008.00001/77.

⁷⁷ *Ibid.*, SOE.008.00001/81.

⁷⁸ David Reece, witness statement, 2 February 2012, DOL3000150001/25, para. 105.

Regulator oversight at Pike River

Introduction

1. This chapter considers the oversight of the mine by the Department of Labour (DOL) inspectorate. The commission has received good co-operation from DOL in providing both historical information concerning the mining inspectorate and direct evidence and records relevant to the inspections conducted at Pike River.
2. Both inspectors gave candid evidence, Michael Firmin at two separate hearings and Kevin Poynter at one for which he returned from Australia. DOL also commissioned an internal operational review of its inspectors' interactions with Pike River Coal Ltd.¹ Conclusions from the Gunningham and Neal review are sometimes referred to in the chapter. In assessing these, and any different views expressed by the commission, it should be borne in mind that the review was based on departmental files (excluding health and safety investigations) and written without access to Pike managers or any post-tragedy documents.²

The statutory background

The functions of inspectors

3. The Health and Safety in Employment Act 1992 defines the functions and powers of the inspectorate with reference to all health and safety inspectors, not just mines inspectors. The inspectors have three functions:
 - to provide information and education to promote workplace health and safety;
 - to ascertain whether the act has been, and is likely to be complied with; and
 - to take all reasonable steps to ensure that compliance is being achieved.³

Other functions may be conferred on inspectors in the act, or by other enactments.

The powers of inspectors

4. Inspectors enjoy extensive powers of entry and inspection at any workplace, and may require an employer to provide assistance, preserve a scene for examination, produce and allow examination of records and provide witness statements. An inspector may take photographs or other forms of enduring records and may also seize anything of evidential value.
5. There is a hierarchy of compliance and enforcement options: an improvement notice, a prohibition notice, an infringement notice and, lastly, an inspector may charge an employer with an offence.⁴
6. An improvement notice identifies a non-compliance, which must then be addressed. The notice may also specify the steps to be taken. A prohibition notice, reserved for failures likely to cause serious personal harm, prohibits an activity until measures to eliminate or minimise the hazard are put in place.
7. Enforcement using an infringement notice is restricted to lesser offences, while an information may be laid in relation to serious harm offences, which carry a maximum penalty of two years' imprisonment, a fine of up to \$500,000, or both.⁵

Duties owed to inspectors

8. The HSE act imposes duties on everyone in a workplace to assist the inspectorate and not to obstruct an inspector in the course of their duties. Anyone in charge of a workplace must maintain a register of accidents that caused

personal harm or might have done so, and an incident register of events that caused serious harm. Serious harm includes significant injuries and illnesses, and conditions that result in hospitalisation for 48 hours or more.⁶

Duties specific to mining

9. The Health and Safety in Employment (Mining – Underground) Regulations 1999 impose specific duties in relation to coal mines. An inspector must be notified of the commencement and cessation of a mining operation and of the installation of a shaft.⁷ Details of the time, place and management of the operation, and contact details, must be notified. Different notification time limits apply, according to the nature of the operation.⁸
10. Regulation 10 defines accidents that must be notified to DOL. They are accidents involving an explosion or ignition, a fire or spontaneous heating, an outburst of gas or water, contact with harmful chemicals, a winding plant event, loss of control of a vehicle, the trapping of an employee, a structural failure, an unplanned fall of ground, a major collapse, an uncontrolled gas accumulation, a main fan failure for more than 30 minutes or an electric shock requiring medical treatment.
11. Regulation 11 requires that mine plans are kept for every operation, are updated at least once every six months and are 'copied to an inspector' at regular intervals. Mine owners must also keep certain other records onsite, which an inspector may inspect as necessary.

The mining inspectorate personnel

12. From May 2005 to November 2010 two inspectors, Michael Firmin and Kevin Poynter, separately had responsibility for the Pike River mine.
13. Mr Firmin obtained a bachelor of science degree in mineral technology from the Otago School of Mines in 1977. After graduating, he joined the Mines Department and over the next 15 years held various office, surface and underground positions. In 1984 Mr Firmin obtained a first class coal mine manager's certificate and subsequently held statutory positions, including about three months as an underground mine manager at Moody Creek near Greymouth. In 1995 Mr Firmin joined the Ministry of Commerce as a health and safety inspector with responsibility for inspecting mines and quarries. In 1998 he transferred to DOL, where he has since worked as a mines inspector.⁹
14. Mr Poynter worked in the coal mining industry from 1977 for about 30 years, from time at the coal face through to management positions in Australia. In 1985 he obtained a first class mine manager's certificate and subsequently held the position of mine manager in three New Zealand mines. He became a trainee health and safety inspector in April 2008 and obtained a certificate of appointment (warrant) in June 2009.
15. The commission considers that both inspectors were adequately qualified and sufficiently experienced. Mr Firmin had limited experience as a mine manager, but this would not have been a difficulty if the inspectorate worked in a supportive environment, was properly resourced and had been able to access specialist advice from other experts. Unfortunately, Messrs Firmin and Poynter faced fundamental difficulties in performing their role, as discussed in Chapter 22, 'The decline of the mining inspectorate'.

The operational methods of the mines inspectors

16. The inspectors' workload was formidable. They were required to inspect all coal mines, metalliferous mines, quarries and tunnels in New Zealand.¹⁰ In early 2010, for example, there were eight underground coal mines, 21 open cast coal mines, 11 metalliferous mines, 925 quarries and four tunnels under construction.¹¹
17. The South Island was divided by the Rakaia River, with Mr Firmin living in Dunedin and responsible for the south, and Mr Poynter based in Westport with responsibility for the north. They shared responsibility for the North Island,

and conducted inspections as time permitted. Quarries were viewed as the last priority, and many North Island quarries were not inspected at all.¹²

18. An 'inherent risk' assessment form was used to set the frequency of inspections to the various workplaces.¹³ However, underground coal mines were automatically classified as high risk, to be inspected every three months.¹⁴ Inspections were either proactive, initiated by DOL, or reactive, in response to an event notified from a particular workplace. Proactive visits (hereafter called inspections) were arranged with the mine operator, not unannounced.¹⁵ Responding to requests for technical information and advice was a further significant aspect of the inspector's role. The Pike managers often raised concerns and sought input from the inspectorate. These contacts were conducted electronically, through meetings or a combination of the two.
19. From June 2009 until the time of the explosion Mr Poynter conducted five proactive inspections at Pike River. He made a similar number of reactive visits to the mine in relation to accidents or other mining incidents. In addition there were numerous attendances concerning technical mining issues raised by the company.¹⁶ A record of interactions was maintained in an information database named INSITE.

Three representative interactions

Introduction

20. An assessment follows of three interactions between the inspectorate and Pike River mine personnel between February 2007 and November 2010. These cover important aspects of the mine's development and provide an insight into the inspectorate's relationship with the company. The commission accepts the assessment that the nature of these interactions was consistent with DOL policy.¹⁷

Location of the main fan underground

21. The first contact with Pike was in May 2005. Peter Whittall phoned Mr Firmin, introduced himself and explained that he wished to develop the access tunnel into the mine without using flameproof machinery, given that the development would be in rock, not coal. After conferring with an Auckland-based colleague, Mr Firmin advised Mr Whittall that designation of the drift as a hard rock tunnel was acceptable, at least until the approach to the Hawera Fault, at which point a coal mine designation might be required.¹⁸
22. The first mine inspection took place on 13 February 2007. Mr Firmin, accompanied by Richard Davenport, a senior technical officer with the energy safety service of the Ministry of Economic Development, visited the mine. Mr Whittall first provided a PowerPoint presentation at the company's Greymouth office. He outlined progress to that time: construction of the access road, establishment of an electrical supply to the mine and development of the drift to 320m. Mr Whittall also explained that the main ventilation fan was to be located underground, with a back-up diesel fan situated at the top of the ventilation shaft. At this point the shaft was to be located in stone to the east of the Hawera Fault. He said this would provide ease of maintenance, whereas there was no space and it was too steep for the fan to be located on the hillside above the shaft.¹⁹
23. Following the presentation, Messrs Firmin and Davenport went to the mine. Mr Firmin inspected the tunnel, focusing on the gradient, roof stability and the adequacy of strata control. Mr Davenport audited the safety of the electricity supply to the mine, which at that stage was an 11kV supply, to be upgraded to a 33kV supply later. He approved the existing installation in a written report that included a request for the ministry to be kept informed about the installation of the upgraded supply.²⁰
24. Mr Firmin prepared handwritten notes of his inspection. These included a simple diagram depicting the intended configuration of the main fan, with the motor located in the intake in fresh air, and the fan separated in the ventilation return and expelling exhaust up the vent shaft.²¹ This proposal concerned Mr Firmin. He had experience of main fans located underground in hard rock tunnels, but never in an underground coal mine. He noted that

the regulations required employers to take all practicable steps to ensure the provision of fresh air in every place in a mine where employees could go.²² The location of the main fan underground was not expressly prohibited. Still not convinced, Mr Firmin said he checked regulations in other countries, but found none that prohibited an underground location. He concluded that fans were put outside for ease of maintenance.²³

25. On 28 February 2007 Mr Firmin wrote to the company about the inspection. He recorded matters relevant to roof support in the drift and also enclosed a copy of Mr Davenport's audit report. The letter made no reference to placement of the main fan underground.²⁴ Mr Firmin neither spoke to anyone about his unease nor considered seeking expert advice.²⁵ On 6 November 2007 Mr Firmin inspected the mine, was told that the fan would now be located to the west of the Hawera Fault and asked for further operational details.²⁶ These were not available.²⁷
26. Mr Poynter became responsible for the Pike River mine in 2008. He, and occasionally Johan Booyse, the high hazards adviser, visited the Pike mine but DOL took no action in relation to the location of the main fan underground. Mr Poynter said that he did not inspect the fan after its installation, or obtain information about its performance.²⁸

Assessment

27. In the commission's view, DOL's actions in relation to this issue were inadequate. Although not expressly prohibited in New Zealand, location of a main ventilation fan underground was at odds with established practice throughout the mining world. Mr Firmin needed to confront the issue in 2007, particularly in November, when he was told that the fan was to be located west of the fault. Failure to question the proposal at that point made it more difficult for Mr Poynter to do so later. Even so, given the delay until mid-2010 when the fan was installed, there was ample time to have dealt with the matter.
28. Nor does the commission accept that the regulatory position in other countries is obscure. An International Labour Organisation (ILO) code treats the location of ventilation fans on the surface as a given: stating the 'surface ventilating fan' is to be 'offset from the nearest side of the mine opening at least 5 metres' in order to avoid explosion forces.²⁹ In addition, regulations in the United States, Canada, Queensland and New South Wales expressly provide,³⁰ or take it for granted, that main fans (as opposed to auxiliary and booster fans) must be installed above ground.
29. This failure not only allowed a highly questionable ventilation system at Pike River, but also set the tone for subsequent interactions between the company and the inspectorate.

Frictional ignitions

30. By October 2008 the drift was developed to a point close to the Hawera Fault. Pit bottom in stone was completed and it was expected that methane levels would increase as the drive towards the fault continued. Because control of the mine had passed from McConnell Dowell to the company, Pike deputies managed the McConnell Dowell crews.³¹
31. On 11 November several methane ignitions occurred in a stub under development off the main drift. A roadheader was cutting when methane was released, which was ignited when the cutter head struck the hard rock floor. Pike's production manager, Kobus Louw, investigated the ignitions and prepared a memorandum containing preventative actions that were to be communicated to crews at tool box talks. The actions included the use of an air mover at the face to assist ventilation, the application of extra water on the cutter head to prevent ignitions and increased methane monitoring at the face before cutting started.³²
32. On 13 November Mr Louw notified Mr Poynter of the ignitions by telephone.³³ The next day Mr Louw emailed a copy of the investigation memorandum to Mr Poynter and they discussed the ignitions and agreed that use of the roadheader would cease, with development to continue using a drill and blast method. Workers would withdraw from underground when blasting occurred. Mr Poynter sent an email to Mr Louw seeking further information and recording that 'the mine should [now] be deemed to be a Gassy Mine'.³⁴ Mr Louw also confirmed by email that an explosive which could not ignite methane would be used for blasting.

33. Mr Poynter discussed the ignitions with Mr Firmin. They agreed the hazard was 'a significant one', but agreed that the steps implemented by the company were adequate.³⁵ Sometime over the next few days Mr Poynter was rung by Harry Bell, a former chief inspector of coal mines, who had assisted McConnell Dowell as a tunnel supervisor in the early development of the drift. Mr Bell had been told of the ignitions by a senior McConnell Dowell employee, who referred to '10 ignitions in the past fortnight'.³⁶ Mr Bell considered the essential problem was the inadequate ventilation from a forcing fan near the portal.³⁷ He told Mr Poynter that work in the drift should be prohibited until the ventilation was improved. He added that he did not mind if the company was told that he was 'the whistle blower', since to his mind the matter was extremely serious.³⁸
34. Mr Poynter considered the matter, but concluded that he could not intervene because 'there is no legislative requirement that determines the method of ventilating coal mines' and 'forcing ventilation when using explosives or developing in stone is an acceptable method'.³⁹ Mr Poynter consulted Mr Booyse, and on 19 November emailed Mr Louw requesting the supervisors' reports for each ignition, weekly ventilation recordings and a ventilation plan to show recording positions. The email continued: 'Have you considered the adequacy of the ventilation. Given that the mine is now in coal and that the amount of gas emissions will only increase as you advance it is my opinion that the ignitions are probably caused by insufficient ventilation at the face.' The situation was termed a matter of extreme concern to be dealt with 'urgently'.⁴⁰
35. On 20 November Mr Poynter again phoned Mr Firmin and discussed whether work should be stopped while an assessment was obtained from a ventilation engineer but they decided to wait for a new risk assessment.⁴¹ Nothing happened for several days until 28 November, when Mr Poynter received an email from Mr Louw to which was attached a McConnell Dowell procedure for the use of explosives in a gassy mine, together with deputies' reports for 24 and 25 November and a ventilation plan.⁴² Mr Poynter responded immediately by email: 'I am still waiting on the shift reports of each of the ignitions and any investigations undertaken'.⁴³
36. On 3 December Mr Louw replied by email, attaching incident/accident and accident investigation reports, both of which related to another methane ignition on 15 November.⁴⁴ Nothing more occurred for three weeks when, on 24 December 2008, Mr Poynter sent a further email to Mr Louw: 'I have been working on this file and noted that I have only received advice of two ignitions. I have been told by a number of people now that there were at least 10.' He requested information on the other incidents.⁴⁵
37. Mr Louw replied the same day: 'Don't know who feed [sic] you information but there was a few ignitions on 4 shifts that I know of and that you should have the information, (including the one at hawera fault [sic]). If there is more then supervisors chose not to report them hence I don't know of them and is not been investigated'.⁴⁶
38. Finally, on 13 February 2009 Mr Poynter recorded in an INSITE entry that the matter was closed.⁴⁷ By then the focus of attention was west of the Hawera Fault, where mine development was under way.

Assessment

39. The commission notes that the Gunningham and Neal review includes an analysis of the inspectors' actions in relation to this aspect.⁴⁸ The authors said that Pike voluntarily provided a detailed flow of safety information, which Mr Poynter cross-checked for completeness. This, they concluded, 'was a sound approach and provides a good basis for concluding that the inspectors discharged their duty to satisfy themselves about the level of compliance by the mine'.⁴⁹
40. In the commission's view, the inspectorate's performance in relation to this aspect was positive in some respects, but not in others. Mr Poynter was decisive when the methane ignitions were first drawn to his attention: he required Pike River to be deemed a gassy mine and secured an agreement not to use the roadheader. He took a consultative approach by discussing matters with Mr Firmin on two occasions and with the high hazards adviser on at least one. This was probably to be expected, given that Mr Poynter had still not obtained a certificate of appointment. He also persisted in contacting Mr Louw when requested information had not been provided.
41. On the other hand, his approach to the interpretation of the regulations was odd. Mr Bell said the underlying

problem was the use of forcing ventilation and said work must stop. Mr Poynter decided he could not act because the regulations did not require the use of exhausting, as opposed to forcing, ventilation. Regulation 28 requires an employer to take all practicable steps to ensure a supply of fresh air in every workplace.⁵⁰ No one ventilation method is prescribed over another. Instead a standard is imposed, leaving it to the mine operator to select an appropriate work method. It should have been obvious to an inspector that he had to decide whether the company had taken all practicable steps to supply fresh air to the face and, if not, what response was appropriate. To decide there was no breach because the regulation did not prevent the use of forcing ventilation was to misunderstand the regulation.

42. The commission does not regard the actions of the company as those of a motivated and compliant employer. The initial report to Mr Poynter came two days after the event. Thereafter, information was sometimes provided only after a follow-up request. The production manager's final response to Mr Poynter bordered on being truculent. There were clear indications that Pike was not properly investigating and reporting notifiable incidents. A reappraisal of the company's compliance status was needed, but did not occur. Instead DOL persevered with a low-level compliance strategy based on negotiated agreements.

Second means of egress

43. The background to this aspect is discussed in Chapter 16, 'Search, rescue and recovery', paragraphs 134–45.
44. In brief, in the mid-1990s Pike planned to have two stone drives into the mine. By 2000 a vertical ventilation shaft was planned, serviced by an electric hoist. In 2005, when the final mine plan was approved, a ventilation shaft remained the proposed second means of egress, but with a ladder system rather than an electric hoist. This was to be a short-term solution until a walkout egress could be developed to exit in the valley of the Pike River stream.
45. The inspectorate first considered a second egress during an inspection on 27 May 2008. This was Mr Poynter's first visit to the mine; he accompanied Mr Firmin. Mr Louw took them underground. The drift was about 20m from the Hawera Fault. Work had begun at the surface to sink the vent shaft. This prompted discussion in which Mr Louw said that a ladderway was to be installed in the shaft to be used for about seven months.⁵¹ His reference to this period was consistent with the longstanding plan to establish a second egress during the early development of the mine.
46. Development of the mine proved slower than predicted. By January 2009 boring of the ventilation shaft was completed, and installation of a construction hoist required to finish development of the shaft was under way. But on 2 February the bottom 30m of the ventilation shaft collapsed and blocked the connection between the shaft and the mine, also causing a loss of ventilation.⁵²
47. On 12 February 2009 Mr Poynter visited the mine, was flown to the surface and lowered down the shaft in the construction hoist. He wanted to understand the issues relevant to recovering the shaft.⁵³ Mr Poynter conducted a further inspection on 8 April, by which time the company had decided to bypass the collapsed portion of the shaft and install the Alimak raise, which took several months to construct.
48. Mr Poynter did not consider the second egress during inspections he made on 9 October 2009 and 22 January 2010. During his next inspection, on 8 April 2010, Douglas White accompanied Mr Poynter underground and the latter raised the matter of a second means of egress. He was told that the workforce had also asked about it. Mr Poynter viewed the shaft, saw a climbing wire and was told that wires extended to the top of the shaft. There was also reference to safety harnesses for use in an escape up the ladder system. Mr Poynter said that although somebody could technically climb up the shaft, and it therefore constituted an egress, in his view it was not a suitable emergency escapeway.⁵⁴ He asked the company to provide a plan and timeline for developing the additional walkout egress and associated elements.⁵⁵
49. Mr Poynter subsequently considered whether enforcement action was required. He decided that 'a prohibition or improvement notice had the possibility of failing if Pike challenged it in the court because technically a person could climb up the shaft and exit the mine', so he favoured a voluntary compliance approach.⁵⁶
50. On 12 April 2010 Neville Rockhouse emailed an action plan to Mr Poynter. The document recorded a risk assessment

meeting conducted by the company on 5 March 2010, at which various actions were agreed about use of the ventilation shaft as an escapeway. One was that the shaft should not be deemed a second egress 'unless another full risk assessment is completed.'⁵⁷ The document did not refer to development of a second walkout egress.

51. Mr Poynter made a further inspection on 12 August 2010. While underground with Mr White he again raised the second egress and recorded the discussion on INSITE: 'The existing second egress is through the shaft. This allows the evacuation of employees one at a time up the ladderway and while this meets the minimum requirement it is agreed that a new egress should be established as soon as possible.'⁵⁸ On 31 August Mr Poynter wrote to Mr White and stated that, given the plan to start coal extraction and the increased underground population, another egress was required 'as soon as possible. Please provide a plan and time line for this work.'⁵⁹
52. Again, nothing occurred until Mr Poynter's next inspection on 2 November 2010. By then, hydro mining had begun and Mr Poynter inspected the hydro panel with Stephen Ellis. At the mine Mr Poynter was given a memorandum prepared by the technical services co-ordinator, Gregory Borichevsky, which outlined a second egress development plan. There was no time to read and consider the memorandum onsite.⁶⁰ The memorandum, addressed to Mr White, proposed a walkout second egress, which would double as a second air intake for the mine, 250m north-west of the existing workings. However, access to the site required building 1400m of roadway, which was estimated to take over 50 weeks, subject to obtaining conservation approvals and resolving any geological problems. Yet it was thought the egress could be completed 'by June to September 2011.'⁶¹
53. Mr Poynter read the memorandum and understood that there would be no development of the second egress/intake until after full hydro coal extraction (as opposed to trial extraction) had begun. He regarded this as unsatisfactory, wanted further details and resolved to discuss the matter with the company, but the explosion occurred before he could do so.⁶²

Assessment

54. The attention given to this issue was clearly inadequate. Providing a second egress from an underground mine is a matter of fundamental importance. The workers recognised this and communicated their concern to senior management. Yet the company took no decisive action to ensure that it met its legal obligation.
55. Decisive action was also required from DOL. Construction of the ventilation shaft and the installation of a ladder system was completed in mid-2009. Pike should have been required to provide its plan for a proper second egress then. When, in 2010, the focus turned to starting hydro extraction the issue of a prohibition notice was the only appropriate response.
56. This was put to Mr Poynter in cross-examination. He referred to the difficulty in interpreting Regulation 23, the need for a decision from someone more senior in DOL if a prohibition notice was issued, and his perception that Pike's management viewed this matter as 'a priority', meaning that a negotiated agreement remained a preferable approach.⁶³ The commission cannot accept this.

Use of the inspectorate's powers at Pike River

The Department of Labour policy

57. As in many countries DOL used a risk-based regulatory approach. Inspectors were to assess the compliance risk posed by individual employers, and tailor a suitable compliance response. If an employer was co-operative and compliant, then informal methods or lesser powers would ordinarily be used rather than intervention.
58. DOL used three broad approaches regarding intervention. The first involved 'negotiated agreements', where inspectors discussed a required improvement with the employer and sought an agreement by negotiation. Next was 'directed compliance', where an improvement notice or a prohibition notice was used to secure compliance. These were appropriate where an employer had a history of non-compliance or where prompt intervention was

needed to prevent immediate serious harm.

59. The third approach involved enforcement action via an infringement notice or a prosecution. These options were appropriate where a workplace failure warranted a deterrent approach.⁶⁴ Enforcement action often had to be preceded by a written warning.
60. Procedure required that negotiated agreements had to be recorded in writing and include a completion date for the agreed actions. If the agreement was not honoured, ordinarily the inspector would need to move on to directed compliance.⁶⁵
61. Improvement notices identified a regulatory breach and, if obvious, the required remedial steps, together with a compliance date.⁶⁶ Prohibition notices had to both identify a breach and why it was likely to cause serious harm. Inspectors were advised to consult if in doubt.⁶⁷ Written warnings were to be given where a non-compliance was found during an inspection, but was immediately remedied. The warning meant an infringement notice for a similar non-compliance could be issued without further warning.⁶⁸

Gunningham and Neal review

62. The authors of the external review considered whether the inspectorate's enforcement approach at Pike River was appropriate. They thought it 'striking' that the inspectors only ever used negotiated agreements in their dealings with the company. This, they noted, could raise the concern that the 'inspectors had been captured' and had acted with undue sympathy towards the company's interests.⁶⁹ But the authors concluded that 'over the period of the Pike River mine's operation, there was no single occasion where the inspectors had needed to take a . . . robust stance because they never met resistance in any form.'⁷⁰

The compliance approach adopted at Pike River

63. Because Mr Firmin and Mr Poynter regarded the company as a responsible and compliant operator, their preferred approach was to conclude negotiated agreements with Pike, but they did not include a deadline for the performance of agreed actions. Indeed Mr Firmin said that 'just about all my letters don't have a timeframe and they should have really but as soon as you stick down a time often, you know, they might be a week later or something and it presents its own problems.'⁷¹
64. The frictional ignitions in November–December 2008 raised a number of concerns, particularly in relation to Mr Poynter's interpretation of the regulations and to the company's attitude towards compliance. The interactions regarding a second egress demonstrate even more clearly the potential pitfalls of negotiated arrangements. Initially there was no written agreement, then an agreement with no date for completion. There was no sense of authority or urgency.
65. In the view of the commission, and contrary to the conclusion reached in the external review, DOL did meet with resistance from the company and should have taken a much stronger stance. Pike may have expressed good intentions, but its actions were another matter. There was no option but to issue a prohibition notice in relation to the second egress and, generally, firmer compliance methods should have been used at Pike, as shown in the next example.

The roadheader investigation

66. At 4:30am on Sunday 14 February 2010 a miner sustained a serious injury to his foot, which was crushed, causing a bone fracture, some 'degloving' and lacerations. He was flown by helicopter to Greymouth hospital. Mr Poynter arrived at the mine at 9:30am, went underground and inspected the roadheader involved in the accident. Subsequently, he prepared an investigation report.⁷²
67. A roadheader bores mine roadways and is equipped to install roof bolts as it moves forward. Holes are drilled into the roof, bolts are inserted and glued in position and tightened to provide strata support. A bolting rig is part of the roadheader and is hydraulically operated. The miner climbed onto the rig to provide manual assistance when the

automatic bolter encountered difficulties owing to excessive roof height. The bolter auto-retracted, crushing the miner's foot between it and the surface of the rig on which he was standing.

68. Mr Poynter's investigation report was detailed and reached a number of key conclusions. These included the victim's actions being contrary to the mine rules, a mine deputy observing a similar action earlier in the shift and doing nothing to prevent a recurrence, the faulty bolter rig not being withdrawn from service and an apprentice fitter operating the machine without authorisation at the time of the accident. The mine deputy was subsequently dismissed. Mr Poynter concluded that the company, the victim and the mine deputy had committed 'a number of possible breaches', but he recommended against prosecutions. He reasoned that the dismissal of the deputy, the serious injuries suffered by the victim and the company's corrective actions justified 'that no further action will be taken'.⁷³
69. This recommendation was approved by Mr Poynter's manager and on 22 September 2010 the matter was closed by an INSITE entry that included this comment: 'further inspection found that the Deadman lever on the opposite bolter had been tied down with an electrical cable tie. Although this had no impact on the incident.'⁷⁴ In cross-examination Mr Poynter accepted that tying down the deadman lever disabled the bolting rig safety device and that this was of itself a serious matter. There was no investigation into this aspect, although Mr Poynter said he had a number of contacts with Mr White concerning workforce briefings about the risk of overriding safety devices.⁷⁵

Assessment

70. The Gunningham and Neal review included discussion of this investigation.⁷⁶ The authors concluded that Mr Poynter's approach was 'entirely consistent with the precepts of responsive regulation, which was the formal approach of DOL to compliance and enforcement'.⁷⁷
71. It is difficult to fathom why there was no prosecution or, at the very least, a written warning issued to Pike. The investigation exposed a serious safety incident involving the miner, a maintenance fitter and a mine deputy. Serious harm resulted and the incident had no mitigating features. Mr Poynter also discovered a disabled safety device on the same machine, which should have increased concern about the safety culture at Pike and called into question the need for a much firmer compliance approach from the inspectors.

The inspection of mine records

Introduction

72. The mine kept comprehensive records compiled by employees throughout the company. Most concerned production and operational issues, but both these and incident and accident reports contained information directly relevant to workplace safety. The records included incident reports, deputy statutory reports, machine and equipment inspection reports, gas data and charts, control room reports, the incident/accident register, the hazard register and the near-hit register.⁷⁸
73. The commission analysed a large part of the available information and data, and compiled schedules that grouped safety-related information according to subject matter.⁷⁹ The topics included mine ventilation, methane spikes, the bypassing of safety devices, tag board issues, emergency equipment, and actual and potential ignition sources.
74. Mr Poynter was questioned by counsel assisting the commission with reference to numerous excerpts from the schedules. Mr Poynter was unaware of most of this relevant safety-related information. Some examples of his answers and reactions follow.

Methane spikes

75. Gas charts recorded methane readings obtained from a sensor at the top of the main vent shaft. Numerous spikes, where the methane reading was 1.25% or more, were recorded in the weeks before the explosion. Mr Poynter agreed that these readings indicated an even higher methane content somewhere in the mine, given that methane

would be considerably diluted by the time it reached the top of the vent shaft. Mr Poynter observed that these spikes were occurring because of uncontrolled gas incidents and 'each one of those, in my view, should've been notified'. He added that the extent of the spikes suggested 'an issue with the ability of the mine to control the gas, and that's a ventilation issue'.⁸⁰

76. Another indicator of methane control problems was the tripping of the main fan or machines when a safety device shut off an engine in response to a high methane level. Mr Poynter was asked whether at any time before the explosion he was aware of the extent of tripping, including tripping of the main fan. He responded: 'not the frequency that I'm being shown here. I was aware of one scenario where I was rung by a deputy to get a clarification of when it was appropriate to, what the regulation said about exiting the mine but not to this extent'.⁸¹

Bypassing and contraband

77. Mr Poynter was also questioned about the practice of bypassing methane sensors or safety devices and confirmed that he was unaware of this practice and that had he known of it an investigation and compliance action would have followed.⁸² Similarly, Mr Poynter did not know about problems with contraband, including the discovery of cigarette butts, cigarette lighters and aluminium drink cans underground. Had he been aware of this conduct occurring in 2009 and 2010 he would have required the mine to 'carry out a retraining programme, like a re-induction around this particular issue and that there would be random daily, random checks every day, every shift, so people were searched before they went underground'. He would also have considered enforcement action against the company.⁸³

A provision of safety data

78. On 22 January 2010, while conducting an inspection at the mine, Mr Poynter saw information from the accident register displayed onscreen. He requested the details for the last three months and received 41 pages by email the same day.⁸⁴ He had not, however, reviewed the information because of time and other work pressures.⁸⁵
79. The commission observed that, in giving evidence, Mr Poynter was obviously disturbed when the extent of the safety issues at the mine was revealed to him. He said that 'there just wasn't enough time' to peruse mine records, that there was no system provided by DOL to facilitate obtaining and analysing documents, that the inspectors were not 'trained in auditing' and agreed that the mine inspectors were essentially there to conduct physical inspections.⁸⁶

Conclusions

80. The commission has reached a number of conclusions:
- The inspectors acted in accordance with DOL policy and largely met the operational requirement to conduct mine inspections at three-monthly intervals.
 - They also collaborated and responded well to requests from the company for technical advice and approvals.
 - The inspectors obtained only a limited snapshot of the mine's physical systems during inspections, and possessed insufficient information to make an informed judgement concerning the level of compliance at Pike River.⁸⁷
 - It was also essential to conduct targeted audits of the documented mine systems and operational information, but the inspectors had no system, training or time to undertake this work.⁸⁸
 - Nonetheless, the inspectors assumed that the mine was compliant and indeed that Pike was a 'best practice' company.
 - The inspectors used only negotiated agreements and then did not always record agreed actions in

accordance with DOL's operating procedures; nor did agreements stipulate a date for the performance of such actions.

- If the inspectors had properly understood the level of compliance at the mine, they would not have used only negotiated agreements but a range of compliance/enforcement options.
- The inspectors found the requirement that employers use 'all practicable steps' to comply with their obligations under Regulations 23 and 28 of the Health and Safety in Employment (Mining – Underground) Regulations 1999 difficult to interpret, and feared that any compliance action could result in a successful court challenge.⁸⁹
- The provision of a second egress from the mine was so serious as to require the issue of a prohibition notice.

81. These conclusions should be viewed in the context of the environment within which the inspectors were forced to operate. In an answer under cross-examination Mr Poynter said, 'We were dysfunctional in that we reported to separate managers. We had one advisor who had no coal background, although he was technically very good . . . and there was no co-ordinated approach even . . . we weren't resourced and we weren't particularly well set up to be able to provide the service that we were expected to provide.'⁹⁰ The commission agrees with these comments, and emphasises the need to consider this section alongside Chapter 22, 'The decline of the mining inspectorate'.
82. The above conclusions represent an assessment of the DOL's actual oversight of the mine. Another question is whether a well led and operationally competent regulator would have acted more decisively at Pike River. The commission considers it is probable that an effective regulator would have issued a prohibition notice when Pike commenced hydro mining in September 2010 without a usable second outlet (egress) from the mine. The notice would have stopped hydro mining until the planned second intake (to double as a walkout egress) was developed and importantly would have provided the opportunity for the development of improved ventilation and methane control within the mine.

ENDNOTES

¹ Neil Gunningham and David Neal, Review of the Department of Labour's Interactions with Pike River Coal Limited, 4 July 2011, DOL0100010001.

² Ibid., DOL0100010001/11.

³ Health and Safety in Employment Act 1992, ss 29(a), 30(b), 30(c).

⁴ Ibid., ss 31, 39, 41, 56(B), 54(A).

⁵ Ibid., s 49(3).

⁶ Ibid., ss 47, 48, 25, sch 1.

⁷ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 8.

⁸ Ibid., reg 8(1).

⁹ Michael Firmin, transcript, pp. 605–07.

¹⁰ Ibid., p. 590.

¹¹ Memorandum, Department of Labour Mining Steering Group to Workplace Services Management Team, 12 February 2010, DOL0020020022/3.

¹² Michael Firmin, transcript, p. 598.

¹³ Department of Labour, Mines Quarries and Tunnels – Indication of Inherent Risk, DOL0020020003/1.

¹⁴ Michael Firmin, transcript, pp. 590, 667.

¹⁵ Ibid., p. 628.

¹⁶ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/2–3.

¹⁷ Alan Cooper, witness statement, 21 October 2011, DOL7770040001/2.

¹⁸ Michael Firmin, witness statement, 19 October 2011, DOL7770040002/4–5, paras 11–18.

¹⁹ Michael Firmin, transcript, p. 2898.

²⁰ Richard Davenport, Inspection Audit Report, 13 February 2007, DOL3000070190/2–3.

²¹ Michael Firmin, notes, DOL3000070008/1.

²² Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 28.

²³ Michael Firmin, witness statement, 19 October 2011, DOL7770040002/7, para. 29.

²⁴ Letter, Michael Firmin to Neville Rockhouse, 28 February 2007, DOL3000070190/1.

²⁵ Michael Firmin, transcript, pp. 2863, 2896–97.

²⁶ Michael Firmin, witness statement, 19 October 2011, DOL7770040002/16, para. 82.

²⁷ Michael Firmin, transcript, p. 2895.

²⁸ Kevin Poynter, transcript, p. 3092.

²⁹ International Labour Organisation, Code of Practice on Safety and Health in Underground Coalmines, May 2006, p. 129, para. 21.5.2., http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/normativeinstrument/wcms_110254.pdf

³⁰ United States: Code of Federal Regulations, Safety and Health Standards – Underground Metal and Nonmetal Mines, 30 CFR § 57.22202(a)(1); Canada: Coalmining Occupational Health and Safety Regulations, 1990, reg 114(1)(b); Queensland: Coal Mining Safety and Health Regulation, 2001, reg 353(1), (3); New South Wales: Coal Mine Health and Safety Regulation 2006, reg 118.

³¹ Jonathan (Joe) Edwards, witness statement, 24 May 2011, MCD0001/18–19, paras 70–73.

³² Memorandum, from Kobus Louw, to all staff, 13 November 2008, DAO.025.34372.

³³ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/14, para. 66.

- ³⁴ Email, Kevin Poynter to Kobus Louw, 14 November 2008, DOL3000010087/1.
- ³⁵ Michael Firmin, notes, 14 November 2008, DOL3000070204/1.
- ³⁶ Henry (Harry) Bell, witness statement, 23 June 2011, FAM0001/10–11, para. 34.
- ³⁷ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/15, para. 76.
- ³⁸ Henry (Harry) Bell, witness statement, 23 June 2011, FAM0001/10–11, paras 35–36.
- ³⁹ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/15, para. 76.
- ⁴⁰ Email, Kevin Poynter to Kobus Louw, 19 November 2008, DOL3000010086/1.
- ⁴¹ Michael Firmin, notes, 20 November 2008, DOL3000070205/1.
- ⁴² Email, Kobus Louw to Kevin Poynter, 28 November 2008, DOL3000020037.
- ⁴³ Email, Kevin Poynter to Kobus Louw, 28 November 2008, DOL3000010085/1.
- ⁴⁴ Email, Kobus Louw to Kevin Poynter, 3 December 2008, DOL3000020036.
- ⁴⁵ Email, Kevin Poynter to Kobus Louw, 24 December 2008, DOL3000010084/1.
- ⁴⁶ Email, Kobus Louw to Kevin Poynter, 24 December 2008, DOL3000020035/1.
- ⁴⁷ Kevin Poynter, INSITE file detail report, 13 February 2009, DOL3000070077/1.
- ⁴⁸ Neil Gunningham and David Neal, Review, DOL0100010001/65, paras 211–35.
- ⁴⁹ Ibid., DOL0100010001/103, para. 369.
- ⁵⁰ Health and Safety in Employment (Mining – Underground) Regulations 1999.
- ⁵¹ Michael Firmin, witness statement, 19 October 2011, DOL7770040002/26–27, paras 150–56.
- ⁵² Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/18–20, paras 91–102.
- ⁵³ Ibid., DOL7770040003/20–21, paras 104–07.
- ⁵⁴ Kevin Poynter, transcript, p. 3076.
- ⁵⁵ Kevin Poynter, INSITE file detail report, 8 April 2010, DOL3000070155/3.
- ⁵⁶ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/38, para. 220.
- ⁵⁷ Email, Neville Rockhouse to Kevin Poynter, 12 April 2010, DOL3000010009/7.
- ⁵⁸ Kevin Poynter, INSITE file detail report, 12 August 2010, DOL3000070169/3.
- ⁵⁹ Letter, Kevin Poynter to Douglas White, 31 August 2010, DOL3000070170/1.
- ⁶⁰ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/47, paras 280, 282.
- ⁶¹ Memorandum, Gregory Borichevsky to Douglas White, 29 October 2010, DOL3000070172/1–2.
- ⁶² Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/47, para. 282.
- ⁶³ Kevin Poynter, transcript, pp. 3080–82.
- ⁶⁴ Department of Labour, Operating Procedure: Improvements and Improvement Notices, 17 October 2005, DOL3000100031/1.
- ⁶⁵ Ibid., DOL3000100031/2.
- ⁶⁶ Ibid., DOL3000100031/4–7.
- ⁶⁷ Department of Labour, Operating Procedure – Prohibition Notices, 5 May 2003, DOL3000100034.
- ⁶⁸ Department of Labour, Operating Procedure – Written Warnings, 5 May 2003, DOL3000100039.
- ⁶⁹ Neil Gunningham and David Neal, Review, DOL0100010001/122, para. 447.
- ⁷⁰ Ibid., DOL0100010001/127, para. 463.
- ⁷¹ Michael Firmin, transcript, p. 2854.
- ⁷² Department of Labour, Crush Incident: Pike River Coal, 14 February 2010, DOL3000070137.
- ⁷³ Ibid., DOL3000070137/13, paras 8.1–8.4.
- ⁷⁴ Kevin Poynter, INSITE file detail report, 22 September 2010, DOL3000070134/3.
- ⁷⁵ Kevin Poynter, transcript, p. 3014.
- ⁷⁶ Neil Gunningham and David Neal, Review, DOL0100010001/125–26, paras 459–60.
- ⁷⁷ Ibid., DOL0100010001/127, para. 464.
- ⁷⁸ Karyn Basher, witness statement, 10 November 2011, CAC0117.
- ⁷⁹ Royal Commission on the Pike River Coal Mine Tragedy (Karyn Basher), Instances of Methane Recorded in ‘CH610 Aux Fan Shaft Methane’ Graphs, Deputy Statutory Reports and Deputies Production Reports (30 September – 19 November 2010), February 2012, CAC0145; Royal Commission on the Pike River Coal Mine Tragedy (Karyn Basher), Summary of Pike River Coal Mine Deputies Production Reports for March and October 2010, November 2011, CAC0116; Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of Pike River Coal Limited Deputy Statutory Reports for March and October 2010, November 2011, CAC0115; Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of Pike River Coal Mine Deputies Production Reports for November 2010, January 2012, CAC0116A; Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of Pike River Coal Mine Deputy Statutory Reports for November 2010, January 2012, CAC0115A; Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, November 2011, CAC0114.
- ⁸⁰ Kevin Poynter, transcript, pp. 3030–31.
- ⁸¹ Ibid., p. 3033.
- ⁸² Ibid., pp. 3033–36, 3043–44.
- ⁸³ Ibid., pp. 3040–43.
- ⁸⁴ Ibid., p. 3011.
- ⁸⁵ Pike River Coal Ltd, Incident Registers – Site Summary – Pike River Mine: Report Period 1/09/2009 to 31/12/2009, 22 January 2010, DOL3000020014/2–42; Kevin Poynter, transcript, p. 3037.
- ⁸⁶ Kevin Poynter, transcript, p. 3038.
- ⁸⁷ Ibid., p. 3018.
- ⁸⁸ Kathleen Callaghan, witness statement, 31 October 2011, FAM00042/46, 57.
- ⁸⁹ As provided for in s 46 of the Health and Safety in Employment Act 1992, and as a result made ineffectual decisions about the location of the underground fan and the adequacy of egress from the mine.
- ⁹⁰ Kevin Poynter, transcript, p. 3040.



After the explosion

- + Search, rescue and recovery
- + The families of the men

Deployment of Pike's emergency response management plan (ERMP)

1. This section examines the effectiveness of Pike's emergency response management plan (ERMP), with particular emphasis on the immediate reaction to the emergency, and what lessons can be learnt. Because the police took control of the emergency response almost immediately the analysis of what happened subsequently is covered from paragraph 19 onwards, 'Police control of the emergency'.

Pike's ERMP

2. Pike had prepared a plan to manage emergencies at the mine, which was part of a wider corporate safety management plan being developed by the safety and training manager, Neville Rockhouse, and is described in Chapter 7, 'Health and safety management'.
3. The core of the ERMP is in a document dated 18 February 2009, written by Mr Rockhouse, and approved by Peter Whittall, as general manager mines.¹ The document appears to be a work in progress. It contains material applicable to Australia but not to New Zealand. The ERMP had not been reviewed as at 19 November 2010.²

Detail of the ERMP

4. The ERMP describes three levels of emergency response according to the seriousness of the event that has occurred. On 19 November 2010 Pike faced a Level 1 incident – an emergency beyond the resources of the mine to manage and requiring external help.
5. The ERMP is centred on the concept of one incident controller, usually the mine manager, who takes control of the emergency and establishes an incident management team (the Pike IMT) that prepares a series of incident management plans. The aim is to have clear responsibilities and good decision-making in an environment of great stress and confusion. The ERMP defines the organisational structures and summarises the duties of the participants on 12 duty cards, which are held in the control room at the mine. These cards are issued as the key positions are filled.

The process of activating the ERMP

6. The process for activating the ERMP is as follows:
 - The control room operator receives information suggesting an emergency and assesses the situation. He or she follows the instructions on Duty Card 1. He or she contacts the most senior manager available and issues Duty Card 2 to that person, who then becomes the incident controller, at least until a more senior manager arrives.
 - The incident controller, using Duty Card 2:
 - evaluates the nature of the emergency and the appropriate level of response (including whether to call for external assistance);
 - forms and leads the Pike IMT to operate from a designated location on site;
 - oversees the incident management plans, including the goals, objectives, priorities and decision-making processes;
 - notifies the Department of Labour (DOL); and
 - issues or ensures the issue of the remaining 10 duty cards to other managers.

- Those remaining 10 duty card holders assume a variety of responsibilities including site access control, operations management (advises the board, notifies families and liaises with the media), equipment control and distribution, provision of mine information, and portal control.

How the ERMP was activated on 19 November 2010

7. Douglas White, the site general manager, says he began to implement the ERMP about 4:30pm, almost 45 minutes after the explosion. His first steps were to allocate the duty cards and recall the senior staff who had left.³ Mr White says that he does not know exactly which cards were issued or to whom or when, 'but the system was fulfilled with respect to ensuring we had enough people to manage the emergency at the time.'⁴
8. Neville Rockhouse had left the mine about 4:30pm, not realising that there was anything wrong. He was called back. On his return he arranged for the incident management room to be established and arrived in the control room shortly before 5:00pm. He says Mr White was holding the red emergency clipboard, which signified to Neville Rockhouse that the emergency procedures had been activated. Mr White said there had been an explosion. He decided to go up the mountain by helicopter to check on the auxiliary fan. Mr White says that before leaving he delegated some actions to Robb Ridl and Terence Moynihan, but he cannot remember what these were. He says he gave instructions that no one was to leave the site. In his absence, Neville Rockhouse became the incident controller and issued duty cards to various people as they arrived.
9. At 5:26pm the two survivors, Daniel Rockhouse and Russell Smith, emerged from the mine. No one was waiting there to provide immediate assistance. Daniel Rockhouse called the control room for help. Neville Rockhouse answered the call, but did not recognise his son's voice.
10. Production manager Stephen Ellis soon arrived in the control room and Neville Rockhouse handed over to him as incident controller, briefing him on events to that stage.⁵ Neville Rockhouse then took a team and equipment to the portal to assist the two survivors.
11. Mr White says: 'Regrettably due to the fact that so much else was going on, I accept that I overlooked sending someone to the portal specifically to meet Daniel and Russell when they came out.'⁶ He added that this caused no actual harm. It is correct that help was made available within minutes but only because Daniel Rockhouse had sufficient strength left after his ordeal to make his second call.
12. Under the ERMP Neville Rockhouse as safety manager should have been given Duty Card 7, which includes responsibilities for co-ordinating emergency services. Because one of his sons, Ben Rockhouse, was one of the 29 workers still in the mine, Neville Rockhouse was unable to assume the role. Mr White does not remember allocating it to anyone else.⁷ He had given no thought to how the police or other emergency services would relate to the Pike IMT.⁸

Douglas White's view

13. Mr White believes he led the emergency response effectively until the police imposed their own incident management structure. When asked to comment on how the emergency structure set out in the ERMP worked, he said, 'None other than the fact that relatively speaking that's exactly how it worked on the day.'⁹
14. Throughout his evidence Mr White maintained that only hindsight revealed a major event had occurred. It was put to him that there was cause for concern from about 4:00pm based on five factors:¹⁰
 - communications (all telemetric information was down);
 - power was out throughout the mine;
 - no communication with the men underground;
 - the unusual smell; and
 - Daniel Duggan's view of events (discussed in Chapter 1, 'Friday afternoon, 19 November 2010').

He answered, 'I would accept that there was cause for concern, in hindsight, but that concern also has to be verified.'¹¹

Conclusions

15. Mr White was faced with a very difficult situation but it would have been more manageable had he started by following the company's ERMP. He was unfamiliar with its principles and detail. He did not take control of the incident. He handed over the incident controller's role to a more junior manager and went off to carry out an investigation of the ventilation shaft that he could have delegated.
16. Although time was of the essence Mr White was reluctant to call out the Mines Rescue Service (MRS) and the emergency services. He could have ordered this soon after the explosion, when he entered the control room and saw that all telemetric information had been lost, the power was off and there was no response to Mr Duggan's attempts to contact people underground. This was unprecedented and had serious implications
17. Only when Mattheus Strydom, the electrician who went underground after the explosion, left the mine at 4:25pm and reported in were the MRS and emergency services called. These delays appear to have made no difference to the survival of the 29 men, but Mr White was not to know that. Further, the delays could potentially have adversely affected the survival of Daniel Rockhouse and Russell Smith.
18. However, Mr White took the stance that an emergency had to be proved before external help was sought. The commission considers that it would have been better to activate the ERMP, including calling emergency services and the MRS as soon as it was clear that the situation was unprecedented, in that all information from the mine was lost and no contact could be made with the men underground. If the situation somehow proved to be not serious, then the MRS and emergency services could have been stood down.

Police control of the emergency

19. The police consider they took the lead agency role at the mine in line with the co-ordinated incident management system (CIMS) model, that they applied that model, albeit with some necessary amendments, and that it worked well.¹² This section summarises the CIMS model and tests the police viewpoint, then assesses the effectiveness of the police-led response and identifies lessons for the future.

CIMS

20. CIMS was designed in 1998 on the initiative of the New Zealand Fire Service (NZFS). Its overall purpose is 'Safer Communities through integrated emergency management'.¹³ It is aimed at the various agencies that provide emergency services, especially the police, ambulance, fire and Civil Defence. It provides a common management structure, principles and terminology which enable the production of consolidated incident action plans (IAPs). These, in turn, allow effective use of the total resources across the agencies.
21. CIMS is built around the concept of one incident controller and three managers acting under his or her authority, as the diagram below shows. These are the manager planning/intelligence, the manager operations and the manager logistics. These four people make up the incident management team (IMT). Under the CIMS model there is only one incident controller and only one IMT, which operates from one incident control point (ICP).

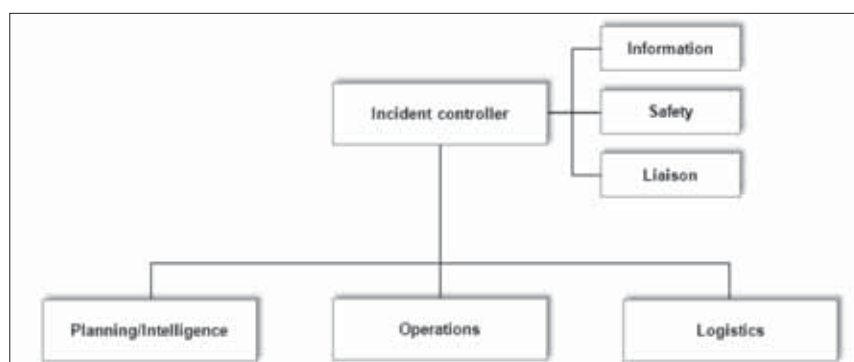


Figure 16.1: Co-ordinated incident management system

22. The incident controller provides the overall direction and co-ordination of the emergency response. There are two concepts used – control and command.
23. ‘Control’ is exercised horizontally across agencies through a consolidated IAP approved by the incident controller. ‘Command’ operates vertically within a single agency, at a level below the IMT. The incident controller does not command those agencies.
24. The manager planning/intelligence gathers and evaluates information and creates the consolidated IAP, which defines response activities and the use of resources. The IAP is for a specific time period (usually of hours) and is regularly renewed. The manager operations contributes to the IAP and implements it. The manager logistics also contributes to the IAP and provides facilities, material, equipment, services and resources, including people, as required to implement the plan.
25. Incidents that occur at multiple sites require an incident controller and IMT at each. This may in turn require overall co-ordination, in which case a response co-ordinator is appointed to provide higher level support. He or she works from a separate emergency operations centre, usually an existing facility. The response co-ordinator does not have an operational function but may provide support in planning/intelligence, logistics, liaison with others involved, and communications. In that event he or she is responsible for approving an incident co-ordination plan that aligns the individual IAPs.
26. The CIMS manual appears to suggest that a response co-ordinator may be necessary for a major incident at a single site, but this is not explicit. Regardless, the manual stresses that incident controllers remain in control of their incidents.
27. The CIMS model assumes one agency will lead the response and other agencies will provide support. The lead agency is determined either by legislation or by agreement among the agencies. The CIMS manual and the NZFS manual assume that the incident controller will come from the lead agency. The manual does not contemplate the involvement of private enterprise and individuals.

So much for the principles. How were they applied in practice?

The police decide to take control

28. The first policeman at the scene was Sergeant David Cross, the duty sergeant at the Greymouth police station. He arrived at 5:13pm. He was accompanied by Constable Shane Thomson. Soon after arrival Sergeant Cross says he met Mr White and Mr Ridl and received brief information. Sergeant Cross says that after the meeting he:
 - advised Police Southern Communications that he ‘had command and control’, that the MRS would be the lead agency for any re-entry or rescue attempt and that ambulance services would be the lead agency for any injured miners;
 - established an incident control point in the conference room in the administration building; and
 - assumed the role of incident controller.¹⁴

Sergeant Cross ‘did not ask Mr White what plans they had in the event of an explosion in the mine, or for a rescue, as I knew we had to wait for the MRS to arrive and start that process’.¹⁵

29. From that point on Sergeant Cross directed police staff at the mine and had various dealings with Mr White and Pike River Coal staff, the MRS, the NZFS and DOL. He stated:

*At no time were police involved in making any decision about promoting or preventing a rescue. We were relying on the advice being supplied by Mines Rescue staff and Pike River Coal senior management, in particular Mr White regarding this issue.*¹⁶

It is clear that the police had not set up a CIMS structure.

30. At 5:40pm, Deputy Commissioner Rob Pope at Police National Headquarters (PNHQ) advised Superintendent Gary Knowles that the police would be the lead agency for the emergency. There is no evidence that other emergency agencies or Pike were consulted.
31. Superintendent Knowles was commander of the Tasman Police District. He was instructed to go to the mine and take control of the operation. Superintendent Knowles had already instructed Inspector John Canning in Greymouth to go to the mine and 'take command'¹⁷.
32. Inspector Canning arrived at the mine at 7:40pm on 19 November and left at 2:30am on 20 November. He attended a number of meetings and issued some instructions to Sergeant Cross. His role under the CIMS structure is unclear: he did not take over as incident controller and does not appear to have assumed the command function.
33. Sergeant Sean Judd arrived at the mine at 11:30pm. He took over from Sergeant Cross as police incident commander at 12:30am on 20 November.¹⁸ He requested the participants meet hourly in the incident control room.

It was apparent to me that that it was time to put in place a more formal Incident Management Team system under the Coordinated Incident Management System model which Sergeant Cross had started.¹⁹

34. Meetings were then held approximately hourly, attended by representatives of the police, the NZFS, St John Ambulance, the MRS and Pike management. There was some confusion about the roles of the participants because the IMT structure was not applied. At the 3:00am meeting Sergeant Judd tried to clarify the situation. According to the MRS:

The Police Incident Controller Shaun [sic] Judd then said that the Police were the lead agency in charge of the search and rescue operation ... [He] emphasised the importance of having a strong IMT structure on-site. He stated that the Police were not experts in mining and would be taking advice on mining related matters (including from MRS) but their role was to ensure that there was an effective IMT and that decisions were documented.²⁰

35. The first IAP was developed early on 20 November and covered the period from midnight to 8:00am. Although incomplete regarding objectives, it did bring together situation reports prepared by the police, ambulance, the NZFS and Pike. The IAP noted that '[t]he Police and supporting Emergency Services are working with Mine Management team to provide a comprehensive Incident Action Plan.²¹ An IMT based on CIMS principles was not established; rather, the control and command functions were fused.
36. Later that morning Inspector Canning arrived with Senior Sergeant Allyson Ealam and Sergeant Judd formally handed over to Inspector Canning as 'forward commander', the police officer in charge at the mine, with Senior Sergeant Ealam as second in charge.²² An IMT based on CIMS principles was not established.

Clarity of decision-making structure in the first 24 hours

37. It is unclear at this stage who belonged to the IMT in terms of the CIMS model. Sergeants Cross and Judd and Inspector Canning appear to have been forward commanders in line with the police command structure, but not incident controllers.
38. Certainly the decision-making structure set up by the police was unclear to some key participants, at least initially. Mr White stated that he realised the police were in charge when he returned to the mine at 6:00pm on 20 November.²³ He was not familiar with CIMS, although he had heard of it.²⁴
39. Mr Ellis says he was chairing the IMT at night and Mr White during the day. He says this continued through the emergency period, though by 20 November he was aware the police had taken charge. For reasons unknown to Mr Ellis, on Tuesday 23 November the police decided to chair the 11:00am and 1:00pm IMT meetings, but then the police asked him to resume chairing later meetings.²⁵
40. Neither Mr White nor Mr Ellis understood at first that key decisions were to be made elsewhere. This became apparent as the emergency continued. Mr White says he knew by 6:00pm on 20 November that all decisions were being channelled back to Wellington and he concentrated on participating in the police process.²⁶

41. The lack of a clear CIMS structure complicated the emergency response at the mine. This was exacerbated by the roles taken by senior police officers and DOL at Greymouth and at PNHQ. This resulted in a hierarchy with at least three levels, slowing down decision-making.

Greymouth

42. Superintendent Knowles had no formal training on the CIMS model but did have experience in it.²⁷ He described the response arrangements as follows:²⁸
- Inspector Canning was the forward commander, based at the mine. His function was ‘tactical’;
 - Superintendent Knowles was incident controller, based in Greymouth. His function was ‘operational’; and
 - Assistant Commissioner Grant Nicholls was the response co-ordinator, based at PNHQ in Wellington. His function was ‘strategic’.
43. On his initial four- to five-hour visit to the mine on the night of 19–20 November Superintendent Knowles did not personally clarify to people at the mine who was the incident controller under the CIMS model. He explained:
- I didn't because prior to my arrival I told Inspector Canning to take command and do that, and also when I arrived it was obvious to me that Sergeant Judd was wearing a fluoro [sic] jacket which said 'Incident Commander' and everyone can see it.*²⁹
44. In any event, after that initial visit Superintendent Knowles operated from Greymouth. He says he visited the mine ‘three or four times’ over the first two days but stepped back so he could make decisions outside the emotional environment prevailing there.³⁰
45. It follows that Superintendent Knowles did not lead the IMT. He spent his time mainly on communications, including regular briefings of families, media, liaison with other agencies and liaison with PNHQ. These activities were onerous and took six to eight hours a day, including preparation.³¹ Superintendent Knowles had 17 people to assist him at Greymouth but lacked the benefit of expert mining advice, unlike the forward commander at the mine.³² He did not appoint an officer to run the separate information function envisaged by CIMS, which is a dedicated resource for communications with the media.
46. Superintendent Knowles could also have appointed an officer to brief the families, but did not do so initially because he had not realised how complex and lengthy the operation would be. Once committed to the regular family meetings, he did not delegate the responsibility to someone else as he felt that would be seen as having ‘backed away’ from the families.³³
47. Superintendent Knowles was the public face of the police operation but did not perform the incident controller role as described in CIMS.

Wellington

48. Assistant Commissioner Nicholls, based at PNHQ, described his role as follows:

*It is the job of the Response Coordinator, operating at a strategic level, to also ensure that the staff on the ground have what they need to act and to ensure that the decision making process includes a robust risk assessment. The problem solving (working out what is to be done) comes from those at the scene (Forward Command and the Incident Controller) while Police National Headquarters provides the means to ensure that what is required is available ... The strategy is the domain of the Response Coordinator while the Incident Controller manages the incident at a direct level working closely with Forward Command.*³⁴

The Risk Assessments were completed at Forward Command with the input of the various experts and agencies on the ground at the mine site. The plans were then forwarded to the Incident Controller who reviewed them with the group of experts he had available. The Assessments [sic] were then sent to the

Response Coordinator for checking and final approval ... I liaised with other agencies involved in the operation ... As the operation progressed I drew on a core panel of experts who provided a review of the risk assessments.³⁵

Power to decide

49. Although Superintendent Knowles had been told at the outset that he had overall command of the operation, that role was in reality assumed by Assistant Commissioner Nicholls at PNHQ. This became clear as difficult issues relating to re-entering and sealing the mine came to the fore. On Monday 22 November Superintendent Knowles received detailed instructions from Assistant Commissioner Nicholls about what he could and could not decide. Superintendent Knowles said, 'I personally didn't need it ... I felt someone in higher command probably thought it was an aid to me.'³⁶
50. Assistant Commissioner Nicholls agreed that, with the benefit of hindsight, many of the decisions he took should have been left with the incident controller. However he maintained that two key decisions – entry to the mine by rescuers and sealing the mine – were correctly made in Wellington.³⁷
51. It is clear that the police regarded those decisions as too weighty for one person and as having national and international significance, and therefore requiring approval at the very top of the police structure.

Functioning of the IMT

52. The police filled all the IMT positions with their own people. The police started what were described as IMT meetings, although neither the police incident controller nor the police forward commander chaired them. Several participants have commented on the large numbers of attendees.³⁸
53. Darren Brady is a senior manager from Queensland's Safety in Mines Testing and Research Station (SIMTARS) and heads the SIMTARS emergency response team. In that capacity, he has experience in responding to mine emergencies and attending state-wide emergency exercises using the mine emergency management system (MEMS), Queensland's mining equivalent of CIMS. Mr Brady was at the mine to provide expert advice on gas monitoring and interpretation. He commented:

In my opinion far too many people were attending these meetings with several organisations over-represented. ... If structured planning, logistics and operation groups had been formed there would be no need for many of those attending the IMTs to be there.³⁹

Activities in these areas appeared to be done by individuals assigned the task, often directly from the incident management team meetings. ... The process would operate differently in Queensland under the Mine Emergency Management System ... with each of the three groups having their own meetings and generally only the co-ordinator of each group attending the IMT meetings. ... This lack of structured groups under each of the co-ordinators may be attributed to the fact that the police were filling these roles.⁴⁰

Access to expert advice

54. The numerous technical matters (for example, on the mine's atmosphere) arising from the emergency were complex and required expert advice. Contrary to Assistant Commissioner Nicholls' understanding, Superintendent Knowles did not have a separate group of experts to assist him at Greymouth. Superintendent Knowles described himself, rightly, as 'the meat in the sandwich' between the mine and PNHQ.⁴¹
55. The group of experts at the mine available to assist the forward commander included a range of highly qualified and experienced people drawn from New Zealand and overseas. For example, at least seven of the 13 mine managers in New Zealand with first class coal mine manager's qualifications were at Pike River.⁴² Those qualifications require knowledge of emergency response in underground coal mines.⁴³ The rescue/recovery plans being prepared at the mine had varying degrees of input from the experts there, including those mine managers, representatives of the mines rescue services of New Zealand, Queensland and New South Wales, and SIMTARS.

56. Risk assessments prepared at the mine were reviewed by Superintendent Knowles and DOL staff elsewhere in Greymouth. Superintendent Knowles then sent the assessments to Wellington to be signed off by Assistant Commissioner Nicholls. Neither Superintendent Knowles nor Assistant Commissioner Nicholls has mining expertise.
57. Assistant Commissioner Nicholls did not appreciate the level of the expertise available at the mine,⁴⁴ and was seeking other expert advice before he signed off the risk assessments. From the morning of 20 November he was in regular contact with James Stuart-Black, national manager, special operations, NZFS. But it was not until 24 November, nearly five days after the first explosion, that Assistant Commissioner Nicholls convened a panel to assist him. The panel was drawn from the national offices of DOL and the NZFS, together with Dr John St George, a mining geologist. Although these people were obviously of assistance, they lacked the relevant mining expertise already available at the mine. By the time of the second explosion on 24 November PNHQ were still trying to find other experts to assist Assistant Commissioner Nicholls.⁴⁵ Dr St George had already told him that the experts at the mine were the best available.⁴⁶

Conclusions

58. The police were faced with a major emergency that did not appear to be under control. They clearly created some initial order by, for example, setting up meetings and starting to prepare IAPs.
59. The police were unaware of Pike's ERMP and there was no discussion about melding the ERMP structure and the police command structure.
60. The PNHQ decision to take control was almost immediate. It was made with no reference to Pike or other agencies. Although this speed was entirely understandable, it was essential that the police confirmed to others their assumption of control and incorporated mining expertise into their decision-making.
61. Filling one or more of the three subordinate positions in the IMT from organisations other than the police would have made up for their lack of mining expertise and experience in responding to emergencies in underground coal mines. Instead the police imposed their normal command structure (operational command and forward command) plus a remote decision-making function based in Wellington.
62. The commission does not accept that the police correctly implemented the principles of the CIMS model at Pike River. It is fundamental that there be one incident controller, located at the incident control point, who controls the direction and co-ordination of the emergency response. He or she decides whether to approve response actions contained in IAPs formulated by the IMT. A response co-ordinator, if one is appointed, does not have an operational function, but may approve a co-ordination response plan. Instead of following the CIMS model, the police set up a complicated three-tiered structure that removed control from the incident controller to a Wellington-based response co-ordinator, who made decisions with assistance from a non-expert panel. The CIMS model is not inflexible, but in this case it was stretched beyond breaking point.
63. The consequences of the police's structure included:
 - an inability for the IMT and the incident controller to act quickly and decisively;
 - decision-making divorced from the reality of the situation at the mine;
 - key decisions, including those about re-entering and sealing the mine, being seen as matters for the police hierarchy, rather than decisions for experts at the mine;
 - a lack of early parallel planning on such vital issues as the survivability of the 29 men and the steps required had they not survived, such as procuring equipment to seal the mine;
 - a bureaucratic approach to the risk assessment process; and
 - non-experts trying to review expert findings on such matters as gas analysis or a drilling proposal.

Role of the Department of Labour (DOL)

64. DOL administers the Health and Safety in Employment Act 1992 (HSE Act). During emergencies, DOL retains its ability to prohibit activities if they may result in serious harm to any person. It also has a role in investigating accidents to determine if there has been a breach of the HSE legislation.
65. DOL provided assistance to the emergency response at the mine, at Greymouth and in Wellington. From a statutory viewpoint DOL had no role in making decisions on the emergency response but was drawn into doing so at Pike River.

DOL assistance

66. DOL Deputy Chief Executive (Labour Group), Lesley Haines, was told about the explosion about 5:00pm on 19 November 2010. She sent to the mine DOL employees who might be able to assist. The first to arrive was mines inspector, Kevin Poynter, about 7:30pm. Ms Haines said:

*The department's role in the search, rescue and recovery operation was in the provision of technical information and advice about mining and safety issues. My own role was leadership of the department's activities relating to the incident. In the search and rescue phase ... the department made available two mines inspectors, both of whom had technical expertise in mining, held a first class mine manager's certificate and were familiar with the mine.*⁴⁷
67. Other staff were also made available at the mine and a temporary office was set up in Greymouth, headed by the DOL regional manager. Ms Haines also assisted with decision-making at PNHQ in Wellington. Thus DOL was represented at the three levels of the structure established by the police. Ms Haines says DOL participated in the risk assessment process at the request of the police.⁴⁸
68. DOL staff, sent to the mine with the vague mandate to provide 'technical information and advice', got drawn into decision-making. Their role caused confusion for other participants. For example, the police thought that 'the Mine's Inspector had ultimate responsibility for authorising any plan.'⁴⁹ This misunderstanding may have been caused by DOL's power to issue a prohibition notice. DOL inspectors had referred to this during discussions about sealing the mine.⁵⁰
69. Ms Haines accepted that 'our role wasn't that clear at the frontline' and that the confusion extended beyond the police.⁵¹ In fact there was confusion beyond the frontline. Ms Haines considered that DOL people were not involved in decision-making,⁵² but documentary evidence of DOL 'approving' risk assessments showed otherwise.⁵³ Ms Haines is correct, though, when she says that the ultimate decisions lay with the police.

Regional manager

70. On 23 November DOL regional manager, Sheila McBreen-Kerr, tried to define the decision-making process for risk assessments flowing through the three levels.⁵⁴ This appears to have been driven by suggestions of delays on DOL's part. The elements of the process she described were:
 - MRS staff and others at the mine formulate plans and risk assessments. DOL people at the mine provide input.
 - The police command centre at Greymouth receives a risk assessment and asks for a DOL review. DOL staff at Greymouth review it, advise police and copy to DOL in Wellington.
 - PNHQ receives the risk assessment for approval. DOL's national office provides consent or seeks a review.
 - PNHQ approves the assessment (or not) and advises the mine.

Conclusions

71. DOL had no people with relevant mining expertise, other than those at the mine. Other DOL staff at Greymouth and Wellington became part of the cumbersome three-tiered response structure. The DOL staff in Wellington were too far from the action and did not have the expertise to understand the issues and make quick decisions.
72. DOL is to be commended for seeking to help with the emergency response but, along with the police, became part of a bureaucratic process that slowed down decision-making.

The risk assessment process

73. An integral aspect of the search and rescue operation was the assessment of the risks associated with intended actions. The police, as the lead agency, required a risk assessment for all hazardous activities. It was prudent to adopt such a strategy.
74. The commission received extensive evidence concerning the effectiveness of the risk assessment process. This included evidence of people from all the agencies involved in the search and rescue operation at the mine, and from the police, DOL and the NZFS.

Conclusions

75. The commission concludes that:
 - The risk assessment structure was cumbersome, involved too many levels and had the potential to cause delay. The actions being assessed for risk required prompt decision-making.
 - The police did not effectively harness the abundance of Australasian mining expertise at the mine. This included members of the New Zealand, Queensland and New South Wales mines rescue services, SIMTARS representatives and Solid Energy New Zealand Ltd and Pike employees. Several held New Zealand first class mine manager's qualifications and similar Australian qualifications.
 - Under CIMS, decision-making should happen at the incident control point where the incident controller is stationed. Risk should be assessed onsite using the services of experts who have both the necessary technical knowledge and a first-hand understanding of the incident. Some experts became disillusioned as operational decisions were made at a distance without their input. One expert left the mine on the evening of 21 November after concluding he could not make a positive contribution, given the structural arrangements and the focus of the rescue effort.⁵⁵ Others contemplated withdrawing from the operation.⁵⁶

Assessment of survivability

76. Discussion of the cause and timing of the men's deaths begins at paragraph 160. The following discussion concerns the process of assessing survivability.
77. When and how should survivability have been assessed during the search and rescue operation? The commission received much evidence that showed the assessment of survivability must begin very early in an operation.
78. A decision about survivability is of fundamental importance. It determines whether an operation focuses on rescue or recovery. But it also affects other operational decisions, including whether the mine should be sealed.
79. At Pike River survivability was not properly confronted until after the second explosion, on the afternoon of 24 November. The assessment should have begun at the first reasonable opportunity, i.e. during the morning of

Saturday 20 November. Suitably qualified experts onsite should have evaluated the available mine information and suitably qualified medical practitioners should have been placed on standby to provide medical opinions as soon as sufficient information was available.

80. Although a decision about survivability would not necessarily have been possible early on, it was essential for the process to begin, so that the matter could be progressively assessed as further information came to hand. The police as lead agency did not fully comprehend the importance of that decision. Had there been advance interagency planning for a catastrophic mine disaster, the question of survivability would have been identified as crucially important and there would have been a process for its evaluation. This is an essential requirement for the future.

Sealing the mine

81. After an underground coal mine explosion there is an ever-present risk of secondary explosions. Their occurrence is likely to damage the mine infrastructure, increase the risk of roof collapse and decrease the chances of body recovery. One possible defence is to seal the mine and starve the underground atmosphere of oxygen. Sealing and inertisation may stop the dilution of methane to explosive levels and prevent further explosions. However, depending on the underground conditions, sealing may also promote an explosion. Sealing will change those conditions, which may bring an explosive fringe and an ignition source into contact.⁵⁷ The other dilemma is that sealing is not an option while life underground remains even a possibility. As one witness said, it is a 'damned if you do and damned if you don't situation'.⁵⁸
82. The commission received consistent evidence from mining experts, including the MRS and Solid Energy, that like survivability, the associated question of sealing the mine should have been considered earlier at Pike River. Everyone agreed that a decision to seal the mine was extremely difficult, given the possibility of survivors underground. But they all expressed concern that a plan and the means to seal the mine should have been in place, ready to be implemented as soon as it was decided there were no survivors.
83. The origin of this problem appears to have been in events that occurred over the first weekend. On the evening of 20 November MRS personnel met and discussed survivability and whether the portal and main vent shaft should be sealed. The group concluded there was only a remote possibility anyone had survived the blast and investigation of the sealing option should begin immediately.⁵⁹
84. At an incident management meeting after midnight, Seamus Devlin, the state manager of the New South Wales Mines Rescue Service, raised the need to consider sealing the mine. This was rejected until there was zero chance of survival.⁶⁰
85. The next day the MRS recommended a sealing plan at the 6:00pm meeting of the IMT. However, DOL officers David Bellett and Johan Booyse indicated they had been advised that any decision to seal the mine would not be approved unless it was clear no one was alive in the mine.⁶¹
86. It seems that the police and DOL reactions to a sealing recommendation inhibited further discussion. Douglas White, however, approached the executive director of SIMTARS, Paul Harrison, concerning deployment of the Queensland Górnicy Agregat Gańniczy (GAG) inertisation unit at Pike River. He also met the police at the Greymouth police station on 23 November, accompanied by Mr Brady of SIMTARS. They explained the capability and deployment of the GAG at the meeting. The response was to begin preparations to bring it to New Zealand, but 'we don't want it in the car park'. This was because the presence of the GAG would send a message that the operation was moving from rescue to recovery.⁶² This was not in line with effective parallel planning, which requires concurrent planning for alternative courses of action.
87. Structured planning to seal, and inertise, the mine was delayed until after the second explosion on 24 November.⁶³ A decision to bring the GAG to New Zealand was made, and the unit and an operating crew left Mackay on the

evening of 25 November and arrived at the mine site the next day. Had there been parallel planning this timeframe would have been shorter. There were two more explosions on 26 and 28 November 2010, before the GAG was commissioned on 1 December, following the construction of a seal and docking station at the portal.

88. The police accepted the need for the GAG, but were reluctant to bring it to New Zealand while the recovery phase continued. However, as Superintendent Knowles acknowledged, better parallel planning is desirable in the future.⁶⁴ There is also a need for advance planning at mine sites, so that an inertisation unit can be readily deployed.

The availability of information on 19 November 2010

The number of men in the mine

89. There is a regulatory requirement to maintain a record of all employees underground, which is to be 'kept at the entry point'.⁶⁵ At Pike River two systems were used to record employees' entry into, and exit from, the mine: a tag board system, and an electronic system known as Northern Lights.
90. The tag board was the main means of tracking who was underground. All Pike employees and contractors were given an individual tag that incorporated a personal photograph and identifying information. Each worker had to hang their tag on the tag board immediately before going underground and retrieve it as soon as they returned to the surface. Initially the tag board was placed at the portal of the mine, but it was later moved to a position outside the lamp room at the administration area, about 1km from the portal entrance.
91. Workers did not always hang or retrieve their tags. Between July 2007 and October 2010 there were 15 incident reports listing instances of non-placement and non-removal of tags, and other irregularities that compromised the reliability of the tag board system.⁶⁶ On 19 November 2010 there were 34 tags on the tag board. The correct number of men underground could not be verified for several hours. This complicated the rescue operation and caused distress to anxious friends and family.
92. The Northern Lights system was acquired in 2008 before the mine reached the coal measures. A microchip was located within intrinsically safe battery packs attached to the men's belts. A scanner was installed at the portal to track the entry and exit of men from the mine. The plan was to install further scanners at additional locations inside the mine as it developed.
93. Neville Rockhouse said the scanner could not detect the microchip if men were 'sitting inside a steel cage' as they travelled on a vehicle into the mine. He said engineering staff were made aware of the problem and were working with the manufacturers to obtain a solution. Despite the problems, he believed the system was still in use at the time of the explosion.⁶⁷
94. The Northern Lights scanner reported to the Pike River control room. Those who had access to the control room computer could check and establish who was underground. An incident report dated 8 November 2010 recorded that the Northern Lights system 'needs new parts and hasn't been running for a long time'.⁶⁸
95. The commission is satisfied the Northern Lights system was not in use on 19 November and that the tag board was not always accurate.

The atmosphere in the mine

96. In an underground emergency, being able to obtain reliable and representative samples of the mine atmosphere is essential. Mines rescue crews depend on this information to determine whether it is safe to enter the mine, and other crucial decisions, including human survival, depend on its availability. The emergency response was impeded by the inability to obtain representative gas samples from the mine and the inadequacy of the available pre-explosion gas data.
97. Fixed sensors were located underground at Pike River. The problems with their location and functioning are described in Chapter 10, 'Gas monitoring'. After the first explosion reporting from all sensors was lost. Although the

sensors were fitted with uninterrupted power supply units, it is likely the sensors or their wiring were damaged in the explosion.⁶⁹ Pike did not have alternative equipment designed to obtain gas samples from within the mine, should the sensors fail and access be restricted. Makeshift methods had to be developed.

98. During the early evening of 19 November Mr White authorised employees to fly to the main vent shaft with hand-held monitoring devices and sample bags to obtain atmospheric samples. This was hazardous, as the men had to enter the fan housing to gain access to the top of the shaft. Another, more fruitful initiative was to position flexible tubes down the vent shaft and connect those to a stomach pump, lent by ambulance personnel, which could suction samples from lower down in the shaft.⁷⁰
99. Bag samples obtained by hand or by use of the stomach pump were flown to the mines rescue station at Rapahoe. A gas chromatograph analysed the samples. By about 9:30am on 20 November a SIMTARS team from Queensland arrived at the mine, armed with two gas chromatographs. This allowed concurrent analysis of samples at two sites, followed by a comparative evaluation of the results across a significant spectrum of gases.⁷¹
100. Samples were mainly taken from the vent shaft and were unlikely to be representative of the atmosphere in the mine. There was a natural ventilation flow from the portal up the vent shaft and vice versa following a ventilation reversal. This meant that the gas readings from vent shaft samples were probably diluted by the ventilation flow. The readings obtained could represent half or even less of the actual gas concentrations in the mine workings.
101. In addition to real-time telemetric gas monitoring systems, many mines install a tube bundle system. It does not require sensors, which are susceptible to damage in an explosion. The disadvantage is a time delay between taking and analysing each sample. At Pike River this delay would have been at least 20 minutes – the time required to draw a sample from the mine to the surface.
102. The company had budgeted to install a tube bundle system by mid-2011. Had this happened before 19 November 2010, it is likely that atmospheric monitoring from at least some locations in the mine would have continued after the explosion. SIMTARS sourced a 10-point tube bundle system, which was commissioned on 13 December and used extensively from then on.

Additional bore holes

103. During the rescue the only surface-to-mine access points were the vent shaft, the slimline shaft and the grizzly borehole. The latter was of limited value because of its location in the drift, where there was a natural ventilation flow. The limited number of, and problems with, the available sampling locations resulted in a decision to drill additional boreholes into the heart of the mine. The preferred location for the first drillhole, PRDH43, was a short distance outbye of the hydro panel to intersect the main return roadway back to the area of the underground fan and vent shaft.
104. Once this location was chosen, a helicopter transported a drilling rig to the hillside site. Drilling began on 21 November and strenuous efforts were made to work as quickly as possible. About 5:00am on 24 November the drillhole reached the required depth, but it had struck the rib wall rather than the roof of the roadway. Within a few hours, however, there was confirmation that gas from the mine was entering the borehole and sampling could begin.
105. After analysis of the first samples, Mr Brady of SIMTARS concluded that 'this data was enough to indicate that an ignition source existed, possibly where an explosive mixture could form so the decision was made that it was not safe to send mines rescue teams into the mine.'⁷² That ended any notion that the underground atmosphere had improved sufficiently to consider re-entering the mine that day. A short time later, at 2:37pm on 24 November, the second explosion occurred.

Use of robots

106. The New Zealand Army provided robots and support crew for use at Pike River. Atmospheric testing equipment was installed and a robot was sent into the drift on 23 November. It travelled 550m before failing, probably

through contact with water. A second robot was obtained and deployed on 24 November. It provided audio-visual information to 800m and then failed. However, power was restored to the first robot and it travelled to 1050m before power was again lost. Both robots remain in the mine.

107. The use of the army's robots in an underground coal mine had not been contemplated before the explosion at Pike River and considerable ingenuity was required to modify the robots for use in a mine.
108. A robot belonging to the Australian Water Corporation was also flown to New Zealand and sent into the mine on the night of 25–26 November. It was equipped to monitor gas levels and transmit audio and visual data. The robot penetrated to 1570m, encountered Mr Smith's abandoned loader and then retreated, having confirmed that the atmosphere in the drift was normal.

Was there a 'window of opportunity'?

109. Immediately after the first explosion there was high public expectation that MRS teams would enter the mine and endeavour to rescue the men, or at least recover their bodies. When a rescue operation did not eventuate, there was disappointment, even frustration.
110. This was probably understandable. Following the Strongman mine disaster near Greymouth in 1967, which claimed the lives of 19 men, a rescue team entered the mine and within 14 hours recovered all but four of the bodies. Similarly, in the 1926 Dobson mine disaster, rescuers entered the mine soon after the explosion and recovered the bodies of four of the nine victims. These, and other, mine tragedies gave rise to a belief that, after an explosion, there was a window of opportunity within which it was possible to enter the mine safely. The assumption was that the explosion would have consumed the methane in the mine atmosphere, and that there was time to re-enter before the methane built up again.
111. There are, however, just as many examples of second explosions that claimed the lives of would-be rescuers. In August 2010 a rescue team entered the Rospudskaya coal mine in Western Siberia before a second explosion, which occurred about four hours after the first one and killed 19 rescuers. In other mines secondary explosions have occurred within even shorter periods, sometimes within only minutes of the first explosion.⁷³
112. The commission had the benefit of expert evidence concerning the so-called window of opportunity, and it all pointed one way. Mines rescue experts from both Australia and New Zealand agreed that, even with the benefit of hindsight, there was no window within which the Pike River mine could have been entered.⁷⁴ The witnesses also explained the basis for their view.
113. First, all mines are different and even sections within a mine may differ. Without accurate and representative information, the atmosphere in an underground coal mine cannot be predicted. That difficulty is particularly acute when the mine ventilation system is not functional as the coal seam continues to produce methane. Damage to the methane drainage system may also add to the accumulation of methane. After an explosion there is also a significant risk of a continuing ignition source, or fire, within the mine. These factors create an unpredictable situation, during which secondary explosions are commonplace.
114. Before re-entry is a safe option there must be reliable and representative information about the conditions underground, especially the make-up of the mine atmosphere and the risk of fire or an ignition source. No information of this kind was available at Pike River. Throughout, the experts onsite were unanimous that, without better information, a safe re-entry was not possible.
115. Second, the concept of a window of opportunity presupposes a time of known duration within which rescuers may safely remain within the mine. Trevor Watts, the general manager of the MRS, gave evidence concerning the time required to enter Pike River and inspect the areas where the men were believed to be working. He explained that ideally a rescue team would have been able to drive the first 1600m into the drift in a driftrunner. At this point the team would have encountered the abandoned loader and if possible, moved it.⁷⁵ Even so, from the end of the

drift a reconnaissance on foot would have been required. The rescuers would have worn long duration breathing apparatus. This was rated to provide four hours of oxygen, but rescuers operate to a one-third rule. That is, the duration of the breathing unit is divided into three: a third for search activity, a third to leave the mine and a third in reserve. This would provide a period of 80 minutes to search the mine workings. Mr Watts considered it would take much longer than this for a team to conduct a search, particularly if there was explosion damage. He thought that more than one entry into the mine would be required.⁷⁶

116. The commission finds that there was no window of opportunity to enter the Pike River mine in the days following the first explosion. There was little or no reliable and representative evidence of atmospheric conditions within the mine to determine whether there was a fire or an ignition source underground. There could be no assurance of safe re-entry, and the decision not to enter the mine was correct.

Self-rescue

117. The term self-rescue refers to the ability of someone to escape from an underground mine after an emergency, without direct assistance from others. History has shown that after an underground fire or explosion very few miners worldwide are saved by mines rescue teams. If miners cannot self-rescue, it is likely that rescuers will not be able to go underground in time to save them. In order to escape miners need immediate access to breathing units and other equipment and aids, as well as emergency training.

Self-rescuers

118. Miners and contractors at Pike River were provided with Dräger Oxyboks K self-rescuers, contained in a canister that can be attached to the user's belt. The self-rescuers contain a chemical substance, which reacts with exhaled carbon dioxide and water vapour to liberate respirable oxygen. It supplies oxygen for about 30 minutes, depending upon the wearer's level of activity and breathing rate.
119. It was standard practice at Pike River for employees to carry a self-rescuer when going underground. The company also provided an underground store of spare self-rescuers. There were 108 self-rescuers stored in two large heavy-duty plastic boxes located in the slimline shaft stub, also known as the upper fresh air base (FAB). Some of the stored self-rescuers were one-hour units.
120. The Dräger self-rescuers were fit for purpose and should have enabled a trained person who survived the explosion to walk to the slimline shaft, obtain a spare unit and escape from the mine via the drift.
121. Concerns about the adequacy of the self-rescuer training arose out of the evidence of two of the three men who were in the mine after the explosion. Despite his concern that there had possibly been an explosion underground, Mattheus Strydom did not carry a self-rescuer with him when he drove into the mine at 4:11 pm. He was forced to retreat when he encountered the fringe of an irrespirable atmosphere.
122. Daniel Rockhouse did have a self-rescuer, but found on 19 November that using one in a real emergency was a 'different story' to training with a dummy self-rescuer.⁷⁷ He donned the device but could not make it work. He then removed and discarded the self-rescuer, succumbing to the irrespirable atmosphere a short time later. Daniel Rockhouse had not participated in an emergency drill in his two and half years at the mine.
123. Training in self-rescuers should include participation in regular exercises using self-rescuers. Those exercises must simulate, as much as possible, the conditions and stress of an actual emergency. Workers must also receive regular refresher training in use of self-rescuers. That did not happen at Pike River.

Compressed air breathing apparatus (CABA)

124. CABA is similar to underwater scuba diving gear. Strapped to the user's back is a compressed air oxygen cylinder that is connected to a positive pressure full face mask. CABA has several advantages over self-rescuers. It is easier to

use, allows its wearer to speak to others and rehydrate, and enables the wearer to undertake other activities such as fire fighting and helping others to escape.

125. There were no CABA units at Pike River. Self-rescuers were the only breathing units available to the workers, although the introduction of CABA was being contemplated.

Changeover stations/fresh air bases/refuge chambers

126. To use self-rescuers and CABA units workers must have a safe place to which they can go in the course of an evacuation. Workers will ordinarily need to exchange their self-rescuers for fresh ones, or exchange them for CABA. A safe place may be a changeover station, an FAB or a refuge chamber.
127. A changeover station is the least sophisticated option and could be as simple as a small space created in a stub using brattice. Fresh air is introduced permanently or temporarily. It is at higher risk of contamination than FABs or refuge chambers. A FAB is generally a constructed and maintained room-like facility properly sealed to maintain a respirable atmosphere inside, even during emergency conditions. Communication and escape equipment are also available. Refuge chambers are the most sophisticated option. They are purpose-built steel rooms, which are usually moveable and provide a continuous source of fresh air from the surface. They contain replacement breathing units (self-rescuers or air cylinders), a communication link to the surface, first aid equipment, food and water.
128. In a coal mine the first objective is always for workers to rescue themselves given the risks of explosions and a toxic atmosphere. If for some reason they cannot do so a refuge chamber provides a place where they may wait in relative safety for rescuers to arrive. Refuge chambers are more commonly used in metal mines, where there is normally no gas and the major risk is of a roof collapse.
129. Pike did not have a refuge chamber. Although Neville Rockhouse raised the purchase of one in late 2009, nothing came of his suggestion.
130. Two locations in the Pike River mine were described as FABs. The first, referred to as the lower FAB, was in the stone drift 1500m inbye of the portal. The second, known as the upper FAB, was in the stub containing the slimline shaft near Spaghetti Junction.
131. The lower FAB was installed by McConnell Dowell during the development of the drift. Located in a stone stub, it was a converted container with sealable double doors. At the time of the explosion it had been decommissioned and was no longer supplied with compressed air. The telephone connection to the surface was not working and replacement self-rescuers, first aid equipment and fire-fighting equipment had been removed.
132. The upper FAB was developed in March 2010 following a risk assessment which found that the main vent shaft was not suitable as a second means of exit from the mine. The slimline stub was 15m deep, 5m wide and 5m high. The methane drainage line passed through the stub and vented through a gas riser to the surface. A roll-down brattice door was installed so the stub could be isolated in an emergency. Fresh air was available from the surface through the 600mm diameter slimline shaft. The stub contained a cache of 108 self-rescuers (60 of 30 minutes' duration and 48 of 60 minutes' duration), first aid equipment, fire-fighting equipment, a digital access carrier (DAC) and three telephones, one of which was connected to the surface. Pike had planned improvements to the slimline stub, such as increasing its size, installing concrete walls and double doors incorporating an air lock system. The improvements were meant to have been completed by June 2010 but had not been done by the time of the explosion.
133. The roll-down brattice screen would not have prevented the FAB being polluted with the toxic atmosphere. Following the explosion, the failure of the underground fan resulted in a reversal of the air circuit, meaning the slimline shaft became a chimney through which noxious explosion products were drawn into the stub and up to the surface. The upper FAB was not a place of safety and was not functional as an FAB at 19 November 2010. It was not even fit as a changeover station.



Figure 16.2: View of the upper FAB from outside⁷⁸



Figure 16.3: View of the upper FAB looking inside⁷⁹



Figure 16.4: Inside the upper FAB looking towards the entrance⁸⁰

Second means of egress

134. Underground mining has a long history of multiple fatalities caused by fire, explosion and roof collapse. Legislation was enacted throughout the mining world making two means of egress from underground mines mandatory.
135. A statutory requirement for a second means of egress existed in New Zealand until 1993 when the Coal Mines Act 1979 was repealed. A replacement provision was included in the Health and Safety in Employment (Mining – Underground) Regulations 1999. Regulation 23 requires employers to take all practicable steps to ensure their mines have suitable and sufficient outlets for entry and exit. Suitability and sufficiency are determined according to the size of the mine, the maximum number of employees, ‘the need to have at least two outlets that are separate from each other but that interconnect’,⁸¹ and the requirement to have at least one outlet that can be traversed on foot and another that has a mechanical means of entry and exit.
136. When the Pike board approved the final mine plan in 2005 the ventilation shaft was the proposed second means of egress with a ladder system to be installed. This was an interim solution. As the mine was developed into the coal measures nearer to the western escarpment, the mine plan contemplated the development of another near-horizontal walkout egress termed an adit, which would also double as a second ventilation intake into the mine.
137. Development of the ventilation shaft in 2009 in its eventual location is described in Chapter 3, ‘The promise of Pike’, paragraphs 47–49. In summary, the shaft located at pit bottom comprised a 2.5m square bypass to a height of 45m, known as the Alimak raise, and a 4.5m diameter shaft to the surface, a total height of 110m.
138. Neville Rockhouse was adamantly opposed to the use of the vent shaft as an escapeway, even as an interim measure. In October 2009 he initiated a risk assessment and invited members of the risk assessment team

to participate in a test climb up the main shaft. Mr Whittall was invited to participate, but on the day another commitment took priority.⁸² The first two men to attempt the climb, Adrian Couchman and Nicholas Gribble, reached the top of the Alimak raise and then abandoned the exercise, doubting their ability to get to the surface. The group concluded that the vent shaft was entirely unsuitable as a second egress.

139. A lengthy risk assessment process followed and in March 2010, a representative group, including Messrs Watts, White and Neville Rockhouse, concluded that the vent shaft was unsuitable as a second means of egress in an irrespirable atmosphere. By the time of the explosion planning for a second egress was under way.
140. Neville Rockhouse also researched the purchase of a coal-safe refuge chamber from Western Australia, at a cost of approximately \$300,000,⁸³ as an interim and partial solution to the second egress problem. The proposal was not taken up, so he proposed the development of the slimline stub as an FAB. Approval was given and some work was undertaken to establish the upper FAB.⁸⁴
141. Mr Poynter raised the adequacy of the vent shaft as a second egress in the course of an inspection visit on 8 April 2010. His actions are reviewed in Chapter 15, 'Regulator oversight at Pike River'. Although he contemplated issuing an improvement or prohibition notice, in the end he took no formal action. On a further visit to the mine on 12 August 2010, when he found no progress had been made, Mr Poynter said that the second egress should be established as soon as possible, and before full coal extraction began.
142. In 29 October 2010 Gregory Borichevsky addressed the development of the second egress in a technical services memorandum to Mr White.⁸⁵ The proposed location of the egress was identified 250m north-west of the then most western margin of the workings. 'High level investigations' were required into numerous aspects, including flooding risk, slope stability, strata control and portal construction, as well as Department of Conservation (DOC) approval. Mr Borichevsky predicted that the egress could be established by June to September 2011.
143. As at 19 November 2010 the ventilation shaft remained the designated second egress. Using it as an escapeway was a fundamentally flawed concept. It was very physically demanding to climb the 105m ladder system in normal conditions. Wearing a self-rescuer it would have been even more difficult, probably impossible. Injured men would have had no chance. After the explosion the vent shaft became a chimney for flame and noxious gases.
144. Development of the hydro panel, and coal extraction, took priority over construction of a proper second egress. That was in spite of the workers' extreme concern that the interim egress was not adequate. Establishment of the second egress should have been prioritised over extraction. Neville Rockhouse agitated for this but with little result.
145. Given the nature of the explosion, and the timing of the men's deaths soon after the event, it is likely the absence of a second egress was not of any practical consequence. But emergencies can take many forms and had the drift been blocked there would not have been an alternative escapeway out of the mine. Extraction should not have been allowed to continue while there was no effective second egress.

Other self-rescue aids

146. Workers may face visibility problems when, in an emergency, a mine becomes filled with smoke. This can cause disorientation and loss of direction. Smoke lines are a simple but useful tool for guiding workers out of the mine or to escape facilities.
147. The lines are attached to the roadway walls or roof, or to mine equipment such as pipelines within reach, and directional cones guide miners in the right direction. Walking canes can be hooked onto the smoke lines, or used to feel for obstructions. Reflective signs may also be used to identify locations or provide directions.
148. Smoke lines and reflective signs were used at Pike River, but there were installation and maintenance problems. The installation of smoke lines did not match development of the mine,⁸⁶ and some lines were inaccessible,⁸⁷ or damaged and not promptly repaired.⁸⁸ There were also concerns about the adequacy of signage installed in the mine.⁸⁹

Use of vehicles in self-rescue

149. Mine personnel transport vehicles designed for use in an emergency provide a faster means of escape and enable injured workers to be rescued.
150. There was a shortage of personnel carriers at Pike in 2010. Men sometimes walked out of the mine because of delays in the taxi service caused by breakdown and maintenance problems. On at least one occasion a group of miners walked off the job because of their concern that the lack of vehicles meant they would be unable to escape quickly enough in an emergency. Pike River's personnel carriers did not incorporate self-escape features.

Self-rescue training and readiness

151. Training is integral to successful self-rescue in an actual emergency. There are three aspects to a best practice training programme:
 - self-rescue training for new miners, usually as part of an induction process;
 - periodic refresher training; and
 - onsite evacuation exercises during which the workforce evacuates the mine in simulated emergency conditions.
152. Pike gave trainee miners induction training spread over a 12-week period. The men worked for three days and spent two days, generally offsite, undergoing training. The spread of the course was considerable, including a self-rescue component provided by the MRS over two separate days. There was instruction in the use of self-rescue units, which included donning a self-rescuer in the dark. There was also tuition about the use of changeover stations and a blind walkout exercise in the MRS training tunnel and a further evacuation exercise at Pike River. The induction training included competency assessments and culminated in the award of an underground extraction certificate.
153. There was little refresher training. Mr White introduced refresher training at the mine in August 2010. It was to be conducted by experienced West Coast miner Harry Bell, and was intended to include self-rescue, but the initiative was not successful. There was one three-hour training session in early October, but the following week only three men were available to attend the session owing to production pressures. The training was put on hold.
154. Contractors made up a significant proportion of the Pike workforce and comprised almost half of the men underground at the time of the explosion. Initially there was no induction training for contractors. During development of the drift McConnell Dowell used its own health and safety programme, and from late 2008 Pike River Coal provided training for the employees of smaller contractors. This induction training included the two-day self-rescue component provided by the MRS. It is doubtful that the entire contractor workforce received training.
155. The commission accepts that the company took steps to provide self-rescue training for its employees and for contractors working at the mine. However, it doubts that training covered the whole workforce.
156. Following development of the workings in coal, there was one drill in October 2009 and a further emergency drill was planned for December 2010. This meant that not all shifts had participated in an evacuation drill. Regular drills covering every shift were planned when the mine attained steady state coal production, but this did not occur.
157. The evidence from the two survivors, and from the electrician who was sent underground, does not encourage confidence in the adequacy of the training these men had been given. The commission also notes that there is no regulatory requirement governing self-rescue training in New Zealand.

Accident/incident reports

158. Pike's accident and incident reports show that there was a range of issues reported on Pike's emergency preparedness through to November 2010. These included: tags not being removed from the tag board, a worker not tagging in when he went underground and too many tags being placed on the board; phones not placed in the right locations, the DAC not being answered by surface control or being faulty; inadequate smoke lines; missing

self-rescuers; damaged or missing fire fighting equipment and fire hoses being used for non-emergency reasons; and medical equipment missing.

159. The reasons given for these incidents included lack of knowledge and training; being unaware of hazards; inadequate work standards; forgetfulness; laziness; misconduct; safety rules not being enforced; inadequate leadership and supervision; and inadequate purchasing and stock.⁹⁰

The deaths of the men

Introduction

160. The timing and cause of the men's deaths is an important issue relevant to several aspects of the search and rescue operation. At an inquest in Greymouth on 27 January 2011 Chief Coroner Judge A.N. MacLean found that:

the death of all 29 men occurred on the 19th of November either at the immediate time of the large explosion which occurred in the mine or a very short time thereafter. It is also clear that the cause of death, although it may well vary in degree between individuals depending on their location, was the result of a substantial explosion and the combination of concussive and thermal injuries due to the explosive pressure wave, together with acute hypoxic hypoxia through exposure to toxic gases and lack of oxygen.⁹¹

This section will evaluate whether the chief coroner's finding needs to be revisited in light of the extensive additional evidence available to the commission.

Expert evidence as to survivability – evidence presented at the inquest

161. The chief coroner's finding was based upon reports from mining experts and medical opinions from three highly qualified doctors. As well as these, the commission heard extensive evidence relating to the mine systems, the search and rescue operation and the views of mining experts on survivability in light of all the information now available.
162. None of the expert evidence was given in person. Instead, Superintendent Knowles produced a number of expert reports.
163. Kenneth Singer, the deputy chief inspector of coal mines in Queensland, Australia, prepared two of the reports. The first, entitled *Explanation of Gas Analysis and Interpretation*,⁹² dated 24 November 2010, explained the analysis of samples obtained at the main shaft after the first explosion, the rate of production of methane from the coal seam in the mine ('methane make') and the impacts of an explosion overpressure. The second report, entitled *Prospects of Survival Pike River Mine*,⁹³ dated 26 November 2010 at 6:00pm, reflected the views of a group of experts who considered survivability at the mine following the second explosion on 24 November. This report assessed survivability by reference to four likely causes of death – blast-wave injuries, burns, oxygen depletion asphyxiation and carbon monoxide poisoning – and in relation to four districts into which the mine was divided for the purposes of the analysis. The group concluded there was no prospect of survival in any part of the mine. However, by the time this report was written, the third explosion had occurred at 3:49pm on 26 November 2010.
164. Another report was prepared by Professor David Cliff, the operations manager of the Minerals Industry Safety and Health Centre, University of Queensland, Australia,⁹⁴ entitled *A Preliminary Evaluation of the Situation at Pike River Coal Mine, as at Sunday 12 December, 2010*.⁹⁵ This concentrated on the physiological impact of a post-explosion gas atmosphere. In particular, Professor Cliff analysed carbon monoxide readings obtained at the main shaft following the explosion. These peaked at a concentration of over 3000ppm (parts per million) and he concluded that it was not unreasonable to assume concentrations more than twice this amount within the mine immediately after the first explosion.
165. Three doctors provided medical opinions, which were produced at the inquest. Dr Andrew Veale, an Auckland respiratory physician, Dr Robin Griffiths, director of occupational and aviation medicine at the University of Otago, and Dr Alan Donoghue, director of health and chief medical officer of a mining company in Perth, all specialise in

the question of survival in oxygen-deprived environments. All three doctors independently concluded that none of the men would have been alive on 26 November, following the third explosion.

166. This was hardly surprising. By then a week had passed with no sign of life from within the mine. However, the reports from the three doctors also included a focus on survivability at the time of, and immediately after, the first explosion. It is clear that this evidence influenced the chief coroner in reaching his conclusion about the immediacy of the deaths.
167. Dr Veale's report was representative of the views of his colleagues. He identified four likely causes of death:
- He considered the men close to the explosion would have been subject to an immediate concussion impact and thermal injuries, with secondary shrapnel effects, which would have been fatal.
 - He thought the compression and expansion wave caused by the explosion would, in the confines of a small mine, have caused internal tear injuries, including to the lungs and sinuses. Associated bleeding, particularly into the lung, would have caused immediate, or delayed, death to men within the main roadways of the mine.
 - He concluded that exposure to carbon monoxide (CO) produced in the explosion would have produced a progressive CO build-up in the bloodstream, which prevents the absorption of oxygen. In a confined environment and without an air source this, too, would have been fatal.
 - Then there was lack of oxygen (hypoxia) caused by the burning of oxygen in the course of the explosion and any subsequent fire. Fresh air contains 20.9% oxygen. An oxygen level less than 10% leads to unconsciousness, and a level less than 6% results in death within minutes. And in combination, CO absorption and hypoxia are a more lethal mix.

An open box at the slimline shaft

168. To recap, the stub containing the slimline shaft, called the FAB, contained various items of equipment to facilitate self-rescue or for use in providing first aid.
169. The equipment included three sizeable boxes sitting on the floor next to the right-hand rib as viewed from the drift. Two of the boxes were of solid blue plastic construction, measured 1100 x 550mm, and 450mm in height, and contained self-rescuers. The third box, made of plywood, was slightly smaller and contained canisters of fire-fighting foam.
170. The blue plastic boxes had an overlapping lid, which could be secured using three metal locking mechanisms on the front. An Environmental Science and Research (ESR) scientist, who examined an identical box at the request of the police, concluded that the locking mechanisms would have been effective against an explosive force, provided they were in the clamped position. If they were unclamped, she was unsure whether the lids might open in an explosion.
171. The three boxes were last examined on 18 November by Mr Couchman, a Pike River safety training co-ordinator. He opened the blue cache boxes, calculated that they contained 108 self-rescuers, then closed and secured the lids.
172. About 2:00pm on 19 November Gary Campbell and Joe Verberne, VLI Drilling Pty Ltd employees, checked the mine methane drainage line, including its entry into the slimline stub. They used a self-rescue box as a step to inspect the gas riser that vents to the surface. They replaced the box with its lid in the closed position.

The C-ALS images

173. On Wednesday 24 November the area at the bottom of the slimline shaft was scanned using a C-ALS (Cavity Auto Scanning Laser System) laser device. The scans were taken before the second explosion. A Solid Energy mining engineer, John Taylor, was in charge of the scanning crew, which is probably the world's most experienced in this work.

174. The probe has a cable back to the surface through which data is recorded from underground. The motorised scanning head can rotate in all directions. It fires a laser beam that travels through the underground void until it hits a solid object. The beam rebounds off the object back to the receiving port and after multiple rotations of the scanner a three-dimensional (3D) image of the void is obtained.
175. Analysis of the data obtained indicated that the scanned images were affected by the presence of airborne water droplets, which interfered with the laser beams and the quality of the images. However, equipment in the stub was still clearly visible, and in Mr Taylor's opinion the lid of one of the large blue boxes was open.
176. On 17 February the crew rescanned the slimline shaft. This revealed that there had been a major roof collapse in the drift, which caused spoil to spill into the stub over the area where the three boxes were positioned, so no further evidence was obtained.

Enhancement of the images

177. At Mr Taylor's suggestion the original scans were sent to Adelaide-based James Moncrieff, an expert in the interpretation of 3D laser images. He enhanced the images and agreed that the lid to one of the blue boxes was open.
178. He found one factor that differed from the conclusions of the ESR scientist in New Zealand. The blue plastic box that she examined could open to only 105° from its closed position. Mr Moncrieff calculated that the C-ALS image showed the lid open to 156° from the closed position.
179. Mr Moncrieff considered that there was only a limited view into the open box, which revealed an object of 'high intensity' in the back corner. This was probably 'a reflective object (shiny or bright).'⁹⁶ Self-rescuers are kept in shiny metal canisters.
180. Mr Moncrieff also enhanced an indistinct image of something lying at floor level in front of the boxes. The data quality of this image was inferior to other images. He concluded that '[t]he size, shape and intensity changes appear ... to be consistent with that of an upper torso shape. However the shape is not consistent with it being a complete body.'⁹⁷ However, he considered that the shape could equally be fallen coal or rock, brattice lying crumpled on the floor or a bucket containing rescue items that had been lowered down the slimline shaft on the evening of 19 November.
181. The last possibility can be discounted. The bucket was retrieved by the scanning crew before C-ALS images were obtained on 24 November and the contents were found to be undistributed.

Conclusions concerning the open lid

182. The commission accepts that one of the blue plastic boxes containing self-rescuers was probably open when scanned on 24 November. However, how it was opened remains unclear. There are at least three possible explanations all of which are conjecture:
- If the box was not securely latched before the explosion, the lid could have been blown open. The overlapping construction of the lid would make it difficult for an explosive force to blow it open. On the other hand, the extent to which the lid was open, 156°, might support this possibility.
 - Someone opened the box and left the lid open before the explosion. However, it is difficult to envisage why anyone would consciously do this, and there was a window of only about an hour and three-quarters from when Messrs Campbell and Verberne saw the boxes with lids closed to the moment of the explosion.
 - Someone survived the first explosion, made his way to the slimline shaft and opened the lid in search of a self-rescuer, but was unable to escape the mine. However, that no one called the control room from the FAB may tell against this possibility.

183. In brief, how the lid was opened remains unexplained and there are at least three possible explanations, one of which could be consistent with a period of survival. Unfortunately, further C-ALS images taken on 17 February 2011 indicate that spoil from a major roof collapse has eliminated any possibility of obtaining further evidence about the open lid.

Expert evidence as to survivability – evidence before the commission

184. Much of the additional evidence before the commission was direct evidence, as opposed to written reports. The commission also heard a personal account of the effects of the first explosion from one of the survivors, Daniel Rockhouse, plus evidence from mining experts, who expressed opinions about survivability after the first explosion.
185. Mr Watts, the general manager of the MRS, concluded that most of the men would have been killed, or rendered unconscious, by the first explosion. Those rendered unconscious would have died from noxious gases, or lack of oxygen, within minutes. If anyone had been able to don a self-rescuer he may have survived for the duration of the device.⁹⁸ He highlighted some relevant factors:⁹⁹
- Pike River was a very small mine, the video evidence showed the intensity and duration of the explosion, suggesting that the initial shock wave was probably immediately fatal or that it rendered the men unconscious.
 - The workforce was trained to self-rescue by walking out of the mine, not to take refuge in the mine, but no one walked out from within the workings.
 - Anyone who survived the immediate effects of the blast and had time to don a self-rescuer would have had 30 minutes of oxygen and time to walk no more than 700m to the FAB, where there were spare self-rescuers.
 - A natural ventilation circuit existed into the mine soon after the first explosion, which probably saved Messrs Rockhouse and Smith and would have enabled a survivor who got to the same location to walk out of the mine.
 - There was no communication from anyone within the mine (apart from Daniel Rockhouse), including from the FAB into which air was downcasting when a telephone was lowered down the shaft at 8:00pm on 19 November.
 - Air pockets would not have existed because Pike River was a gassy mine and methane would have risen to fill the higher inbye areas of the mine as air was displaced. Following an earlier failure of the main fan the mine gassed out in about nine hours.¹⁰⁰
186. Mr Devlin, the New South Wales Mines Rescue Services manager, supported Mr Watts' assessment. He said it was 'almost certain' that the men died, if not immediately, then within the first hour after the explosion.¹⁰¹ His experience, based on other mine disasters, was that if the explosion did not result in instantaneous death, then the subsequent contaminated atmosphere and lack of oxygen would have been fatal. Mr Devlin formed this assessment when he reached Pike River, and by the time he gave evidence nothing had occurred to change his view.

Conclusions

187. The chief coroner found on the basis of medical evidence that the men died at the time of the explosion, or a short time after it. The evidence of the mining experts was generally supportive of this finding. The open box lid in the slimline stub could indicate that someone survived for a period, but this is conjecture and only one of at least three possible explanations.
188. The commission finds that the 29 men probably died instantly, or from the effects of noxious gases and oxygen depletion soon after the explosion on 19 November. It heard no evidence sufficient to displace the chief coroner's findings concerning the timing, or cause, of the deaths.

The recovery operation

Introduction

189. Recovery of human remains from the mine became the principal objective following the second explosion on 24 November. There has been limited progress towards achieving this objective. Understandably this is a source of great concern and frustration to many of the men's families. In this section the commission reviews the key developments to the present time.

The period to 31 December

190. Between 2:37pm on 24 November and 1:50pm on 28 November three further explosions occurred. The risk of still more explosions, and the need to bring fires burning in the mine under control, made sealing the mine the first priority. This was the key objective for the balance of the year.
191. In early December a temporary seal was constructed, after two shipping containers were inserted into the portal and a seal effected around them. This enabled the GAG brought from Queensland to be commissioned and it began pumping gas and steam into the mine to extinguish any fires. The vent shaft was also sealed using a fabricated metal cap. Subsequently, the Floxal, a nitrogen generating unit from Australia, was substituted for the GAG. However, atmospheric readings from the mine deteriorated and the GAG was recommissioned.
192. On 13 December Pike River Coal Ltd went into receivership, with John Fisk, Malcolm Hollis and David Bridgman appointed joint receivers. Before Christmas, the company in receivership presented a draft re-entry plan to the police, which envisaged stabilisation of the mine over 45 days at a cost of \$3.87 million, and recovery of the remains over 70 days at a cost of \$6.99 million.¹⁰² Earlier, the MRS had also provided a draft re-entry plan to the police and the company.¹⁰³ Neither plan was adopted.

Key events in 2011

193. Early in the new year fires and heatings in the mine were brought under better control. Ongoing monitoring using a tube bundle system allowed for an improved understanding of the mine atmosphere. The focus became to stabilise the atmosphere, finalise a plan and effect a staged re-entry into the mine.
194. On 9 March the police relinquished control of the recovery operation to the receivers,¹⁰⁴ who assisted by an expert panel formed by them, the MRS, SIMTARS, DOC, DOL, Solid Energy and others, continued recovery-related work. This included nitrogen injection using the Floxal, drilling new boreholes, thermal imaging to identify gas leaks from the mine, further sealing and scanning inside the mine from boreholes.
195. The families were frustrated at the lack of progress, and in May their counsel convened a meeting of interested parties in Christchurch to discuss means of advancing the recovery operation. The main agreed outcome was that a working group should begin immediately to plan for re-entry into the mine beyond the rock fall at the inbye end of the drift.
196. A difference of view developed over the best approach to re-entry into the mine. In August the MRS proposed a 'reconnaissance walk' up the drift to the rock fall.¹⁰⁵ The drift atmosphere was irrespirable, with less than 3.5% oxygen detected, and the re-entry team would need to use breathing apparatus. The objective was to establish the conditions in the drift from pit bottom in stone to the rock fall, and whether there were any bodies in this area.
197. The mine manager, Mr Ellis, disagreed with this approach. He favoured establishing a remote seal near the rock fall, by drilling a borehole at that location and injecting an expandable foam (Rocsil). The Rocsil would create a seal and enable the drift to be reventilated using a forcing fan at the portal. MRS teams could then enter the drift in a respirable atmosphere.¹⁰⁶ Mr Ellis presented this option for approval by the expert panel, but not the MRS proposal.¹⁰⁷ Pressed in cross-examination at the September hearings, he said, 'We will reclaim that tunnel before Christmas, I'm quite confident of that.'¹⁰⁸ In the event, re-entry proved more complex than expected.

198. Some progress has been made towards re-entry. The MRS constructed temporary seals at 170m, and then at 108m and 70m into the drift. A nitrogen buffer zone was established between the 108m and 70m seals. This enabled the December 2010 seal at the portal to be removed. The company then installed permanent steel doors at 35m and 5m inbye, to provide an airlock entrance into the mine.¹⁰⁹ In December drilling of the Rocsil borehole began, but it was not completed until January 2012.

Key events to date in 2012

199. During January the outbye area of the drift was degassed and ventilated up to the MRS temporary seal at 170m.
200. In March, Solid Energy reached a conditional agreement with the receivers to purchase the mining assets of Pike, and in May the agreement became unconditional. On 17 July 2012, a subsidiary of Solid Energy, Pike River Mine (2012) Ltd, took ownership of the assets. That day the government, Solid Energy and the subsidiary signed a deed relating to body recovery. It requires Solid Energy to 'take all reasonable steps to recover the remains' provided this 'can be achieved safely, is technically feasible and is financially credible'. The Crown agreed to contribute to recovery costs over and above those 'required for commercial mining purposes'. No timeframe is prescribed, and recovery of the remains hinges on a resumption of 'commercial mining operations'.¹¹⁰
201. Before the deed was concluded, emeritus professor Jim Galvin, University of New South Wales, gave Solid Energy advice concerning the risks associated with, and the likelihood of, body recovery. He considers there are very substantial risks involved in re-entering the old workings, as opposed to the drift area of the mine. These include drowning if water has accumulated, explosion if air enters the workings and hot spots exist, fire from spontaneous combustion, roof fall owing to the absence of strata maintenance, and exposure to carcinogens (products from underground coal fires), fungi and bacteria which can flourish in an unventilated mine environment. In addition, there is likely to be a need to clear rock falls within the mine using mining machinery in an irrespirable atmosphere. Working in these conditions, wearing breathing apparatus, would be particularly hazardous. Accordingly, Professor Galvin concluded it was 'extremely unlikely' that the risks could be managed, 'irrespective of the level of expenditure',¹¹¹ so he views recovery of the remains as a remote possibility.

Keeping the mine safe

202. The commission is required to recommend what ought to be done to ensure the safety of the mine and the surrounding areas if the mine is not reopened. This proviso poses a difficulty because it is uncertain whether the mine will be reopened and any decision concerning reopening may be some years off. The safety of the mine in the meantime, and in the long term, requires separate consideration.
203. Pending a decision concerning a resumption of mining, Solid Energy obtained an independent review of security at the mine site. Arrangements in place to safeguard the mine and its surrounds include continuous monitoring of the underground atmosphere using a tube bundle system, controlling access to the mine site by a series of security gates, remote camera surveillance of the approach road and site and an immediate response arrangement in the event the area is entered by intruders. Trained personnel also oversee the onsite facilities on a regular basis.¹¹² The commission considers these arrangements are adequate. If control of the mine is transferred to a new owner similar arrangements should apply. This could be done by way of a condition attaching to the transfer of the permit, or imposed if a new permit is issued.
204. If the mine is not to be reopened it will need to be permanently sealed. At present the shafts into the mine are capped and multiple steel doors are installed at the mine entrance.¹¹³ These seals will have to be made permanent, probably using concrete. The commission considers that arrangements to make the mine safe on a permanent basis should be agreed in consultation between the mine owner, the regional or local authorities and the land owner or administrator.

ENDNOTES

- ¹ Pike River Coal Ltd, Emergency Response Management Plan (ERMP), 18 February 2009, DAO.001.00096.
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- ³ Ibid., p. 1129.
- ⁴ Ibid., p. 1317.
- ⁵ Neville Rockhouse, transcript, p. 1374.
- ⁶ Douglas White, transcript, p. 1138.
- ⁷ Ibid., p. 1326.
- ⁸ Ibid., p. 1299.
- ⁹ Ibid.
- ¹⁰ Ibid., pp. 4865–66.
- ¹¹ Ibid., p. 4866.
- ¹² Simon Moore, transcript, p. 1632.
- ¹³ New Zealand Fire Service Commission, The New Zealand Coordinated Incident Management System (CIMS): Teamwork in Emergency Management, 1998, SOE.001.00027/2.
- ¹⁴ David Cross, witness statement, 1 July 2011, POLICE.BRF.11/3–6, paras 9–28.
- ¹⁵ Ibid., POLICE.BRF.11/5, para. 23.
- ¹⁶ David Cross, witness statement, 1 July 2011, POLICE.BRF.11/15, para. 106.
- ¹⁷ Gary Knowles, witness statement, 1 July 2011, POLICE.BRF.18/14, para. 63.
- ¹⁸ David Cross, witness statement, 1 July 2011, POLICE.BRF.11/15, para. 104.
- ¹⁹ Sean Judd, witness statement, 1 July 2011, POLICE.BRF.14/6, para. 27.
- ²⁰ New Zealand Mines Rescue Service, Brief of evidence of New Zealand Mines Rescue Service, 1 August 2011, MRS0030/12, para. 62.
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- ²² Allyson Ealam, witness statement, 1 July 2011, POLICE.BRF.16/7, para. 37.
- ²³ Douglas White, transcript, p. 1178.
- ²⁴ Ibid., p. 1264.
- ²⁵ Stephen Ellis, transcript, p. 2250.
- ²⁶ Douglas White, transcript, p. 1156.
- ²⁷ Gary Knowles, transcript, p. 2151.
- ²⁸ Gary Knowles, witness statement, 1 July 2011, POLICE.BRF.18/8, para. 28.
- ²⁹ Gary Knowles, transcript, p. 2115.
- ³⁰ Ibid., pp. 2101–02.
- ³¹ Ibid., p. 1896.
- ³² Gary Knowles, witness statement, 1 July 2011, POLICE.BRF.18/62, para. 320.
- ³³ Gary Knowles, transcript, p. 1893.
- ³⁴ Grant Nicholls, witness statement, 1 July 2011, POLICE.BRF.29/11–12, paras 32–33.
- ³⁵ Ibid., POLICE.BRF.29/13, para. 36.
- ³⁶ Gary Knowles, transcript, p. 2104.
- ³⁷ Grant Nicholls, transcript, p. 1681.
- ³⁸ Seamus Devlin, transcript, p. 2037; Darren Brady, transcript, p. 1970.
- ³⁹ Darren Brady, transcript, p. 1970.
- ⁴⁰ Ibid., p. 1969.
- ⁴¹ Gary Knowles, transcript, p. 1886.
- ⁴² Grant Nicholls, transcript, p. 1738.
- ⁴³ Ibid., p. 1856.
- ⁴⁴ Ibid., p. 1660.
- ⁴⁵ Ibid., pp. 1727–28, 1826.
- ⁴⁶ Ibid., p. 1799.
- ⁴⁷ Susan (Lesley) Haines, transcript, p. 2341.
- ⁴⁸ Ibid., p. 2342.
- ⁴⁹ Stephen Christian, witness statement, POLICE.BRF.12/14, para. 56.
- ⁵⁰ David Bellett, witness statement, DOL7770020004/5, para. 24.
- ⁵¹ Susan (Lesley) Haines, transcript, pp. 2354, 2356.
- ⁵² Ibid., p. 2372.
- ⁵³ Sheila McBreen-Kerr and Brett Murray, Approval of Down-hole Video, 23 November 2010, DOL7770020002_10/1.
- ⁵⁴ Sheila McBreen-Kerr, Pike River Mine Disaster Risk Assessment Approval Process Chart, 23 November 2010, DOL2000010032/2.
- ⁵⁵ Craig Smith, transcript, p. 2651.
- ⁵⁶ Timothy Whyte, witness statement, 28 June 2011, CFMEU0001/18, para. 69 referring to Clive Hanrahan's advice to police that the Queensland Mines Rescue Service team would return to Australia if Pike's management did not start sharing information and providing assistance.
- ⁵⁷ Darren Brady, transcript, p. 1975.
- ⁵⁸ Trevor Watts, transcript, p. 2509.
- ⁵⁹ New Zealand Mines Rescue Service, Brief, MRS0030/17, para. 82.
- ⁶⁰ Seamus Devlin, transcript, p. 2053.
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- ⁶³ Ibid.
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- ⁶⁶ Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, 7 November 2011, CAC0114/31–32.
- ⁶⁷ Neville Rockhouse, transcript, pp. 1340–41.
- ⁶⁸ Royal Commission on the Pike River Coal Mine Tragedy, Summary of the Reports, CAC0114/31 (Incident number 1126).
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- ⁷¹ Darren Brady, witness statement, 24 August 2011, SIM0001/6, paras 4.4–4.5.
- ⁷² Ibid., SIM0001/8, para. 5.16.
- ⁷³ New Zealand Mines Rescue Service, Brief, MRS0030/93, para. 491.
- ⁷⁴ These experts included Trevor Watts, General Manager New Zealand Mines Rescue Service; Douglas White, Site General Manager, Pike; Seamus Devlin, State Manager, New South Wales Mines Rescue Services of Coal Services Pty Ltd; Darren Brady, Manager SIMTARS Occupational Hygiene, Environment and Chemistry Centre; and Kenneth Singer, Deputy Chief Inspector of Coal Mines. Messrs Brady and Singer work for the Queensland government.
- ⁷⁵ Trevor Watts, transcript, p. 2483.
- ⁷⁶ Ibid., pp. 2483–91, 2550–53.
- ⁷⁷ Daniel Rockhouse, transcript, pp. 1067–68.
- ⁷⁸ Fresh Air Base (FAB) photographs (Phase Three Hearing exhibit 44, produced by Neville Rockhouse), EXH0044/3.
- ⁷⁹ Ibid., EXH0044/4.
- ⁸⁰ Ibid., EXH0044/7.
- ⁸¹ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 23.
- ⁸² Peter Whittall, transcript, p. 2686.
- ⁸³ Neville Rockhouse, transcript, p. 1363.
- ⁸⁴ Email, Neville Rockhouse to Adrian Couchman, 17 March 2010, DAO.011.21810/2–3.
- ⁸⁵ Memorandum, Gregory Borichevsky to Douglas White, 29 October 2010, EXH0024/1–2.
- ⁸⁶ Email, Adrian Couchman to Neville Rockhouse, 3 March 2010, DAO.011.21810/1.
- ⁸⁷ New Zealand Mines Rescue, Pike River Emergency Response August Audit, 12 September 2010, DOL7770030096/2.
- ⁸⁸ Michael Smit, Police/DOL interview, 19 December 2010, INV.03.07753/42; Russell Smith, Police/DOL interview, 9 February 2011, INV.03.13092/64–65.
- ⁸⁹ Lyndsay Main, Police/DOL interview, 17 December 2010, INV.03.06096/50, 52.
- ⁹⁰ Royal Commission on the Pike River Coal Mine Tragedy (Katherine Ivory), Summary of the Reports of Certain Incidents and Accidents at the Pike River Coal Mine, November 2011, CAC0114/31–38.
- ⁹¹ Counsel's Submissions and Coroner's Findings, 27 January 2011, INV.01.27510/8.
- ⁹² Kenneth Singer, Explanation of Gas Analysis and Interpretation, 24 November 2010, PIKE.17762.
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⁹⁶ James Moncrieff, witness statement, 29 August 2011, POLICE.BRF.51/15, para. 42.

⁹⁷ Ibid., POLICE.BRF.51/26–27, para. 72.

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¹⁰⁰ Ibid., p. 2452; New Zealand Mines Rescue Service, Brief, MRS0030/13, para. 64.

¹⁰¹ Seamus Devlin, transcript, p. 2044.

¹⁰² Pike River Coal Ltd, Pike River Coal Mine Re-entry Plan to Facilitate Recovery of Deceased Miners (Draft), 22 December 2010, DAO.007.20116/2–3.

¹⁰³ New Zealand Mines Rescue Service, New Zealand Mines Rescue Service Mine Re-entry Action Plan for Pike River Mine, 5 December 2010, MRS0066.

¹⁰⁴ New Zealand Police, Pike River Coal to Implement Mine Stabilisation Plan, 9 March 2011, SOE.003.00104/1.

¹⁰⁵ New Zealand Mines Rescue Service, Reconnaissance of the Main Drift at the Pike River Mine: Risk Assessment, 16 August 2011, PRCL.1284.

¹⁰⁶ Stephen Ellis and Gregor Hamm, Tunnel Reclamation Proposal, 29 August 2011, PRCL.1908.

¹⁰⁷ Stephen Ellis, transcript, p. 2302.

¹⁰⁸ Ibid., p. 2305.

¹⁰⁹ Ibid., p. 2299.

¹¹⁰ Deed relating to body recovery at the Pike River Coal Mine, 17 July 2012, SOL0503445.001.

¹¹¹ Jim Galvin, Attachment 'B' – Potential Risks Associated with Body Recovery at Pike River Coal Mine, 10 June 2012, FAM0061, pp. 21–26.

¹¹² Letter, Catherine Schache to James Wilding, 18 September 2012, CAC0176.

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The families of the men

Introduction

1. Many people were affected by the Pike River tragedy, and none more so than the families and friends of the 29 men. Some filed witness statements detailing concerns about the search and rescue operation and seven family members appeared before the commission. This chapter reviews the initial contact with family members following the explosion, the conduct of family briefings, and the manner and extent to which the families were kept informed of subsequent developments.

Initial contact with family members

2. After the explosion Pike needed to establish who remained underground. As discussed in Chapter 16, 'Search, rescue and recovery', there were problems with both the placement and removal of tags from the tag board.
3. At 4:40pm the police communications centre was told that 25 to 30 people remained in the mine. At 5:55pm Douglas White told police officers that 33 men were thought to be underground. At 6:00pm a count of the tags on the board indicated that 32 men were in the mine. At 7:30pm Peter Whittall told the media he understood 27 men were underground – 15 Pike employees and 12 contractors. By 4:30am on 20 November that number had been revised to 29 missing. This figure was further revised to 28 a few hours later, and then at an 8:00am media briefing Mr Whittall confirmed the correct numbers; 29 men were missing underground – 16 Pike employees and 13 contractors.
4. Pike had required its employees and contractors to supply details of next of kin who were to be contacted in the event of an emergency. The health and safety induction checklist, completed before employees and contractors began work at the mine, provided space for the contact details of one person nominated as next of kin. There was no space for alternative contacts.¹ Pike asked workers to inform it of any changes to their next of kin details.²
5. After the explosion, the company decided not to contact next of kin until accurate information was available. As noted, that took about 16 hours. Meanwhile, media reports of the explosion were broadcast in New Zealand and overseas as early as 5:00pm, New Zealand time. Families were immediately desperate for confirmation of the whereabouts of their men. The explosion had occurred 15 minutes before a number of workers were to finish at 4:00pm with, in some cases, a new shift ready to go underground. There was much uncertainty. Family members phoned the company and the police in search of information, but neither could give them information. By mid-evening the Red Cross had established a facility in Greymouth where families could register their contact details.
6. At 7:30am on Saturday 20 November the first family meeting was held at the welfare centre in Greymouth. This was followed by a media briefing, at which it was confirmed that 29 men were still in the mine, but names were not released.
7. By this time families living in the Greymouth area had sufficient information to know whether their man was missing. The failure of a worker to return home the previous night was stark confirmation of the worst. But the families had not received formal advice from the company concerning who was underground.
8. More distant family members were left in the dark. For example, Richard Valli, brother of Keith Valli, lived in Southland but was named as his brother's next of kin in Pike's records. On learning of the explosion, he spoke to his brother's partner, who thought that Keith had worked a day shift on 19 November. Phone calls were made to Pike, but these were either not answered or the person who answered could provide no information.

9. The Valli family arrived in Greymouth on Saturday towards the end of the 4:30pm family meeting. Richard Valli asked Mr Whittall to confirm whether his brother was missing. Mr Whittall could not do so. Richard Valli then asked the proprietor of the hotel where his brother stayed in Greymouth and '[h]e confirmed that Keith was on day shift and that he had left for work that [Friday] morning. This was the first confirmation he was down the mine.'³
10. The witness statements of other family members contained similar accounts. The families of the two Australians, two British citizens and one South African among the 29 men experienced particular difficulty in obtaining information.
11. Some of Pike's next of kin details were out of date, which contributed to the difficulties contacting the families.⁴ However, there were also family members correctly listed as next of kin who were never formally notified by Pike that their men were still underground.⁵

Communications with family during the rescue phase

Communication methods used

12. From Saturday 20 November family meetings were held each day to brief the families on developments in the search and rescue operation. Typically the meetings took place at 7:30am and 4:30pm.
13. There were two principal speakers at the meetings: Superintendent Gary Knowles spoke on behalf of the police and Mr Whittall on behalf of Pike. Before each meeting Mr Whittall was briefed on recent developments by company staff, particularly Messrs White and Stephen Ellis, who initially worked alternating 12-hour shifts at the mine. Commendably, a 'families first' policy applied throughout the search and rescue so that families received information before it was given to the media.
14. The police set up an 'e-text tree',⁶ which was used to send messages to the cellphones of family members. These messages informed families of meeting times and significant developments. An 0800 number provided 24-hour access to the on-duty inspector, who was either Inspector Wendy Robilliard or Inspector Mark Harrison.
15. Some family members experienced difficulties obtaining information directly from the police in the first few days of the rescue operation because they were not listed as next of kin in Pike's records.⁷

Family meetings: were false hopes raised?

16. A consistent theme in the witness statements filed by the families was that they were given false hope about the chances that the men had survived the initial explosion and about the prospects of their rescue.
17. The flavour of what the families were told emerges from a sample of the information they were given, including comments made to the media on the evening of Friday 19 November. About 7:30pm on Friday Mr Whittall told media representatives in Wellington there was 'no evidence of fatalities at this stage',⁸ but nor had there been any communication from the men still in the mine. Later that evening, while Mr Whittall travelled to the mine, Pike chairman John Dow told the media that all the men were equipped with portable self-rescuers and knew where additional air was stored in the mine.⁹
18. About 5:30am on Saturday 20 November Mr Dow told the media it was possible that those underground could have made their way to the mine's safety refuge, where fresh air could be available.¹⁰ At an 8:00am media briefing meeting in Greymouth Mr Whittall said he hoped the state of the ventilation in the mine would be known by 2:00pm, so a rescue could proceed.¹¹ He referred to a compressed air line and said:

*We have kept those compressors going and we are pumping fresh air into the mine somewhere so it is quite conceivable that there is a large number of men sitting around the end of that open pipe waiting and wondering why we are taking our time getting to them.*¹²

19. At the morning media briefing on Sunday 21 November Superintendent Knowles said that the focus was still on a rescue operation, but the risks were too great to allow rescuers underground.¹³ One of the risks was the possibility of a fire in the mine.

20. Experts at the mine had debated the existence of a fire as early as Saturday. They considered a fire a real possibility, if not a likelihood. At family meetings, Mr Whittall described a possible ignition source in the mine as a 'heating'.¹⁴ By way of explanation he referred to 'smouldering rags' or a 'gas hob burning in a kitchen'.¹⁵ Generally, the tone of the information supplied at family meetings throughout the weekend conveyed that all or at least some of the missing men could still be alive.
21. This contrasted with what some others were told. Over the weekend Mr Ellis visited Daniel Rockhouse, who was suffering from 'survivor guilt'. He assured Daniel Rockhouse that in his view the shock wave from the first explosion would have killed the men further into the mine.¹⁶ Mr Ellis did not, however, share this with Mr Whittall, and when questioned at the commission's hearings he said this was because he also believed there was still a slim chance that some men survived until the second explosion.¹⁷ This is more likely evidence of Mr Ellis trying to help Daniel Rockhouse rather than withholding information from Mr Whittall.
22. At the hearings Mr Whittall was questioned about survivability. Counsel for the families drew attention to the impact of explosive forces upon men in such a small mine, the lack of oxygen without a functioning ventilation system and questioned how the men could have escaped the effects of carbon monoxide poisoning. Mr Whittall responded that Pike continued to pipe compressed air into the mine and that men could have found refuge in stubs and used brattice to create a barrier to prevent their exposure to noxious gases.¹⁸ The commission found that answer to be unduly optimistic in the circumstances.
23. That said, the commission does not consider Mr Whittall was dishonest about the information he supplied at family or media briefings. His state of mind was captured in an answer he gave under cross-examination with reference to the witness statements of next of kin: 'while their heads believed that the men may have gone, their hearts still wanted to hope for that miracle and I was in exactly the same position'.¹⁹
24. By Monday 22 November, it was recognised that the information being provided at family meetings lacked balance. That day Mr Whittall told the media that while it remained a rescue operation, 'the reality is, it's been three days. The reality is we haven't heard anything from anyone since the two guys came out of the pit. The reality is for the families now it's becoming more and more grave with every hour that goes past'.²⁰
25. On Tuesday 23 November Police Commissioner Howard Broad visited Greymouth. One of several matters he raised with Superintendent Knowles was the tone of communications with the families. The need for a change of approach was accepted.
26. The commission generally accepts the criticism made in many of the families' witness statements that the information provided at family meetings, particularly over the weekend, stimulated false hopes. Some family members had accepted the loss of their men at an early stage. They were familiar with coal mining or knew others who understood the realities of methane explosions in coal mines. But many of the families did not come from a coal mining background and relied very much on the information received during family meetings. This emphasises the need to be careful about how information is conveyed to families. A person who is emotionally involved in the events may not be the right person to act as spokesperson.

Advice of the second explosion

27. On Wednesday 24 November the gas levels in the mine improved and a rescue attempt by Mines Rescue Service (MRS) members was being considered. Superintendent Knowles and Mr Whittall were at the mine at the time of the second explosion at 2:37pm. After discussion, and viewing video footage, it was clear that no one could have survived the second explosion. Both men returned to Greymouth for the family meeting to be held later in the afternoon. Next of kin were sent a text message about 3:00pm: 'OPERATION PIKE – there will be a significant update at the 4.30 family meeting. It is recommended that all families attend'.²¹
28. Superintendent Knowles and Mr Whittall met briefly in the recreation centre car park before the meeting. The Honourable Gerry Brownlee, the Minister of Energy and Resources, was also present. Mr Whittall saw it as his responsibility to tell the families about the second explosion. There were up to 500 people in the recreation centre,

including young children and a significant police contingent. Mr Whittall spoke first. He began by saying that earlier in the day the gas levels had shown improvement, and he had been called to the mine because the MRS was preparing to go in. People began to cheer and clap. Mr Whittall, Superintendent Knowles and Mr Brownlee raised their arms and motioned for silence. Then Mr Whittall told the audience of the second explosion. The reaction was one of extreme distress; people began to wail and sob. Superintendent Knowles explained that the second explosion was not survivable, so the operation had moved to a recovery phase.

29. Recollections differed about whether Mr Whittall or Superintendent Knowles revealed the fact of the second explosion. This is of no moment. The important point is the initial comments Mr Whittall made about a possible rescue attempt. These words were the subject of strident criticism in many of the families' witness statements. They complained that the meeting was mishandled and that the ill-chosen opening words raised the families' hopes, only to have them dashed.
30. The commission accepts the key announcement was mishandled, or, as one witness put it, that matters 'went horribly wrong'²² and that this caused added distress for family members. That said, the commission accepts Mr Whittall's evidence that this outcome was unforeseen and entirely unintended. He was under great pressure and, in the agony of the moment, he sought to begin on a positive note. This led to extra anguish for next of kin, but in all the circumstances, it would be unfair for the commission to criticise him.

Were there deficiencies in updating the families?

31. The witness statements filed by some family members raised concerns about the provision of information, including an apparently unreasonable delay in providing information, and claimed that in one instance the information was misleading.

CCTV recording

32. The first concern related to the closed-circuit television (CCTV) recording of the first explosion, taken at the portal. This was not viewed in the control room as the explosion occurred, but was retrieved later and a number of people saw the recording during the evening of 19 November. However, it was some days before this information was shared with the families.
33. Curiously, at the outset no one drew the existence of the recording to the attention of either Superintendent Knowles or Mr Whittall. Mr Whittall first learnt of the camera at the portal when he visited Russell Smith on 21 November. That evening he asked Mr White to obtain a copy of the recording. On 22 November, at an interagency briefing, Mr Whittall showed the recording to Superintendent Knowles. On the afternoon of 23 November Mr Whittall showed it at a family meeting.
34. Some family members considered they should have seen it much earlier. They felt they would then have had a better appreciation of the size of the first explosion and been more able to assess the reliability of the information they were given.
35. The commission understands the concern but does not find anything sinister about the delay in playing the recording. The delay was a result of the two spokespeople not becoming aware of its existence for some days. Once Mr Whittall became aware of the recording, prompt action was taken and it was soon shown to the families. Importantly, the families viewed the recording before it was shown to the media.
36. The second concern was whether the recording shown to the families depicted the full duration of the explosive blast recorded at the portal. The original recording showed an explosion that lasted 52 seconds. Bernard Monk told the commission his wife, Kathleen, timed the recording as it was shown by Mr Whittall at 32 seconds.
37. Mr Whittall said he had not sought to mislead anyone about the duration of the explosion. After his call to Mr White on 21 November, a memory stick was delivered to him in Greymouth the following day. He did not have the 'technical capability of editing a video like that',²³ and simply used the memory stick he was given. The commission accepts Mr Whittall's evidence. Nor is there evidence to suggest that anyone else edited the recording. Danie du Preez, the communications and monitoring engineer at Pike River, provided the recording. He did not edit it.²⁴

C-ALS images

38. Another concern of the families related to the images taken by the Cavity Auto Scanning Laser System (C-ALS) device on 24 November at the foot of the slimline shaft. Mr Monk said that neither the families nor their counsel were made aware of the images until the inquest on 27 January 2011, and even then their potential significance was not explained. The written evidence given to the chief coroner included a one-line reference to 'evidence of a self-rescuer box open' in the fresh air base.²⁵ After the inquest, Mr Ellis arranged for Solid Energy New Zealand Ltd's John Taylor to show the C-ALS images to some family members, but this demonstration did not draw attention to the open box. As a consequence, counsel for the families, oblivious to the potential significance of the images, had already invited the chief coroner to find that the men died at, or about, the time of the first explosion.
39. In late March 2011 counsel for the families received confidential advice about the open box. An approach to the police resulted in a meeting at the Hornby police station, at which Mr Monk and counsel were shown an image of the open box in a manner that enabled them to grasp its potential significance. This prompted an approach to counsel assisting the commission. As a result, Mr Taylor and others gave evidence at the Phase Two hearings. The C-ALS images were fully explored.
40. The commission considers that beyond recording this concern and setting out the background, it is not necessary to consider the matter further. Having seen and understood what is involved in producing an understandable C-ALS demonstration, the commission is not surprised that the potential significance of the images remained shrouded for some time. Although the delay was unfortunate, thanks to the vigilance of the families and their counsel, the matter has been addressed.

Communications during the recovery phase

41. Immediately after the second explosion, recovering their men became of the utmost importance to many of the effected families. Not everyone shared this viewpoint. The mother of one of the men stated that 'not all families want the recovery of the remains, preferring their loved one to be left to rest in peace. That millions would be spent to achieve recovery I find untenable.'²⁶ A majority of family members, however, remain committed to recovery of the remains.

Police communication

42. Following the change from a rescue to recovery operation, family meetings continued to be held but with decreasing frequency from December 2010. After the police withdrew from the operation and handed the mine to the receivers, the police family liaison officers continued to attend meetings with the families. Communication through the e-text tree and the 0800 number continued.
43. On 16 January 2011, the police set up a secure, private website accessible only by registered family members. It contains a range of information and is a forum for families to ask questions. The website remains online.

November to December 2010

44. In late November 2010, Prime Minister John Key visited Greymouth and met the families. Following the company going into receivership in December 2010 he said, 'I gave a commitment to the families at Pike River I'd do everything I could to get their men out. I stand by that.'²⁷
45. The MRS asserted in an institutional statement to the commission that 'once it had been decided that it was a recovery operation Mr Whittall made comments to the media that "the boys" would be brought home for Christmas.'²⁸ This, MRS suggested, was foolhardy because no one could provide a timeline for recovery.
46. The commission, however, received no evidence confirming that Mr Whittall had spoken of a recovery by Christmas. On 29 November 2010 he was quoted as saying that the families had asked if they would get their men home by Christmas, but that he responded 'it could be some weeks before the bodies were returned' and 'without being too

blunt, Christmas is another X on the page as far as what the rescue teams are working towards. They've got to look at the actual time it takes them to do their job.²⁹

47. These comments probably explain the source of the assertion contained in the MRS statement. Mr Whittall did not endorse a recovery by Christmas, but his reference to a period of 'some weeks' was unfortunate. Understandably, the families listened with an optimistic ear and believed that recovery of the men was not too far off.

Developments in 2011

48. Throughout 2011 the families pursued recovery of the remains, including convening the meeting of interested parties in May 2011 (discussed in Chapter 16, paragraph 195) and questioning witnesses during the commission's hearings, including Mr Ellis when he gave evidence in September 2011. Although there was only modest progress towards re-entry into the drift, there were no signals that the chances of recovery were remote.
49. With a commitment to plan for re-entry made at the meeting in May 2011 and Mr Ellis' comments in September that the tunnel would be reclaimed by Christmas 2011, the message was that progress was being made toward re-entry and ultimately, potential body recovery. But by late January 2012 an adequate plan to seal, reclaim and re-enter the tunnel had not been developed.

Sale of the mine in 2012

50. The mine was sold to Solid Energy in mid-2012 (discussed further in Chapter 16, paragraph 200). As part of the sale process, Solid Energy carried out due diligence and met with the families several times. Solid Energy has explained they 'can see no way to safely carry out a standalone re-entry of the abandoned workings as part of a body recovery'. Solid Energy's position, made clear to the families, is that recovery can be attempted only as part of a wider commercial mining operation.
51. A briefing received by the families from Solid Energy chief executive Dr Donald Elder in May 2012 was based on advice Solid Energy had received from Professor Jim Galvin. The families were provided with a copy of Professor Galvin's report, and obtained an independent review of it from their own expert. It was made clear that successful recovery of the remains was very unlikely, and that if recovery did occur it may be many years away (See Chapter 16, paragraph 201). This seems to have been the first time the families were given a realistic appraisal of the situation based on evidence and in a manner that could not support their hopes.

Impact on the families

52. As noted earlier, the commission received both written and oral evidence in 2011 from members of the families. Many spoke of their dismay that the bodies had not been recovered and that no end was in sight. A high level of frustration, even anger, was evident concerning the delay in finalising and effecting a recovery plan.
53. In April 2012 the commission received evidence from Kathryn Leafe, chief executive of the Focus Trust, which provides social services to the West Coast community. The trust gave support after the tragedy and has continued to do so. Ms Leafe stated:

In most post-disaster situations by the six month point, the primary stressor or event is usually over and it is the secondary stressors that are the cause of concerns. However, with Pike River, the primary event is still in many ways ongoing as there remains the possibility of the recovery of human remains. Therefore families have been in a prolonged stage of grief and are still dealing with the primary stressor.³⁰

Her statement also explained that this has not only increased the demand for support, but also made providing it more complex.

54. In July 2012, senior counsel for the families filed a submission contending that the families received 'information which proved hopelessly optimistic throughout 2011', and that they were left 'to find their own way' because there was a 'lack of authoritative leadership over this period'.³¹
55. He said that the families attended the briefing in May 2012 with excitement, anticipating that re-entry and recovery may

be likely given the sale of the mine to Solid Energy. Instead, they were 'shocked by the harsh realities' outlined, of which they had 'no forewarning', so the outcome was devastating.³² As a result, the families' present focus is upon re-entry into the drift where they believe there may be remains in the section between pit bottom in stone and the rock fall.

Conclusion

56. The commission accepts that communications with the families concerning body recovery have not been well managed. Statements made in the period following the explosions raised expectations that the remains would be recovered within a modest timeframe. When this did not happen the families were naturally frustrated, and eventually angry. The management of communications is a matter of concern because it affected the families' ability to cope with the loss of their men.
57. The modest progress made in 2011 was, in the commission's view, a reflection of the complexities that confronted the receivers, MRS and others. The mine represented a unique re-entry challenge, given the combination of a single entry into the mine, the four explosions in late 2010, a major fire in the workings, at least one significant rock fall and limited knowledge of the underground conditions.
58. It seems it was not until the mine sale in 2012, when the government required that the terms of sale include a commitment from the purchaser to recover the bodies, that the hazards were fully assessed. This perhaps explains some of the communication deficiencies in 2011. After that assessment, Solid Energy confronted the problem, promptly met with the families and told them of the realities of the situation, unwelcome as the news proved to be.

Responsibility for recovery

59. The families underlined to the commission the isolation they have felt since the explosion. They have had to push for recovery and have felt on their own. The families seek a recommendation relating to who will retain responsibility for pursuing the question of recovery as far as reasonably possible because their 'abandonment has been deep seated and plagued them every day since the 19th of November'.³³
60. In Queensland and New South Wales, the company, through mine management, has control of the recovery operation and would be responsible for the costs. The company works in co-operation with other organisations, such as mines rescue and the mines inspectorate. Once the mine is safe and re-entry possible, the police are responsible for recovery of the remains. In practice, the police take control of the remains on behalf of the coroner only after the remains are retrieved by other specialty organisations, such as mines rescue. In both Queensland and New South Wales most coal mines are run by large companies who have the resources to cope with a recovery operation. There does need to be clarity about who is responsible for recovering the remains in New Zealand, especially where the mining company has limited funds or is in receivership. The pursuit of recovery should not be left solely to the friends and families of those who have died.
61. Recovery of the remains from Pike River now lies within the control of Solid Energy and the other parties to the July 2012 body recovery deed (discussed in Chapter 16, paragraph 200). The deed defines the new owner's obligations in relation to body recovery and contains mechanisms that enable the government to exercise some oversight. The commission is not in a position to influence these matters.

Welfare support provided to the families

Unstinted praise for welfare support

62. Criticisms contained in the families' witness statements about communication with them were balanced by unstinted praise of the support services made available.
63. One mother, for example, said: 'I cannot fault, or speak highly enough of the way we were treated by the personnel

of Pike River Coal, NZ Police, Mine Rescue, the Government, Air NZ, the Mayor and people of Greymouth, and the many voluntary groups we were helped and supported by during this time.³⁴

64. The spokesperson for some of the families, Mr Monk, said this about the support services:

The support offered, taken up and provided by Air New Zealand was outstanding. Many family members say [sic] great value in the liaison they had with Air New Zealand staff. The Air New Zealand support person for us was a constant prop.

Our police support liaison officer, Constable Terri Middleton, was simply excellent. She had so much empathy towards the family and was a wonderful communicator.

We received fantastic support from the Red Cross. They provided food, cups of tea, their facilities and as much information as they were able to give. There was a huge support from the local churches, the Greymouth community and the businesses, the local polytech, Victim Support and as time went on, the wider New Zealand community.

I also found great support and leadership from Greymouth Mayor Tony Kokshoorn. In those early days before the family group was organised, he was the voice for the families.³⁵

65. Other witness statements mentioned the assistance provided by John Robinson as the family liaison officer for Pike. He was assisted by Adrian Couchman, and also Denise Weir, previously human resources manager at Pike. She flew to Greymouth from Australia and for over three weeks voluntarily helped to co-ordinate Pike's support efforts.
66. On the evening of 19 November Air New Zealand sent its special assistance team to Greymouth and within 48 hours as many as 30 airline staff were based in the town. A liaison person was assigned to each of the 29 families who, as necessary, were given support in relation to travel, accommodation, obtaining passports and other immediate needs. The team remained until 29 November, when a staged departure began.
67. The police also established a Greymouth-based family liaison team to provide information on the rescue and recovery operations, and gather information as necessary. Two inspectors managed the team, which comprised 22 police staff at its height. Each family was assigned a liaison officer.
68. An online survey subsequently conducted by the police indicated that family members were highly satisfied with the performance of the liaison officers, the facilitation of family meetings and the quality of their secure website. The police plan to train 40 police staff who will undertake victim liaison duties on an as required basis in response to major disasters. The police are also developing written liaison guidelines to promote national consistency in relation to major crisis management.
69. The commission acknowledges the outstanding level and value of the support offered to the families by numerous agencies and individuals including (in addition to those already mentioned) St John Ambulance, Tai Poutini Polytechnic, the Grey District Council, the Accident Compensation Corporation, Work and Income New Zealand, the Salvation Army and the ministries of Social Development and Health. It also commends the police initiative to further develop its crisis liaison capacity.

Some early difficulties

70. As noted in paragraph 11, the identification of 'next of kin' caused some difficulties in terms of communication with family members. It also had an impact on who received welfare support services in the first few months following the explosion. When the Focus Trust became aware, in December 2010 and January 2011, of family members who had received little or no contact from support services, it set about building a better picture of individual family profiles. The trust found there were 'significantly more than 29 separate family units and a number of families where "next of kin" is complicated'.³⁶ All were entitled to access support services.

Conclusions

71. The experiences undergone by the families of the deceased men suggest that the strategies and processes for communicating to them need improvement. Some recommendations are made in Chapter 32, 'Improving the emergency response'.

ENDNOTES

¹ Pike River Coal Ltd, PRCL H & S Induction Checklist, 27 November 2008, DAO.001.08679/4.

² See Pike River Coal Ltd, Employee Handbook: Induction Training, 2008, DAO.002.05609/15.

³ Richard Valli, transcript, p. 2595.

⁴ Gary Knowles, transcript, p. 2111.

⁵ See for example, Tammie O'Neill (wife of Peter O'Neill), witness statement, 18 July 2011, FAM00010/2, paras 3–4.

⁶ Wendy Robilliard, witness statement, 1 July 2011, POLICE.BRF.54/4, para. 12.

⁷ See for example, Carol Rose (mother of Stuart Mudge), transcript, p. 2582.

⁸ 'Pike River Coal Mine CEO', Close Up [Television broadcast], 19 November 2010, <http://tvnz.co.nz/close-up/mining-disaster-3904365/video?vid=3904435>

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¹² One News, Newstalk ZB and New Zealand Press, Miners Spend Second Night Underground, 21 November 2010, <http://tvnz.co.nz/national-news/miners-spend-second-night-underground-3905380>

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¹⁴ Barbara Dunn, Operation Pike Barb's Notes: Fri 19 Nov – Wed 24 Nov, 19–24 November 2010, PIKE.01842/14.

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¹⁶ Stephen Ellis, transcript, pp. 2289–90.

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²⁰ Peter Whittall, as cited by Stacey Shortall, transcript, p. 2797.

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²⁵ Bernard Monk, transcript, p. 2613.

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²⁷ Radio New Zealand, Who Will Pay for Mine Recovery Operation Unclear, 14 December 2010, <http://www.radionz.co.nz/news/pike-river-2010/64183/who-will-pay-for-mine-recovery-operation-unclear>

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²⁹ 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>

³⁰ Focus Trust West Coast, Royal Commission of Inquiry Pike River Mine Coal Mine Tragedy: Submission, FOC0001/13, para. 94.

³¹ Nicholas Davidson, Counsel for the Families of Men Who Died in Pike River Mine – Submissions for Families in Response to Minute No. 14, 19 July 2012, FAM0061/9, paras 37–38.

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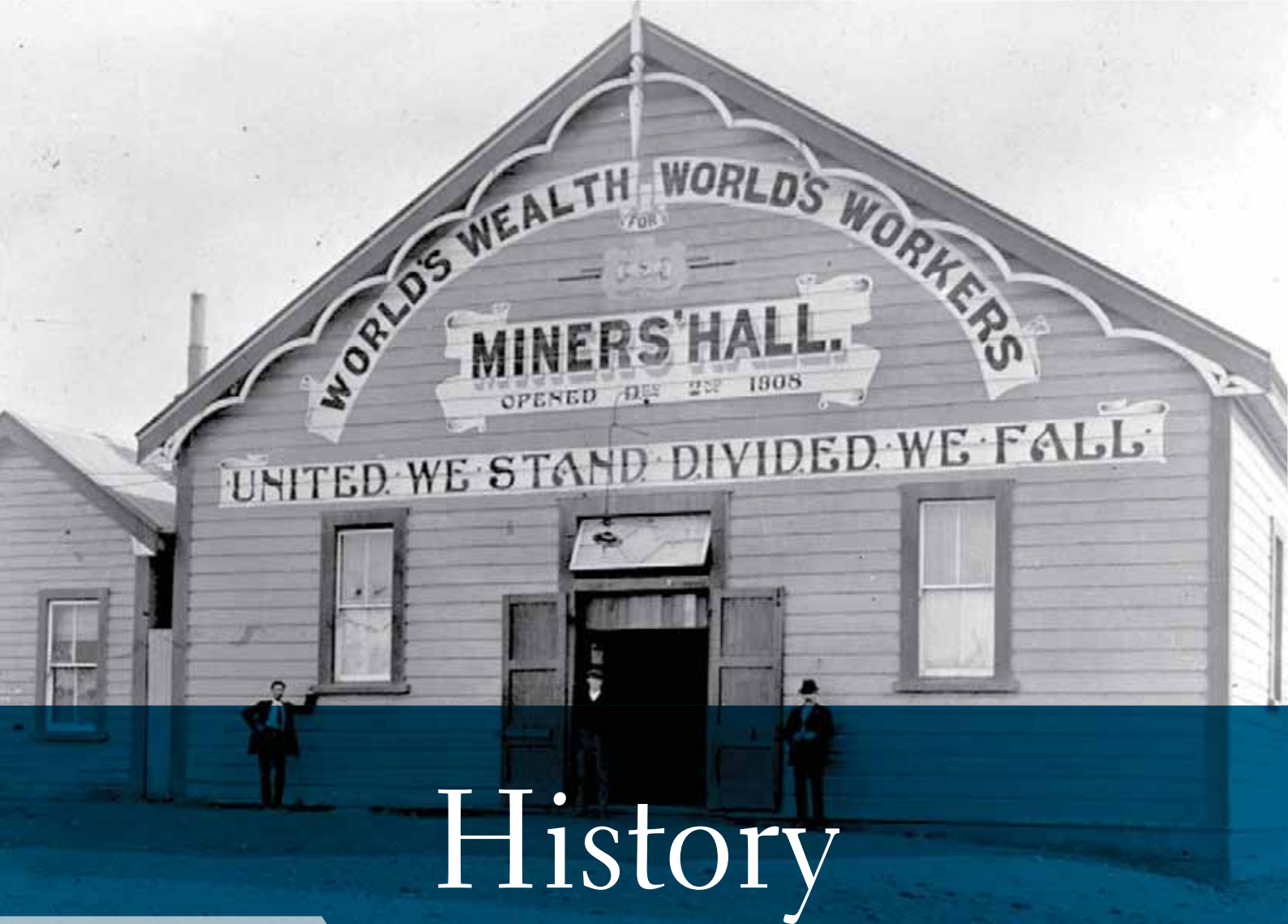
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Part 2

+ Proposals for reform



History

- + Major change is required
- + Coal mining in New Zealand
- + A failure to learn

Major change is required

Introduction

1. In this part of the report the commission sets out in detail its proposals for reform and makes its recommendations. This chapter brings together a number of key conclusions that are contained in later chapters.
2. The proposals arise from the commission's review of health and safety in underground coal mining but may often have relevance to other industries. They are based on an assessment of the evidence the commission received during its inquiry, a review of best practice overseas and research into past disasters in New Zealand and elsewhere.

New Zealand's poor health and safety performance

Injury and fatality rates

3. New Zealand's rate of work-related injury and fatality is far above that of the best-performing countries. The rate is about one third greater than Australia's. Country-specific differences in industry and hazards may account for some differences in performance, but it is clear that New Zealand performs poorly.

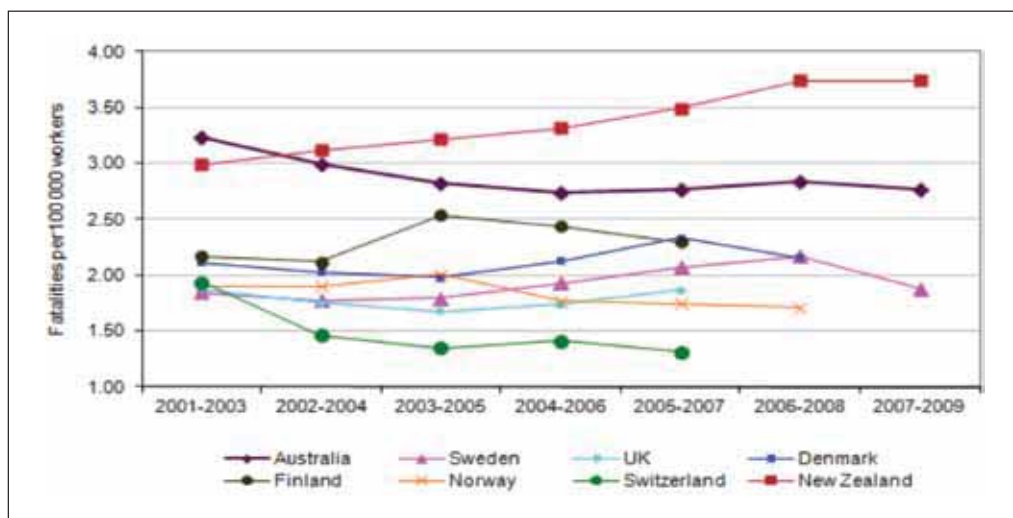


Figure 18.1: Comparison of work-related injury fatality rates with best-performing countries¹

4. The Department of Labour (DOL)'s *State of Workplace Health and Safety in New Zealand* of June 2011 paints a bleak picture. It is the first time key statistics have been brought together and it is intended that they be published annually.²
5. There were approximately 85 workplace deaths in 2008³, 445 serious injuries in 2009 and 228,300 accident compensation claims in 2008. The notified fatalities for 2010, including those at Pike River, are described as indicating a likely increase in the death rate.⁴
6. Data from the International Labour Organisation (ILO) shows that New Zealand's fatality rates are worse than those in many other advanced countries.

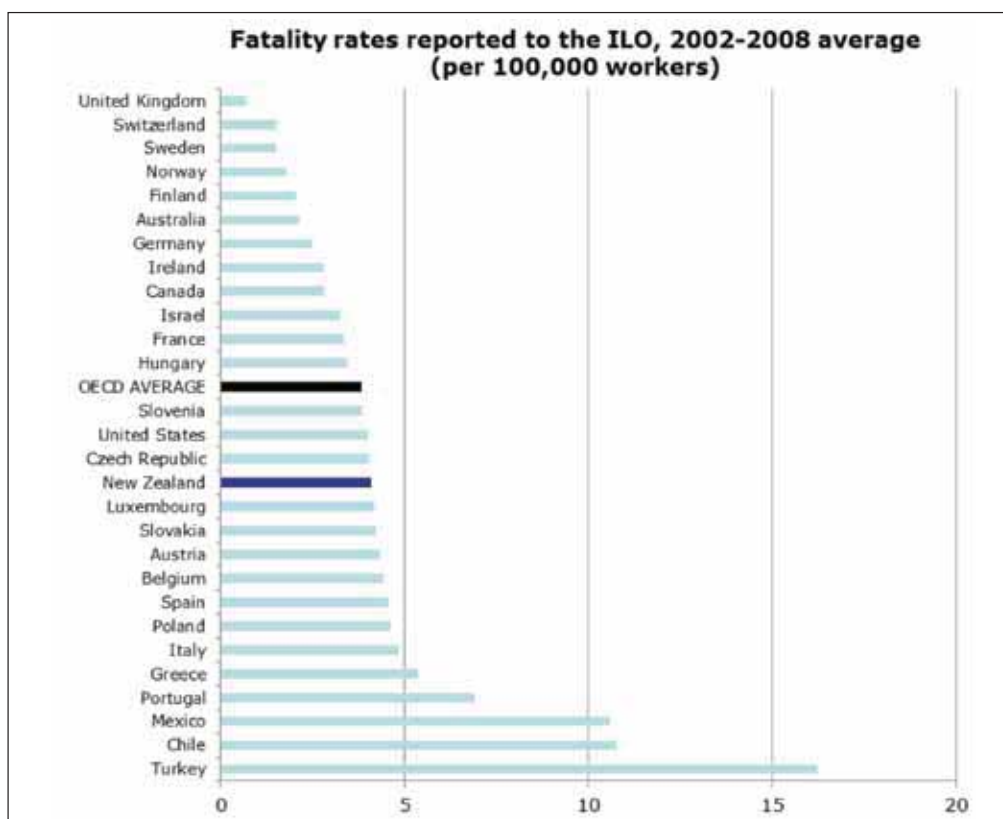


Figure 18.2: Fatality rates notified to ILO ⁵

7. Australia's fatality rates have reduced significantly over the last 10 years.⁶ Rates in the United Kingdom have reduced substantially since it introduced modern health and safety legislation in 1974.⁷

Occupational disease

8. Accident compensation claims for workplace disease were 27,000 in 2008, an increase of 26% over six years. Workplace disease accounts for an estimated 700–1000 deaths annually. There are inadequate measures of occupational disease, but *State of Workplace Health and Safety* mentions the development and piloting of a model for the surveillance of occupational cancer, respiratory diseases and dermatitis.⁸

Industry and worker involvement

9. New Zealand has about 470,000 workplaces and two million workers. Eighty-nine per cent of businesses say they have processes in place to manage health and safety in the workplace and 85% of employees consider that health and safety risks are being well managed; 39% of small and medium enterprises say they have difficulty dealing with or setting up health and safety systems; 66% of businesses say that they train their staff in health and safety.⁹ The number of people completing ACC-funded health and safety representative courses dropped from 9735 in 2008–09 to 4153 in 2010–11 mainly as a result of a 44% funding cut in 2009–10.¹⁰

Overseas health and safety regimes

10. The commission has looked at the health and safety regimes that apply to mining in other countries. The most relevant and useful regimes have proved to be in Australia, especially the major mining states of Queensland and New South Wales. These regimes are recognised as representing best practice.¹¹
11. Further, those states have kept pace, legislatively and administratively, with modern developments in a way that New Zealand has not. Much of the comparative analysis by the commission has therefore focused on Queensland and New South Wales.

Resources available to the regulator

12. New Zealand generally has fewer resources allocated to policing health and safety than the Australian states.



Figure 18.3: Field inspectors (excluding mining inspectors) per 10,000 employees by jurisdiction, 2009–10¹²

13. The total of 145 inspectors employed by DOL in 2009–10 equates to 0.8 inspectors per 10,000 employees. As shown in Figure 18.3, Western Australia was the lowest of the Australian jurisdictions, but still had a ratio of inspectors to employees almost 20% higher than New Zealand's.¹³
14. The latest benchmarking data shows that New Zealand also has the second lowest government expenditure on health and safety regulation per employee (at a little over two-thirds the Australian average).¹⁴ This comparison is illustrated in Figure 18.4.



Figure 18.4: Occupational health and safety expenditure per employee by jurisdiction, 2008–09¹⁵

15. New Zealand is not well resourced on a per employee basis compared with Australian jurisdictions. In 2008–09 DOL spent approximately \$19 (Australian) per employee, compared with more than \$40 for the highest two jurisdictions. The average across all Australian states was \$30 per employee.¹⁶

The 1972 Robens committee¹⁷

Principles still relevant

16. In 1972 the Robens committee reviewed the entire framework of health and safety in the United Kingdom and recommended far-reaching changes. The recommendations heavily influenced health and safety developments across the Commonwealth, including the 1992 legislative changes in New Zealand. Thinking has developed over the last 40 years but the commission has found that the core principles remain relevant.

17. The Robens committee recognised that health and safety standards cannot be improved without the contribution of employers, workers and the government regulator. More self-regulation was required, under which everyone accepts appropriate responsibilities for health and safety. This includes the board of directors and senior managers, who should, as part of their normal functions, set the policies and promote the right attitudes to health and safety throughout the company.
18. The committee recommended the replacement of 'prescriptive' legislation and regulation, which had tended to focus on specific hazards, with legislation based on principles that could be flexibly applied to the health and safety issues facing employers. But it also stressed that the new legislative approach would not be effective without the right approach to implementation.¹⁸ Three aspects are especially relevant.

Implementation

19. First, employers should be provided with more prescriptive guidance through regulations and codes of practice which could be easily amended. Such guidance was expected to be necessary for general matters relating to most forms of employment, specific types of hazards and particular industries such as agriculture, mining or construction.
20. Second, worker participation was essential when designing and monitoring health and safety policies in the workplace. Without worker co-operation and commitment real progress was impossible.¹⁹
21. Third, the regulator should be a single purpose, professional organisation. Robens recommended an autonomous authority whose functions should include both policy advice and operational delivery (including advice and inspections), administering standards (including codes of practice), working with industry and employee associations and conducting research, education and training. A forward-looking and systematic approach to accident prevention was needed, rather than relying wholly on backward-looking injury rates.
22. The Robens committee considered that the regulator should focus solely on health and safety. It should be subject to broad policy direction by a minister. It should be headed by a senior executive reporting to an executive board chaired by a person publicly recognised in the field. The committee warned against the board being merely advisory on the grounds that its advice may not be followed.²⁰
23. The executive board would be supported by expert advisory and technical bodies. The authority should not be placed within a government department because it would not have a separate identity. As the Robens committee noted, 'responsibility is diffused vertically in departmental hierarchies that eventually culminate in senior civil servants and ministers who devote to the subject whatever time they are able to spare from other competing preoccupations.'²¹ The eventual result was the establishment of the United Kingdom Health and Safety Executive Agency.²²

The Health and Safety in Employment Act 1992 (HSE Act)

24. Twenty years after the Robens committee report, most of its legislative recommendations were included by New Zealand in the HSE Act. This legislation imposed a general duty on employers to 'take all practicable steps' to ensure the health and safety of workers.
25. Administration of the legislation was placed in the multi-functional DOL (now part of the Ministry of Business, Innovation and Employment),²³ but the department lost focus and did not keep up with modern thinking in policy, regulation, strategy and operations. This deterioration was not restricted to administration in respect of underground coal mining.
26. Long-term health and safety strategy was based mainly on backward-looking injury rates and took little account of lead indicators or the special features of high-hazard industries. In the mining context employers were left alone with little guidance or oversight, and no approved codes of practice. There was little emphasis on worker participation and no routine contact between the inspectorate and employee representatives.

27. The inspectorate lost its capacity and focus. Resource allocation was not based on solid risk analysis and data. Compliance strategy, including enforcement, was outdated. Only two inspectors were left to service the underground coal mining industry and they had other duties as well.

Recent government initiatives

The High Hazards Unit

28. Following the Pike River tragedy, in September 2011 the government established the High Hazards Unit within DOL. Its focus is health and safety in the mining and petroleum and geothermal sectors.
29. The unit has been a welcome improvement, but some problems remain. These are discussed in Chapter 24, 'Effectiveness of the health and safety regulator'.

Funding increases

30. In May 2012 the New Zealand government announced an extra \$37 million funding over four years for the health and safety regulator. The purpose is to increase the number of field inspectors by 20%, from 148 to 180, by 2015. At the same time, the minister of labour ordered a fundamental review of the health and safety system by an independent taskforce.²⁴

What should be done

31. It is primarily in the implementation and administration of the health and safety legislation that New Zealand has lost its way, with knock-on effects on industry performance. In Part 2 of the report the commission analyses what needs to be done about it. The starting point is reform of the regulator.
32. Major and rapid change is required. The Pike River tragedy is a wake-up call for all industries, not just for those in underground coal mining. It is also a wake-up call for the government and for regulators.
33. There are 16 primary recommendations in this report, which are supported, where necessary, with more detailed recommendations. The commission trusts that those charged with responding to this report will also attach weight to the views and conclusions in the text. Those recommendations couched directly in terms of the underground coal mining industry may have wider relevance.
34. Recommendations are found at the end of the relevant chapters that follow and are reproduced in Volume 1.

ENDNOTES

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² Department of Labour, The State of Workplace Health and Safety in New Zealand, June 2011, p. 1.

³ The document does not provide the same categories of data for any one year.

⁴ Department of Labour, State of Workplace Health and Safety, p. 3.

⁵ Kate Wilkinson (Minister of Labour), Cabinet Paper – Proposal to Increase Investment in Safe Skilled Workplaces Using Unallocated Revenue from the Health and Safety in Employment Act Levy, 4 April 2012, DOL7770060003/7, paras 31–32.

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¹⁵ Ibid., DOL4000010005/89.

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¹⁷ Lord Robens (Chairman), Committee on Safety and Health at Work, Safety and Health at Work: Report of the Committee 1970–72, 1972, HMSO, 1972.

¹⁸ Lord Robens (Chairman), Safety and Health at Work, pp. 49–50.

¹⁹ Ibid., pp. 21–23.

²⁰ Ibid., pp. 36–39.

²¹ Ibid., p. 35.

²² For information on the agency see: <http://www.hse.gov.uk>

²³ Aviation and maritime health and safety are administered by Crown agents, the Civil Aviation Authority and the Maritime Safety Authority, which are close to the Robens model.

²⁴ Kate Wilkinson, (Minister of Labour) Media Release: Workplace Safety to Get Funding Boost, 2 May 2012, <http://www.beehive.govt.nz/release/workplace-safety-get-funding-boost>

Coal mining in New Zealand

Introduction

1. This chapter gives an overview of the characteristics of the coal resource and the coal mining industry in New Zealand and in Australia.

New Zealand coal fields

Main characteristics

2. New Zealand's coal resources are estimated to be over 15 billion tonnes, 80 to 85% of which are South Island lignites. The recoverable quantities of the 10 largest deposits are estimated at over 6 billion tonnes. Sub-bituminous and bituminous resources are estimated to be 3.5 billion tonnes; the recoverable quantity is uncertain.¹ The coal basins generally range in size from 150km² to 1500km². They often contain small coal fields.
3. New Zealand straddles the Pacific and Indo-Australian tectonic plates. Consequently coal seam geology can be complex, with changes in thickness and dipping over short distances. There can be marked structural disturbance, including multiple partings or splits, normal and reverse faulting and overfolding. The quality, thickness, structure and integrity of the seams can vary significantly over short distances. The faulting and complexity at the Pike River mine are not unusual.
4. The coals vary from lignite to semi-anthracite. They can be prone to spontaneous combustion and gas outburst. Gas content can vary within and between mines and ranges from non-gassy to highly gassy. The coals can have high water content. Some fields are located in areas of high rainfall. Inundation can occur, sometimes from old workings.
5. Many coal fields lie near regions of high ecological significance. Rock may be sulphur bearing, with potential for acid mine drainage and subsequent environmental damage. Streams and other natural resources require protection in accordance with environmental legislation.² Additional protections and consents are required to mine in land administered by the Department of Conservation (DOC).
6. The topography is often difficult, making access challenging and requiring mines to have relatively self-contained infrastructure and rescue facilities. The weather is variable, with many areas prone to high rainfall, fog and cloud cover. The weather can impede search and rescue operations, as was the case at the Pike River mine.
7. The complex geology, especially faulting and steep dipping, means that conventional mechanised mining methods are sometimes not very effective. Solid Energy New Zealand Ltd, the largest New Zealand underground coal mine operator, has responded by using hydro mining on the West Coast. This method was also used at the Pike River mine. A technique uncommon in most of the world, it requires specialised equipment and training. Combined with the geological conditions of the West Coast, hydro mining provides challenges for safety management.³
8. Some countries, especially those on the Pacific Rim, have coal fields similar to those in New Zealand. But those distant from tectonic plate boundaries, including Australia, South Africa, India, Western Europe and the eastern United States, are often of much greater lateral extent, and have simpler and more predictable geology.

Production

9. The large lateral seams found overseas can accommodate substantial underground coal mines with high production rates. By contrast, underground coal mines in New Zealand are small and have not been able to sustain

high production rates. The highest reported production by a New Zealand underground coal mine in one year was 500,000 tonnes, from the Spring Creek mine. Initial expectations had been up to 1.8 million tonnes per annum.⁴ Production at Pike River was initially estimated to be up to 1.3 million tonnes per annum,⁵ but that was revised downwards. By October 2010 the production forecast to June 2011 was 320,000–360,000 tonnes.⁶

10. Difficult geology, low production rates and New Zealand's distance from international markets make mining here economically challenging. Two factors offset these problems: the high quality of some New Zealand coal, especially that from the West Coast, and the commodities boom over the last decade and consequent increase in international coal prices.⁷

Planning

11. Great care is needed when planning, developing and operating underground coal mines. Detailed exploration is required. Insufficient resource definition has resulted in many mines being uneconomic or facing unforeseen health and safety risks. Three of the six large underground coal mines commissioned in New Zealand in the last 35 years have failed.⁸
12. Even successful mines have had problems. Solid Energy gave the example of its Spring Creek mine, situated about 20km as the crow flies from the Pike River mine. There was exploration in the 1980s and 1990s but the joint venture partners were not prepared to commit the major capital required to develop a large mine. Instead they adopted the less costly option of accessing a high-quality seam nearer the surface. The preliminary plan and budget were approved in 1999, 'under time pressures, with too little geological and resource investigation completed and with only a short-term view of the future mine plan. These combined decisions compromised the mine for the next 12 years, resulting in challenges for safe and economic mining that have had to be overcome with difficulty ever since and are still felt today.'⁹
13. Spring Creek did not achieve its initial production targets. Costs escalated. By 2001 the mine was placed on care and maintenance. This means that production is halted but the site is managed so that it remains safe and stable, ready to be reopened if circumstances alter.
14. In 2002 Solid Energy became the sole owner. It reopened the mine and carried out further drilling to improve the resource information. As Dr Donald Elder, chief executive officer of Solid Energy, said, '[i]n mining, where certainty of geological information is the key to good mine planning and operations, the unexpected only ever has negative consequences. So it was with Spring Creek. For the next six years the mine struggled and repeatedly failed to meet its production and financial plans.'¹⁰

Observations

15. This leads to three observations. First, the economics, the timeframe from design to production, and the technical and legal requirements of underground coal mining in New Zealand cannot be directly determined by overseas experience.
16. Second, New Zealand operators may require knowledge and expertise, including in hydro mining, that overseas operators may not have. Everyone involved – miners, supervisors, management, the board, training institutions, advisers and regulators – must possess this specific and specialised background. Similarly, particular mining equipment may be required. Some overseas equipment may not be suitable.
17. Third, the principles underlying safe mining in New Zealand are the same as those overseas. Mine operators need to control the risks of the unforgiving underground environment by comprehensive measures including hazard identification and safety management, strata control, ventilation and gas management systems and equipment. Suitable equipment, trained workers and expert advisers are essential.

New Zealand coal mining industry

18. New Zealand has produced coal since the late 1840s. It was a major energy source, but from the 1950s to the 1970s hydro power, cheap imported oil and then gas from the Taranaki region became significant energy sources. There was a general decline in demand for coal and many small and inefficient mines began to close.¹¹ The number of coal mines reduced from 216 in 1952 to 78 in 1973. Currently there are approximately 22 coal mines, five of which are underground. Production has been suspended at two underground mines, including Pike River, and two open cast mines.¹² The industry is dominated by Solid Energy and otherwise comprises very small operators.
19. Correspondingly, the number of people employed in the industry decreased from approximately 5000 in the 1950s to 1500 by the 1970s. In 2010 coal mining employed between 1030 and 1700 people,¹³ of a total New Zealand workforce of approximately 2 million.
20. Over the last few decades annual coal production has grown, to about 5 million tonnes in 2011 (see Figure 19.1). That trend is predicted to continue.

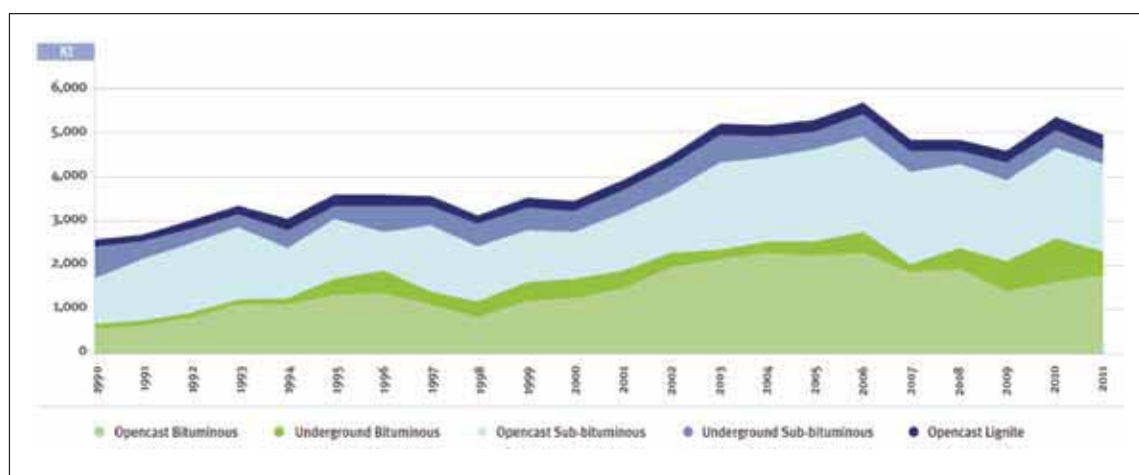


Figure 19.1: New Zealand coal production¹⁴

21. There have been significant changes in the way in which coal is mined in New Zealand. Up to the 1940s coal was mined almost exclusively using underground methods. Since the Second World War open cast mining has been in the ascendancy (see Figure 19.2). By the 2000s only about 20% of annual coal production came from underground mines.



Figure 19.2: Open versus underground mining¹⁵

22. Underground coal mining still has a place in New Zealand. It is practised by several operators, including Solid Energy at its Huntly East mine in the North Island and at Spring Creek.

Australian coal mining industry

23. New Zealand's largest coal mining neighbour is Australia. It is one of the largest producers in the world and has the fourth largest coal reserves. In 2010–11, Australia produced 347.6 million tonnes of saleable coal, approximately 22% (76.1 million tonnes) of which was produced by underground methods and approximately 72% (271.5 million tonnes) by open cast methods. New Zealand's total coal production represents less than 2% of Australian coal production.
24. Approximately 97% of Australian saleable coal is produced in Queensland and New South Wales.¹⁶ In the 2010–11 year Queensland produced 179.8 million tonnes from 59 mines, 15 of which were underground. The industry directly employed 32,453 people. New South Wales produced 156.9 million tonnes from 61 mines, 30 of which were underground. The industry directly employed 21,126 people. Western Australia, South Australia and Tasmania produced approximately 11 million tonnes in seven mines employing about 1000 people. The Northern Territory does not produce coal.¹⁷
25. The industry includes large multinationals, some of which own several mines. Many mines are large scale, using high production methods such as longwall mining. Hydro mining is not used.
26. Australian coal industry workers tend to be paid more than their New Zealand counterparts. That attracts New Zealand workers, contributing to a shortage of experienced coal mine workers on this side of the Tasman. As a result New Zealand operators may be required to train workers or source them from overseas.

Conclusions

27. Coal mining in New Zealand has some unique characteristics, which must be accommodated at all stages of mine design, development and operation. But the need for careful health and safety management, and the systems required to achieve this, are the same as overseas.
28. Despite the differences in scale, New Zealand can benefit from close co-operation with Australia, especially the main mining states of Queensland and New South Wales. That theme is reflected in this report.

ENDNOTES

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² See the Resource Management Act 1991.

³ Donald Elder, transcript, p. 6.

⁴ Ministry of Economic Development, Phase Four, 16 March 2012, MED4000010001/29, para. 101.

⁵ Ibid. This was to come from a combination of production and roadway development.

⁶ Pike River Coal Ltd, Activities Report: Quarter ended 30 September 2010*, DAO.007.11332/2.

⁷ Donald Elder, witness statement, 8 June 2011, SOL306956_1/16, para. 32.

⁸ Huntly West mine exploded in 1992, producing little further coal before being closed. Mount Davy suffered rock, coal and gas outbursts and fatalities before closing three years after first development and the Pike River mine exploded before any significant production. Ministry of Economic Development, Phase Four Paper, 16 March 2012, MED4000010001/26, para. 91.

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¹⁰ Ibid., SOL306956_1/21, para. 52.

¹¹ Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/10–11, paras 18–19.

¹² Ministry of Economic Development, New Zealand Petroleum and Minerals, Operating Coal Mines, 16 March 2012, <http://www.nzpam.govt.nz/cms/coal/coal-resources/operating-coal-mines>

¹³ It has not been possible to ascertain the exact number of people employed in the industry, in part due to conflicting data and, it is assumed, different definitions of the categories of people that should be included, e.g. whether contractors should be included.

¹⁴ Ministry of Economic Development, New Zealand Petroleum and Minerals, graph, http://www.med.govt.nz/sectors-industries/energy/image-library/energy-data-and-modelling/coal/Coal-1.gif/image_view_fullscreen

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¹⁷ Data sourced from the Queensland Department of Natural Resources and Mines and Coal Services Pty Ltd.

Introduction

1. This chapter discusses previous tragedies and the failure to learn from them.

New Zealand coal mine tragedies

2. New Zealand's main New Zealand main coal mine tragedies, not including the Pike River mine tragedy, are set out below.¹

DATE	WHAT HAPPENED	DEATHS	INQUIRY	MAIN PROBLEMS
21 February 1879	Explosion of methane at Kaitangata coal mine, Otago	34	Coronial inquest	Warnings about dangerous practices were not heeded. Insufficient gas record keeping and ventilation. Use of naked light (open lamp) despite previous detection of methane.
26 March 1896	Explosion of methane and coal dust at Brunner coal mine, West Coast	65	Royal commission of inquiry	The explosion was the result of ignition of coal dust from 'blown out shot' fired contrary to rules of the mine, in a part of the mine where no one should have been working. Miners believed there had been an accumulation of methane and inadequate ventilation, which was not accepted by the commission.
28 January 1900	Substantial fire at Westport-Cardiff coal mine, Mokihinui. (The mine had been closed in September 1899 due to a failure to produce marketable coal and lack of funding.)	0	Royal commission of inquiry	Presence of conditions supportive of spontaneous combustion. The mine was not adequately monitored. (During operation of the mine, there was inadequate ventilation and insufficient enforcement of statutory requirements.)

DATE	WHAT HAPPENED	DEATHS	INQUIRY	MAIN PROBLEMS
21 June 1907	Fire burning at Nightcaps colliery, Southland	3	Royal commission of inquiry	The management of the mine was poor, there was inadequate ventilation during the shift and inadequate daily examinations. Naked lights were used instead of safety lamps and workers were not withdrawn when conditions were dangerous. There was also lax enforcement by the inspector.
12 September 1914	Explosion of methane and coal dust at Ralph's colliery, Huntly	43	Royal commission of inquiry	Inadequate examinations for gas in old workings and inadequate ventilation. Naked lights were used instead of safety lamps. Failure to report injury caused by a previous explosion. Shot-firing in dusty mine. The inspector failed to ensure strict and immediate compliance with recommendations, failed to require use of safety lamps and did not properly examine old workings.
3 December 1926	Explosion of coal dust at Dobson colliery, Dobson	9	Royal commission of inquiry	Laxity in issue of oil safety lamps. Lamps were left unattended in the mine. There was inadequate stone dusting despite the requirement by the inspector to stone dust all roads.
15 November 1929	Explosion of methane and coal dust at Linton coal mine, Ohai	3	Royal commission of inquiry	Inadequate ventilation, stone dusting, supervision of shot-firing (which was non-compliant) and detection of contraband (matches taken underground).
24 September 1939	Fire at Glen Afton No. 1 coal mine, Huntly	11	Royal commission of inquiry	Fire initially caused by cigarette or naked light, not completely extinguished. Inadequate reporting at mine of fire. Ventilation fan not on while men in mine.
6 November 1940	Explosion of methane at Kayes coal mine, Ten Mile Creek, Greymouth	5	Commission of inquiry	Methane ignited by worker lighting cigarette.

DATE	WHAT HAPPENED	DEATHS	INQUIRY	MAIN PROBLEMS
31 August 1955	Inrush of mud and water at Renown colliery, Huntly	1	Commission of inquiry	<p>The majority considered the tragedy was unforeseeable in light of existing knowledge and previous experience. Management was efficient and up to accepted standard.</p> <p>The minority considered the accident was foreseeable. Mine manager failed to inspect the surface following a large roof fall beneath a watercourse. The deputy and underviewer were not told of the watercourse above the pillaring operation.</p>
17 January 1958	Explosion of methane at Westhaven coal mine, Collingwood	4	Commission of inquiry	Inadequate ventilation, failure to search for contraband (matches and lighter taken underground) and failure to carry out examinations. Mine manager made untrue entries of searches and examinations and presence of fifth man working the mine concealed.
19 January 1967	Explosion of methane and coal dust at Strongman coal mine, West Coast	19	Commission of inquiry	<p>Insufficient pre-shift examinations, insufficient gas testing, failure to report occurrences of gas, non-compliant shot-firing and inadequate ventilation.</p> <p>The district and chief inspectors had failed to take action despite being aware of dangerous practices, including the non-compliant shot-firing and ventilation problems.</p>
18 September 1985	Fire caused by spontaneous combustion at New Imperial (Boatmans No. 4) coal mine, Reefton	4	Court of inquiry ²	<p>Pillaring conducted too close to return airway, failure to detect signs of spontaneous combustion due to lack of examinations, mine plans not submitted to the inspector and poor ventilation management practices – main fan not running and ventilation door connecting the intake and return was kept open.</p> <p>Inspector not able to make frequent inspections of mines in his area due to workload.</p>

DATE	WHAT HAPPENED	DEATHS	INQUIRY	MAIN PROBLEMS
23 September 1992	Explosion of methane caused by spontaneous combustion at Huntly West coal mine, Waikato	0	Investigation by mines inspector	Insufficient reporting to mines inspector and mines rescue service, failure to adequately extinguish fire and failure to immediately withdraw workers when smoke encountered.
4 June 1998	Outburst of coal, mudstone and methane at Mount Davy coal mine, West Coast	2	Coronial inquest	Unforeseeable and unavoidable event in light of industry knowledge at the time.
8 March 2006	Inrush of water at Black Reef (Tiller) coal mine, Greymouth	1	Coronial inquest	No effective health and safety system in place, no risk assessment undertaken, inadequate information, inaccurate mine plans, the knowledge and experience of the underground manager was insufficient and no training plan was established for him, and failure to plan for possibility of inundation.
8 September 2006	Unplanned goaf fall at Roa coal mine, Blackball	1	Coronial inquest	Manager's support rules not followed, no strata management plan and no review of pillaring operations.

Figure 20.1: New Zealand coal mine tragedies

3. Recurring themes include:
- an insufficient regulatory framework;
 - the health and safety regulator not properly conducting inspections nor ensuring legislative compliance;
 - operators not identifying and managing hazards, including inadequate ventilation and gas management systems;
 - operators not providing miners with proper training, equipment and oversight; and
 - miners not following safe practices.

Overseas tragedies

4. Similar themes are apparent in overseas coal mining tragedies, some of which are outlined below.

Westray

5. On 9 May 1992 a methane and coal dust explosion in the Westray mine, Pictou County, Nova Scotia, Canada killed all 26 miners underground. The mine had been open for nine months. Sparks from the cutting parts of a continuous miner provided the source of the ignition. There was inadequate ventilation, treatment of coal dust and training. Westray was a 'stark example of an operation where production demands resulted in the violation of the basic and fundamental tenets of safe mining practice'.³ Management failed to instil a safety mentality in its workforce. It ignored or encouraged a series of hazardous or illegal practices. The body responsible for the mine planning

approval process did not perform its duties properly. The body most responsible for regulating the safety of the mine failed to enforce the law.

Moura No. 2

6. On 7 August 1994 a methane explosion at Moura No. 2 mine, Queensland, Australia, killed 11 miners. Ten survived. A second explosion two days later led to the mine being sealed. The bodies of the miners have never been recovered. The investigation found that the ignition was caused by spontaneous combustion in a sealed panel.⁴ Factors contributing to the first explosion included failing to prevent heating in the panel, failing to capture and evaluate signs of heating over an extended period, failing to identify that sealing the panel could result in accumulation of methane within it and failing to withdraw people from the mine when there was potential for an explosion. Management did not ensure that all miners underground were aware the panel had been sealed. It did not inform miners that they could choose not to go underground.
7. In 1996 the Moura No. 2 investigation report was reviewed by a New Zealand task force led by the Ministry of Commerce, which was then responsible for health and safety in underground coal mines.⁵ It made recommendations directed at managing spontaneous combustion, training, the need for underground coal mines to have ventilation officers, gas monitoring, sealing and emergency facilities.

Sago

8. On 2 January 2006 an explosion at the Sago coal mine in West Virginia, United States, killed 12 miners. Sixteen miners survived. The Mine Safety and Health Administration (MSHA) report dated 9 May 2007 identified the likely immediate cause of the explosion as a lightning strike, which transferred energy to an abandoned pump cable within a sealed area of the mine, igniting accumulated methane. The explosion destroyed the seals and filled parts of the mine with carbon monoxide. Failings included not building the seals in accordance with the approved plan and not immediately notifying the MSHA and mines rescue of the accident. Even so, rescue teams would not have been allowed underground immediately because of the high levels of toxic gases and the risk of a further explosion. An internal review into the MSHA's actions identified weaknesses in its performance, including a failure to follow established inspection procedures, poor and uncorrected performance of the inspectors, weaknesses in enforcement actions, a failure to recognise a deficiency in the approved emergency plan and outdated and unclear procedural instructions.

Upper Big Branch

9. On 5 April 2010 a coal dust explosion that resulted from a methane ignition at the Upper Big Branch coal mine, West Virginia, United States, killed 29 workers and injured two others. The MSHA found that the operator 'promoted and enforced a workplace culture that valued production over safety, including practices calculated to allow it to conduct mining operations in violation of the law'.⁶ In the four years before the explosion, miners did not make health and safety complaints to the MSHA because they were intimidated by management and told that raising safety concerns would jeopardise their employment. Because health and safety inspectors had given prior notice of visits, violations could be hidden. The operator had two sets of health and safety hazard records. One was required by law and available to miners and inspectors. The other, not available to miners or inspectors, contained internal production and maintenance reports. It included hazards not noted in the first set.
10. Basic safety measures could have prevented the explosion. The longwall shearer was not maintained safely and was, therefore, an ignition source. The methane monitoring, ventilation and stone dusting were inadequate and ventilation and roof control plans were not followed. Mine examinations were not properly performed and obvious hazards were not identified. Workers were not adequately trained and refreshed about their tasks, health and safety, and hazard recognition. The MSHA inspectors failed to follow established policies and procedures, compromising enforcement efforts. In the 18 months before the explosion, the Upper Big Branch mine received 684 citations for violations, yet the MSHA failed to use other enforcement mechanisms. The inspectors did not identify many of the mine's failings. There was inadequate review of the operator's record books.

11. International coal mining tragedies have received significant media coverage, including the Upper Big Branch mine tragedy, which occurred only six months before the Pike River tragedy. Domestic and international mining tragedies provided a strong warning about the need for strict management of underground coal mine hazards and effective regulation. Non-coal mining tragedies also provided relevant lessons.

Non-coal mining tragedies

Erebus Flight 901

12. On 28 November 1979 Air New Zealand flight TE901 crashed into Mount Erebus in Antarctica, resulting in the death of all on board. A royal commission of inquiry analysed the organisational factors that contributed to the accident by allowing human error or failing to negate it. It led to the creation of a specialist New Zealand Civil Aviation Authority (CAA). The CAA establishes standards, monitors adherence to standards, and investigates accidents and incidents. A scientific approach is used. It collects data on error and violation producing conditions, supervisory and organisational issues and reports on these formally on a quarterly basis.⁷ That data underlies safety initiatives, including education campaigns, monitoring and compliance action. This scientific approach has still not been fully reflected in the Department of Labour's regulatory approach.

BP Texas City oil refinery

13. On 23 March 2005 an explosion at the BP Texas City oil refinery, United States, killed 15 people and injured more than 170 others. The BP US Refineries Independent Safety Review Panel (the Baker panel, as it was known) identified it as a process safety accident. BP had neither effective safety leadership nor adequate safety systems to address the risk of catastrophe. Process safety was not established as a core value across its US refineries nor effectively incorporated into management decision-making. The Texas City refinery had 'not established a positive, trusting, and open environment with effective lines of communication between management and the workforce',⁸ a required part of a good process safety culture. The process safety education and training at BP was inadequate. The Baker panel found 'significant deficiencies existed in BP's site and corporate systems for measuring process safety performance, investigating incidents and near misses, auditing system performance, addressing previously identified process safety-related action items, and ensuring sufficient management and board oversight'.⁹ Many of the deficiencies were identifiable in lessons from previous process safety incidents. The issue of process safety had been highlighted as long ago as the Piper Alpha oil rig tragedy in 1998, when 167 people lost their lives.

Cave Creek

14. On 3 July 1995 a viewing platform collapsed at Cave Creek, on New Zealand's West Coast. Fourteen people died. There had been significant failings by the relevant regulatory agency, the Department of Conservation. The commission of inquiry recommended that the government institute a combined regional disaster and trauma plan for the West Coast, to provide for unambiguous overall leadership of emergency responses, the prior resolution of all likely conflicts and the co-ordination of all services involved. Following Cave Creek, the co-ordinated incident management system (CIMS), described in Chapter 16, 'Search, rescue and recovery' was developed. The 2005 West Coast regional plan provided for the control of mine emergencies (by the police). But underground coal mine emergencies were not included in CIMS training and the 2010 West Coast regional plan did not state who would control them.
15. The Cave Creek commission also recommended that a family liaison officer be appointed immediately after a tragedy to make all appropriate information available to those with an interest greater than that of the general public. The aim was to allay as much as possible the fear and anxiety of the victims' friends and family.

Conclusions

16. As its inquiry proceeded the commission noted the extent to which the themes identified by inquiries into previous tragedies were repeated at Pike River. History demonstrates that lessons learnt from past tragedies do not automatically translate into better health and safety practice for the future. Institutional memory dims over time. This confirms that good health and safety performance is only achievable with the effective, continued involvement of the three key participants: employers, employees and the government regulator.

ENDNOTES

¹ For a history of coal mine tragedies see W.P. Brazil, *A Summary of the Evolution of Coal Mining Safety Legislation Together with a Traditional Viewpoint*, May 1995, DOL0010010001. There are other tragedies not listed that resulted in coronial inquiries. See CAC0177.

² Under s 181 of the Coal Mines Act 1979, the minister of energy could direct a formal investigation be held into accidents resulting in death or injury where a mines inspector believed the accident was caused by the owner, mine manager, engine driver or any other person employed at the coal mine. The investigation would be held before a court of inquiry, consisting of a magistrate appointed by the minister.

³ K. Peter Richard, 'Prelude to the Tragedy: History, Development, and Operation', in *The Westray Story: A Predictable Path to Disaster: Report of the Westray Mine Public Inquiry*, November 1997, <http://www.gov.ns.ca/lae/pubs/westray/summary.asp#prelude>

⁴ Queensland Warden's Court, *Wardens Inquiry: Report on an Accident at Moura No 2 Underground Mine on Sunday, 7 August 1994, 1996*, CAC0152.

⁵ Ministry of Commerce, Mining Inspection Group, *Review of the Recommendations from the Wardens Inquiry into the Accident at Moura No 2 Mine, Queensland on Sunday August 7 1994, 1996*, EXH0003.

⁶ United States Department of Labor, Mine Safety and Health Administration, *Coal Mine Safety and Health, Report of Investigation: Fatal Underground Mine Explosion April 5, 2010 – Upper Big Branch Mine-South, Performance Coal Company*, 12 November 2011, p. 2, <http://www.msha.gov/Fatals/2010/UBB/FTL10c0331noappx.pdf>

⁷ Kathleen Callaghan, witness statement, 31 October 2011, FAM00042/19, para. 69.

⁸ BP U.S. Refineries Independent Safety Review Panel, *The Report of the BP U.S. Refineries Independent Safety Review Panel*, 2007, p. xii, http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/SP/STAGING/local_assets/assets/pdfs/Baker_panel_report.pdf

⁹ *Ibid.*, p. xiv.

**TURN ON
HEADLIGHTS
& HAZARD LIGHTS**



The regulators

- + Collaboration between government agencies
- + The decline of the mining inspectorate
- + Management of the mining inspectorate
- + Effectiveness of the health and safety regulator
- + A new regulator

Collaboration between government agencies

Introduction

1. The mid-1980s and early 1990s were a time of significant change in New Zealand. The economy was deregulated and major reforms were introduced in the state sector. It is within this context that a new legislative framework was established for health and safety. The Crown Minerals Act 1991, the Resource Management Act 1991 and the Health and Safety in Employment Act 1992 all came into force. Industry-specific legislation applying to mining was repealed.
2. This chapter provides an overview of the Coal Mines Act 1979 and of the changes that led to separate regimes for permitting, resource management and health and safety in coal mining. It then covers some of the consequences of the separation of functions. Of most concern is the lack of consideration given to health and safety during the various approval processes. This is a significant gap in regulatory oversight.

Law reform

Coal Mines Act 1979

3. Before the changes the Coal Mines Act 1979 was the main statute governing mining activities. It provided a prescriptive set of rules and regulations specific to the coal mining industry and was administered by one government agency. It covered coal prospecting, mine licensing and the regulation of coal mines, including coal mine management, certificates of competence, safety, employment, and accident notification and investigation. This act and other legislation – the Coal Mines (Licensing) Regulations 1980, the Coal Mines (Mine Management and Safety) Regulations 1980 and the Coal Mines (Electrical) Regulations 1980 – treated coal mining as a specialist area requiring highly prescriptive standards. The act was administered by the Mines Division of the Ministry of Energy.
4. The minister of energy granted coal mining licences over defined areas. Applications for licences were made to the Mines Division and their assessment included review by mines inspectors. Notice that a licence application had been lodged was served on landowners and occupiers and publicly notified. Local authorities had to report on environmental effects. Copies of applications were forwarded to the commissioner of Crown lands and to the relevant catchment boards or the Soil Conservation and Rivers Control Council for review and comment.
5. After consultation, the minister approved a work programme and set the conditions of the licence. These covered many matters, including resource extraction, environmental effects and mine safety.¹ The chief inspector of mines had input into the application and licence conditions. The mines inspectors were involved from the outset.
6. It was a standard condition of all mining licences that mining operations be carried out in accordance with an approved work programme. This covered the proposed development of the mine, extraction of coal and general plans for future development. As well as these site specific conditions, licences contained general conditions such as rents and royalties and supplying information. Operators were also required to use the licence land 'only for coal mining purposes in accordance with the Act and any regulations issued under the Act'.² That included compliance with health and safety provisions.
7. Coal mine owners had a statutory duty to make financial provisions and ensure the coal mine was managed, worked, planned and laid out in accordance with the Coal Mines Act. This included requirements on safety matters such as shafts and outlets, removal of pillars and control of dust. The act allowed for workmen's inspectors. The regulations had detailed provisions relating to certificates of competence and qualifications, conduct of the people

employed and the duties of mine managers. They included standards for mine systems and equipment such as ventilation and use of explosives.

Changing times – the 1990s

8. Both the Coal Mines Act 1979 and the Mining Act 1971, which applied to gold and silver mining, emphasised the use of land for mineral development over other uses. During the 1980s this became 'increasingly unacceptable' as the legislation governing mining was 'seen to unreasonably override the rights of land owners'.³
9. In 1986 the Ministry of Energy released a discussion document on mining legislation. One of its purposes was to find a better balance between the interests of the mining industry and the concerns of other parties, including local authorities and landowners. Many other parts of the mining legislation were in need of change because of matters concerning mineral ownership, mining titles, environmental protection, public participation, complex licensing procedures, and the roles and responsibilities of the various authorities.⁴
10. A major review of natural resource management, including mining, started in the late 1980s, and led eventually to the separation of the allocation of mining permits from management of the environmental effects of mining. This was reflected in the Crown Minerals Act 1991 and the Resource Management Act 1991.
11. The environmental reforms, which also resulted in the Environment Act 1986 and the Conservation Act 1987, and the establishment of the Ministry for the Environment and the Department of Conservation (DOC), changed the balance between environmental protection and economic production and the shape of the government agencies managing natural resources.
12. In 1992 the Health and Safety in Employment Act (HSE Act) was passed. It imposed general duties on all employers, including mine operators, to take all practicable steps to ensure health and safety. The prescriptive Coal Mines Act was repealed. Mine operators were to determine how to manage health and safety using appropriate hazard management practices. The drive to deregulate the economy and improve business competitiveness was evident in the new act. Initially the legislation lacked some key elements, such as strong employee participation provisions, and the delays in developing new regulations can be traced in part to a belief that the HSE Act was operating effectively without them.⁵
13. Like some other hazardous industries, including construction, geothermal energy, petroleum and quarries and tunnels, mining was no longer subject to a separate legislative scheme. Regulation regarding permitting, health and safety and environmental issues was allocated to various national and local government organisations, which were expected to act independently and impartially. It was expected, too, that the potential for conflicts of interest would be minimised, for example between the Crown's commercial interest in mining and its role in preserving the environment or making decisions about health and safety. This did not mean agencies should not work cooperatively.

The regulatory framework

Mining permits and land access

14. The Crown Minerals Act 1991 deals with the way in which rights to extract minerals and petroleum resources are allocated by the government. It sets out the rights and responsibilities of resource users and the functions and powers of the minister of energy. Exploration and mining permits are issued in accordance with government policies set out in the minerals programmes, which were prepared by the Ministry of Economic Development on behalf of the minister and issued by the governor-general.
15. New Zealand Petroleum and Minerals (formerly Crown Minerals) is the operating division of the ministry responsible for granting permits, monitoring compliance with permit work programmes and collecting royalties. It also promotes new investment in the minerals estate.

16. New Zealand Petroleum and Minerals aims to allocate resources efficiently and to generate a fair financial return for the Crown. It does not consider health and safety matters.
17. The Crown Minerals Act 1991 and Conservation Act 1987 together regulate mining on the conservation estate.
18. If mining is to occur on conservation land, the minister of conservation authorises access, taking into account the need to preserve and protect the area. Mining activities can be approved, irrespective of whether they are contrary to conservation purposes, provided there are safeguards against the potential adverse environmental effects of mining.⁶
19. When assessing applications for land access, DOC looks principally at the above ground effects of the operation. Ongoing monitoring of operations has a similar purpose. DOC does not consider whether a mining proposal involves workplace health and safety risks.

Resource management

20. The purpose of the Resource Management Act 1991 is to promote the sustainable management of natural and physical resources.
21. Local councils are responsible for its implementation. They grant land use and resource consents required for mining operations to proceed. The focus is on managing the actual and potential effects of an activity on the environment. Health and safety can be considered, but in practice the emphasis is on public, not workplace, health and safety.⁷

Health and safety

22. The HSE Act promotes prevention of harm to all employees. DOL helps employers to meet their obligations, determines whether they are complying, or likely to comply, with the act and takes enforcement action if necessary.
23. No approvals are required from DOL before mining operations start. DOL's oversight begins as soon as there is a workplace and may therefore include the exploration phase. However, despite the preventative approach of modern health and safety law, DOL has no involvement in the consenting stages of a mining operation. It does not contribute to decisions on granting mining permits, access arrangements or resource and land use consents. It is not required to approve mining activities before operations start.

The need for collaboration

24. The commission has not found anything to suggest fundamental flaws in the separation of permitting, mining safety and environmental law. It is common practice in other jurisdictions, such as New South Wales and Queensland, and in the main Canadian coal mining state of Alberta. New Zealand is not out of step.
25. The problem is not so much with the law, though there are weaknesses that are addressed later in this report, but with the way the laws were administered after the reforms. The benefits of the unified approach of the Coal Mines Act and mining inspectorate were lost.
26. The local councils – Buller, Grey and West Coast – worked together on resource consents. They appointed a lead agency and relied on reports, such as the annual planning document required by DOC, for monitoring purposes.
27. But sharp demarcation lines developed between the central agencies. The Ministry of Economic Development and DOL in particular interpreted their responsibilities narrowly, and there appears to have been little dialogue or sharing of relevant information during Pike's development.⁸ Similarly, while DOC worked diligently to fulfil its statutory obligations it did not engage with either the ministry or DOL. Information collected about mining operations during approval and monitoring processes was therefore not shared.

Conclusions

28. Collaboration is required to make the system work and ensure that high-risk operations are adequately monitored. There should be closer contact between agencies, or business units within agencies, during the approval, planning and design of new mines and the production and decommissioning stages.

29. The increased collaboration required between regulators before permits are issued is in part the subject of government proposals to strengthen the Crown Minerals regime. Those proposals are dealt with in Chapter 27, 'Strengthening the Crown Minerals regime'.

ENDNOTES

¹ Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/23, para 74.

² Ibid., MED0000010001/23, para. 73.

³ Ibid., MED0000010001/85, para. 294.

⁴ Ibid., MED0000010001/86, paras 295–96.

⁵ Department of Labour, HSE Regulations: Process, 30 May 1994, DOL0010010008/1.

⁶ Crown Minerals Act 1991, s 61(2).

⁷ Resource Management Act 1991, s 5; Ministry for the Environment, Phase Four Paper, 16 March 2012, MFE4000010001/8, para. 25.

⁸ Although the Conservation Act 1987, Resource Management Act 1991, Crown Minerals Act 1991 and the Health and Safety in Employment Act 1992 have different purposes there are circumstances where the same matter or information is relevant under more than one act, e.g. mining methods or access to mine plans.

The decline of the mining inspectorate

Introduction

1. This chapter explores the history and functioning of the mining inspectorate during three periods: under the Coal Mines Act 1979, when there was a separate inspectorate for coal mines; in a transition period from 1992 to 1998, after the enactment of the Health and Safety in Employment Act 1992 (HSE Act); and from 1998, when the coal mine inspectors became part of the Department of Labour (DOL) and were known as extractives inspectors.¹

The inspectorate under the Coal Mines Act 1979

2. Under the Coal Mines Act 1979 there was a specialist coal mines inspectorate, as it was then known, based in the Ministry of Energy, latterly the Ministry of Commerce. It was involved in major aspects of coal mining and the coal mining industry, including policy.²

Inspectors

3. The act provided for a chief inspector, district, electrical and mechanical inspectors of coal mines.³ Chief inspectors could support and review the actions of the inspectors. They held first class coal mine manager's certificates and had significant coal mining expertise, usually as manager of a large and challenging New Zealand mine such as Strongman, which had problems with gas and spontaneous combustion.⁴ The chief inspector attended conferences of the Australian chief inspectors.

Inspections

4. District inspectors had coal mining expertise and inspected mines within a particular geographical area. Inspections occurred with and without notice and following notification of incidents and accidents. Small mines were inspected monthly and large mines inspected weekly.⁵ That reflected the mine's rate of progress and the time required for a comprehensive inspection.
5. Mines that posed a high level of hazard could receive greater attention, which resulted from discussion within the inspectorate rather than from a formal hazard assessment system.⁶ Frequent inspection allowed the inspectors to become familiar with mines and to respond to problems swiftly and in an informed manner.

Relations with workers

6. Inspectors had close relations with workers and workmen inspectors, who inspected mines on behalf of the workers. Those close relations were supported, and in some cases required, by the Coal Mines Act 1979. For example, inspectors had to inspect a mine as soon as practicable after notice of a serious accident and notify workmen inspectors of the proposed inspections. Workmen inspectors could accompany the inspector and make their own report to the mine manager.⁷

Scrutiny of mine plans

7. Inspectors scrutinised mine plans at two stages. First, not less than three months before the beginning of each calendar year mine managers had to submit plans showing the proposed development and extraction for that year and the next nine years. Significant detail was required for the upcoming year – the haulage roads, airways, stoppings, boreholes and pump sumps – and increasingly less detail for the later years. Work could not be carried out until the plans were approved by an inspector.⁸

8. Second, mines producing up to 12,000 tonnes of coal per annum had to provide plans every 12 months, and mines producing more than 12,000 tonnes every six months. If an inspector believed a plan to be incorrect, a survey could be required, paid for by the mine owner.⁹
9. The plans enabled inspectors to understand what was going on within a mine. They would be checked against legislative requirements and for indications of sound mining practice, a concept that incorporated health and safety. Any issues would be raised with the licence holder.¹⁰

Licensing

10. The involvement of the inspectorate started at an early stage. There were two types of licence: coal prospecting and coal mining. Each included conditions, into which the chief inspector could have input. Coal mining licences commonly included resource extraction, environmental and safety conditions.¹¹

Competence of workers

11. The inspectorate was involved with competence assessment. A board of examiners ascertained the suitability of applicants for mining certificates of competence. Its membership was specialised and included the chief inspector and two holders of a first class coal mine manager's certificate with at least 10 years' coal mining experience and active involvement in the industry.¹²

High-voltage electrical equipment

12. The electrical inspector within the inspectorate assessed the use of standard voltage electrical equipment. Separate from the inspectorate was an Energy Safety Group, based in the Ministry of Energy, which authorised the use of and surveyed the high-voltage electrical lines often used by mines to supply electricity to underground equipment.¹³ The group's results went to the inspectorate.¹⁴

Summary

13. The inspectorate was influential and had comprehensive involvement in major aspects of coal mining. It could ensure that health and safety was taken into account from an early stage. But this period should not be viewed through rose-tinted glasses. There were still accidents during the 13 years of the Coal Mines Act 1979. One, the fire at the Boatmans No. 4 mine, Reefton, on 18 September 1985, resulted in four deaths.¹⁵

The transition period from the early 1990s to 1998

The late 1980s/early 1990s

14. In 1989 the Ministry of Energy was abolished.¹⁶ The coal mining inspectorate, by then known as the Mining Inspection Group (MIG), was transferred to the Energy and Resources Division of the Ministry of Commerce. Following the Resource Management Act 1991, the MIG's resource management function was transferred to regional authorities. Consequently, its staffing was reduced and its work became more concerned with health and safety.
15. By 1992 the MIG's annual budget was approximately \$3 million, funded almost entirely by levies collected from the extractive industries.¹⁷ There was some industry resistance to the cost of levies, which led to an independent review in 1991, but there was 'agreement on the efficacy of the group and the quality of its inspection and advisory services'.¹⁸

Transfer of the Mining Inspection Group deferred

16. In 1993 consideration was given to transferring the MIG to DOL, in order to rationalise staffing and resources, and to improve the effectiveness of the delivery of health and safety services 'through the availability of additional disciplines and support staff in the Department of Labour'.¹⁹

17. As a 1994 briefing paper of the Ministry of Commerce and DOL noted, both the MIG and the mines it serviced resisted the transfer, claiming it would have a bad effect on occupational safety and health in the industry.²⁰ The briefing paper also raised legislative and administrative difficulties. These included the fact that, because of the 'different institutional histories of the inspectorates', the extractives industries considered the MIG to be 'more "professional"'. This was reflected in generally higher qualifications and more experience, 'leading to... generally better terms and conditions of employment'. DOL also believed that attempting to integrate such staff into Occupational Health and Safety would be likely to 'create a number of management issues' including 'Branch Managers having responsibilities for staff and activities they do not fully understand'.²¹
18. The transfer did not proceed at that stage. The MIG remained with the Ministry of Commerce to provide occupational health and safety services for the mining, quarrying, petroleum and geothermal industries. DOL retained policy responsibility for those industries. The arrangements were agreed at ministerial level.²²
19. In July 1998 MIG was transferred to DOL, with Cabinet approval.²³ There were two exceptions. First, the Energy Safety Group, by then in the Ministry of Commerce, continued to provide electrical safety services to the sector. Second, the permitting function remained with the Ministry of Commerce.

Staffing

20. From 1993 to 1998 the MIG consisted of about 20 to 25 people.²⁴ In 1995, for example, there were three coal inspectors, three mining engineers, five quarry inspectors, one electrical/mechanical engineer, two petroleum/geothermal inspectors, two regional managers, one group manager and eight support staff.²⁵

Inspection frequency

21. The inspection frequency reduced. In 1993–94 all underground mines were to be inspected every two months. In 1995 that reduced to every three months because an 'increased emphasis on education and training' made the greater frequency unrealistic.²⁶ A 1996 mining inspectorate report 'indicates that a continued shortage in staff numbers and an increase in educational activities resulted in a reduction in field inspection work'.²⁷ The declining number of minerals and coal inspections over the 1991–97 period is shown in Figure 22.1.

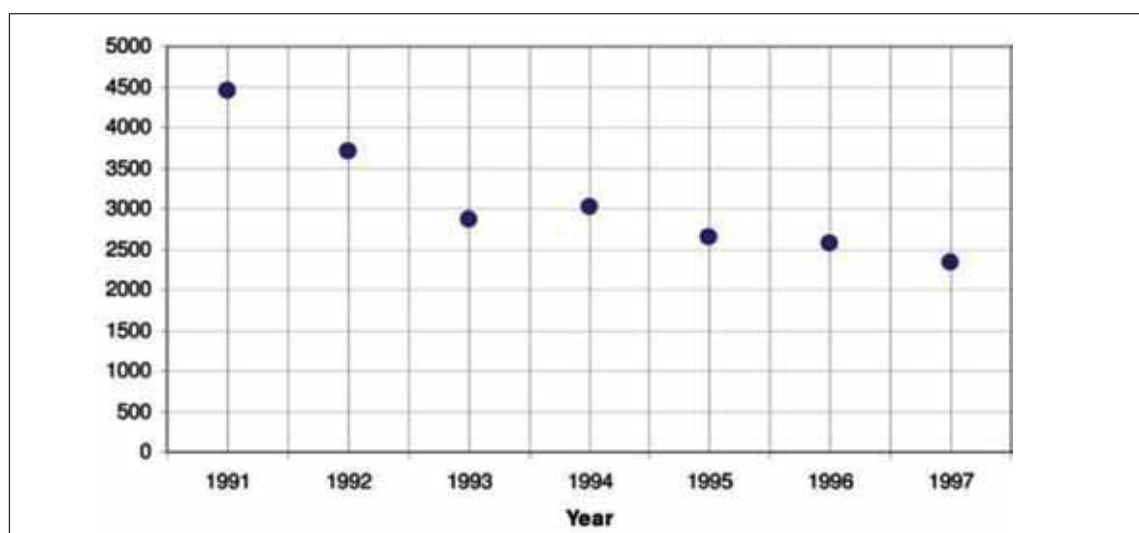


Figure 22.1: Number of minerals and coal inspections 1991–97²⁸

Serious harm frequency rates

22. At the same time, mining serious harm frequency rates increased, as shown in Figure 22.2. The MIG's 1995 annual report noted that mine operators considered 'reduced inspection frequency and lack of mining regulations' were contributing factors.²⁹

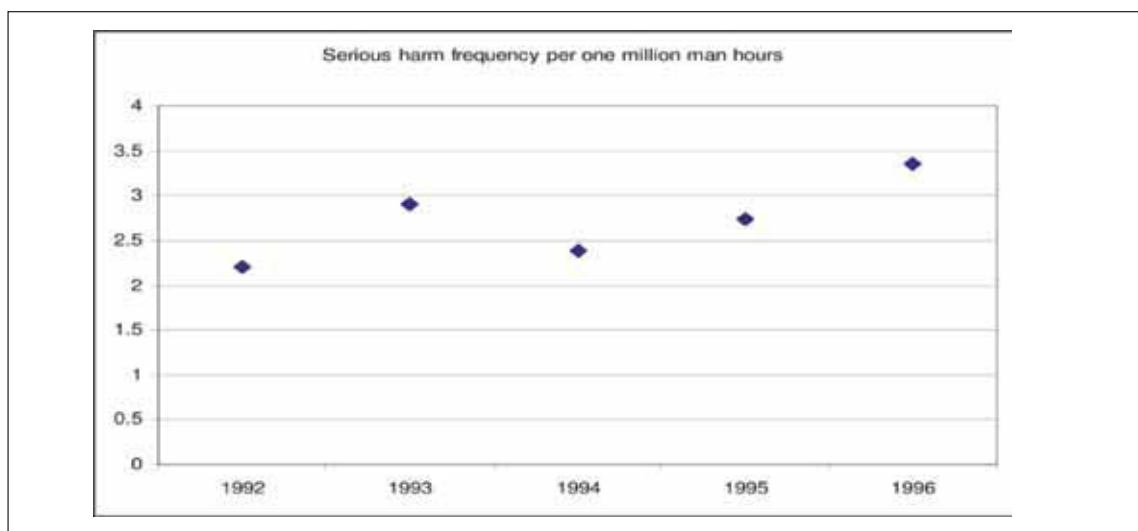


Figure 22.2: Serious harm frequency rates³⁰

Education

23. The MIG's involvement in education lessened. The board of examiners had been disestablished and the Extractive Industry Training Organisation (EXITO) now provided training and issued certificates of competence.³¹

Responsibilities

24. Responsibility for health and safety was increasingly seen as falling squarely on the operator. This was seen as allowing reduced but targeted surveillance.³²

Summary

25. The period, from the early 1990s to 1998, was the beginning of the decline of the mining inspectorate. By the end of the period it had no statutory role in permitting and environmental matters. The number of inspections was reducing and reported serious harm rates were increasing.

The mining inspectorate from 1998

26. There was continued decline after July 1998, when the MIG was transferred to DOL. The separate mining inspectorate ended.
27. Following the transfer, the inspectors fell within a department responsible for inspecting almost all New Zealand workplaces. They became part of the body of approximately 140 warranted health and safety inspectors within DOL,³³ who were mainly generalist inspectors but could access technical expertise.³⁴
28. The mining inspectors were responsible for all 1000 or so coal and metalliferous mines, tunnels and quarries. Because they were also generalist health and safety inspectors and inspectors under the Hazardous Substances and New Organisms Act 1996, they had some responsibility for non-extractives matters.
29. The inspectors were not required to have expertise in the mining method used by the mines they inspected.³⁵ The two extractives inspectors in 2009–10, Michael Firmin and Kevin Poynter, did not have hydro-mining expertise, the method used by two main underground coal mines, Pike River and Spring Creek.
30. Underground coal mines tended not to be inspected by inspectors with other skills. This meant that neither mechanical inspectors nor those with expertise in workplace fatigue were inspecting underground coal mines.³⁶
31. From 2009 DOL assumed increasing responsibility for electrical equipment inspection,³⁷ but lacked the required expertise. By July 2011 it had appointed an electrical inspector, but he did not have coal mine electrical expertise.

This is a complex area requiring specialist knowledge,³⁸ for example of sensor systems for gas and ventilation, variable speed drives and flameproof and intrinsically safe equipment.

32. The department did not have enough expertise to inspect the range of major hazards in underground coal mines, including geological, geotechnical, strata, spontaneous combustion, poor ventilation, methane and electrical. Assessing those and their controls requires a diverse range of expertise. Compliance cannot be assured by someone with mine manager qualifications physically inspecting a mine.³⁹ DOL told the commission that ‘the technical nature and potential for catastrophic (low-frequency high-consequence) events in the underground extractives sector, particularly coal mining, is recognised and the sector is serviced by two full-time mines-qualified Health and Safety inspectors.’⁴⁰

Too few mining inspectors

33. At the time of the transfer several mining inspectors resigned, meaning only two transferred to DOL.⁴¹ Aside from February 1999 until early 2001 when there were three mining inspectors, DOL did not increase their number for three reasons:
- there was no longer a legislative requirement to collect specific levies on coal mining,⁴² this was seen as removing the need to inspect each workplace at least annually, and provide a minimum level of service;
 - although the numbers of inspectors had fallen, the inspection rates and inspector ratios were still higher than for any other sector, making it difficult to justify increases,⁴³ and
 - other authorities had taken over a number of functions previously performed by the MIG.⁴⁴
34. From 2001 to October 2011 the number of mining inspectors fluctuated between one and two.⁴⁵ From April 2008 the two inspectors were Mr Firmin and Mr Poynter. Mr Firmin was based in Dunedin. He had been an inspector since 1995, but his warrant was only extended to include underground coal mines in February 1999.
35. Mr Poynter was based in Westport and started in April 2008. He received his certificate of appointment in June 2009, after completing training.⁴⁶ That allowed Mr Poynter to use the powers, including of inspection, under the HSE Act. But before completing training and being warranted he was conducting inspections. He would have had to involve a warranted inspector were enforcement steps required.⁴⁷
36. Mr Poynter resigned in June 2011, which left only Mr Firmin for three months until September 2011. This was not the first time Mr Firmin was alone. Since February 1999 he had been the sole mining inspector on three other occasions: from March 2001 to June 2001, from October 2004 to July 2005 and from December 2006 until April 2008, all periods when an inspector had left but not yet been replaced.⁴⁸
37. Because there were no mining inspectors in the North Island, Mr Firmin and Mr Poynter were responsible for inspecting all New Zealand extractives workplaces.⁴⁹ They alternated responsibility for the North Island on a six-monthly cycle.⁵⁰
38. From the 2004–05 business year onwards there were 20 quarry inspectors, but they were generalist inspectors whose warrants were extended to include quarries. Only some received additional training, given by the extractives inspectors. It is unclear how many actually inspected quarries. Many quarries were not being inspected.⁵¹ In Mr Firmin’s recollection, the last dedicated quarry inspector had left DOL about five years before the July 2011 commission hearing.⁵²

Expertise and professional development

39. Mining inspectors must meet prescribed qualification and experience criteria, which are not specific to underground coal mining.⁵³ DOL requires them to hold a first class mine manager’s certificate of competence,⁵⁴ and provides initial training in such topics as legislation, compliance assessment and prosecution. This does not focus on underground coal mines and is not taught by people with mining expertise.⁵⁵ Mr Poynter’s training did not deal

with the main mining regulations, the Health and Safety in Employment (Mining – Underground) Regulations 1999. His ventilation training was 'based on ventilation principles in normal workplaces like factories or warehouses.'⁵⁶ The compliance training did not focus on complex mine systems.⁵⁷ In essence, his first class mine manager's certificate of competence was seen as reflecting sufficient industry-specific expertise.

40. There was no requirement for ongoing professional development, but Mr Firmin attended a Queensland risk management course in 2010.⁵⁸ There were training deficiencies in hazard identification,⁵⁹ auditing, workplace culture,⁶⁰ management practices, emergency response, inspections and investigations. In their review, Gunningham and Neal stated that 'the mines inspectors felt particularly disadvantaged, seeing themselves as specialists within a generalist inspectorate which did not see the need to equip them with mining specific skills they needed'. They quoted Mr Firmin:

Management's approach is – all you need [is] to check people's systems and any inspector can [do this] ... but I say I want ventilation, engineering training, geotechnical training, and they say it's not your responsibility why do you need training to that degree. ... sometimes I say I am coming [to a mine] to do ventilation, show us all you have done, but I need the qualifications to ask, is it adequate?... You have to have continuous professional development ... I need to be competent, up with developments ... I want to be current, go on courses, sit exams. It helps my credibility on site.⁶¹

Fewer inspections

41. In the year to 30 June 1997, before the MIG transferred to DOL, it completed 2246 compliance inspections, 157 of which were of 18 underground coal mines – an average of 8.7 inspections a year.⁶² By the late 2000s DOL had decided that underground coal mines would be inspected four times a year. Additional visits occurred in response to incident notifications. That inspection frequency had to be justified. Mr Firmin recalled:

*about three years ago when people at the Mining Steering Group started to challenge, 'Well, do you need to go to these places. How long do you need to go there?' And they weren't sort of trying to stop us, just saying, 'Well, do you need to do this? You need, there's less inspectors why do you need to go to these places this often?'*⁶³

42. A reduction in the number of inspections, called workplace assessments,⁶⁴ is reflected in data supplied by DOL.

Count of workplace assessment processes conducted in terms of the ANZSIC classification of B11 (Coal, black coal & brown coal mining) 1998–2011	
YEAR	WP ASSESSMENT PROCESS
1998	109
1999	211
2000	190
2001	53
2002	154
2003	184
2004	137
2005	43
2006	8
2007	58
2008	42
2009	47
2010	36
2011 ⁶⁵	17
TOTAL	1289

Figure 22.3: Mining – the number of workplace assessments

43. From 1999 to 2005 there was a steady increase in the number of serious harm notifications from the extractives sector.⁶⁶

44. The inspection regime reflected the number and workload of mining inspectors rather than the risks posed by individual underground coal mines.⁶⁷ In Queensland the inspection regime is based on a systematic assessment of the hazards of individual mines, using a mines inspection planning tool.
45. Nothing in the way inspectors carried out their duties meant that four inspections per year gave the same assurance as the previous average of 8.7.⁶⁸

Nature of inspections

46. Inspectors have to be notified at least 14 days before a mine is worked or a tunnel is started.⁶⁹ By then the design will have been finalised. Notifications do not include detailed design information.⁷⁰ Thus the inspectors have limited influence in this area.
47. Inspections were notified in advance,⁷¹ rather than a mixture of with or without notice, as used under the Coal Mines Act 1979 and in many overseas jurisdictions.
48. Between four to eight hours was spent inspecting a large underground coal mine.⁷² That time allocation and four inspections per year made it impossible to inspect all the workings of a large underground mine and assess the safety management and incident and accident reporting systems. Even allowing for a targeted approach, the inspection time and frequency were inadequate.
49. Inspections usually involved going under ground to check such aspects as the ventilation, roof bolting, stoppings and stone dusting. But mines were not systematically checked for compliance with the HSE Act and its regulations. As Gunningham and Neal note, the

*starting point was certainly not an audit or other assessment of the company's health and safety management systems. They did not, for example, concern themselves specifically with whether the mine's occupational health and safety management system met legal requirements, complied with recognised practices or were subject to periodic review.*⁷³
50. Inspectors were not trained to audit mine systems,⁷⁴ despite auditing being one of the prescribed areas of examination for a health and safety inspector.⁷⁵ Nor did they have an audit tool.⁷⁶ Mr Firmin said that auditing was 'generally not something that anybody in the department, to my knowledge, does.'⁷⁷ He recalled the mining inspectors raising the matter, but nothing came of it.⁷⁸ Following the Pike tragedy, the government commissioned an urgent audit of underground coal mines using Australian experts, supported by DOL.

Contact with workers, worker representatives and health and safety officers

51. There was limited contact with workers and their representatives. The inspectors usually spoke to workers, but not in a systematic way. They did not always give workers feedback about investigations. DOL did not provide workers with the inspectors' contact details. Mr Firmin could not recall underground coal mine workers ever phoning to raise a health and safety issue.⁷⁹
52. Worker representatives rarely raised issues with the inspectors.⁸⁰ Only once had Mr Firmin received a hazard notice issued by a worker representative under the HSE Act, which related to an open cast coal mine.⁸¹ When concerns were identified, inspectors did not always contact health and safety representatives, missing the opportunity to inform them and also gather relevant information.⁸²
53. The inspectors' contact was often with the mine manager or operational management. For example, Mr Poynter had little contact with the health and safety manager at Pike, partly because of time pressure.⁸³

Culture

54. The inspectors had raised internally the subject of their assessing workplace safety culture in mines, but they lacked the training to do this. DOL had developed a general workplace safety culture questionnaire, but it was not used by inspectors at underground coal mines.⁸⁴

Education and experience

55. The inspectors conducted information visits, which involved giving workers health and safety information, but it is not known how effective these were. Although inspectors were not involved in either granting qualifications or industry training, they were concerned about the adequacy of qualifications.⁸⁵
56. Inspectors generally did not assess the ratio of experienced to inexperienced workers or routinely focus on the adequacy of workers' training and experience for particular tasks.⁸⁶

Gathering and use of data

57. Ideally, health and safety regulators should gather and analyse a range of modern health and safety data – lag and lead indicators and personal and process safety data. The legislation requires notification of some, but not all, of that data. The regulator needs the capacity to analyse it.
58. DOL received serious accident data from underground coal mines but did not analyse it to identify patterns.⁸⁷ The inspectors lacked the time for this task and had not been trained to do so.⁸⁸ Certain categories of high-potential incidents had to be notified to DOL,⁸⁹ but it did not analyse them.⁹⁰ Underground coal mine process safety data did not feature. DOL did not gather lead indicator data for underground coal mines.⁹¹
59. The inspectors lacked a proper profile of underground coal mines, for example of their operations, key personnel, systems and hazards.⁹² This was a result of a failure by DOL to collect and collate relevant information. Mr Firmin gave evidence that INSITE can produce a summary of the compliance history of an operator, but that summary does not include negotiated agreements, even if they have been breached.⁹³ It seems that INSITE cannot be readily searched to identify whether the same problem has arisen before with an employer. Inspectors needed to check the record of each interaction with a mine operator, which was time-consuming.

Enforcement

60. DOL aimed to seek voluntary compliance by using the minimum regulatory intervention.⁹⁴ The mining inspectors favoured low-level enforcement tools, particularly negotiated agreements, rather than requiring compliance through improvement, prohibition and infringement notices, and prosecutions. As Figures 22.4 and 22.5 show, there has been increased use of prohibition notices since the Pike River tragedy.

Improvement and Prohibition Notices issued in respect of coal mines 1 January 2005 – 30 June 2011		
YEAR	IMPROVEMENT NOTICE	PROHIBITION NOTICE
2005	73	0
2006	5	1
2007	10	3
2008	16	0
2009	16	0
2010	2	2
2011	1	5
TOTAL	123	11

Figure 22.4: Improvement and prohibition notices

**Negotiated Agreements and Infringement Notices issued in respect of coal mines
2004/2005 – 2009/2010**

YEAR	NEGOTIATED AGREEMENT	INFRINGEMENT NOTICE
2004/2005	–*	13
2005/2006	203	4
2006/2007	909	12
2007/2008	667	17
2008/2009	662	7
2009/2010	528	4
TOTAL	2969	57

*Negotiated agreements have only been in use since 2005.

Figure 22.5: Negotiated agreements and infringement notices

61. Prosecutions occurred in response to accidents, but usually only when serious harm resulted.⁹⁵
62. There was a suggestion that higher approval was required for use of prohibition notices. Mr Poynter said in relation to Pike: 'A prohibition notice would likely have to be approved by someone other than myself . . . So a prohibition for a – that stopped a mine producing coal would – that's a decision that would have to have [sic] asked from higher above.'⁹⁶ Although prior consultation and sometimes legal advice may be desirable, inspectors should have authority to take decisive enforcement action.

Summary

63. From 1998 onwards the number and range of expertise of people inspecting mines declined. The mining inspectors' workload was formidable and the inspection frequency reduced. Training was insufficient. Modern health and safety data was not used to assess the risks posed by individual mines and focus the inspectors' efforts. Workers and worker representatives were not sufficiently involved with inspectors.

Conclusions

64. Since the HSE Act came into force, there has been a substantial decline in the capacity and effectiveness of the mining inspectorate and a loss of identity. It was understaffed, especially in later years. It lacked the required range of expertise. Its approach was outdated and its training and systems limited. There was inadequate contact with workers and worker representatives. The inspectors could not properly do their job of ascertaining and taking reasonable steps to assure health and safety compliance in underground coal mines.⁹⁷

ENDNOTES

¹ This report uses the terms 'mining inspector' and 'mining inspectorate'.

² Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/56, para. 213.

³ Appointments were made under the State Services Act 1962. See Coal Mines Act 1979, ss 8–10.

⁴ Robin Hughes, transcript, pp. 234–35.

⁵ Ibid., p. 238.

⁶ Ibid., pp. 239–40.

⁷ Coal Mines Act 1979, ss 173, 177(2)–(3).

⁸ Ibid., ss 136, 136(1).

⁹ Ibid., s 151(3).

¹⁰ Robin Hughes, transcript, pp. 244–45.

¹¹ Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/23, para. 74.

¹² Coal Mines Act 1979, ss 210, 214.

¹³ High-voltage lines meant until they were stepped down by transformer to less than 650 volts.

¹⁴ Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/55, para. 210.

¹⁵ There were 12 mining related fatalities between 1980 and 1991, Coronial Services, Mining deaths between 1979 and 2006, 21 December 2010, CAC0177/1

¹⁶ Ministry of Energy (Abolition) Act 1989.

¹⁷ Department of Labour, Tier Two Paper, 10 May 2011, DOL0000010001/47, para. 140.

¹⁸ Ibid., DOL0000010001/48, para. 142.

¹⁹ Ibid., DOL0000010001/48, para. 143.

²⁰ Department of Labour and Ministry of Commerce, Administration of Health and Safety in Employment Act in Mining, Quarrying, Petroleum and Geothermal Industries, 8 April 1994, DOL0010010011/2, para. 6.

- ²¹ Ibid., DOL0010010011/3, paras 13–14.
- ²² Department of Labour, Tier Two Paper, 10 May 2011, DOL0000010001/49, para. 148.
- ²³ Ibid., DOL0000010001/50, paras 150–51; Cabinet Office, Delivery of Occupational Safety and Health Services to the Extractive Industries, 23 March 1998, CAB (98) M 10/5D(1), MED0010040034/1.
- ²⁴ 23.5 full-time equivalents.
- ²⁵ Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/81, para. 280.
- ²⁶ Ibid., MED0000010001/82, para. 282; Ministry of Commerce, Report of the Ministry of Commerce for the Year Ended 30 June 1995, MED0010040027/71.
- ²⁷ Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/82, para. 283; Mining Inspection Group, Ministry of Commerce, 1996 Annual Report, 1997, MED0010040030/12.
- ²⁸ Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/83, para. 287. The commission does not have inspection data dealing discretely with the 1993–98 period.
- ²⁹ Mining Inspection Group, Ministry of Commerce, 1995 Annual Report, 1997, MED0010040032/12; Ministry of Economic Development, Tier Two Paper, 6 May 2011, MED0000010001/82, para. 285.
- ³⁰ Ibid., MED0000010001/83, para. 286. It is not known whether increased compliance with serious harm reporting requirements contributed to the increase.
- ³¹ Regulation 17 of the Health and Safety in Employment (Mining Administration) Regulations 1996 grants the secretary of labour power to recognise an organisation as being able to issue certificates of competence. The only organisation so recognised is EXITO. See Department of Labour, Department of Conservation, Ministry of Economic Development and Ministry for the Environment, Joint Legislative Framework Paper, 6 May 2011, CLO0000010001/92, para. 315.
- ³² See, for example, George Munro, 'Opening the Doorway to Self-Management in the Mining Industry – The Reduced Site Surveillance Programme', in 1997 New Zealand Minerals and Mining Conference Proceedings, MED0010040031.
- ³³ About half of the inspectors are also warranted as inspectors under the Hazardous Substances and New Organisms Act 1996. Contractors also undertake audits under that act.
- ³⁴ Susan (Lesley) Haines, witness statement, 20 June 2011, DOL7770010001/4, para. 15.
- ³⁵ Michael Firmin, transcript, p. 2810.
- ³⁶ Ibid., p. 603. The exception is inspections under the Hazardous Substances and New Organisms Act 1996.
- ³⁷ Department of Labour, Tier Two Paper, 10 May 2011, DOL0000010001/64, para. 228.
- ³⁸ Michael Firmin, transcript, pp. 603–04, 635.
- ³⁹ Ibid., pp. 635–38, 2809.
- ⁴⁰ Geraint Emrys, witness statement, 20 June 2011, DOL7770010002/5, para. 25.
- ⁴¹ Letter, Brett Murray to Aedeon Boadita-Cormican, 6 July 2012, MBIE3000010002/1.
- ⁴² Ministry of Energy (Abolition) Amendment Act 1998, s 3, which came into force 1 July 1998.
- ⁴³ Department of Labour, Tier Two Paper, 10 May 2011, DOL0000010001/52, para. 161.
- ⁴⁴ Ibid., DOL0000010001/52, para. 162.
- ⁴⁵ Letter, Brett Murray to Aedeon Boadita-Cormican, 6 July 2012, MBIE3000010002/1.
- ⁴⁶ Kevin Poynter, transcript, p. 2965.
- ⁴⁷ Kevin Poynter, witness statement, 19 October 2011, DOL7770040003/8, para. 27.
- ⁴⁸ Letter, Brett Murray to Aedeon Boadita-Cormican, 6 July 2012, MBIE3000010002/1.
- ⁴⁹ Michael Firmin, transcript, pp. 597–98.
- ⁵⁰ Neil Gunningham and David Neal, Review of the Department of Labour's Interactions with Pike River Coal Limited, 4 July 2011, DOL0100010001/38–39, para. 114.
- ⁵¹ Michael Firmin, transcript, p. 598; Memorandum, Department of Labour Mining Steering Group to Workplace Services Management Team, 12 February 2010, DOL0020020022/2.
- ⁵² Michael Firmin, transcript, p. 601.
- ⁵³ Health and Safety in Employment (Prescribed Matters) Regulations 2003, reg 6.
- ⁵⁴ Neil Gunningham and David Neal, Review, DOL0100010001/50, para. 159.
- ⁵⁵ Kevin Poynter, transcript, p. 2966.
- ⁵⁶ Ibid., pp. 2966–67.
- ⁵⁷ Ibid., pp. 2966–68.
- ⁵⁸ Michael Firmin, transcript, pp. 2812–13.
- ⁵⁹ Kevin Poynter, transcript, p. 2968.
- ⁶⁰ Ibid., p. 2983.
- ⁶¹ Neil Gunningham and David Neal, Review, DOL0100010001/98, para. 346.
- ⁶² Department of Labour, Tier Two Paper, 10 May 2011, DOL0000010001/50, para. 153.
- ⁶³ Michael Firmin, transcript, pp. 643–44.
- ⁶⁴ Department of Labour, Answers to Questions for Department of Labour, 31 August 2011, DOL7770010009/6–7, paras 14, 19 (Table 4).
- ⁶⁵ Figures to 30 June 2011, the end of 2010/11 financial year.
- ⁶⁶ Department of Labour, Tier Two Paper, 10 May 2011, DOL0000010001/52, para. 165.
- ⁶⁷ Michael Firmin, transcript, pp. 643–45.
- ⁶⁸ Ibid., p. 644.
- ⁶⁹ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 8.
- ⁷⁰ Michael Firmin, transcript, pp. 630–31.
- ⁷¹ Ibid., p. 628.
- ⁷² Ibid., p. 629; Michael Firmin, witness statement, 22 June 2011, DOL7770010005/5, para. 21.
- ⁷³ Gunningham and Neal, Review, DOL0100010001/89, para. 306.
- ⁷⁴ Michael Firmin, transcript, p. 2810.
- ⁷⁵ Health and Safety in Employment (Prescribed Matters) Regulations 2003, reg 6(1)(a)(vi).
- ⁷⁶ Kevin Poynter, transcript, p. 2985.
- ⁷⁷ Michael Firmin, transcript, p. 2810.
- ⁷⁸ Ibid., p. 2811.
- ⁷⁹ Ibid., p. 612.
- ⁸⁰ Ibid., pp. 640–41.
- ⁸¹ Ibid., p. 641.
- ⁸² Ibid., p. 2832.
- ⁸³ Kevin Poynter, transcript, pp. 3118–20.
- ⁸⁴ Michael Firmin, transcript, p. 640.
- ⁸⁵ Kevin Poynter, transcript, pp. 2993–96.
- ⁸⁶ Michael Firmin, transcript, p. 641; Kevin Poynter, transcript, p. 2996.
- ⁸⁷ Michael Firmin, transcript, p. 614.
- ⁸⁸ Ibid., pp. 614, 639.
- ⁸⁹ Health and Safety in Employment Act 1992, s 25; Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 10.
- ⁹⁰ Kevin Poynter, transcript, pp. 2979–80.
- ⁹¹ Michael Firmin, transcript, pp. 2813–19.
- ⁹² Ibid., pp. 2830–31.
- ⁹³ Ibid., p. 2829.
- ⁹⁴ Susan (Lesley) Haines, witness statement, 20 June 2011, DOL7770010001/6, para. 30.
- ⁹⁵ Department of Labour, Answers to Questions, DOL7770010009/29, paras 67–69.
- ⁹⁶ Kevin Poynter, transcript, p. 3081.
- ⁹⁷ Health and Safety in Employment Act 1992, s 30; Michael Firmin, transcript, p. 2809.

Management of the mining inspectorate

Introduction

1. This chapter explores how the mining inspectorate was managed, supported and reviewed within the Department of Labour (DOL).

Management and support

2. Mining inspectors were managed or supported by a team leader, the senior advisor high hazards (extractives) and the Mining Steering Group (MSG).

Their direct reporting line

3. Mr Firmin and Mr Poynter, and non-mining inspectors, reported to team leaders in Dunedin and Christchurch respectively. Those team leaders reported to service managers, who reported to the southern regional manager.¹ In keeping with DOL's policy of merging the mining inspectors with the generalist inspectorate, line management had no mining expertise.
4. The structure had several consequences. First, line management did not adequately understand the needs of an underground coal mining inspectorate. As one of the inspectors told Gunningham and Neal, 'There is a gap between generalist staff and us. I have had four managers in the past 11 years – each comes in assuming mining is no different from anything else and I try and educate them.' This lack of understanding sometimes made it difficult for the inspectors to carry out their duties effectively. Mr Firmin was once temporarily refused permission to travel 'because of resource limitations, which would have had the consequence of preventing him from engaging in almost all mine inspections required in his workplan.'²
5. Second, the two mining inspectors lacked adequate specialist support and their geographical separation made it hard for them to support each other.
6. Third, there were administrative and budgetary tensions because each region 'administered its own budget but funding inspectors to travel to the North Island came from the Southern region'. Even in the South Island the inspectors had to travel extensively, 'so travel and overnight accommodation costs arose as an issue.'³
7. Every month the inspectors reported in detail to their team leaders. For example, Mr Poynter reported that at Pike:
 - during the development stage of the mine, methane ignitions had been notified, the number of which were only discovered as part of an investigation;⁴
 - the stone dusting appeared inadequate;⁵
 - there appeared to be a breakdown of the strata management plan because pull testing of bolts had not been done for a long time;⁶
 - workers had raised the issue of the second means of egress, which was 'up the shaft, which is a 120m climb';⁷ and
 - given the plans for production and an increase in the number of workers underground, it was agreed 'that the existing second egress should be enhanced by the completion of another egress as soon as possible.'⁸

8. The reports, both on Pike and other mines, contained information that should have caused a review of the department's approach to compliance. For example, from March 2010 to June 2010 Mr Poynter reported that a gold mine was operating in breach of the requirement to have two means of egress:⁹

Single access into [undisclosed] Mine has been open and operating since approx [undisclosed] and has had several visits from previous Inspectors. This has not been raised before. Owner managing risks. Have raised issue with Owner but have not [sic] issued any notices at this stage ... Breach of the HSE Underground Mining Regulations.¹⁰

9. In evidence Mr Poynter described the gold mine, which had operated for many years, as having a long single entry and no other way out.¹¹ Even after Mr Poynter raised the issue in March 2010, enforcement was slow. Reports for June 2010 and July 2010 record that Johan Booyse, then the senior advisor high hazards (extractives), and Mr Firmin were to visit the mine.¹² The August 2010 report records that an improvement notice had been issued and was being disputed.¹³ By September 2010 Mr Firmin was 'working on Negotiated agreement to construct Second Egress.'¹⁴ The October 2010 report records 'Second egress agreed and Neg Agreement with Dol [sic] to complete.'¹⁵
10. A mine was allowed to operate unlawfully for many years in a way that had potential for serious harm or death. Inspectors who visited before Mr Poynter had not acted. After Mr Poynter's involvement, enforcement action still took approximately six months.
11. Health and safety concerns were often identified or reported at extractives sites, including a roof fall that resulted in serious injury,¹⁶ and another fall that buried a mining machine.¹⁷ These and other health and safety concerns should have raised questions about the effectiveness of DOL's scrutiny of the industry.
12. The shortage of mining inspectors featured regularly in reports. From August 2009 to September 2009 Mr Poynter reported that:

With only two warranted Inspectors covering the country resources are extremely stretched. In addition there is a lack of knowledge or inspections of high-risk extraction sites throughout the lower half of the North Island.

Plans to inspect Underground Tunnel in Auckland Area but nothing has been done to evaluate the need in the lower half of the NI.

The impact or risk on the Department should anything occur is high.¹⁸

13. Mr Poynter's November 2009 to October 2010 reports repeated those comments and added, 'We are attempting to ensure all high-risk underground operations are visited but there are a large number of high-risk quarries that will not be proactively inspected.'¹⁹ Mr Firmin also reported problems: 'Not able to inspect some high-risk sites in Auckland and Waikato. Partly because manager limited travel. Issue of what needs to be inspected needs to be addressed.'²⁰
14. These problems went to the heart of the inspection function. The team leaders were unable to address major issues, which involved significant policy and resource implications, but the issues were known about higher up in DOL.

The senior advisor high hazards (extractives)

15. This position, based in the national office in Wellington, existed from 1988, although by another name. The role included:²¹

Work to bring about a significant improvement in workplace health and safety in the extractives sector ...

Provide professional and technical advice to the Department in the development of policy and standards as they apply to workplace productivity in the coal mining industry ...

Build effective relationships with key national and international stakeholders in the mines and quarries industries to ensure New Zealand mining and quarrying operations are managed in a safe and productive manner consistent with international best practice and to meet the strategic needs of the country.²²

16. The role was not concerned wholly with health and safety. The senior advisor and mining inspectors were part of the workplace group, whose functions include 'workplace relationships,' 'productivity' and 'health and safety.'²³ This reflected the breadth of DOL's portfolios, 'which include labour, immigration, employment and accident compensation.'²⁴

17. No significant improvement in health and safety was possible, given the limited number of mining inspectors and the inadequate systems. Additionally, the senior advisor had no staff or budget.²⁵ Mr Firmin thought the lack of budget and authority 'frustrated him [the senior advisor] in his efforts to try and work with us within the industry'.²⁶
18. The role did not include direct oversight of the mining inspectors.²⁷ As Gunningham and Neal state, Messrs Poynter and Firmin had 'far less contact' with the senior advisor than they did with their team leader. 'He did not supervise their operational duties. They would contact Mr Booyse primarily when they needed specialist advice on an issue or in relation to the quarterly meetings of the Mining Steering Group'.²⁸ Following the Gunningham and Neal review, the structure was changed and by July 2011 the inspectors reported to the senior advisor.²⁹
19. The inspectors needed expert support and guidance, but the senior advisor was not required to have underground coal mine expertise. The advisor was a member of the MSG and privy to the major issues facing the inspectors. Like their team leaders, he was probably powerless to remedy them.

Mining Steering Group (MSG)

20. This group, which was created following two underground coal mine tragedies in 2006, was to:
 - be a forum for national planning and setting of operational priorities across the sector*
 - ... be a means of monitoring and resolving emergent mining issues*
 - ... be responsible for improving the consistency of approach by mines inspectors in relation to regulatory checks and visits*
 - ... enable the coordinated involvement of relevant line managers*
 - ... assist with Dept's development of industry standards, guidelines and operating procedures.*³⁰
21. According to the deputy chief executive of DOL's Labour Group, the MSG brought together 'all the resources working ... on mining, and their managers, to maximise the effectiveness of their efforts'.³¹
22. Its members were the mining inspectors, the senior advisor and relevant team leaders, service managers and regional managers. Mining expertise was limited. For example, at one point the group questioned the need to store copies of the mine plans sent by operators to the inspectors and queried their purpose. The senior advisor and inspectors had to explain the importance of the plans. The group agreed to 'Seek legal opinion on what responsibilities flowed to the DOL following the handover from the MED [Ministry of Economic Development]'.³² This was in 2010, over a decade after the department took over mines inspection.
23. The group was supposed to meet every three months but did not always do so.³³ It met between two and four times per year, although DOL stated that 'minutes may not always have been formally recorded and circulated after every meeting'.³⁴ The group discussed issues that, if addressed, could have substantially improved health and safety in mining.
24. Forming operational links with other agencies was seen as desirable, especially with the Ministry of Economic Development, to whom permit holders had to submit proposed mining plans. Those plans, if sufficiently detailed, may have assisted the inspectors. To Mr Firmin's knowledge, that link had not been established by July 2011.³⁵
25. Professional development was discussed but thwarted by budget constraints. The July 2009 minutes record that the senior advisor was to 'look for opportunities for funding and for appropriate courses etc to increase inspectors [sic] development ASAP'.³⁶ In Gunningham and Neal's words:
 - A concern that the training provided to the mining inspectors might be inadequate is hardly new. During a 2006 review³⁷ concerns were expressed (particularly given the anticipated growth of the industry) not just about the need for specialist training but also regarding the inspectorate's core skills in areas such as investigation, report writing, record keeping, work planning and legal knowledge, machinery guarding etc.*³⁸
26. The MSG discussed whether 'Johan [Booyse], Kevin [Poynter] and me [Mr Firmin] would go out and do some audits but again we were, you know there was lack of funding and it was just something we'd work on once we well could get some funding for that and put into the action plan for next year'.³⁹ DOL's mining business plan for 2010–11 contemplated the inspectors conducting a joint audit or inspection, but Mr Firmin said this did not happen.⁴⁰

27. In July 2009 the group discussed making available a 'basic H & S [health and safety] Management plan for small business to use.⁴¹ By November 2011 it had not been produced. The senior advisor was concerned about the adequacy of the mining information on the DOL website, in particular the lack of mining regulations, guidelines, safety statistics, good practices and audit tools,⁴² but much of this material did not exist.
28. Mr Poynter discussed with the MSG and senior managers his concerns about not reporting to a mine expert. He considered 'it made it a little bit dysfunctional in that with Michael [Firmin] reporting to somebody in Dunedin, me reporting to somebody in Christchurch and Johan [Booyse] reporting to somebody in Wellington, we were hardly an inspection or a mining inspection group. It was really difficult to try and have a co-ordinated approach.'⁴³
29. The MSG was unable to tackle the problems confronting the inspectors. It appears to have lacked a budget and the authority to make key decisions.⁴⁴ It was disestablished on 19 August 2011.⁴⁵

Lack of guidance information

30. The mining inspectors lacked sector-specific departmental guidance material. They had generic guidance, including an *Investigations Best Practice* manual and DOL operational procedures and guidance, but these had no focus on underground coal mines.⁴⁶ These deficiencies were compounded by the absence of codes of practice and guidelines for the industry, upon which the mining inspectors could have relied. Consequently, the inspectors sometimes used regulations issued under the repealed Coal Mines Act 1979, or overseas material.⁴⁷
31. DOL did not compare its level of enforcement in underground coal mining with that for other industries, or with overseas levels.⁴⁸ A comparison could have helped the inspectors to evaluate their approach.

Inadequate reviews of inspectors

32. Performance reviews were intended to be, but were not always, conducted quarterly.⁴⁹ Because they were undertaken by a team leader, not a coal mining expert, it was not possible to carry out a qualitative evaluation. The approach Mr Firmin took to inspecting particular coal mines, including Pike, was never reviewed.⁵⁰ Mr Poynter said:

*Nobody with a technical background ever sat down with me and discussed that performance approach. In fact, I was praised from time to time for being what they termed trying to follow the modern regulator view and work with voluntary compliance. The first major review of any work that we'd done, I guess, came after the November 19, and done by Gunningham and Neal.*⁵¹
33. DOL policy required that, where possible, inspectors contacted health and safety representatives to seek information and keep them abreast of compliance action. But the inspectors did not know about this policy.⁵² Mr Firmin was not aware of any check upon the extent to which he performed this function.⁵³
34. The inspectors' accident investigations were reviewed by team leaders or service managers,⁵⁴ not someone with coal mining expertise.

Resourcing of the mining inspection function

35. Higher levels of DOL, in particular the Workplace Services Management Team (WSMT), knew about the inadequate resources and shortage of extractive inspectors. The WSMT consisted of the group manager workplace services, the national support manager, the chief adviser health and safety, the chief adviser workplace relationships, and the four regional managers.⁵⁵

Request for more resources

36. From mid-2009, the MSG focused increasingly on the shortage of mining inspectors. The group's July 2009 minutes record concern that adequate inspection services could not be maintained. One inspector, John Walrond, had left and was not replaced. Mr Poynter had 'pointed out that in Tasmania before the Beaconsfield Accident, the Chief Inspector of Mines had written to his minister stating he was not in a position to provide an adequate inspection service with the resources at his disposal'.⁵⁶
37. The MSG considered the shortage again on 10 December 2009,⁵⁷ and decided to raise it with the WSMT. A group member cautioned that 'this is a difficult decision for WSMT, with no funds available, and may mean a trade-off with other staff'.⁵⁸ In February 2010⁵⁹ the group provided to the WSMT a memorandum dated 12 February 2010, which described the shortage as posing 'significant political, reputational and service standard/delivery risks to the DoL'.⁶⁰ The potential for catastrophe was described as 'very real'.⁶¹ The group pointed out that '[b]ased on the current staffing levels, there is no realistic means for the DoL to service all high-hazard mining, tunnel or quarry operations, low-risk operations are not currently serviced'.⁶²
38. The memorandum identified that the shortage had an adverse effect on other projects, for example developing a safety management system for small mines, technical guidance and an employee participation plan.⁶³ The position was likely to get worse due to productivity growth in New Zealand. Put simply, there were too few inspectors to inspect all extractives workplaces, advise the industry and help workers, both then and in the foreseeable future.
39. The WSMT rejected employing a third mining inspector.⁶⁴ By the July 2011 commission hearing, an additional inspector had still not been appointed. The WSMT was disestablished as from 31 August 2011.⁶⁵

Staffing costs

40. DOL provided the direct salary and superannuation costs of staff employed in the mining inspection area from 2004–05 to 2010–11. These remained fairly constant:

2004/05	\$331,000
2005/06	\$294,000
2006/07	\$248,000
2007/08	\$178,000
2008/09	\$371,000
2009/10	\$348,000
2010/11	\$323,000

Figure 23.1: Salary and superannuation costs for the mining inspection function

41. Those costs do not equate to salaries of the two mining inspectors. Before the Pike River tragedy, a mining inspector's salary was up to about NZ\$76,000.⁶⁶ This does not compare well with industry and overseas equivalents.
42. In Mr Poynter's view, the mining inspection function was not set up and resourced sufficiently to fulfil the statutory function of ascertaining whether the Health and Safety in Employment Act 1992 has been, or is likely to be, complied with.⁶⁷

Oversight of the mining inspection function

43. DOL did not review the effectiveness of moving the mining inspectorate from the Ministry of Commerce to DOL: 'After the Cabinet decisions were made to transfer the MIG to the department it considered there was no mandate to complete a review'.⁶⁸

44. Nor, before the Pike River tragedy, did it review the resources, size, operations, support and training of the inspectorate.⁶⁹ DOL stated that resourcing decisions took place within the wider workplace services business planning process.⁷⁰ It is unclear how this was done without first assessing the effectiveness and needs of the inspectorate.
45. There appears to have been no formal system for reviewing the mining inspectorate after a serious injury or fatality in a mine.⁷¹ Mr Firmin thought there would be a procedure for reviewing performance following criticism by a coroner or court, but he had no knowledge of this occurring.⁷² The 2006 Black Reef and Roa mine tragedies resulted in the formation of the MSG and a 2006–09 mining policy review.⁷³

The Gunningham and Neal review

46. DOL commissioned Professor Neil Gunningham and Dr David Neal to review its interactions at the Pike River mine.⁷⁴ The problems they identified included a lack of general systems audits by the mining inspectors, a failure to ensure the development of codes of practice, insufficient professional development, inadequate written guidance for inspectors and managers' lack of mining expertise.⁷⁵
47. Gunningham and Neal considered that '[g]iven the small size of the mining industry, its statistical profile and the anticipated level of risk, the Department's allocation of resources to mine inspection is reasonable.'⁷⁶ The inspectors' workload was considered reasonable and their performance and compliance approach at Pike River appropriate, because Pike was perceived as co-operative and responsive to informal safety recommendations. Safety culture was seen as 'largely intangible' and did not lend itself to ready investigation.⁷⁷ DOL was seen as a modern regulator. Evidence before the commission does not support these conclusions.

2006–09 mining policy review

48. Following the 2006 fatalities at Black Reef and Roa, the then minister of labour asked DOL to review whether the regulatory framework was 'effective in the high-hazard underground mining environment, and whether there was a case to return to greater regulatory prescription and re-establish a separate mining inspectorate.'⁷⁸
49. The policy review began in mid-2006 and, according to a DOL briefing paper, was 'conducted over a significant period of time in order to ensure a thorough, consultative review of a technical regulatory framework, and to avoid ad hoc reactions and unnecessary regulation.'⁷⁹ The review appears to have been given little priority.
50. Initially DOL took a broad approach. In 2006 it identified a possible need for clearer regulatory requirements, third-party checks for some underground activities and a code of practice focusing on small business operations.⁸⁰ Various papers were developed, including a consultation paper titled *Improving Health and Safety Hazard Management in the Underground Mining Industry*,⁸¹ which sought feedback about safety cases, hazard notification, better guidance, improving employee participation and improving health and safety inspections.
51. There was a wide range of submissions.⁸² There was support for mines to have health and safety systems and hazard management plans from the outset,⁸³ and for risk management to be supported by detailed guidance or approved codes of practice.⁸⁴ Greater prescription was not supported.⁸⁵ Unions and workers backed improving employee participation by using check inspectors, but employers and the industry did not.⁸⁶ Several submitters sought increased inspectorate resourcing and more frequent inspections.⁸⁷
52. As time went on, the review increasingly focused on small mines. Two of the three main recommendations concerned small mines while other problems identified at an early stage were not dealt with.
53. In July 2009 a briefing paper to the minister of labour proposed that:⁸⁸
 - operators of small mines be required to document their health and safety system and hazard management plans when operations began. The minister disagreed;

- the competency requirements for managers of small underground coal mines (fewer than eight people) be raised. The minister agreed, and this was changed in 2010; and⁸⁹
 - DOL should address worker and union concerns about the quality of employee participation in underground mining through improved information and employee participation provisions. The minister agreed.
54. The MSG was concerned that they had not been allowed enough time to provide effective feedback into the review.⁹⁰ This is consistent with an insufficient connection between the inspectors and DOL's policy group.⁹¹ James Murphy, the policy manager, workplace health and safety, who joined DOL in September 2008, could not recall the mining inspectors, senior advisor or the MSG ever raising policy issues.⁹²

Risk registers

55. The DOL risk registers from 2005 to 2011 identify risks relevant to the mining inspectorate. In March 2010 the following risk was added: 'Limited mining resource. May have service failure, certainly very constrained service. Reputational risk in an event.'⁹³ This identification of reputation at risk is understandable but overlooks the real issue, the health and safety of mine workers.
56. The April to June 2011 risk register records that DOL had known for a considerable time that a Waikato mine was operating with one egress in breach of the regulations.⁹⁴ It also notes, essentially as a result of the demands of the Pike investigation, 'a significant business risk of some service delivery and/or business function failing due to unsustainable [sic] work load of a Team Leader being shared across other staff.'⁹⁵

Conclusions

57. Management and oversight of the mining inspectors were deficient, leaving the inspectors inadequately supported. Problems affecting the inspectorate and the resulting risks were known at many levels of DOL, but were not competently addressed. Generally there was an inadequate focus on the health and safety risks posed by the underground coal mining industry.

ENDNOTES

¹ Neil Gunningham and David Neal, Review of the Department of Labour's Interactions with Pike River Coal Limited, 4 July 2011, DOL100010001/38, para. 110.

² Ibid., DOL100010001/38, para. 113.

³ Ibid., DOL100010001/39, para. 115.

⁴ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 5 December 2008, DOL3000090027/2, 7.

⁵ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 2 September 2010, DOL3000090046/3.

⁶ Ibid.

⁷ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 7 May 2010, DOL3000090042/3.

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

⁹ The requirement is imposed by reg 23 of the Health and Safety in Employment (Mining – Underground) Regulations 1999.

¹⁰ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 7 April 2010, DOL3000090041/6; Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 7 May 2010, DOL3000090042/7; Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 7 May 2010, DOL3000090043/7; Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 5 July 2010, DOL3000090044/7.

¹¹ Kevin Poynter, transcript, p. 3085.

¹² Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 5 July 2010, DOL3000090044/7; and Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 2 August 2010, DOL3000090045/7.

¹³ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 2 September 2010, DOL3000090046/7.

¹⁴ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 6 October 2010, DOL3000090047/6.

¹⁵ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 1 November 2010, DOL3000090048/6.

¹⁶ Michael Firmin, ORP April 2010, DOL3000090018/1.

¹⁷ Michael Firmin, Operational Review Process Monthly Report – Staff Member, 3 November 2008, DOL3000090001/4.

¹⁸ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 3 September 2009, DOL3000090035/6.

¹⁹ Kevin Poynter, Operational Review Process Monthly Report – Staff Member, 3 December 2009, DOL3000090038/6.

²⁰ Michael Firmin, Operational Review Process Monthly Report – Inspectors, 3 September 2010, DOL3000090022/11.

²¹ That role was current as at 31 August 2011: Department of Labour, Answers to Questions for Department of Labour, 31 August 2011,

DOL7770010009/14, para. 33.

²² Department of Labour, Answers to Questions for Department of Labour: Appendix H – Position Description Senior Advisor High Hazards, 31 August 2011, DOL7770010009_02/3.

²³ Ibid., DOL7770010009_02/2.

²⁴ Ibid.

²⁵ Ibid., DOL7770010009_02/3.

²⁶ Michael Firmin, transcript, p. 605.

²⁷ Department of Labour, Answers to Questions, DOL7770010009/14, para. 33.

²⁸ Neil Gunningham and David Neal, Review, DOL0100010001/38, para. 112.

²⁹ Michael Firmin, transcript, p. 600.

³⁰ Department of Labour, Mining Steering Group, Minutes, DOL0020020011/1.

³¹ Susan (Lesley) Haines, witness statement, 20 June 2011, DOL7770010001/7, para. 32.

³² Department of Labour, Mining Steering Group, Minutes, 31 March 2010, DOL0020020011/8 and /9.

³³ Michael Firmin, transcript, p. 606.

³⁴ Department of Labour, Answers to Questions, DOL7770010009/15, para. 37.

³⁵ Michael Firmin, transcript, p. 610.

³⁶ Department of Labour, Mining Steering Group, Minutes, 10 July 2009, DOL0020020011/24.

³⁷ Review of Coverage of Clients by the Extractives Inspectorate, 2006, as cited by Neil Gunningham and David Neal, Review, DOL0100010001/98, para. 347.

³⁸ Neil Gunningham and David Neal, Review, DOL0100010001/98, para. 347.

³⁹ Michael Firmin, transcript, p. 622–23, Department of Labour, Mining Steering Group, Minutes, 10 July 2009, DOL0020020011/25.

⁴⁰ Michael Firmin, transcript, p. 623. These planned audits were not those commissioned by the government following the Pike tragedy and undertaken by Australian experts with DOL support.

⁴¹ Department of Labour, Mining Steering Group, Minutes, 10 July 2009, DOL0020020011/23–24.

⁴² Ibid., DOL0020020011/25.

⁴³ Kevin Poynter, transcript, p. 2974.

⁴⁴ Michael Firmin, transcript, pp. 606–07.

⁴⁵ Department of Labour, Answers to Questions, DOL7770010009/17, para. 42.

⁴⁶ Michael Firmin, transcript, p. 2823.

⁴⁷ Ibid., pp. 647–48; Kevin Poynter, witness statement, 22 June 2011, DOL7770010006/4, para. 18.

⁴⁸ Kevin Poynter, transcript, p. 2980.

⁴⁹ Ibid., p. 2975.

⁵⁰ Michael Firmin, transcript, pp. 2817–19.

⁵¹ Kevin Poynter, transcript, p. 2981.

⁵² Michael Firmin, transcript, p. 2832; Kevin Poynter, transcript, p. 2970.

⁵³ Michael Firmin, transcript, p. 2833.

⁵⁴ Ibid., pp. 2820–21.

⁵⁵ Department of Labour, Answers to Questions, DOL7770010009/18, para. 46.

⁵⁶ Department of Labour, Mining Steering Group, Minutes, 10 July 2009, DOL0020020011/21.

⁵⁷ Department of Labour, Mining Steering Group, Minutes, 10 December 2009, DOL0020020011/19.

⁵⁸ Ibid.

⁵⁹ Memorandum, Department of Labour, Mining Steering Group to Workplace Services Management Team, 12 February 2010, DOL0020020022.

⁶⁰ Ibid., DOL0020020022/1.

⁶¹ Ibid., DOL0020020022/4.

⁶² Ibid., DOL0020020022/3.

⁶³ Ibid., DOL0020020022/5.

⁶⁴ Department of Labour, Mining Steering Group, Minutes, 17 February 2010, DOL0020020021/1.

⁶⁵ Department of Labour, Answers to Questions, DOL7770010009/19, para. 47.

⁶⁶ Michael Firmin, transcript, p. 599.

⁶⁷ Kevin Poynter, transcript, pp. 3039–40.

⁶⁸ Department of Labour, Answers to Questions, DOL7770010009/10–11, para. 28.

⁶⁹ Ibid., DOL7770010009/7, para. 20.

⁷⁰ Ibid.

⁷¹ Michael Firmin, transcript, p. 615.

⁷² Ibid., pp. 615–16.

⁷³ The MSG minutes of 31 March 2010 record what appears to be relatively informal feedback by the investigator into the Black Reef mine tragedy. Issues were identified with DOL processes, mine plans being needed and the extractives inspectors needing to take proper file notes of their visits: Department of Labour, Mining Steering Group, Minutes, 31 March 2010, DOL0020020011/12.

⁷⁴ Professor Gunningham is a lawyer, social scientist and co-director of the National Research Centre for Occupational Health and Safety at the Australian National University. Dr Neal is a senior barrister, consultant in health and safety law and member of the Law Council of Australia's Occupational Health and Safety Committee: Neil Gunningham and David Neal, Review, DOL0100010001/6.

⁷⁵ Ibid., DOL0100010001.

⁷⁶ Ibid., DOL0100010001/9, para. 8.

⁷⁷ Ibid., DOL0100010001/12, para. 22.

⁷⁸ Department of Labour, Briefing: Underground Mining – Background on Department of Labour's Legislative and Investigative Approach, 20 December 2010, DOL0010020492/5, para. 20.

⁷⁹ Ibid., DOL0010020492/5, para. 22.

⁸⁰ Department of Labour, Answers to Questions for Department of Labour: Appendix J – Bundle of Documents Regarding 2006–2010 Review, DOL7770010009_07/17.

⁸¹ Department of Labour, Improving Health and Safety Hazard Management in the Underground Mining Industry, March 2008, DOL0010020279.

⁸² Department of Labour, Summary of Public Submissions on Discussion Paper Improving Health and Safety Hazard Management in the Underground Mining Industry, September 2008, DOL0010020323/5.

⁸³ Ibid., DOL0010020323/12.

⁸⁴ Ibid., DOL0010020323/12–13.

⁸⁵ Ibid., DOL0010020323/6.

⁸⁶ Ibid., DOL0010020323/16.

⁸⁷ Ibid., DOL0010020323/18.

⁸⁸ Department of Labour, Briefing: Options for Improving Health and Safety in Underground Mining, 2 July 2009, DOL0010020445.

⁸⁹ Health and Safety in Employment (Mining Administration) Amendment Regulations 2010.

⁹⁰ Department of Labour, Mining Steering Group, Minutes, 10 July 2009, DOL0020020011/24.

⁹¹ Michael Firmin, transcript, p. 607.

⁹² James Murphy, transcript, p. 503.

⁹³ Department of Labour, Answers to Questions for Department of Labour: Appendix M – Risk Register Extracts, March 2010, DOL7770010009_12/3.

⁹⁴ Ibid., 4 August 2011, DOL7770010009_12/2.

⁹⁵ Ibid., DOL7770010009_12/4.

Effectiveness of the health and safety regulator

Introduction

1. This chapter evaluates the effectiveness of the Department of Labour (DOL)¹ in regulating health and safety in the underground coal mining industry. In order to do so the commission has found it necessary to examine the department's wider functions, structures and strategies, within which its regulation of the industry took place. That broader look has been limited in scope but has identified the issues described in this chapter. The commission has taken these issues into account when making its comments and formulating its recommendations.²
2. The chapter begins with an acknowledgement of the changes made following the Pike River tragedy.

Changes to the Department of Labour since the Pike River tragedy

3. DOL accepts that its regulation of health and safety in underground coal mining has been inadequate. Since the Pike River tragedy it has made or foreshadowed important changes to improve its performance.

High Hazards Unit

4. DOL has reviewed its approach to high-hazard industries,³ and created, with additional funding, a High Hazards Unit for the extractives, petroleum and geothermal sectors. This is headed by a general manager in Wellington. Below are two chief inspector positions, one for extractives and the other for petroleum and geothermal workplaces. Three specialist inspectors will report to each chief inspector.⁴ Risk assessment will determine the frequency of inspections and other interventions, including systems audits.⁵
5. There have been continuing difficulties in staffing the High Hazards Unit. It was established from 26 September 2011, but has had a chief inspector for the extractives sector (including mining) for only part of that time, seconded from the Queensland regulator.⁶ In August 2012 the position remained vacant and the recruitment process was ongoing. Of the three specialist inspectors only one, Michael Firmin, is a warranted mining inspector. The second, Brian Harrington, who holds a first class mine manager's certificate, is still undergoing training and is expected to be warranted in September 2012. The third, David Bellett, is an experienced inspector and investigator, but does not have coal mining expertise.⁷ Recruiting and retaining specialist mining inspectors will be difficult, given international demand.
6. The department has also reviewed its management of health and safety. The Mining Steering Group and Workplace Services Management Team have been disestablished and a new Labour Group Leadership Team created.⁸

Proposal to increase investment

7. Following a 2012 proposal by the minister of labour, health and safety funding will be increased by approximately \$37 million from 2012 to 2016.⁹ The increase comes from the Health and Safety in Employment (HSE) Act 1992 levy, not all of which has previously been allocated. There will be more inspectors and they will focus on the areas of

highest risk.¹⁰ There will be better support for joint and industry-led initiatives and employee participation.¹¹ Links with the Accident Compensation Corporation (ACC) and other interested parties will be strengthened. DOL has set a target of reducing the number of workplace fatalities and serious injuries by 25% by 2020.¹² This will still leave New Zealand behind comparable countries, including Australia and the United Kingdom.

8. In the commission's view the changes are a step in the right direction, but do not go far enough.¹³

Leadership of health and safety

9. DOL now appreciates the importance of, and deficiencies in, its leadership of health and safety. As the minister's proposal noted, 'the Pike River tragedy and Royal Commission hearings indicate areas of weakness in the effectiveness and credibility of the regulator, and the ability to support industry-led activity and effective employee participation.'¹⁴
10. The minister proposed a strategic review of the health and safety system,¹⁵ which Cabinet directed be undertaken by an independent working group.¹⁶ The six-member group is to report by 30 April 2013.¹⁷ The review is to be wide ranging and will examine whether New Zealand's health and safety system is fit for purpose.
11. Many submissions to the commission were also concerned about inadequate leadership of health and safety. As Dr Kathleen Callaghan stated:

failures of the system reflect leadership and governance and that is not to personalise this critical issue. ... If one had to isolate the one critical factor in the scientific literature pertaining to positive health and safety performance it would be 'leadership'. Credibility of the leader is paramount ...

The DOL, in my view, does not lead as it should. It does some very good things as this submission records. But the threats to its credibility are significant. The bar set for NZ workplaces is not being met by the Regulator itself. ... Until this changes, and the Regulator leads by example, until the Regulator 'walks its own talk' the evidence suggests that there is unlikely to be any real change to OH&S in NZ. The leader will not have the confidence of the workplace. This comment goes beyond mining.¹⁸

The functions and structure of the Department of Labour

Many functions

12. At the time of the Pike River tragedy, DOL had many functions. It administered 23 acts and 67 sets of regulations. Four of the acts were major: the Immigration Act 2009, the Health and Safety in Employment Act 1992, the Employment Relations Act 2000, and the Accident Compensation Act 2001.¹⁹ It did so through six groups: Immigration, Labour, Policy and Research, Business Services, Legal and International, and Executive.²⁰
13. The labour, and policy and research, groups were described as having 'substantial involvement in health and safety matters.'²¹ But the labour group was responsible for employment and health and safety functions and policy advice, and accident compensation policy advice. A subgroup, workplace services, was responsible for employment and health and safety. The policy and research group's responsibilities included labour market, employment, immigration and health and safety advice.

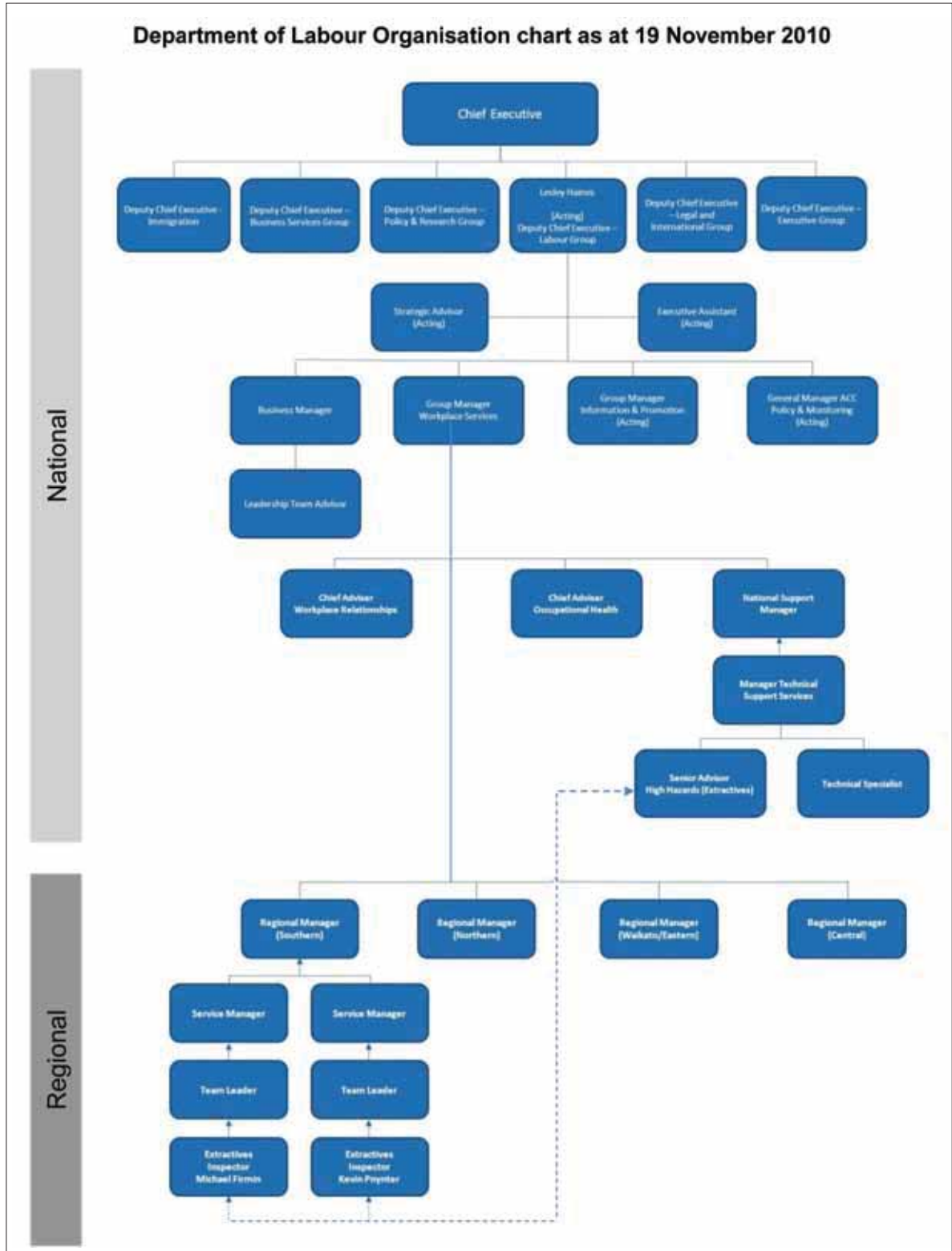


Figure 24.1: Department of Labour organisation chart as at 19 November 2010²²

Responsibilities of the senior officers and leadership teams

- The senior DOL officers had broad responsibilities, of which health and safety was just one.²³ That breadth was also reflected in the high-level leadership teams. At 19 November 2010 DOL had two teams relevant to health and safety. The first was the Strategic Leadership Team, made up of the chief executive and the deputy chief executives of each of the six groups:

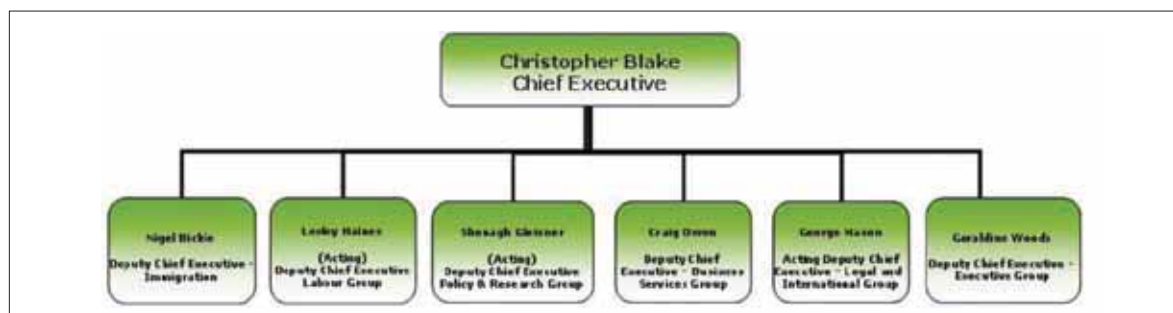


Figure 24.2: Strategic leadership team as at 19 November 2010²⁴

15. The second was the Workplace Leadership Team within the labour group. Its members included a strategic adviser, business manager, workplace services manager, information and promotion manager and ACC policy and monitoring manager:

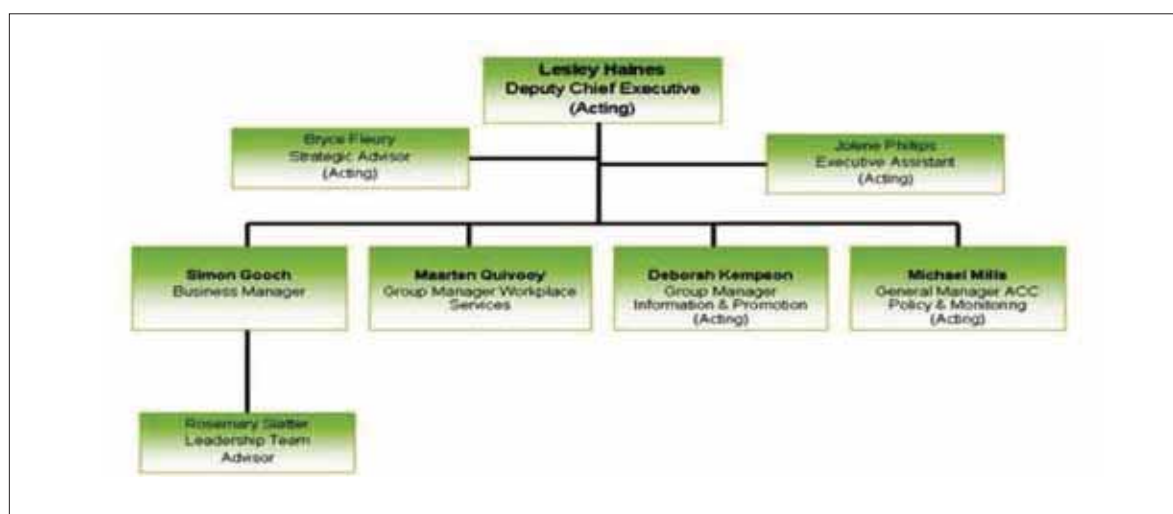


Figure 24.3: Workplace leadership team as at 19 November 2010²⁵

16. The labour group leadership team created following the Pike River mine tragedy also has broad responsibilities.²⁶
17. As at 19 November 2010 no one in either the strategic leadership team or the workplace leadership team had health and safety expertise, except for the acting deputy chief executive of the legal and international group, who had relevant legal experience. One member of the lower level workplace services management team had health and safety expertise.²⁷ Only three of the relevant members of the policy and research group appear to have had health and safety expertise. The request for an additional extractives inspector was first raised by mine inspectors at level seven of DOL, and had to pass up through two different groups over many months before it was declined.²⁸ The lack of understanding of the importance of the problem was clear.

Economic focus

18. Health and safety is not the main focus of DOL's statements of intent for 2010–13²⁹ and 2011–14,³⁰ which are aimed at improving economic performance. An increased focus on health and safety is apparent in DOL's statement of intent for 2012–2015.³¹

Conclusions

19. Health and safety in New Zealand was not led by a body for which improving health and safety was its sole, or even major, objective. Health and safety was just one of the responsibilities of a department with many responsibilities.
20. This diluted the attention paid to health and safety and contributed to an unwieldy structure in which senior officers had limited opportunities to develop health and safety expertise.

Shared responsibility at governance level

21. DOL recognised the importance of shared responsibility at governance level in its June 2005 10-year strategy, which proposed 'an effective governance arrangement, including a tripartite body'.³²
22. The Workplace Health and Safety Council was established in 2007 to provide representative leadership and advise the minister responsible for workplace health and safety.³³ The members include representatives from government, employer and employee organisations.³⁴ The council did not seek to participate in this inquiry, but the commission received its minutes and submissions from groups represented on the council or whose members attended meetings.³⁵
23. The council was to meet quarterly, but has met less often.³⁶ The meetings were attended by council members as well as stakeholder representatives, from ACC, DOL, Maritime New Zealand, the Ministry of Transport and Pike, among others.
24. Significant health and safety issues were referred to the council. In 2010, for example, it was told about 'limited frontline capabilities' within DOL,³⁷ and that 'injury stats are flat-lining with no significant decline and do not compare well with other like countries'.³⁸ Planned cuts to ACC health and safety representative training programmes were discussed.³⁹ On 18 February 2010, a council member noted frustration at 'endless reports and suggested the Council should meet in between the scheduled quarterly meetings and without other officials'.⁴⁰ The minister expressed concern that the 10-year plan and the council were 'not being as effective as they could be. She stated that both the Strategy and the Council need to have achieved more'.⁴¹
25. Submissions to this commission raised similar concerns. One submitter said the council:

*has not effectively engaged with the broader health and safety community, nor been given the necessary support to perform an accountability function. As a result initiatives identified under the Workplace Health and Safety Strategy have largely been allowed to wither and been replaced by a series of somewhat disjointed Action Plans which, whilst addressing important issues, seem to be lacking in strategic insight.*⁴²
26. The New Zealand Council of Trade Unions expressed concern that the council lacked power and a statutory basis, and thus could be ignored. It felt that 'those key functions... policy discussions, standard setting, oversight and monitoring of what goes on, on a tripartite basis should be done through a... statutory established national level council'.⁴³
27. In summary, New Zealand lacked effective shared governance, despite its importance being recognised in the DOL 10-year strategy. As Robens concluded 40 years ago, advisory committees have little influence; an executive board is required if there is to be effective participation in decision-making.

High-level health and safety expertise

28. The 10-year strategy also identified a need for high-level health and safety expertise. It contemplated that the National Occupational Health and Safety Advisory Committee (NOHSAC), established in 2003, would continue to give independent, evidence-based occupational health and safety advice to the relevant minister.⁴⁴ Its members included experts in public health, risk management, medicine and health, and safety surveillance systems.⁴⁵
29. NOHSAC's reports went to the heart of many of New Zealand's health and safety problems. In 2006, for instance, it noted that the 'amount of funding provided to prevent workplace harm appears to be significantly less than what actually may be required'.⁴⁶ In real terms the 2005–06 funding was less than the amount provided in 1989–90.⁴⁷
30. This 2006 report also pointed out that existing approved codes of practice were sometimes inconsistent with best practice, and that more were needed. A 2008 report affirmed the importance of approved codes of practice and other guidance; the right ones had to be developed, disseminated and complied with.⁴⁸
31. The foreword to NOHSAC's August 2008 fifth annual report highlighted mounting concerns. Though essential, policy documents, on their own, would not 'lead to an improvement in the prevention of occupational disease

and injury in New Zealand'. There had been 'virtually no progress on even the most basic and easily achievable recommendations'. There had, for example, been 'four years of talk, but virtually no action, on simple and easily achievable recommendations such as the recording and coding of occupation on routinely collected data such as death registrations, cancer registrations and hospital admissions',⁴⁹ which was essential to the surveillance and therefore the prevention of occupational disease and injury.

32. NOHSAC's earlier reports had shown 'significant gaps' in the guidance materials that were supposed to 'encourage and facilitate compliance'.⁵⁰ Its latest report was undertaken in conjunction with the Office of the Australian Safety and Compensation Council and both it and NOHSAC were 'concerned that very little effort has been made to identify the relative importance of codes of practice and guidance materials to the functioning of the entire OHS regulatory system'.⁵¹
33. NOHSAC noted with concern, too, that 'the number of field active inspectors in occupational health and safety has decreased from 1.2 inspectors per 10,000 employees in 2001 to 0.8 inspectors per 10,000 employees in 2004' and proactive workplace visits from DOL inspectors had gone down from '26,405 in 1994/95 to less than 5,000 currently'.⁵²
34. NOHSAC was abolished in 2009 as part of a reprioritisation of government expenditure.⁵³
35. Serious problems identified by NOHSAC remain. In 2011 there were still substantial data deficiencies.⁵⁴ As is noted in Chapter 26, 'An effective regulatory framework', codes of practice and guidance are still inadequate, at least in the extractives sector.

The Department of Labour's 10-year strategy

Principles

36. The 10-year strategy, which aims to significantly reduce New Zealand's work toll,⁵⁵ sets out four principles:
 - prevention: focusing on preventing workplace illness and injury;
 - participation: participation by all groups involved in the workplace, including workers, health and safety representatives, unions, employers, industry and government agencies;
 - responsibility: employers are primarily responsible for health and safety, although employees have some personal responsibility; and
 - practicability: health and safety is based on what is reasonable, including the potential for harm, current knowledge and the cost of health and safety measures.⁵⁶

The commission endorses the prevention and participation principles.

37. The responsibility principle is narrowly expressed and concentrates on employers, while recognising some role for employees. But statutory responsibility for the prevention of harm in the workplace extends to a range of people, including the self-employed, contractors and machinery suppliers and repairers.⁵⁷ More importantly, the statement on responsibility overlooks the critical role of the regulator, whose inspectors inform, educate and ensure compliance,⁵⁸ functions integral to attaining the , whose inspectors inform, educate and ensure compliance, functions integral to attaining the Health and Safety in Employment Act 1992's objective.
38. The practicability principle reflects the definition of 'all practicable steps' in the HSE Act.⁵⁹ Whether a step is practicable depends on such factors as the nature, severity and likelihood of the potential harm and the availability, cost and effectiveness of the solution. The regulator has a crucial role in disseminating information about those. This is an aspect of the inspectorate's basic functions and reinforced by DOL's role in promulgating guidance material, including approved codes of conduct.⁶⁰
39. The way in which these two principles are explained understates DOL's pivotal role, and has been reflected in inadequate practice. That understatement is now recognised in DOL's initiatives to improve its performance.

Review of the 10-year strategy

40. A range of groups made submissions when the 10-year strategy was reviewed in 2009.⁶¹ Their concerns, which mirrored many of those expressed by NOHSAC, included the following:⁶²
- the leadership of health and safety was inadequate;
 - the strategy did not provide sufficiently meaningful goals and measures;
 - accident and injury rates would be most improved by refocusing the strategy on the high-hazard sectors;
 - resources were inadequate;
 - inspection rates had fallen to an unsatisfactory level;
 - policy initiatives were not reaching the 'coal face';
 - there was a lack of approved codes of practice and guidance;
 - health and safety surveillance data and benchmarking data were lacking;
 - managers and supervisors needed access to effective health and safety training;
 - there was no approved code of practice for employee participation;
 - employers and representatives needed more encouragement to use employee participation processes; and
 - workplace health and safety culture needed to be improved in order to make a sustainable improvement in workplace health and safety.
41. Many of these concerns, including inadequate resources, an insufficient focus on high-hazard industries and a lack of guidance, were still evident at the time of the Pike River tragedy.
42. The 2009 review led to a National Action Agenda for 2010 to 2013, published in March 2011, which 'sharpens the focus on action.'⁶³ Since then there has been a more fundamental rethink about workplace health and safety in New Zealand.

Focusing on high-risk sectors

43. The 10-year strategy and national action agenda identified the need to focus on the high-risk sectors:⁶⁴

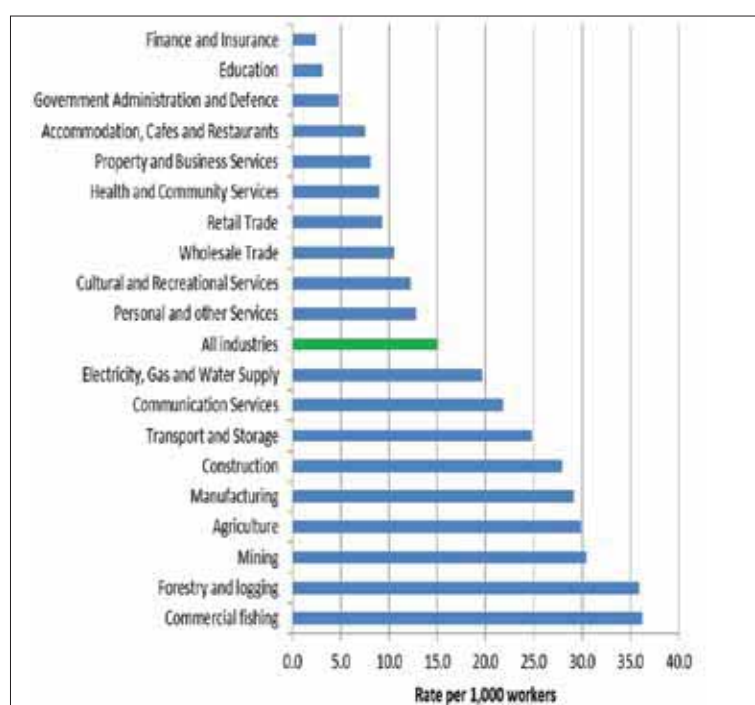


Figure 24.4: Highest risk sectors – injury rates⁶⁵

44. Although mining had the third highest injury rate, in contrast to the construction, agriculture, forestry, manufacturing and fishing industries, it was not seen as a priority area.⁶⁶ This seems to be because of a focus on industries with 100,000 or more full-time equivalent workers.⁶⁷ This approach was too blunt.
45. The creation of the High Hazard Unit improves matters by recognising the risk profile of the mining, petroleum and geothermal industries. But Dr Callaghan, after consultation with Acting Professor Mark Taylor of the Light Metals Research Centre, University of Auckland, considers there are significantly more high-hazard industries.⁶⁸ DOL agrees.⁶⁹
46. Interestingly, the highest risk sectors were identified primarily according to personal injury data – the consequences of individual accidents – but high-hazard industries are at risk of catastrophic process safety accidents, which are, by their nature, low frequency high consequence events. As the Pike River mine tragedy demonstrates, a focus on personal injury rates alone is not adequate to identify the ultimate workplace hazards. Until recently, there was no sign that catastrophic risk featured in the department's strategic thinking.

Accountability and review of the department

Performance measures

47. DOL lacks sufficient measures of its health and safety regulatory performance. Its 2011 annual report records that it had 'delivered' on the four intermediate 2010–11 outcomes, including that 'workplaces are healthier and safer'.⁷⁰ The performance measures upon which this conclusion was based included:
 - *The percentage of customers who indicated they were satisfied with the overall quality of service delivery received ...*
 - *The percentage of investigations completed within five months of notification of the event.*
 - *The percentage of workplaces that, after six months, have satisfactorily addressed the compliance or enforcement requirements identified.*
 - *The percentage of e-enquiries requiring a substantive response that are responded to within three working days.*
 - *The percentage of workplace assessments targeted at industries identified in the Workplace Health and Safety Strategy Action Plan.*⁷¹
48. Those measures did not demonstrate how the core statutory health and safety functions have been performed and whether health and safety compliance has improved. As a consequence substantial problems with DOL's health and safety regulatory performance were largely invisible.
49. The *Performance Information for Appropriations: Vote Labour* for 2011–12 shows additional measures that improve the situation somewhat, including the number of approved codes of practice developed, revised or revoked.⁷² However better, qualitative, measures are needed, and should be included in the 10-year strategy and lower level plans.

Review and audits

50. DOL has had at least eight reviews and restructurings from when the HSE Act came into force until May 2012.⁷³ Those were 'in response to policy changes, tightening financial constraints, and the need to realign the Department's health and safety function with those of other agencies (such as the Department's Employment Relations Service and ACC's injury prevention function)'.⁷⁴
51. DOL's internal reviews of its health and safety performance have been limited. They include a review commissioned in August 2010 of the quality of its investigation decision processes. The report of May 2011 found that significant improvements to investigation and compliance processes were needed.⁷⁵ Certain changes were agreed to in November 2011 and have been or are being implemented.⁷⁶

52. The health and safety performance of the regulator should be regularly reviewed and audited, using appropriate health and safety performance measures. The reviewers should include external health and safety experts.⁷⁷

Conclusions

53. DOL has been ineffective as the regulator of health and safety in the underground coal mining industry and its strategic approach to health and safety in general provides cause for concern. The reasons include:
- a lack of national leadership by the department, which has damaged its credibility;
 - no shared responsibility at governance level, including the absence of an active tripartite body;
 - not following the expert advice from NOHSAC on, for example, the need for approved codes of practice; and
 - insufficient departmental focus and expertise regarding health and safety, especially at the senior management levels, caused by its multiple functions, its organisational structures and management groups, gaps in its multi-year strategies and planning, poor performance measures and infrequent self-review.
54. The government and DOL have made significant changes since the Pike River tragedy. The setting up of the High Hazards Unit, the ministerial task force and the increased funding are steps in the right direction. For those improvements to be sustainable, and for New Zealand's poor health and safety record to be improved, the right administrative platform needs to be created, in the form of an expert regulator focused solely on health and safety. The characteristics of such a regulator are discussed in Chapter 25, 'A new regulator'.

ENDNOTES

¹ Now part of the Ministry of Business, Innovation and Employment.

² See the commission's Terms of Reference, para. (i), in Volume 1 of this report.

³ See, for example, Department of Labour, Practical Proposals for Improving the Department of Labour's Approach to High Hazard Industries, July 2011, DOL3000180051.

⁴ Department of Labour, Additional Submissions on Questions Arising During Final Submissions, 16 April 2012, DOL7770010010/3, paras 4–6; Letter, Brett Murray to Cameron Mander, 24 July 2012, MBIE3000010004/2.

⁵ Department of Labour, Additional Submissions, DOL7770010010/3, para. 7; Department of Labour, Phase Four Paper, 16 March 2012, DOL4000010005/18–20, paras 62–69.

⁶ Gavin Taylor, Chief Coal Mines Inspector, Queensland: Letter, Brett Murray to Cameron Mander, 24 July 2012, MBIE3000010004/1–2.

⁷ Letter, Brett Murray to Cameron Mander, 24 July 2012, MBIE3000010004/1–2; Michael Firmin, transcript, p. 616.

⁸ The Mining Steering Group was disestablished from 19 August 2011 and the Workplace Services Management Team from 31 August 2011: Department of Labour, Answers to Questions for Department of Labour, 31 August 2011, DOL7770010009/17, 18–19, paras 42, 47.

⁹ Kate Wilkinson (Minister of Labour), Proposal to Increase Investment in Safe and Skilled Workplaces Using Unallocated Revenue from the Health and Safety in Employment Act Levy, 4 April 2012, DOL7770060003/20; Cabinet Minute of Decision: Proposal to Increase Investment in Safe and Skilled Workplaces Using Unallocated Revenue from the Health and Safety in Employment Act Levy, 16 April 2012, CAB Min (12) 12/14, DOL7770060004.

¹⁰ Kate Wilkinson (Minister of Labour), Proposal to Increase Investment in Safe and Skilled Workplaces, DOL7770060003/11–12, paras 57–61; Cabinet Minute of Decision: Proposal to Increase Investment in Safe and Skilled Workplaces, DOL7770060004/2, para. 5.

¹¹ Kate Wilkinson (Minister of Labour), Proposal to Increase Investment in Safe and Skilled Workplaces, DOL7770060003/2, para. 9.

¹² Ibid., DOL7770060003/3, para. 10; Cabinet Minute of Decision: Proposal to Increase Investment in Safe and Skilled Workplaces, DOL7770060004/3, para. 13.1.

¹³ Similar views are apparent from submissions. For example, Impac Services Ltd expressed concern that DOL's post-Pike River changes are not the start of a widespread and sustainable set of initiatives: Impac Services Ltd, Submission by Impac Services Ltd to Phase 4 of the Pike River Royal Commission, 9 March 2012, IMP0001/6.

¹⁴ Kate Wilkinson (Minister of Labour), Proposal to Increase Investment in Safe and Skilled Workplaces, DOL7770060003/8, para. 36.

¹⁵ Ibid., Appendix 1, DOL7770060003/23–24.

¹⁶ Cabinet Minute of Decision: Proposal to Increase Investment in Safe and Skilled Workplaces, DOL7770060004/3, para. 14.

¹⁷ The members are Robert Jager, Chairman of Shell New Zealand and General Manager of Shell Todd Services (chair); Mavis Mullins, Director at Paewai Mullins Shearing; Michael Cosman, Managing Director of Impac Services Ltd; Paula Rose, former National Manager Road Policing; William Rosenberg, Policy Director/Economist for the Council of Trade Unions; and Paul Mackay, Manager Employment Relations at Business New Zealand: Kate Wilkinson (Minister of Labour), Health and Safety Review Taskforce Appointed, 6 June 2012, <http://www.beehive.govt.nz/release/health-and-safety-review-taskforce-appointed>

¹⁸ Kathleen Callaghan, witness statement, 23 March 2012, FAM0058/10–11, paras 47–48.

¹⁹ Department of Labour, Annual Report for the Year Ended 30 June 2011, p. 127, <http://www.dol.govt.nz/publications/general/ar1011/annualreport1011.pdf>

²⁰ Ministry of Business, Innovation and Employment, Structure, <http://www.dol.govt.nz/about/organisation/our-org-structure.asp>. The ministry is currently planning restructuring, the nature of which is not yet fully settled.

²¹ Christopher Blake, witness statement, 20 June 2011, DOL7770010004/4, para. 17.

²² Compiled from publicly available documents and the charts shown in

Neil Gunningham and David Neal, Review of the Department of Labour's Interactions with Pike River Limited, 4 July 2011, DOL0100010001/36, 174–75.

²³ Neil Gunningham and David Neal, Review, DOL0100010001/174.

²⁴ Ibid., DOL0100010001/175.

²⁵ Ibid., DOL0100010001/174.

²⁶ The minutes of the current labour group leadership team show that it deals with a diverse range of matters, only some of which are related to health and safety: Department of Labour, Labour Group Leadership Team Meeting Minutes, 1 September 2011–1 May 2012, DOL3000180001–DOL3000180035.

²⁷ Dr Geraint Emrys.

²⁸ See Chapter 23, 'Management of the mining inspectorate'.

²⁹ Department of Labour, Statement of Intent 2010/11–2013/14, 2010, <http://www.dol.govt.nz/publications/general/soi2010/soi-2010.pdf>

³⁰ Department of Labour, Statement of Intent 2011–2014, 2011, <http://www.dol.govt.nz/publications/general/soi2011/soi-2011.pdf>

³¹ Department of Labour, Statement of Intent 2012–2015, 2012, <http://dol.govt.nz/publications/general/soi2012-2015/soi-2012-2015.pdf>

³² Ruth Dyson (Associate Minister of Labour), Workplace Health and Safety Strategy for New Zealand to 2015, June 2005, CAC0004/16.

³³ The role and terms of reference were revisited by the council at various times, see for example: Workplace Health and Safety Council, Meeting Minutes, No. 11, 18 February 2010, CAC0003/45–46.

³⁴ Its members are identified as the Hon. Kate Wilkinson, Minister of Labour; Helen Kelly, President of the New Zealand Council of Trade Unions; Phil O'Reilly, Chief Executive of Business NZ; Andrew Casidy, a union official and advocate; Fritz Drissner, Health and Safety Co-ordinator for the New Zealand Amalgamated Engineering, Printing and Manufacturing Union; Paul Jarvie, Manager Occupational Health and Safety, Employers and Manufacturers Association; and Panu Raea, a lawyer and General Manager of Safety and Employee Well-being at Air New Zealand (<http://www.dol.govt.nz/whss/whsc/whsc-members.asp>).

³⁵ Accident Compensation Corporation, Air New Zealand, the Department of Labour, the New Zealand Amalgamated Engineering, Printing and Manufacturing Union, the New Zealand Council of Trade Unions and Pike.

³⁶ From the minutes published on the Ministry of Business, Innovation and Employment, Labour Group's website, in 2010 it appears to have met only three times and twice in 2008 and 2011: <http://www.dol.govt.nz/whss/whsc/meetings.asp>

³⁷ Workplace Health and Safety Council, Meeting Minutes, No. 11, 18 February 2010, CAC0003/46.

³⁸ Workplace Health and Safety Council, Meeting Minutes, No. 12, 12 May 2010, CAC0003/33.

³⁹ For example: Workplace Health and Safety Council, Meeting Minutes, No. 8, 13 May 2009, CAC0003/69–70; No. 9, 17 September 2009, CAC0003/60–62; No. 12, 12 May 2010, CAC0003/37–38.

⁴⁰ Workplace Health and Safety Council, Meeting Minutes, No. 11, 18 February 2010, CAC0003/45.

⁴¹ Ibid., CAC0003/44. The minutes for 12 May 2010 record that the council discussed the minutes from this meeting and 'confirmed that they were correct, if a little harsh in their recording of the discussion with the Minister over the Council's role and achievements': Workplace Health and Safety Council, Meeting Minutes, No. 12, 12 May 2010, CAC0003/31.

⁴² Impac Services Ltd, Submission, IMP0001/7.

⁴³ Ross Wilson, transcript, p. 5503.

⁴⁴ Ruth Dyson (Associate Minister of Labour), Workplace Health and Safety Strategy, CAC0004/26.

⁴⁵ National Occupational Health and Safety Advisory Committee, First Annual Report to the Associate Minister of Labour, June 2004, pp. 3–4, http://ohsnetnz.org.nz/images/pdfs/NOHSAC_AR_03-04.pdf

⁴⁶ Allen & Clarke Policy and Regulatory Specialists Ltd, Occupational Health and Safety in New Zealand (NOHSAC Technical Report 7), 2006, p. v, <http://ohsnetnz.org.nz/documents/NOH11098TechRep7Web.pdf>

⁴⁷ Ibid.

⁴⁸ Gunningham & Associates, Review of Key Characteristics that Determine the Efficacy of OHS Instruments (NOHSAC Technical Report 9), 2008, <http://ohsnetnz.org.nz/documents/EfficacyofOHSInstrumentsTechReport9.pdf>

⁴⁹ National Occupational Health and Safety Advisory Committee, Fifth Annual Report to the Minister of Labour, August 2008, p. 1, <http://ohsnetnz.org.nz/documents/AnnualReport2008.pdf>

⁵⁰ Ibid., p. 2.

⁵¹ Ibid., p. 1.

⁵² Ibid., p. 2.

⁵³ Department of Labour, Response of the Department of Labour to Request for Information, June 2012, DOL7770060067/8, paras 16–17.

⁵⁴ Department of Labour, State of Workplace Health and Safety in New Zealand, June 2011, <http://www.dol.govt.nz/whss/state-of-workplace/DOL%2011724%20State%20of%20Workplace.pdf>; Impac Services Ltd, Submission, IMP0001/5; Chapter 22, 'The decline of the mining inspectorate'; Chapter 23, 'Management of the mining inspectorate'.

⁵⁵ Ruth Dyson (Associate Minister of Labour), Workplace Health and Safety Strategy, CAC0004/9.

⁵⁶ Ibid., CAC0004/10.

⁵⁷ Health and Safety in Employment Act 1992, ss 6, 16–19.

⁵⁸ Ibid., s 30.

⁵⁹ Ibid., s 2A.

⁶⁰ Ibid., s 20.

⁶¹ They included academics, employees, unions, employers, industry, and local and central government. The sectors included agriculture, construction, education, government, health and safety, medical and transport: Department of Labour, Review of the Workplace Health and Safety Strategy for New Zealand to 2015: Summary of Written Submissions, 2009, CAC0001/4.

⁶² Ibid., CAC0001/13–17.

⁶³ Department of Labour, National Action Agenda 2010–2013, March 2011, DOL0020010015/4.

⁶⁴ Ruth Dyson (Associate Minister of Labour), Workplace Health and Safety Strategy, CAC0004/28.

⁶⁵ Kate Wilkinson (Minister of Labour), Proposal to Increase Investment in Safe and Skilled Workplaces, DOL7770060003/8.

⁶⁶ Department of Labour, National Action Agenda 2010–2013, March 2011, DOL0020010015/6.

⁶⁷ Ibid., DOL0020010015/15.

⁶⁸ Kathleen Callaghan, witness statement, 23 March 2012, FAM0058/11–12, para. 54.

⁶⁹ Department of Labour, Practical Proposals for Improving the Department of Labour's Approach to High Hazard Industries, July 2011, DOL3000180051/9.

⁷⁰ Department of Labour, Annual Report for the Year Ended 30 June 2011, 2011, p. 19, <http://www.dol.govt.nz/publications/general/ar1011/annualreport1011.pdf>

⁷¹ Ibid., pp. 56–57.

⁷² Performance Information for Appropriations: Vote Labour: Economic Development and Infrastructure Sector – Information Supporting the Estimates 2011/12, DOL0020010007/14–15.

⁷³ Department of Labour, Response of the Department of Labour to Request for Information, 15 May 2012, DOL7770060002/2–3, paras 2–7. This may not include the Labour Committee, Inquiry into the Administration of Occupational Safety and Health Policy: Report of the Labour Committee, 1996.

⁷⁴ Ibid., DOL7770060002/3, para. 8.

⁷⁵ Department of Labour, Response of the Department of Labour to Request for Information, June 2012, DOL7770060067/12, paras 28–32.

⁷⁶ Ibid., DOL7770060067/12–13, paras 33–35.

⁷⁷ For example the Civil Aviation Authority is externally audited by the International Civil Aviation Organisation http://www.caa.govt.nz/publicinfo/ICAO_audit.htm

A new regulator

Introduction

1. A new regulator concerned solely with health and safety is required if New Zealand's poor health and safety record, including in underground coal mining, is to be improved. This chapter discusses the functions, form, strategy and resources of a new regulator.

Functions

2. The purpose of the health and safety regulator is to promote the prevention of harm to everyone in or near a workplace. The regulator should promote excellence in management, including systematic management, of health and safety. As part of that, it needs to ensure that inspectors carry out their functions properly. These functions include providing advice and information to employers, employees and other people, ascertaining compliance with the Health and Safety in Employment Act 1992 (HSE Act) and taking action to ensure compliance.
3. The regulator should:
 - advise the minister on workplace health and safety policy and operations;
 - administer and review the legislation and regulations, including promulgating codes of practice and guidance material;
 - provide workplace health and safety information to industry, employers, unions and workers;
 - promote and co-ordinate research, training and education;
 - carry out monitoring activities, including inspections and system audits; and
 - work with a wide range of other bodies, including industry, unions and safety organisations both in New Zealand and overseas.¹
4. To credibly perform these functions, the regulator should have:
 - a sole focus on health and safety;
 - effective leadership;
 - a flat structure with minimum levels of management;
 - expertise in health and safety at all levels;
 - access to a broad range of external expertise;
 - well-qualified and trained inspectors;
 - a strong connection between its policy advice and compliance functions; and
 - effective relationships with government agencies and other stakeholders.

Form of a new regulator

5. There are three options:
 - the status quo, integrated into the Ministry of Business, Innovation and Employment

- an autonomous function, within the ministry; or
- a Crown entity, with its own executive board.

First option – the status quo

6. The Department of Labour (DOL) lost public and industry confidence. Because it had multiple functions, it was unable to maintain sufficient focus on health and safety policy, strategy and operations. Health and safety expertise was lacking. The people with that expertise were mainly at the lower levels of the department. DOL is now part of the new Ministry of Business, Innovation and Employment, which is also responsible for many functions.
7. The commission has been briefed on the high-level design of the new ministry.² The proposal separates policy and regulatory administration. Health and safety administration is to be part of a regulatory practice group responsible for administering a range of laws and regulations.
8. The minister has announced major initiatives to improve health and safety, including a fundamental review of the health and safety system to ensure it is fit for purpose. The commission agrees with those initiatives but considers it will be difficult to achieve necessary change if responsibility for health and safety administration remains essentially as it was – in a ministry mixed with other functions. Senior officials are likely to continue facing the same difficulty in maintaining focus on health and safety, a difficulty predicted by Robens.

Second option – an ‘autonomous’ function within the ministry

9. The commission has considered whether an ‘autonomous’ health and safety function should be established within the new ministry. There are two possibilities: a dedicated health and safety group with a statutorily independent function, or establishing the health and safety regulator as a ‘departmental agency’, in line with the recent government proposals for ‘better public services’.³
10. A dedicated health and safety group within the ministry would be an improvement on the current proposal, but would it provide the right platform to drive the major reforms required? The group head would be subject to ministry priorities, would be bidding internally for the group’s budget and is likely to be drawn into more general departmental management issues.
11. In Queensland, the administration of health and safety laws for the extractive industries is performed as part of an autonomous function within a department. The regulator operates through a division of the Department of Natural Resources and Mines and administers health and safety laws only in respect of the mining, petroleum and gas industries. The division is headed by the deputy director-general, safety and health, who is also the commissioner for mine safety and health.⁴ The division is well regarded internationally, as is Queensland’s mine safety record.
12. The departmental agency model envisaged by the government’s recent proposals offers more hope of success than the status quo. Departmental agencies are an adaptation of the executive agencies structure used in the United Kingdom. If health and safety is to be administered through a departmental agency the agency would form part of the ‘host’ ministry but would be headed by its own chief executive, who would be employed (and subject to performance reviews) by the state services commissioner.
13. The chief executive of the departmental agency would be directly accountable to the minister for the agency’s operational performance. People working for the agency would be employed by the host department, but employer responsibilities would be delegated to the chief executive of the departmental agency.
14. The chief executive of the ministry would be responsible for administering the departmental agency’s funds. The agency would work according to the policy and funding of the ministry. The ministry’s chief executive, in consultation with the chief executive of the departmental agency, Treasury and the State Services Commission, would be responsible for agreeing on the agency’s strategy, policy and resources. The ministry would advise the minister on the agency’s strategy, policy and funding. It follows that the departmental agency will be essentially concerned with operational delivery in line with externally determined strategy, policy and funding.

The government introduced an omnibus bill, including the departmental agency proposal, into Parliament on 30 August 2012.

15. A regulator constituted as a departmental agency has some attractions in setting the right focus on health and safety. But its role would not be wide enough to drive the much-needed major reform, which will require policy, legislation, regulation and operational changes. Another concern is that the departmental agency concept is unproven in New Zealand, and health and safety may not be an appropriate area in which to pioneer the new approach.
16. The United Kingdom has recently considered reducing its number of public bodies, including making some of them executive agencies. Importantly, it decided not to change the status of the regulator, the Health and Safety Executive, which will remain the equivalent of a New Zealand Crown entity.⁵

Third option – a Crown entity

17. The minister's proposals recognise that in international best practice responsibility is shared between employers, workers and regulators.⁶ This approach is at the heart of the 1972 Robens report, which identified that:

the 'user interests' in this field – that is to say the organisations of employers and workpeople, the professional bodies, the local authorities and so on – must be fully involved and able to play an effective part in the management of the new institution. A principal theme . . . is the need for greater acceptance of shared responsibility, for more reliance on self-inspection and self-regulation and less on state regulation. This calls for a greater degree of real participation in the process of decision-making at all levels. . . . It is essential, therefore, that the principles of shared responsibility and shared commitment should be reflected in the management structure of the new institution.⁷

18. Lord Robens recommended governance by a board comprising a chairman, regarded by the public as authoritative about health and safety, an executive director and a number of non-executive directors. Their expertise would encompass the industrial management, trade union, medical, educational and local authority spheres. All members would be involved in policy and decision-making and implicated in the decisions made.⁸ An executive, not advisory, board was needed:

The distinction is vital. It is no secret that the main representative advisory committees which currently provide advice to government in this field . . . have not been altogether successful. They have met infrequently. They have no executive function. The fact of their existence has apparently done little to reduce the pressures which lead to protracted consultation on new or revised statutory regulations . . . Representative advisory bodies of this kind have no way of ensuring that their advice really affects what the Government actually does . . . What is needed is participation in the actual making of decisions, both at technical level . . . and also in the overall management of the system, at the level where policy is determined.⁹

These principles are reflected in the current structures of the UK Health and Safety Executive.

19. If the health and safety regulator were established as a Crown entity, it would be directed by a focused executive board appointed according to the general criteria set out in the Crown Entities Act 2004. These require board members to have appropriate knowledge, skills and experience which, in this case, would include recognised health and safety expertise. Unlike the other two options, the Crown entity option would enable that expertise to be directly involved in setting policy and strategies. The board would oversee the reform programme, set strategy and performance measures and appoint the chief executive.
20. The minister would appoint board members for fixed terms. The board would have independent statutory responsibilities, for example in the audit and inspection programmes, which would be delegated to the chief executive.
21. The minister would approve the regulator's strategic statement of intent and the regulator would report regularly

to the minister. It would provide an annual report to Parliament. It would be monitored by the ministry on behalf of the minister. The ministry would give the regulator advice and support. On policy advice and legislative reform, the regulator would work closely with the ministry and would bring direct experience from its operations.

22. The commission has considered which form of Crown entity would be most appropriate. Two other health and safety regulators, Maritime New Zealand and the Civil Aviation Authority, are classified as Crown agents, a form of Crown entity with the least independence from ministerial direction. The new regulator could be classified in the same way. As a Crown agent, the regulator would be required by the minister to give effect to government policy and follow 'whole of government' directions.

Preferred option – a new Crown agent

23. On balance, the commission prefers the creation of a new Crown agent with an exclusive focus on workplace health and safety because:
- the health and safety regulator will have its own identity and could start to rebuild public confidence;
 - an executive board would give the chief executive strategic direction and support as well as directly appraising performance;
 - the appointment of an executive board would ensure that a broad range of expertise, including health and safety expertise, is available at the highest level;
 - the remuneration structure would be aligned more directly to the marketplace for specialists such as mining inspectors;
 - policy advice to the minister would be improved by drawing on the expertise of the new Crown agent, which would have a small policy division;
 - the regulator would be on the same footing as the Civil Aviation Authority and Maritime New Zealand; and
 - a Crown agent would provide the right platform to drive the required major improvements to New Zealand's poor health and safety performance, identified in recent government proposals for reform.

Compliance strategy

Introduction

24. The new regulator will need a modern and effective compliance strategy superior to that used by DOL.¹⁰ The strategy will need time to become fully effective.
25. A compliance strategy typically involves a wide range of interventions; enforcement is only one element. Other interventions include providing advice and education, issuing guidance and approved codes of practice, and recommending changes to laws and regulations. Compliance strategies should promote and maintain public confidence that health and safety legislation is being administered fairly and consistently. An effective strategy will reduce costs for businesses which have not previously received the help they need to comply with the HSE Act.

Best practice compliance strategy

26. The compliance strategy should include clear policies on the use of enforcement tools and penalties. The strategy should be communicated to employers, who need to know exactly what to expect from the regulator and how it will respond to breaches of the law.
27. A best practice strategy takes an evidence and risk-based approach to deciding which compliance tools are appropriate for individual cases or for groups within an industry. That typically involves identifying specific risks,

assessing the likelihood that they will happen and what impact they will have, and then managing the most significant risks. Assessing the type and level of risk helps with making decisions about how closely and when to monitor an entity's compliance. The level of intervention should be proportionate to the level of risk and the likely seriousness of the non-compliance. The regulator needs to address the causes, and not just the symptoms, of non-compliance.

28. To implement an effective risk-based strategy, the new regulator needs a clear picture of the risks and drivers of compliance within an industry. That requires gathering and analysing reliable and relevant information about operators, the industry and the regulatory environment. The information should include comprehensive data, which indicate the preventative measures being taken to avoid harm to workers and the effectiveness of those measures.

Field inspection programme

29. The field inspection programme should define the types of activities to be carried out, by whom, how often and how they will be reported. The frequency of activities will depend on the potential consequences of non-compliance, the operating environment of the industry, technological complexity and the compliance profile of the particular workplace. Visits by inspectors to a workplace should be a mixture of announced and unannounced visits.
30. The Queensland Mine Inspectorate's compliance activities are guided by the Mine Inspection Planning System (MIPS),¹¹ an electronic tool that assists inspectors to schedule their activities and allocate resources. Resources are initially allocated based on the mine's inherent hazard profile, but are then based on the performance of the mine. So a high-risk mine might be initially subject to a high level of monitoring, but that would decrease if the mine shows it is managing health and safety well. The opposite is also true. This dynamic process allows the mines inspectorate to respond to changing circumstances at a mine, such as a change in management, and allocate resources accordingly.

Implementation by inspectors

31. Inspectors need clear guidance and training to ensure that their actions follow the regulator's strategy. The compliance strategy needs to feed into policies and procedures. Inspectors need training in conducting inspections and audits, and in the use of the enforcement tools. Inspectors specialising in an industry need specific, industry-focused training as well as generic health and safety training. Inspectors need to collaborate with their counterparts overseas and stay up to date with international best practice.
32. The inspectors' activities should be regularly reviewed by their manager, who needs to have relevant expertise. Such reviews should include checking that decisions are consistent and in line with policy. Inspectors need quick access to legal support in complex situations.

Review of the strategy

33. The new regulator should regularly monitor the effects of its strategy on compliance behaviour. Only by doing so can the regulator check whether progress is being made. This requires designing qualitative and quantitative performance measures that can demonstrate progress. Lessons learnt should be used to improve strategy, policies and procedures. Appropriate benchmarks should be developed against other agencies in New Zealand and overseas.

Resourcing

34. The budget will need to be assessed by the new board when it has determined the regulator's strategy and programmes.

Health and safety levy

35. Currently, all businesses pay the same flat rate for the health and safety levy. That requires review because some businesses receive a far greater level of service than others. The amount spent administering health and safety in the mining and petroleum sectors, for example, may exceed the levies collected.

36. The levies have not traditionally been fully allocated to the regulator. In principle the levies should be spent on health and safety administration and be fully allocated to the regulator.¹² The new Crown agent should be able to transfer funds between years as needed.

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.

ENDNOTES

¹ These responsibilities are drawn from those identified in the Robens report and remain applicable to the health and safety regulator: Lord Robens (Chairman), Committee on Safety and Health at Work, *Safety and Health at Work: Report of the Committee 1970–72, 1972*, HMSO, 1972, p. 36.

² Ministry of Business, Innovation and Employment, Decision Document: High Level Design, 31 July 2012, MBIE300010006.

³ For the proposed departmental agency model, see Bill English (Deputy Prime Minister) and Jonathan Coleman (Minister of State Services), Better Public Services Paper 3: Departmental Agencies, 4 May 2012, <http://www.ssc.govt.nz/sites/all/files/bps-2306543.pdf>

⁴ For more information, see Queensland Government, Mining and Safety, Safety and Health, 16 July 2012, <http://mines.industry.qld.gov.au/safety-and-health/default.htm>

⁵ United Kingdom Cabinet Office, Public Bodies Reform – Proposals for Change, 14 December 2011, p. 24, http://www.cabinetoffice.gov.uk/sites/default/files/resources/Public_Bodies_Reform_proposals_for_change.pdf

⁶ Kate Wilkinson, (Minister of Labour) Proposal to Increase Investment in Safe and Skilled Workplaces Using Unallocated Revenue from the Health and Safety in Employment Act Levy, 4 April 2012, DOL7770060003/8, paras 37–38.

⁷ Lord Robens (Chairman), *Safety and Health at Work*, p. 36, para. 114.

⁸ *Ibid.*, p. 37, para. 118.

⁹ *Ibid.*, para. 117.

¹⁰ The best-practice approach for government agencies in New Zealand is set out in *Achieving Compliance: A Guide for Compliance Agencies in New Zealand*, published in June 2011. It was produced by the central government's Compliance Common Capability Programme Steering Group and sponsored by the Department of Internal Affairs.

¹¹ Queensland, Department of Employment, Economic Development and Innovation, Mine Inspection Planning System (MIPS), April 2011, CAC0109.

¹² There are other organisations with valid claims to the HSE levy, such as Maritime New Zealand and the Civil Aviation Authority. They should continue to receive funds from the levy required for the purposes of administering the HSE Act in their specialist areas.



The regulatory framework

- + An effective regulatory framework
- + Strengthening the Crown minerals regime

An effective regulatory framework

Introduction

1. The health and safety regulatory framework for underground coal mines should be changed so that it is effective and consistent with best practice. This chapter considers the changes needed and how they should be achieved.

The general regulatory framework

Legislative hierarchy

2. New Zealand's health and safety regulatory framework is largely based on the British Robens model. At the apex is the Health and Safety in Employment Act 1992 (HSE Act), which imposes general duties and contemplates a supporting framework of regulations and guidance, including approved codes of practice and standards. The HSE Act repealed sector-specific legislation, including the Coal Mines Act 1979 and its associated regulations, leaving New Zealand with no health and safety legislation specific to coal mines. The legislation, however, allowed for more detailed regulations and approved codes of practice.

Regulations

3. Regulations are intended to elaborate on the duties in the HSE Act. The Robens report envisaged them covering general matters applicable to most forms of employment, particular types of hazard and particular industries.¹ They can impose duties on a wide range of people, including employers, employees, those who control places of work, and manufacturers and suppliers of equipment. Their scope can include registration, licensing and notification of use of plant and places of work, incident notification and investigation, certification of competence and recognition of training organisations. A breach of regulations is an offence.²

Approved codes of practice

4. Approved codes of practice are intended to provide guidance about how to fulfil duties. They can cover a wide range of matters, including work practices, characteristics for manufactured plant, protective equipment design and employee participation. Compliance with approved codes of practice is not mandatory, but the courts may have regard to relevant approved codes when determining whether the HSE Act has been breached.³

Other forms of guidance

5. Other guidance can include domestic, international and industry codes,⁴ Australian/New Zealand standards and overseas legislation. Certain categories, for example Australian/New Zealand standards, documents published by or by the authority of the New Zealand government and overseas legislation, may be incorporated by reference into, and thus form part of, regulations.⁵

Developing regulations and guidance

6. The governor-general makes regulations by order in council, on the recommendation of the appropriate minister. Approved codes of practice are prepared at the direction of and subject to the approval of the minister.⁶ In practice, the regulator should identify the need for regulations and approved codes of practice and, having sought ministerial approval, lead their drafting. Approval is not required for voluntary guidance, which may be developed by the Department of Labour (DOL) or others involved, preferably with departmental support.

The adequacy of the general supporting framework

7. A supporting framework of regulations and guidance, including codes of practice, is an essential element of the general duty-based regime. But the development of a framework in New Zealand has been unsatisfactory. In 1996 the parliamentary *Inquiry into the Administration of Occupational Safety and Health Policy* emphasised its importance. Some specific industries, including mining, required some prescription, and both employers and employees asked that more resources be put into the development of codes.⁷
8. Various regulations and approved codes of practice were then promulgated, but in the 2000s that largely ceased. In 2008 the National Occupational Health and Safety Advisory Committee (NOHSAC) expressed concern that 'the Robens model of performance-based legislation has not been fully implemented or supported in New Zealand'. There was a clear need for approved codes and guidance materials, but there had been a 'lack of commitment over the last decade to providing information to workplaces in line with the Robens model'. NOHSAC regarded it as 'imperative, therefore, that the full model of the Robens approach to OHS [occupational health and safety] regulation is implemented and appropriate codes of practice, and particularly guidance material, provided for workplaces immediately'.⁸
9. Contributing factors identified by NOHSAC included insufficient departmental resources, difficulties regarding the development of approved codes of practice, problems with removing outdated codes, and a lack of collaboration between the professional disciplines and government agencies.⁹

An inadequate framework for underground mining

10. Reflecting those general concerns, the supporting framework for underground coal mining is inadequate:
 - there are sector-specific regulations, but they are not comprehensive and need revision;
 - there are no approved codes of practice; and
 - other guidance is insufficient. There are some Australian/New Zealand standards of relevance,¹⁰ but they are not tailored for the sector. The extractives industry association, MinEx Health and Safety Council, developed industry guidance, but lacked sufficient DOL support.
11. The effect on health and safety in underground coal mining is serious. Duty holders may not know the best method of complying with the HSE Act. Some may develop and use effective methods but others may not. Researching and developing those methods is a business cost and requires skill and resources that employers may lack.
12. Without approved codes of practice, DOL mining inspectors have occasionally consulted repealed legislation and overseas legislation, regulations and standards when ascertaining compliance with the HSE Act. The absence of these codes meant that DOL's investigation report relied heavily on overseas material.
13. This situation compares unfavourably with many overseas jurisdictions. DOL engaged Professor Michael Quinlan to review several of those, as part of a detailed submission supporting the development of an improved framework.¹¹ Most of the jurisdictions reviewed had detailed supporting regulations, codes of practice or guidance for major mining hazards. It was a common theme of submissions to the commission that the supporting framework needs revision.

The mining regulations

14. The Robens report expressly recommended regulations for particular industries including mining,¹² but from 1992, when the HSE Act came into force, until 1996 there were no sector-specific regulations. In 1996 a New Zealand review committee led by the Ministry of Commerce considered the recommendations of the Australian inquiry into the 1994 Queensland Moura No. 2 tragedy.¹³ It recommended a supporting framework addressing the risks

to employees arising from fires and explosions' and strengthening mine management through clearly defining responsibilities. The committee noted 'considerable consternation'¹⁴ about the lack of specific coal mining legislation:

To regard coal mining as being 'the same as any other industry', for the purposes of statute, is to ignore the findings of a number of Commissions of Inquiry and the historical fact that it has been, and continues to be, a potential source of multiple fatalities in a workplace. The uneven progress of the HSE (Mining Council) Regulations through the consultation process is due in no small part to the failure of various key agencies to understand the unique hazards and difficulties facing the industry and a readiness to interfere with the process of putting these regulations in place on the basis of undemonstrated pretext ...

The pursuit of deregulation in the context of underground coal mining would have a highly negative – indeed, potentially dangerous – effect on the industry. It has been tried, in fact it pre-existed the current regime in England and Europe during the 18th and 19th centuries when the victims of coal mine disasters were counted in their hundreds. Regulation of specific duties and functions for colliery management structure has been reiterated following colliery explosions time and time again. How often does it need to be said?¹⁵

15. Sector-specific regulations were introduced in the 1990s. The Health and Safety in Employment (Mining Administration) Regulations 1996 reinstated competency requirements that existed before the HSE Act came into force. The Health and Safety in Employment (Mining – Underground) Regulations 1999 addressed many, but not all, major hazards. In 2011, as a result of DOL's 2006–09 mining policy review, competency requirements for small mine management were increased.¹⁶ But problems remained.

All practicable steps

16. The 1999 regulations often repeat the 'all practicable steps' phrase used in the HSE Act. The all practicable steps test depends on the relevant circumstances, including the nature, severity and knowledge about potential harm and the cost of addressing that harm.¹⁷ Using that phrase in regulations maintains flexibility but can lead to ambiguity and imprecision.
17. For example, regulation 23 deals with outlets and requires employees to 'take all practicable steps to ensure that ... every mine or tunnel has suitable and sufficient outlets', having regard to a range of factors. Regulation 29 deals with measurement of air from fans and requires employers to take 'all practicable steps' to ensure that the quantity of air flow is measured and any recirculation prevented. These matters are critical to safety: an all practicable steps qualification is unacceptable.

Focus and scope

18. Some regulations have an inadequate focus or scope. For example, regulation 10 of the Health and Safety in Employment (Mining – Underground) Regulations 1999 requires notification to DOL of certain incidents or accidents, including fires. During commission hearings, there was dispute about whether fires include sparks, a source of ignition, and thus constitute a high-potential incident that could result in serious harm or catastrophe. The underlying issue is that the regulations should require notification of all high-potential incidents.
19. Regulation 4 of the Health and Safety in Employment (Prescribed Matters) Regulations 2003 prescribes the content of accident and serious harm registers that workplaces must keep.¹⁸ They must record any investigation, but the prescribed form only requires advice of whether an investigation was undertaken. If a summary or details of any investigation had to be included, then inspectors who review registers would be able to identify the central issues and assess the effectiveness of the investigation. The regulation is also unclear about whether employers are required to investigate all incidents and accidents.

Lack of support for a safety management system

20. The HSE Act requires potential and actual hazards to be systematically identified and assessed. Significant hazards must be eliminated, isolated or, failing that, minimised. The legislation does not prescribe how this should be done,

but in complex organisations and high-hazard industries a documented health and safety system is necessary. The mining regulations do not expressly require such a system.

21. DOL is developing a model health and safety management system for small mines, but all underground coal mines should have such a system.¹⁹

Scrutiny of mine design

22. Professor Quinlan noted that poor design, planning and technical flaws were causal factors in a number of mining incidents.²⁰ Similarly, Impac Services Ltd noted that research had illustrated the 'importance of planning and design ... Approximately 40% of fatal accidents were found to have their origins in decisions made prior to work starting.'²¹
23. Effective regulatory involvement in health and safety should start at an early stage. The HSE Act envisages this, but regulation 8 of the 1999 regulations only requires a health and safety inspector to be notified of an operation in which a mine is worked or a tunnel is made 14 days or more before mining starts.²² By then, design would have been finalised.

Safety cases

24. Submissions to the commission raised the introduction of safety cases. A safety case comprises a comprehensive suite of documentation showing that an operation is acceptably safe.²³ The safety case is assessed by a regulator, who approves the start or continuation of an operation. In New Zealand safety cases are used in the offshore petroleum industries²⁴ but overseas their use extends to a greater range of hazardous industries.
25. Safety-case documentation is extensive and can include the operational control arrangements, the hazard identification and management system, procedures for managing change, contractor management, competency, emergency arrangements, incident and accident investigation, communication and workforce consultation, auditing and quality assurance.
26. There were conflicting views about requiring safety cases in underground coal mines. The New Zealand Council of Trade Unions and the Amalgamated Engineering, Printing and Manufacturing Union supported partial safety cases, including regulatory approval.²⁵ The Construction, Forestry, Mining and Energy Union supported the Queensland approach,²⁶ which requires underground coal mines to have documented safety management systems, but stops short of requiring regulatory approval.
27. Solid Energy did not support safety cases. Because they have not been implemented elsewhere it sees risks in New Zealand 'going it alone'. It considers that the safety case will use departmental resources that could be better applied elsewhere.²⁷ DOL did not support safety cases. It preferred early disclosure of certain safety management documents for new underground mines and when there was a change of ownership. It considered these could be assessed but not approved.²⁸ Professor Quinlan suggested the selective use of a safety-case regime when mining conditions warrant it.
28. The commission is not convinced that, at this stage at least, safety cases should be mandatory. More research is needed about their efficacy and content in underground coal mining. The regulator would need significant resources and skills to scrutinise them, which it currently lacks. Immediately necessary are early notification of proposed mines, and operators providing, and the regulator reviewing, mine plans and core health and safety documents.

The penalty regime

29. Penalties must deter potential offenders and ensure that health and safety obligations are taken seriously. Dr Kathleen Callaghan stated that to do so the range of punishments must be sufficient to cause discomfort.²⁹

30. New Zealand has significantly lower maximum penalties than those in some comparable overseas jurisdictions. The penalty for the most serious health and safety offence is up to two years in prison and a fine of up to NZ\$500,000,³⁰ whereas in some Australian states serious health and safety offences carry penalties of up to AUD\$3 million for a corporation, AUD\$600,000 or five years' imprisonment for an officer or person conducting a business and AUD\$300,000 or five years' imprisonment for a worker.³¹
31. The possible introduction of an offence of corporate manslaughter was also raised with the commission. In 2008 the offence of corporate manslaughter was introduced in the United Kingdom.³² It allows prosecution of companies and organisations when serious management failures result in death, reflecting community outrage at serious health and safety failures by management.
32. The New Zealand regime should be reviewed. Increased penalties for companies should be considered, as should the introduction of an offence of corporate manslaughter.

An effective supporting regulatory framework for underground coal mining

33. An effective supporting regulatory framework for underground coal mining is required. Mining regulations should be reviewed and approved codes of practice and guidance issued and periodically reviewed. Comprehensive coverage of major underground coal mining hazards is vital. Decisions are needed about whether regulation, approved codes of practice, other guidance or a combination are appropriate for any particular hazard. Professor Quinlan preferred major hazards to be addressed in regulations because guidance is not forceful enough.³³
34. As the Robens report recommended, drawing up regulations requires the best available expertise from independent organisations and industry.³⁴ The commission considers there should be a single focus expert task force whose members include health and safety experts, and mining industry, regulator and worker health and safety representatives, supported by technical experts such as ventilation and geotechnical engineers. The task force should be separate from the 2012 ministerial task force carrying out a broad review of health and safety.
35. Adopting, with amendment, relevant parts of the Queensland and New South Wales underground coal mining frameworks, which are more developed than New Zealand's, would save significant time.
36. Some urgent and obvious changes could be included in new approved codes of practice, to be later replaced by regulation. This would provide early guidance to the industry, workers and the regulator.

Changes for the task force to consider urgently

37. The commission has identified specific changes it suggests the expert task force should consider urgently. No doubt the task force will identify more.³⁵ They include:
 - 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 for 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.
38. Other recommendations relating to health and safety laws, regulations or approved codes of practice are detailed in other parts of this report: Chapter 27, 'Strengthening the Crown minerals regime'; Chapter 28, 'Improving corporate governance'; Chapter 29, 'Improving management leadership'; Chapter 30, 'Worker participation'; Chapter 31, 'Qualifications, training and competence'; Chapter 32, 'Improving the emergency response'; and Chapter 33, 'Improving emergency equipment and facilities'.
39. A more detailed list for the expert task force to consider follows:

TOPIC	TO BE CONSIDERED
All practicable steps test	Its use in regulations can cause ambiguity, lacks precision and should be minimised.
Electrical hazards	Technology advances need to be better accommodated and regulated.
	The nature of the restricted zone needs clarification. The extent to which electrical equipment may be placed in coal measures, and the necessary protections, require addressing.
Emergency equipment and facilities	Emergency equipment, including self-rescuers and compressed air breathing apparatus (CABA), should be required at suitable places and spacings underground.
	Changeover or refuge stations should be defined and required.
	The need for at least two means of ingress and egress must be stated more clearly.
	The means of ingress and egress must accommodate workers, rescue personnel and equipment.
	The mine should also accommodate swift sealing and emergency inertisation.
	Emergency navigational aids to egresses, self-escape facilities and equipment should be mandatory.
Emergency response	There should be comprehensive operator emergency response management plans addressing: <ul style="list-style-type: none"> • the facilities and training required to enable and support self-rescue and rescue; • how atmospheric conditions will be monitored following an emergency; and • emergency mine sealing and inertisation, including airlocks and docking stations.

TOPIC	TO BE CONSIDERED
	Operator emergency management plans should be compatible with CIMS, the co-ordinated incident management system used by New Zealand's emergency services.
	Operator emergency management plans should be provided to the Mines Rescue Service (MRS), the regulator and other relevant emergency services.
	Emergency response should be tested internally and subject to training exercises involving external agencies.
Roles, expertise and competency	Roles important to health and safety should be mandatory.
	Minimum competencies should be provided and/or reassessed for all important health and safety roles.
	The level of training and supervision required for new and inexperienced workers should be clarified.
Gas monitoring	Underground atmospheric monitoring requirements need defining and strengthening.
Governance	The statutory responsibilities of directors for health and safety should be reviewed.
Health and safety management systems	<p>Documented health and safety management systems should be expressly required. Documentation and the corresponding systems should:</p> <ul style="list-style-type: none"> • cover key risk areas such as mine ventilation, spontaneous combustion, gas management, methane drainage, strata control, training, employee and contractor oversight and emergency response; • cover or integrate with the health and safety systems of contractors; • provide for change management; and • be reviewed when there is significant change in mine plans or operations.
	Key health and safety management system documentation should be provided to and scrutinised by the regulator at an early stage and when there are substantial changes, including of ownership.
	Health and safety management systems should be regularly audited and reviewed.

TOPIC	TO BE CONSIDERED
Incident and accident notification and investigation	All high-potential incidents must be notified.
	Whether incidents and accidents must be investigated by the operator or employer should be clarified.
	Sufficient detail of incident and accidents and their investigation should be more readily available to regulators.
Methane control, monitoring and drainage	The requirements for monitoring and managing methane need better definition and strengthening.
	Methane drainage, including pre-drainage, should be required in appropriate circumstances.
Management	The health and safety roles and responsibilities of the mine manager should be defined and strengthened.
Mine plans	The minimum requirements for the content of mine plans, including those showing stoppings and ventilation, should be reviewed. Plans should be certified by a registered surveyor, and be made available to inspectors and the MRS on a regular basis.
Spontaneous combustion	Regular testing and monitoring should be required.
Strata control	Strata management plans should be required.
Ventilation	The notification requirements for uncontrolled accumulations of flammable or noxious gas need strengthening.
	A ventilation officer, responsible for key aspects of the ventilation system, should be required.
	Placement of main fans underground in coal mines must be prohibited.
	Explosion protection should be required for main fans.
	Design and construction standards for ventilation control devices, such as stoppings and overcasts, are required.
Withdrawal of workers when gas present or ventilation fails	The requirements to withdraw workers from a mine following a ventilation failure or uncontrolled accumulation of flammable or noxious gas need strengthening.

TOPIC	TO BE CONSIDERED
Worker participation	Employers should have to make available to all workers, without request, the results of monitoring of workplace conditions that affect health and safety.
	Workers should be involved in the development of health and safety management systems, principal hazard plans and safe operating procedures that bear on their health and safety.
	All underground coal mines should be required to have a documented worker participation health and safety scheme.
	Contractors should have similar rights to employees to participate in processes to improve health and safety in the workplace.
	The functions and powers of health and safety representatives should include inspections and stopping activities when there is immediate danger of serious harm.
	Area inspectors appointed and paid for by unions representing coal mine workers should be introduced with the power to stop activities when there is immediate danger of serious harm.

Figure 26.1: Considerations for the expert task force

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.

ENDNOTES

¹ Lord Robens (Chairman), Committee on Safety and Health at Work, *Safety and Health at Work: Report of the Committee 1970–72, 1972*, HMSO, 1972, p. 43, para. 136.

² Health and Safety in Employment Act 1992, ss 22, 23(1), 50(1)(c).

³ *Ibid.*, ss 29(1), 20(9).

⁴ For example, International Labour Organisation, *Code of Practice on Safety and Health in Underground Coalmines, 2006* and the MinEx Health and Safety Council, *Industry Code of Practice: Underground Mining and Tunnelling*, October 2009, MINEX0005.

⁵ Health and Safety in Employment Act 1992, s 23(2)–(3).

⁶ *Ibid.*, ss 21, 20.

⁷ Labour Committee, *Inquiry into the Administration of Occupational Safety and Health Policy: Report of the Labour Committee, 1996*, DOL0010010023/5, p. 9, para. 3.1.

⁸ Neil Pearce, Evan Dryson, Philippa Gander, John Langley and Mark Wagstaffe, *Review of the Key Characteristics that Determine the Efficacy of OHS Instruments: Report to the Minister of Labour, 2008*, p. 17, http://ohsnetnz.org.nz/documents/Review_of_the_key_characteristics_that_determine_the_efficiency_of_OHS_instruments-2.pdf

⁹ *Ibid.*

¹⁰ For example, Standards Australia and Standards New Zealand, *Risk Management – Principles and Guidelines (AS/NZS ISO 31000:2009)*, 20 November 2009; Standards Australia and Standards New Zealand, *Occupational Health and Safety Management Systems – Specification with Guidance for Use (AS/NZS 4801:2001)*, 15 November 2001; and Standards Australia and Standards New Zealand, *Occupational Health and Safety Management Systems – General Guidelines on Principles, Systems and Supporting Techniques (AS/NZS 4804:2001)*, 15 November 2001.

¹¹ Michael Quinlan, *Analysis Report: Reviewing Evidence to Assess Whether the Conclusions & Recommendations of the 2006–2009 Mine Safety Review are Still Relevant and Changes in the Regulatory Framework the Royal Commission Might Consider*, DOL4000010003/17, para. 36.

¹² Lord Robens (Chairman), *Safety and Health at Work*, p. 43, para. 136.

¹³ Ministry of Commerce, *Mining Inspection Group, Review of the Recommendations from the Wardens Inquiry into the Accident at Moura No 2 Mine, Queensland on Sunday August 7 1994, 1996*, EXH0003.

¹⁴ *Ibid.*, p. 17.

¹⁵ *Ibid.*

¹⁶ Health and Safety in Employment (Mining Administration) Regulations 1996, reg 11, amended on 13 January 2011 by Health and Safety in Employment (Mining Administration) Amendment Regulations 2010, reg 4(1).

¹⁷ Health and Safety in Employment Act 1992, s 2A.

¹⁸ That requirement is imposed by s 25(1)–(1B) of the Health and Safety in Employment Act 1992 and applies to all workplaces.

¹⁹ In July 1994 a code of practice that supported a hazard management approach was promulgated but it was not tailored to underground coal mines: Department of Labour, Occupational Safety and Health Service, *Managing Hazards to Prevent Major Industrial Accidents, 2004*, <http://www.osh.dol.govt.nz/order/catalogue/pdf/hazardac.pdf>

²⁰ Michael Quinlan, *Survey Report Reviewing Evidence from High Hazard Incidents and Matters Related to Regulation in Underground Mining*, DOL4000010002/11–14, paras 40–47.

²¹ Impac Services Ltd, *Submission by Impac Services Ltd to Phase 4 of the Pike River Royal Commission*, IMP0001/10.

²² In some cases the timeframe is shorter: Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 8.

²³ Tim Kelly, *A Systematic Approach to Safety Case Management (SAE Technical Paper 2004-01-1779)*, 2004, SAE International.

²⁴ The regulations are currently being reviewed: Department of Labour, *Review of the Health and Safety in Employment (Petroleum Exploration and Extraction) Regulations 1999: Discussion Paper, 2012*, <http://www.dol.govt.nz/consultation/petroleum-regulations/petroleum-regs-discussion.pdf>

²⁵ New Zealand Council of Trade Unions, *Submission on Phase 4 Issues on Behalf of New Zealand Council of Trade Unions Te Kauae Kaimahi, 16 March 2012*, NZCTU0001/11–12; New Zealand Amalgamated Engineering, Printing and Manufacturing Union, *Final Submissions of the New Zealand Amalgamated Engineering, Printing and Manufacturing Union, 26 March 2012*, EPMU0035/5.

²⁶ Construction, Forestry, Mining and Energy Union, *Submission on Behalf of the Construction, Forestry, Mining and Energy Union in Respect of Phase Four: Policy Aspects, 30 March 2012*, CFMEU0041/11, para. 21.5.

²⁷ Solid Energy New Zealand Ltd, *Final Submissions to the Royal Commission on the Pike River Coal Mine Tragedy*, SOL545717/70, para. 21.73.

²⁸ Department of Labour, *Phase Four Paper, 16 March 2012*, DOL4000010005/57, para. 243 and DOL4000010005/23, para. 86.

²⁹ Kathleen Callaghan, *witness statement, 23 March 2012*, FAM0058/29, para. 3.17; New Zealand Council of Trade Unions, *Submission, NZCTU0001/36–37*, para. 14(a)–(d).

³⁰ Health and Safety in Employment Act 1992, s 49.

³¹ See Queensland's Work Health and Safety Act 2011, Division 5, Offences and Penalties. The act does not apply to coal mining, which is subject to the Coal Mining Safety and Health Act 1999, pt 3, s 34. The Coal Mining Safety and Health Act 1999 has lesser penalties than the Work Health and Safety Act 2011, but they are still higher than those in New Zealand.

³² The Corporate Manslaughter and Corporate Homicide Act 2007, which came into force on 6 April 2008.

³³ Michael Quinlan, *Analysis Report*, DOL4000010003/24–25; Department of Labour, *Phase Four Paper, 16 March 2012*, DOL4000010005/54, para. 229.

³⁴ Lord Robens (Chairman), *Safety and Health at Work*, p. 49, para 159.

³⁵ DOL has identified many areas of concern: Department of Labour, Phase Four Paper, 16 March 2012, DOL4000010005/31–33, para. 125.

Strengthening the Crown minerals regime

Introduction

1. The Ministry of Economic Development (now part of the Ministry of Business, Innovation and Employment) looks after the Crown's economic interests in the minerals it owns. The Crown grants rights, by way of exploration or mining permits, to companies to mine for coal.
2. Mining cannot occur without a permit, which gives the operator exclusive rights to the mineral resources. The Crown has an interest in coal extraction for three reasons: economic development, security of energy supply and generation of revenue. The technical and economic viability of a proposal, and a range of other factors, are taken into account before a permit is issued.
3. The ministry's evaluation, and subsequent monitoring, of the Pike application for a mining permit was weak. This chapter analyses why and reviews the steps the ministry is taking to rectify the problems. The steps include considering health and safety at the permitting stage.

Summary of law

4. Crown-owned minerals are managed and administered through the Crown Minerals Act 1991, regulations and minerals programmes.

Crown Minerals Act 1991

5. The Crown Minerals Act 1991 sets out the rights and responsibilities of resource users and the functions and powers of the minister of energy. It provides for the allocation of Crown-owned minerals through permits to undertake prospecting, exploration or mining.
6. The minister's powers and functions under the act are delegated to the chief executive of the Ministry of Economic Development. Those functions include the preparation of minerals programmes, the granting of minerals permits and the monitoring of the effect and implementation of minerals programmes and permits. Approving changes to the terms of permits and transfers and other dealings with permits are also delegated.

Regulations

7. The Crown Minerals (Minerals and Coal) Regulations 2007 prescribe the information required for mining permit applications, the reporting obligations and the fees payable.¹ The key information required with an application is:
 - a statement of the technical qualifications and financial resources of the applicant;
 - a map of the permit area;
 - evidence for an exploitable mineral deposit or mineable resource, which must include inferred, indicated and measured mineral resources; and probable and proved reserves; and
 - the proposed work programme, with an overview of how the permit area will be worked. The statement includes information on the size, nature, extent and siting of the mining operations, the mining methods to be used and the mining and production schedule.

Minerals programmes

8. Minerals programmes outline the government's policies and procedures for allocating permits to explore and mine Crown-owned minerals and obtain a fair royalty payment in return.
9. The public is consulted on minerals programmes. They are approved by the governor-general and have a similar legal status to a regulation.
10. The first Minerals Programme for Coal was issued in 1996. The Pike permit to mine was granted under this programme. The minerals programme was updated in 2008 but is the same in principle.²
11. Under the 2008 minerals programme a permit will be granted if the applicant has identified and delineated a mineable mineral resource or exploitable mineral deposit, if the area of the permit is appropriate and if the intention is to economically and practicably deplete the resource in accordance with good mining practice.
12. In addition, a work programme is approved if the objective is to extract minerals through good mining practice, if the area of land is appropriate and adequate for the activities to be carried out and if mining should result in increased knowledge of New Zealand mineral resources. The applicant must have the ability to act in a technically competent manner and with diligence and prudence in undertaking the programme of work.
13. Other factors to be considered include estimates of mineral resources, mining feasibility studies, proposed mining methods, extraction schedules, geotechnical and mine design aspects of operations, project economics and whether the proposed operations are in accordance with good mining practice.³

Problems with permitting

No consideration of health and safety

14. Health and safety matters were not considered when reviewing Pike's proposals to develop the mine. The minerals programme for coal, which sets out the government's policy, specifically excludes this.

Insufficient information and analysis

15. The application for a permit by Pike in March 1996 contained limited analysis of the feasibility of the operation and the geological, technical and economic risks associated with it.⁴ The application, approved in 1997, was based on a pre-feasibility study. It did not include estimates of initial capital requirements, the costs of the operation, expected profitability or other matters that might be required to establish economic viability. The proposed mining methods were uncertain, making it difficult to establish whether extraction was likely to be in line with good mining practice. A feasibility study was not completed until 2000.⁵
16. As Ministry of Economic Development geologist Alan Sherwood said, 'A proposition was put forward in the application with a general indication of the way in which the deposit would be worked but there wasn't anything that I would call a feasibility study with the application.'⁶ The level of geological information was sufficient to establish or delineate the coal resource but not detailed enough to enable a mine to be designed.⁷ The commission was also told that 'the data provided to Crown Minerals ... would not be adequate to meet the evaluation of an application criteria established under the Minerals Programme for Coal (1996).'⁸
17. The approval documents prepared by the ministry do not demonstrate a thorough evaluation.⁹ No evident process was used to judge the proposal against the criteria in the coals programme, including how good mining practice was assessed.¹⁰
18. It seems at that time the ministry had limited expertise and experience in assessing the adequacy of applications against the comprehensive criteria for granting a mining permit or in assessing commercial risk.¹¹ Thorough assessment at the permitting stage is important as lack of information about factors such as geology, coal characteristics and seam gas content can increase financial and health and safety risks and the possibility that a mine would be managed 'on the run'.¹²

Monitoring of mineral permits

19. Monitoring of mineral permits is one of the four functions of the minister of energy under section 5(c) of the Crown Minerals Act 1991. After the Pike mining permit was granted, however, there is no evidence of any monitoring or auditing of compliance with the work programme, or the permit conditions. No questions were asked about the operation, despite delays in development and production, and escalating costs. There was no analysis of annual summary reports or other reports on exploration or mining activities.¹³
20. A file note dated 23 February 2007 states that the last technical material received from Pike was filed in 1997.¹⁴ Even when annual work statements and mine plans were received there was no review of material or process to follow. 'We just ensure that that information is given and we don't now go back to the permit holder and approve anything that has been put before us.' When it was suggested to Mr Sherwood that it sounded as if such information was filed away, he replied, 'That's not too far from the truth.'¹⁵
21. Overall the approach to monitoring was passive, as the ministry itself has recognised. It has recently described its relationship with operators as 'somewhat reactive and correspondence based, rather than forward-looking and based on a mutual understanding of permit-specific issues.'¹⁶

Good mining practice

22. Both the Crown Minerals Act 1991 and the minerals programmes contain requirements that emphasise the need for mining to be undertaken in accordance with good mining practice.
23. Section 43(2)(b)(i) of the act enables the minister to withhold approval if he or she considers that the work programme is contrary to recognised good exploration or mining practice. Good mining practice is defined, in part, in the Minerals Programme for Coal 1996:

Good exploration or mining practice cannot be defined unequivocally. Rather, it is a concept implying that a permit holder will undertake prospecting, exploration or mining in a technically competent manner and with a degree of diligence and prudence reasonably and ordinarily exercised by experienced operators engaged in similar activities under similar circumstances and conditions.¹⁷

24. The 2008 minerals programme sets out criteria for determining whether a work programme meets good mining practice.¹⁸ These include mining methods being suitable and technically effective, given the geology of the area, and mine development and production operations being designed and conducted to maximise extraction and avoid sterilisation and waste. There must also be ongoing appraisal and definition of geology and structure of the mineral deposit so the most suitable mine development and production operations can be planned.
25. Given the prominence of 'good mining practice' in both the act and minerals programmes, it is difficult to accept the logic of excluding consideration of health and safety.
26. When asked to explain the distinction between health and safety aspects of good exploration or mining practice and the non-health and safety aspects, Mr Sherwood stated:

I think that's as you've inferred, sir, that's very difficult to answer because at the end of the day when you get into the business of actually operating a mine, the two become inseparable, however our key consideration is the allocation of a resource to mine and so we are precluded by the programme from considering the health and safety aspects of the same information that might contribute to that.¹⁹

27. It is impossible to distinguish between good mining practice as it applies to extraction of the resource and good mining practice that enhances worker safety. The two are inextricably linked. Economic returns will not be maximised unless extraction occurs efficiently and safely. Design of mining processes must incorporate health and safety considerations. The Crown has an interest in both aspects at all stages in a mine's development. There has to be consideration of whether a mine will operate according to laws and regulations, including those relating

to health and safety. The level of scrutiny will vary depending on the stage of development of a mine and the information available.

Recent developments

Natural resources policy

28. In 2008 there was a renewed focus on New Zealand's petroleum and mineral resources and their contribution to economic growth.
29. The Petroleum Action Plan was established to encourage development of the petroleum sector.²⁰ It included a review of the Crown's capability and resourcing (Action 3); a review of the regulatory, royalty and taxation arrangements for petroleum (Action 5); and a review of health, safety and environmental legislation in New Zealand and other jurisdictions to assess the adequacy of New Zealand's regulatory environment for offshore petroleum operations (Action 8). The programme paves the way for better oversight of underground coal mining.
30. In September 2010, the *Comparative Review of Health, Safety and Environmental Legislation for Offshore Petroleum Operations* considered whether the health and safety and environmental framework for New Zealand's petroleum sector needed to change. The report's recommendations were based on a comparative analysis of regulatory frameworks in four other jurisdictions – the United Kingdom, Australia, Ireland and Norway.²¹
31. Two recommendations are pertinent to minerals developments: first, that the ministry be empowered to consider health, safety and environment at the resource allocation stage, and second, that a review be undertaken to identify ways to improve interagency co-ordination on health, safety and environmental regulation.
32. The third major development is a review of the Crown Minerals Act 1991, regulations and programmes. One of the key objectives is 'to ensure that better coordination of regulatory agencies can contribute to stringent health, safety and environmental standards in exploration and production activities'. The outcome of the review will be amendments to the act and new minerals programmes and regulations. The proposals, if advanced, will be an improvement on current practice. They include:
 - Assessment of an applicant's health, safety and environment policies, capability and record before or during the permitting process. This review would be undertaken by the Department of Labour and an organisation with environmental expertise.
 - More proactive management of high-risk mineral activities, including underground coal mining, owing to their high technical and geological complexity. There will be an annual review of work programmes every three years and the ministry will have annual meeting with coal mine operators.²²
 - More information will be sought from high-risk permit holders so the Ministry of Business, Innovation and Employment can better manage and oversee activities.
33. The initiatives proposed in the review of the Crown Minerals Act 1991 and operational changes already under way are a step in the right direction. Some of the proposals remain short on detail and were not formally government policy at the time of writing. It is not clear how the initiatives will be implemented – in legislation, regulations, the minerals programme, as a condition of a permit or through voluntary agreements – and the weight that will be attached to them.
34. The proposal to consider health and safety matters at the permitting stage is a significant and welcome shift in ministry policy. The proposed consultation with mining inspectors as part of the process of approving a mining permit recognises the importance of early consideration of health and safety. This goes some way to addressing concerns regarding lack of early regulatory involvement.
35. In addition, the Ministry of Business, Innovation and Employment should formally provide information to prospective permit holders on their obligations under New Zealand health and safety laws. This will raise awareness

of health and safety obligations from the outset. In Queensland, for example, a guide to the application of coal mining safety and health legislation is provided to applicants.

36. Compliance with the Health and Safety in Employment Act 1992 and regulations should be a general condition of mining permits. This would give a clear signal of the importance placed on safe mining operations by the Crown. Failure to comply could be grounds for revocation of the permit.

Operational changes

37. In 2010 a capability review of Crown Minerals, a business unit of the Ministry of Economic Development, was undertaken by external consultants. A core finding was that 'capability is not fit for purpose in terms of realising value to the Crown of its minerals estate ... the capability to manage and plan the overall permitting process, to set and monitor work plans, and to ensure compliance is inadequate to ensure that the potential value of the Crown's minerals estate is fully realised.'²³ The review led to restructuring of Crown Minerals. It is now called New Zealand Petroleum and Minerals. The new unit includes a minerals group whose role is development of minerals-related strategy, promotion and investor relations activities, and management of permitting. Staff numbers are being progressively increased from about 40 to 70.²⁴
38. The review recommended that the ministry strengthen the strategic leadership and commercial orientation of the Crown Minerals group to build a credible lead agency to work with investors, industry and government and establish the necessary interagency alignment required for a whole of government approach to the sector.
39. The new business unit has a petroleum group and a minerals group. Each group has three units: strategy, planning and promotion; exploration; and production. By structuring the units in this way the different risks associated with exploration and production activities can be better identified and managed.²⁵
40. These changes, coupled with the move to more proactive management of higher risk operations, including underground coal mines, should help to alleviate the problems evident in the allocation and management of the Pike permit.

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.

ENDNOTES

- ¹ These regulations replaced the Crown Minerals (Minerals and Coal) Regulations 1999. These were preceded by Crown Minerals (Forms – other than Petroleum) Regulation 1992, which would have applied at the time of the Pike application.
- ² Material differences include the 2008 programme not containing legislative detail or repeating the provisions of the Crown Minerals Act and changes to royalty rates and the basis for calculating royalties. Department of Labour, Department of Conservation, Ministry of Economic Development and Ministry for the Environment, Joint Legislative Framework Paper, 6 May 2011, CLO0000010001/18, para. 41.
- ³ Ministry of Economic Development, Minerals Programme for Minerals (Excluding Petroleum) 2008, 1 February 2008, CLO0010010350/28, para. 8.1.
- ⁴ Pike River Coal Company Ltd, Application to the Ministry of Commerce for a Coal Mining Permit Covering the Pike River Coal Field, February 1996, MED0010070015.
- ⁵ AMC Resource Consultants Pty Ltd, Final Feasibility Study, 23 June 2000, DOC0010030006, Vols 1–2; NZOG0010 (Vol. 3), NZOG0011 (Vol. 4), NZOG0007 (Project Summary).
- ⁶ Alan Sherwood, transcript, p. 398.
- ⁷ *Ibid.*, p. 394.
- ⁸ Murry Cave, witness statement, June 2011, CAV0001/34, para. 91.
- ⁹ Crown Minerals reports, Mining Permit Application 41-453, 18 August 1997, MED0010070017 and 22 September 1991, MED0010070018.
- ¹⁰ Alan Sherwood, transcript, p. 389.
- ¹¹ *Ibid.*, p. 382.
- ¹² David Reece, transcript, p. 4517.
- ¹³ Richard Cook, witness statement, 17 June 2011, MED7770010004/5–6, para. 17.
- ¹⁴ Alan Sherwood, Site Visits West Coast 19–22 February 2007, 23 February 2007, MED0010070049/1.
- ¹⁵ Alan Sherwood, transcript, pp. 400, 405.
- ¹⁶ Ministry of Economic Development, Review of the Crown Minerals Act 1991 Regime: Discussion Paper, March 2012, MED4000010004/10.
- ¹⁷ Ministry of Commerce, Minerals Programme for Coal, 1 October 1996, MED0010070001/108, para. 14.3.
- ¹⁸ Ministry of Economic Development, Minerals Programme for Minerals (Excluding Petroleum) 2008, 1 February 2008, CLO00010010350/21, para. 5.4.
- ¹⁹ Alan Sherwood, transcript, p. 390.
- ²⁰ Ministry of Economic Development, Petroleum Action Plan, <http://www.med.govt.nz/sectors-industries/natural-resources/oil-and-gas/petroleum-action-plan/>
- ²¹ Atkins Holm Joseph Majurey Ltd and ERM New Zealand Ltd, Comparative Review of Health, Safety and Environmental Legislation for Offshore Petroleum Operations, September 2010, Ministry of Economic Development, CAC0011/5, para. E.1.
- ²² Ministry of Economic Development, Phase Four Paper, 16 March 2012, MED4000010001/53, para. 190.
- ²³ Martin Jenkins, Maximising Gains from New Zealand's Petroleum and Mineral Resources, 14 June 2010, MED0100010003/10, para. 22.
- ²⁴ Ministry of Economic Development, Phase Four Paper, 16 March 2012, MED4000010001/64, para. 236.
- ²⁵ Ministry of Economic Development, Tier Three Paper, 3 June 2011, MED0000020001/30, para. 73.



Industry and workers

- + Improving corporate governance
- + Improving management leadership
- + Worker participation
- + Qualifications, training and competence

Improving corporate governance

Introduction

1. Protecting the health and safety of workers is not a peripheral business activity. It is part and parcel of an organisation's functions and should be embedded in an organisation's strategies, policies and operations.
2. This requires effective corporate governance. Governance failures have contributed to many tragedies,¹ including Pike River. This chapter considers how best to ensure that governance is effective.

The board of directors

The role of the board and directors

3. The board and directors are best placed to ensure that a company effectively manages health and safety. They should provide the necessary leadership and are responsible for the major decisions that most influence health and safety: the strategic direction, securing and allocating resources and ensuring the company has appropriate people, systems and equipment.
4. The directors should:
 - ensure the company has a comprehensive health and safety management plan;
 - ensure that plan is fit for purpose and reviewed regularly;
 - provide adequate resources and time for that plan to be implemented; and
 - obtain independent evidence of the effectiveness of that plan.

The legislative framework

5. The Health and Safety in Employment Act 1992 (HSE Act) supports effective health and safety governance by requiring companies as employers to take all practicable steps to ensure health and safety and to systematically identify and address significant hazards.
6. The act does not place an express duty on the board or the individual directors of a company. This contrasts with the situation of other groups. Employers, employees, those who control places of work, the self-employed, principals and those who sell and supply plant for use in workplaces, are required to take all practicable steps to ensure health and safety within their sphere of control.
7. By contrast, individual directors (and officers and agents of companies) can only be prosecuted, under section 56, if a company fails to ensure the health and safety of its workers, and a director 'directed, authorised, assented to, acquiesced in, or participated in, the failure.'² In those circumstances a director is liable, as a secondary party, for the breach of duty committed by the company as an employer.
8. The interpretation of section 56 can produce invidious results. In smaller companies where directors are 'hands on' and make, or participate in, operational decisions there may be scope to prosecute both the company and its directors. In a larger company the section is less likely to be applicable because the board of directors is divorced from day-to-day operational decision-making. Yet it may be health and safety failures at larger companies that cause process safety accidents leading to multiple fatalities.
9. Other countries have grappled with the problem of director liability and their experiences are informative.

The United Kingdom (UK)

10. In the UK, the Robens report identified the need for a greater health and safety focus at director (and senior management) level:

The boardroom has the influence, power and resources to take initiatives and set patterns ... if directors and senior managers are unable to find time to take a positive interest in safety and health, it is unrealistic to suppose that this will not adversely affect the attitudes and performance of junior managers, supervisors and employees on the shop floor.³

11. More recently, the UK Health and Safety Executive commissioned reviews of published research on the influence of directors on a company's health and safety performance. Professor Philip James, concluded that:

directors do exert an importance influence over their organisation's health and safety management and performance. ... while directors appear to consider that they already face considerable legal, commercial and societal pressures to take responsibility for health and safety ... their commitment to the issue is often problematic and frequently seen to be so by other managers.

Statutory health and safety requirements, including those giving rise to individual, personal, legal liabilities, serve as one of the most important drivers of director actions in respect of health and safety. However, there would seem to be scope to explore whether ... the introduction of 'positive' health and safety duties on directors would act to improve their motivation ... The evidence ... is seen to provide a strong, but not conclusive, basis for arguing that the imposition of such duties would ... usefully supplement the liability that directors currently face.⁴

12. Another reviewer, Professor Frank Wright, supported improved training of directors and promotion of health and safety leadership by them, in conjunction with issuing an approved code of practice addressing their responsibilities.⁵
13. Section 37 of the UK Health and Safety at Work Act 1974 contemplates prosecutions of directors where a health and safety offence is committed by the company 'with the consent or connivance of, or [was] attributable to any neglect on the part of, any director, manager, secretary or other similar officer of the body corporate.'⁶ This provision is broader than its New Zealand counterpart because directors are liable where a company's wrongdoing is attributable to 'any neglect' by them that contributed to the company's breach of duty.
14. This broader provision has not been altogether successful. Neglect contemplates the existence of a duty, personal to the director, which has been breached and in a manner which contributed to the company's failure to protect its workers. If there is no such duty, then proof of neglect will be difficult and prosecution of the director unlikely.
15. In 2000 the British government published its strategy, *Revitalising Health and Safety*, which called upon the Health and Safety Executive to develop a code of practice on directors' responsibilities. The strategy also envisaged that legislation should be introduced to place directors' responsibilities on a statutory footing.⁷ The subsequent code of practice provided good guidance on the role of directors in promoting health and safety. However, some companies did not adopt the code.
16. Between 2003 and 2010 three private members' bills were introduced in the UK to place a primary duty on directors to take all reasonable steps to ensure that a company met its health and safety obligations.⁸ None was passed. The concept of neglect remains without a corresponding personal duty upon directors.

Australia

17. Australia has taken several initiatives on the health and safety duties of directors.
18. The proposal to harmonise health and safety legislation across all Australian states resulted in the Model Work and Safety Bill, which has been enacted at federal level, and in the Australian Capital Territory, New South Wales, Northern Territory and Queensland. Section 27 provides that the 'officer' of a corporate entity 'must exercise due diligence to ensure that the person conducting the business or undertaking complies with [their] duty of obligation'. Hence,

the primary duty of care placed on a person conducting a business to ensure the health and safety of workers, is supplemented by a duty of due diligence placed on officers of the company.

19. Due diligence, defined in section 27(5), requires officers to take reasonable steps to understand the business risks and hazards, and ensure that adequate resources and information, compliance and verification processes, are in place. The legislative scheme places a positive duty on officers of a company and defines the extent of that duty through the concept of due diligence.
20. Another example exists in the narrower context of mining, where some states impose positive duties on directors. The Queensland Coal Mining Safety and Health Act 1999 provides that the 'executive officers of a corporation must ensure that the corporation complies with this Act.'⁹
21. As Professor Neil Gunningham has noted, 'Deterrence is particularly effective when applied to individual decision-makers. However, it is crucial that the appropriate decision-makers are targeted, and this implies a focus on senior corporate managers and directors, rather than mine managers and surveyors.'¹⁰

Conclusions

22. The HSE Act does not place on directors shared or individual responsibility for ensuring the safety of the employees. Section 56 is ineffective, at least with reference to larger companies, where directors have normally delegated to executive management the operational decisions that give rise to breaches of health and safety.
23. What is needed, as experience in the UK and Australia indicates, is a statutory duty requiring directors to play their part at the governance level in ensuring that the company has an effective health and safety management system. This could be achieved by the addition of a duty on directors in the 'other duties' section of part two of the HSE Act. A failure to meet that duty would constitute an offence.
24. These conclusions are based on the commission's assessment of a mining tragedy, while the proposed changes are of general application to all companies. Accordingly the commission does not formally recommend the changes be made but rather that the issues should be reviewed.

Guidance available

New Zealand guidance

25. Directors have access to a wealth of guidance about good governance practice, including information produced by the New Zealand Institute of Directors,¹¹ and free guides provided by firms offering risk management services.

Australia/New Zealand standards

26. Section 5 of the HSE Act describes the object of the legislation as promoting the prevention of harm to workers through, among other things, the systematic management of health and safety. Other provisions also emphasise a systematic approach, for example in relation to the identification of hazards.¹²
27. There are three relevant standards jointly issued by Standards Australia and Standards New Zealand: AS/NZS ISO 31000:2009 on risk management, AS/NZS 4804:2001 on guidelines for setting up health and safety management systems, and AS/NZS 4801:2001 on auditable specifications for health and safety management systems.¹³
28. The Australian/New Zealand standards provide a systematic approach to developing health and safety management systems. AS/NZS 4804:2001 is comprehensive and applicable to organisations of any size and type. It is particularly relevant to high-hazard industries. The topics include:
 - how to set up a system;
 - how to continually improve the system;
 - the resources required;

- measuring performance, including the use of lead indicators;
- integration of the system with other management systems;
- employee involvement;
- internal and external audit of the system; and
- incident investigation and remedial action.

Auditing health and safety management systems

29. 'Audit' means a systematic examination against defined criteria to determine whether the activities and results conform to planned arrangements. AS/NZS 4801:2001 establishes an audit framework, principally for the use of independent auditors but the framework can also be used for internal audit or management reviews.
30. A board of directors wishing to ensure that its health and safety management system is systematically developed and reviewed could usefully start with ensuring that directors understand these standards and that its senior management is using the standards as a guide.

Some common governance principles

31. New Zealand guidance on governance describes important principles that company directors, especially those in high-hazard industries, should keep in mind when considering their health and safety risks.
32. Best practice recommended by the New Zealand Institute of Directors identifies the importance of 'holding to account'. This means that the board 'holds management strictly and continuously to account through informed, astute, effective and professional oversight'.¹⁴

International guidance

33. There is also international advice for boards of directors. A good example is the guide published jointly by the UK Health and Safety Executive and the UK Institute of Directors.¹⁵ The guide makes the following important points:
 - The board should set the direction for effective health and safety management and make it an integral part of organisational culture and performance standards.
 - The board should be aware of the significant risks faced by the business, including health and safety risks.
 - The board should ensure that health and safety is properly resourced, risk assessments are carried out, specialist advice is received where necessary, and employees are involved.
 - Health and safety is a key business risk and failure to include it in business decisions can lead to catastrophe.
 - Health and safety must be part of business decisions at all levels, not treated as an 'add-on'.
 - Board members should be trained to assess health and safety risks and promote their understanding throughout the organisation.
 - Board members should ensure that they receive adequate information on the organisation's performance, including lead indicators (preventative or process safety information) as well as lag indicators (incidents and injury rates). The board should receive immediate reports of significant failures.
 - There should be periodic audits of the effectiveness of the management structures, risk controls and performance. The auditor should have unrestricted access to the internal and external auditors.
 - The impact on health and safety of changes, such as the introduction of new processes, should be assessed and reported to the board.
 - The board should receive regular reports on the health and safety performance of contractors.
34. The New Zealand health and safety regulator could assist directors by issuing an approved code of practice on how

good governance practices can be used to manage their organisation's health and safety risks. The UK guidance would be a suitable base for that code. The regulator should work with the New Zealand Institute of Directors to produce the code.

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.

ENDNOTES

¹ See, for example, Chapter 2, 'Accident analysis – some concepts'; and also the United Kingdom Health and Safety Executive, *Directors' Responsibilities for Health and Safety: The Findings of Two Peer Reviews of Published Research* (Research Report 451), 2006, pp. 4–5, <http://www.hse.gov.uk/research/rrpdf/rr451.pdf>

² Health and Safety in Employment Act 1992, s 56(1). Directors can also be parties to a health and safety offence pursuant to the Crimes Act 1961, s 66.

³ Lord Robens (Chairman), Committee on Safety and Health at Work, *Safety and Health at Work: Report of the Committee 1970–72*, 1972, HMSO, 1972, p. 15, para. 46.

⁴ United Kingdom Health and Safety Executive, *Directors' Responsibilities for Health and Safety*, pp. 37–38, <http://www.hse.gov.uk/research/rrpdf/rr451.pdf>

⁵ *Ibid.*, pp. 26–27.

⁶ Health and Safety at Work Act 1974 (UK), s 37(1).

⁷ United Kingdom Health and Safety Executive, *Revitalising Health and Safety: Strategy Statement*, June 2000, p. 26, para. 68, <http://www.hse.gov.uk/revitalising/strategy.pdf>

⁸ Company Directors (Health and Safety) Bill 2003; Health and Safety (Directors' Duties) Bill 2004–05; Health and Safety (Company Director Liability) Bill 2009–10. See also: Edward Beale, Brenda Brevitt, Sally Broadbridge, Louise Butcher and Timothy Edmonds, *Health and Safety (Directors' Duties) Bill: Bill No 22 2004–05* (House of Commons Library Research Paper 05/18), 1 March

2005, <http://www.parliament.uk/briefing-papers/RP05-18.pdf>

⁹ Coal Mining Safety and Health Act 1999 (Qld), s 262.

¹⁰ Neil Gunningham, *Mine Safety: Law Regulation Policy*, 2007, Federation Press, p. 179.

¹¹ New Zealand Institute of Directors, *Principles of Best Practice for New Zealand Directors: The Four Pillars of Effective Board Governance*, 2010. <https://www.iod.org.nz/Publications/TheFourPillarsOfGovernanceBestPractice.aspx>

¹² Health and Safety in Employment Act 1992, s 7.

¹³ Standards Australia and Standards New Zealand, *Risk Management – Principles and Guidelines* (AS/NZS ISO 31000:2009), 20 November 2009; Standards Australia and Standards New Zealand, *Occupational Health and Safety Management Systems – General Guidelines on Principles, Systems and Supporting Techniques*, (AS/NZS 4804:2001), 15 November 2001; Standards Australia and Standards New Zealand, *Occupational Health and Safety Management Systems – Specification with Guidance for Use* (AS/NZS 4801:2001), 15 November 2001.

¹⁴ New Zealand Institute of Directors, *Principles of Best Practice*, p. 3.

¹⁵ Institute of Directors and United Kingdom Health and Safety Executive, *Leading Health and Safety at Work: Leadership Actions for Directors and Board Members*, October 2007, pp. 1–8, <http://www.hse.gov.uk/pubns/indg417.pdf>

Improving management leadership

Introduction

1. The commission is recommending new mining regulations and more guidance from a single-purpose and expert regulator. This will provide more help to directors and managers but will also require more of them. To make the changes effective, the board of directors and its managers will need to lead better health and safety performance across their organisations. Chapter 28, 'Improving corporate governance', discussed the contribution required from directors at the governance level and should be read in conjunction with this chapter, which deals with the leadership role of managers. 'Managers' means the chief executive down to the managers responsible for specific functions.
2. This chapter also reviews the role of the statutory mine manager and recommends that the duties be defined. It recommends that the mine manager be given some statutory protection when decisions are made beyond that person's control.

Leading improvements in health and safety performance

Risk management

3. Health and safety should be a core objective of any organisation, not a thing apart or a matter left to the health and safety manager. All employees must take responsibility for health and safety, but especially the managers from whom subordinates take their cues. Managing health and safety risks follows the same principles that apply to managing any other risks faced by the company. Robust risk management systems are essential. The risk of non-compliance with health and safety requirements needs to be identified generally across the work site and in each specific area of operations. The risks should be discussed in both formal and informal forums. The role of the health and safety committee should be clear and supported. As Chapter 30, 'Worker participation', makes clear, involvement of employees is essential.

Actions speak louder than words

4. Managers should demonstrate by their actions that they take health and safety seriously. This is done not only at the formal level, such as developing comprehensive safety management plans and ensuring that progress is reported, but also through the managers' day-to-day behaviour. For example, if managers say that health and safety is important but do not ensure that comprehensive safety systems are operating and do not ensure that all incidents are properly investigated, an appropriate health and safety culture cannot be built.

Management information

5. Management information systems (MIS) are necessary if risks are to be managed. The MIS for health and safety should be based on the health and safety management system, which should identify the crucial information to be reported to confirm the mine is operating safely. The MIS brings that crucial information together and enables trends to be revealed. Performance measures, qualitative and quantitative, should be designed and departures from standards highlighted by the MIS.
6. With modern technology it has never been easier to design good MIS and make the information widely and easily accessible to others, including the workforce and, as required, the directors. Modern MIS allow the information to be

presented at different levels of detail appropriate to the recipient's position. Good MIS avoid excessive reliance on personal communications, important as they are.

Training and guidance

7. There are two straightforward steps managers might take to improve their personal leadership of health and safety. First, if they have not had training in this area, then they should make sure they get it. There are courses tailored for different levels of managers, including chief executives. Second, there are best practice guides available, which contain expert advice for managers on leading health and safety. Much of that advice is about how to demonstrate personal commitment. There is no approved code of practice yet in New Zealand but in the interim managers should consult the best practice guides.
8. The United Kingdom health and safety regulator has issued a useful best practice guide for leading health and safety in high-hazard industries.¹ This recommends that managers commit to detailed actions under four headings:
 - achieving a positive health and safety culture in the organisation;
 - leading by example;
 - ensuring that a range of systems is in place to support first class management of health and safety; and
 - ensuring worker participation.

Approved code of practice needed

9. The New Zealand health and safety regulator should issue guidance, similar to that issued by the United Kingdom, by way of an approved code of practice for managers. The code should be developed at the same time as the approved code of practice already recommended for directors (Recommendation 6).

Strengthening the statutory mine manager's role

The regulations

10. The Health and Safety in Employment (Mining Administration) Regulations 1996 require the employer to appoint someone to manage the mining operation and to personally supervise the health and safety aspects. Employees must comply with the manager's instructions on health and safety. For a mine the size of Pike River, the manager must hold a certificate of competence as a first class coal mine manager.² The mine manager has no detailed responsibilities,³ which has caused confusion for employers and for the inspectorate.

Defining the role

11. The mine manager's responsibilities and functions need to be defined. New Zealand should have regard to the definitions in the Queensland legislation applicable to the site senior executive.⁴ Under the Queensland law, the person in this role has comprehensive obligations, including:
 - ensuring that health and safety risks are acceptable;
 - developing and operating a single safety management system for everyone at the mine;
 - maintaining a management structure that supports health and safety, including documenting the responsibilities and competencies of senior positions;
 - ensuring adequate training of workers;
 - providing for adequate planning, organising, leadership and control of the operation; and
 - supervision of shift operations, monitoring the working environment, procedures, equipment and installations, and inspections of each workplace at the mine.

12. Problems occur when the statutory mine manager with these responsibilities does not have the power to discharge them. For example, the mine manager may wish to buy equipment considered essential for the safe working of the mine but cannot get permission from higher management or the board. In that situation the regulations should require the statutory mine manager to document the proposal and the employer should either accept this or provide a formal response setting out the reasons for not doing so. The concept is similar to that already contained in section 19B(4) of the Health and Safety in Employment Act 1992 regarding recommendations of a workplace health and safety committee. The mine manager should be required to alert the regulator by sending it a copy of the proposal and the formal response.

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.

ENDNOTES

¹ United Kingdom Health and Safety Executive, Leadership for the Major Hazard Industries: Effective Health and Safety Management, 2004, <http://www.hse.gov.uk/pubns/indg277.pdf>

² Health and Safety in Employment (Mining Administration) Regulations 1996, regs 7, 11.

³ Department of Labour, Pike River Mine Tragedy 19 November, 2010: Investigation Report, [2011], DOL3000130010/240, para. 5.8.3.

⁴ Coal Mining Safety and Health Act 1999 (Qld), ss 42, 55.

Introduction

1. This chapter explores the regulatory framework for worker participation and recommends some improvements. Although aimed at health and safety in underground coal mines, some of the recommendations have wider application.
2. Worker participation is essential to keeping workplaces healthy and safe. Workers have practical experience in the daily hazards that arise and employers need their contribution to manage such hazards. Worker participation is required by the International Labour Organisation (ILO)'s Occupational Safety and Health Convention 1981 (C155), which was ratified by New Zealand in 2007.

Regulatory framework

3. The Health and Safety in Employment Act 1992 (HSE Act) places a general duty on all employers to give employees reasonable opportunities to participate in improving health and safety.¹ That includes providing a safe working environment, safe facilities and plant and identifying and managing hazards. Employees can participate directly or indirectly, through health and safety representatives and joint employer/employee health and safety committees.
4. The contribution employees make depends on their knowledge and expertise, the information and training they are given, the effectiveness of the health and safety processes in their workplace and the degree of support they receive from the regulator. Employers are required to provide employees with a range of information such as the results of health and safety monitoring by the employer or the regulator, emergency procedures, identified hazards, potential hazards and the location of safety equipment.² Employers must take all practicable steps to ensure that their employees are competent to perform their work safely, or are supervised by someone with sufficient knowledge and expertise.³
5. The HSE Act requires employers with 30 or more employees to develop an employee participation system. Where there are fewer than 30 employees, an employee participation system is required only if an employee or a union representative requests it. The HSE Act requires only that the system have a review process.⁴

Health and safety representatives and committees

6. Two ways of involving workers in the management of health and safety are through elected health and safety representatives and joint health and safety committees. The role of representatives includes fostering positive health and safety management practices, identifying hazards and drawing them to the employer's attention, consulting health and safety inspectors and promoting the health and safety of employees.⁵
7. Health and safety representatives must have ready access to information about workplace health and safety, and they must be given paid leave for health and safety training.⁶ Only trained representatives can issue hazard notices, which may recommend steps for dealing with the hazard, and they can choose to notify a health and safety inspector that they have issued a notice.⁷
8. Health and safety committees are committees of workers with the ability to make recommendations. The employer must either adopt the recommendations of a health and safety committee (or a health and safety representative) or explain in writing why the recommendations have not been adopted. There is no stipulated timeframe for responding.

Employee rights to refuse work

9. Employees can refuse to do work they believe is likely to cause them serious harm. They can continue to refuse if they are unable to resolve the matter with their employer and they have reasonable grounds for believing that the work is likely to continue to cause them serious harm. Reasonable grounds include advice from a health and safety representative that the work is likely to cause serious harm.⁸ This right to refuse work on health and safety grounds must be exercised individually (including individually by each member of a group), but under the Employment Relations Act 2000 employees can also collectively decide to strike for health and safety reasons. The lawfulness of a strike, as opposed to an individual refusal to work, is subject to the Employment Relations Act 2000.
10. Employees must be aware that they have the right to refuse to work and understand what that means. To exercise their rights, employees need sufficient information and training about the hazards to which they may be exposed and the harm they could suffer.

Problems with the framework

11. The framework provided by the HSE Act for employee participation is generally sound. It gives employees the means to ensure their workplace is run in a healthy and safe manner and to protect themselves. However, the framework has limitations regarding contractors, the requirement to develop a system, the range of information readily available to employees and the powers of health and safety representatives.

Contractors

12. The HSE Act distinguishes between employers' duties to their employees and to contractors, including their supervision and training. Principals and people in control of a workplace are generally required to ensure that contractors, subcontractors and their employees are not harmed while lawfully at work,⁹ but are not expressly required to ensure that they are competent to do the work safely or that they are supervised. This can be problematic when a business or person is engaged to do work in an unfamiliar environment. For example, a coal mine may contract experienced builders to erect structures underground who do not understand the mine's unique hazards. Employers should have a positive duty to take all practicable steps to ensure that contractors are competent to do work safely or are adequately supervised.
13. Nor does the requirement for an employee participation system cater adequately for modern workplaces where the workforce consists of employees, contractors and subcontractors. The government has addressed the absence of an express requirement for businesses to collaborate in the Health and Safety Amendment Bill (No. 2). The bill requires collaboration by all who have duties at the same place of work, except employees. Those people will be required to work together to meet their employee participation duties (and other duties). The bill was introduced to Parliament in August 2008 and needs to be progressed.

Requirement for employee participation system

14. While all employers must provide opportunities for employees to participate in ongoing health and safety processes, only those with 30 or more employees are required to have a system. As a result, small businesses may have no formal or documented systems that can be the subject of audits and that will ensure workers know how they can participate. All underground coal mines, regardless of their size, should have documented worker participation systems. In small workplaces, such systems could be quite simple.

Information readily available

15. Employees are not entitled, as a matter of course, to receive the full range of information about health and safety in their workplace. Unless they request it, employees do not have to be given information about hazards they will not be exposed to or will not create.¹⁰ But that information may be useful for assessing how well the employer identifies and manages hazards.

16. Employees should not have to ask for information about workplace monitoring; they need it to understand the conditions of their workplace. But they may not want to alert others, including their employer, to their interest in the information. Section 11(2)(b) of the HSE Act should be framed as a positive duty to make such information available to all workers without request.
17. Employers are not required to provide workers with the results of their investigations into health and safety incidents. These should be automatically made available to workers without them having to ask. The information may have to be provided in a form that does not breach the employer's other obligations, such as protecting the privacy of employees involved in or disciplined as a result of the investigation.

Power of health and safety representatives to inspect

18. The HSE Act does not give health and safety representatives the right to gather health and safety information through workplace inspections. Such inspections would provide a fuller picture of workplace hazards and their management than is possible from merely examining documents and talking to workers. Representatives should be able to carry out inspections, including during their normal working hours.

Power of health and safety representatives to protect workers

19. Health and safety representatives may discover hazards that are a source of immediate harm, but they have no power to stop activities.¹¹ Representatives can inform workers of the hazard and the workers can choose whether to stop work. Workers may not, however, have sufficient training or information to make an informed choice. They may also worry that refusing to work will jeopardise their employment or contract.
20. Health and safety representatives can raise the hazard with the employer, but the employer may not agree that work should stop immediately. The representatives can refer the matter to the regulator but that may not ensure immediate action either.
21. Trained health and safety representatives should be able to stop all or part of operations when there is an immediate danger to workers. This would give them a similar power to that of Queensland's site safety and health representatives to stop work.
22. Because stopping a business's operations has such a serious impact, the decision should be made only by health and safety representatives who have received sufficient training in health and safety, and in the exercise of that power.

Union check inspectors – underground coal mines

Background

23. The New Zealand Council of Trade Unions (NZCTU), the Engineering, Printing and Manufacturing Union (EPMU) and the Public Service Association (PSA) argued for the introduction of union check inspectors, similar to those previously known as workmen's national inspectors.
24. Workmen's national inspectors, appointed by the union, were used in underground coal mines before the HSE Act. They inspected mines where union members worked and reported their findings to the mine manager. If the workmen's national inspector reported that the mine or part of it was dangerous to life, or that any dangerous practice existed, the mine manager had to forward a copy to the mines inspector. But the workmen's national inspector could not require that work stop or workers be withdrawn.¹²
25. The union check inspectors now advocated for are based primarily on the union-appointed industry safety and health representatives in Queensland. They can direct operations be suspended when they believe the risk from coal mining operations is unacceptable.¹³

26. The industry does not support union check inspectors, with Solid Energy New Zealand Ltd saying employee participation can be adequately assured without them. Both the Coal Association of New Zealand (CANZ) and Solid Energy were concerned that such inspectors could make safety issues 'a focal point for any unrelated industrial conflict'.¹⁴ The commission was not provided with evidence to support that concern or to show it occurs in Queensland. CANZ and Solid Energy also suggested that union check inspectors could undermine engagement of all employees in health and safety.

Advantages of union check inspectors

27. A union check inspector would be an extra set of eyes and ears, and a further line of defence. Such inspectors may have made a difference at Pike River. Experience in Queensland shows that workers are more willing to report problems to their industry safety and health representatives than to the mines inspector, which means the representatives may be better informed. Union check inspectors would not be subject to the same employment concerns as workers (including health and safety representatives).
28. Union check inspectors could also play a valuable role in small underground coal mines where there are few workers and establishing sophisticated worker participation systems may be more difficult. It may not be appropriate for such mines to elect trained health and safety representatives, and union check inspectors could fill the gap.
29. The mines inspectorates in Queensland and New South Wales support the use of union check inspectors: 'We are comfortable with this. Don't see them as abusing their powers. If it has ever been an issue then the inspectorate deals with it.'¹⁵
30. Union check inspectors, appointed and paid by the union representing coal mine workers, should be introduced. They should have the power to enter and examine an underground coal mine. If they reasonably believe there is an immediate danger to the health and safety of a worker or workers, they should be able to stop operations. In all other cases where there may be danger, they should be required to refer their concerns to a mines inspector.
31. Their powers should apply only to health and safety matters. The regulator would investigate any allegations that union check inspectors were acting with any other motivation. If the allegations were justified, the appointed representative could be removed by the regulator.
32. Union check inspectors would need sufficient training and experience in underground coal mining and health and safety to ensure that they can properly and effectively exercise their powers. At the least, they would need a deputy's certificate of competence.

Practical measures to support worker participation

Employer support

33. The workplace environment needs to encourage workers to exercise their rights and perform their duties effectively. Employers should create a 'no-blame culture' that values health and safety and that supports workers who raise health and safety concerns. This requires leadership and commitment by management and the building of trust with workers, including health and safety representatives.
34. The development of high-trust relationships takes time. Senior management must be willing to listen to workers' concerns about health and safety and should respond to them promptly, even if only to explain why no action has been taken. The response should be given directly to the worker who reported the problem. All workers should be informed about the problem and the response.
35. The employer should support the health and safety committee by providing an employer representative who is senior enough to ensure that any concerns raised are dealt with quickly and appropriately.

36. Managers and supervisors need to demonstrate competence in workplace health and safety. A reasonable level of knowledge will help managers to judge the quality of the health and safety advice they receive and maintain constructive relationships with health and safety representatives. Performance appraisal and reward systems should recognise health and safety as a key results area.
37. The effectiveness of worker participation systems should be regularly reviewed and any problems addressed.

Union support

38. Trade union support may make it more likely that worker participation and representation will result in improved health and safety, but this may not be the case where there are difficult worker/employer relationships. A sample of mines at two Australian companies showed that below average safety performance was more common at the more heavily union-dominated workplaces where there were also adversarial relationships between workers and management and low levels of trust.¹⁶
39. The unions should support workers and health and safety representatives, regardless of union membership. In terms of training representatives, the NZCTU said it 'has accepted responsibility to act on behalf of all workers and not just union members. It does so because it regards workplace health and safety as a crucially important issue and because, although its resources are very limited, the union movement has the networks and the experience to reach out to all workplaces.'¹⁷

Regulator support

40. In early 2010, the Department of Labour (DOL) recognised the importance of the regulator actively supporting employee involvement in workplace health and safety and the role of health and safety representatives.¹⁸ DOL inspectors should engage with workers and their representatives regularly and make their contact details available. They should routinely consult health and safety representatives during inspections and audits. When possible, a representative should accompany the inspector during a visit.
41. The regulator should issue an approved code of practice on worker participation, and should promote it – and worker participation more generally – through education and publicity. Workers need to understand their rights and obligations; health and safety representatives need to understand their role. The code should help employers to meet their obligations and improve worker participation.
42. Health and safety representatives need to be well trained. Training is provided mainly by the NZCTU, Business New Zealand and Impac Services, and funded by the Accident Compensation Corporation (ACC) and by DOL through the Employment Relations Education Contestable Fund. ACC's funding has dropped substantially in recent years. DOL has provided more money, but has not been able to meet the entire shortfall. The government should ensure sufficient funding is available to train health and safety representatives.

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 their audits or inspections.

ENDNOTES

¹ Health and Safety in Employment Act 1992, s 19B.

² Ibid., ss 11–12.

³ Ibid., s 13.

⁴ Ibid., s 19C.

⁵ Ibid., sch 1A, pt 2. These are mandatory functions for health and safety representatives elected following a failure by an employer to develop a system when required. Health and safety representatives who are part of an agreed employee participation system have the functions as agreed between the employer, employee and if applicable, the union.

⁶ Ibid., s 19E.

⁷ Ibid., s 46A.

⁸ Ibid., s 28A.

⁹ Ibid., ss 15, 18.

¹⁰ Ibid., s 11(2)(b).

¹¹ Before the HSE Act was passed, the Occupational Safety and Health Bill proposed giving health and safety representatives the power to stop dangerous work and giving employees the right to refuse to do dangerous work. Those provisions were not retained by the HSE Act. The right to refuse work was inserted into the HSE Act in 2003 to comply with ILO Convention C155.

¹² Coal Mines Act 1979, s 175.

¹³ Coal Mining Safety and Health Act (Qld), s 167(1).

¹⁴ Adam Holloway, transcript, p. 5480.

¹⁵ Neil Gunningham and Darren Sinclair, ACARP Research Report Mine Safety Regulation: Towards a National Approach, March 2010, p. 18.

¹⁶ Neil Gunningham, Mine Safety: Law Regulation Policy, 2007, Federation Press, p. 201.

¹⁷ New Zealand Council of Trade Unions, Submissions on Phase 4 Issues, 16 March 2012, NZCTU0001/24.

¹⁸ Department of Labour, Workplace Services Practice Note – Health and Safety – No: 2010/11: Engagement with Health and Safety Representatives, March 2010, DOL3000100005.

Qualifications, training and competence

Introduction

1. This chapter reviews what is needed to improve the competency of the mining workforce and ensure that New Zealand's coal industry can attract and retain the skilled people it needs.
2. The Health and Safety in Employment (Mining Administration) Regulations 1996 needs reform to better define the roles, accountabilities and qualifications required. The new regulations should be aligned with those in Australia so that qualified and competent workers can move easily between the two countries.
3. At the same time the regulator needs to work closely with industry and relevant training organisations to ensure that the qualifications competency and training framework meets regulator and industry requirements. Chapter 26, 'An effective regulatory framework', recommends changes to the 1999 underground regulations, which will also lead to greater alignment with Australia and help to shape the new training curriculum.

Existing legal requirements

4. The legislation imposes a duty on employers to provide training and supervision.¹ In the mining sector these duties are buttressed by safety regulations prescribing certain mandatory competency standards (certificates of competence) for safety critical roles in mines.² In underground coal mines these roles include mine manager, mine deputy, mine underviewer, gas tester, mine surveyor and winding engine driver.
5. These regulatory requirements are based on a longstanding appreciation that the qualifications and competencies of the workforce are central to managing hazards. Indeed, a suitably trained workforce is one of the first lines of defence against a major accident.³

Key issues

Deficiencies and gaps in the regulations

6. The regulatory system should drive training programmes that produce a qualified and competent workforce which is aware of the major risks in underground coal mining and how to manage them.
7. Deficiencies and gaps in the regulations are holding back the development of the workforce. Although the regulations require employers to ensure that every employee holds a current certificate of competence for their position,⁴ they do not state the safety critical duties of position holders in sufficient detail or create role specific accountabilities.⁵ All of these are spelt out in Queensland regulations.⁶
8. The New Zealand regulations have failed to keep pace with comparable thinking overseas, most recently, the regulatory approach recommended by the Australian National Mine Safety Framework (the safety framework). The Council of Australian Governments' Standing Council on Energy and Resources is overseeing the implementation of this framework. It aims to achieve a nationally consistent occupational health and safety regime for the Australian mining industry.⁷
9. The safety framework calls for rules to specify the key positions necessary for the safe operation of a mine. People's functions and required competencies also need to be specified in legislation or regulation.⁸ By contrast, the New Zealand regulations are narrow in scope and lack detail, which causes confusion.

10. DOL proposes that new regulations should introduce new statutory roles, including a site senior executive and a ventilation officer, and that a general review of the competency requirements should follow.⁹ The commission has concluded that this much needed regulatory reform should focus on three objectives: increasing the scope of regulated roles to ensure alignment with Australia; clearly prescribing the roles, responsibilities and accountabilities of duty holders; and ensuring that all new and inexperienced workers are given appropriate training and supervision.
11. The scope of the new regulations should be generally aligned with Australian requirements. The regulations should define competencies up to and including management and supervisory levels. This will require regulation to move beyond the current statutory positions: a statutory ventilation officer is urgently needed. Mine manager and other key technical and supervisory roles should have clear accountabilities and penalties for non-compliance.
12. The new regulations should support these changes by setting out detailed requirements for new and inexperienced workers to be given basic training and supervision, in line with the general provisions in the Health and Safety in Employment Act 1992 (HSE Act) on training and supervision.¹⁰ Operators should keep a training/supervision register for periodic inspection by the regulator.

Insufficient oversight from the regulator

13. Changes should be made to the relationship between the regulator and the recognised industry training organisation for the coal sector – the Extractive Industry Training Organisation (EXITO). There is not enough regulator oversight of the qualifications competency and training framework.
14. Presently, DOL does not oversee or provide input into the curriculum; nor does it take any active role in the accreditation of competencies for any of the critical safety roles defined in the regulations. This task has been left to EXITO and to providers teaching individual unit standards.¹¹ The relationship between DOL and EXITO is largely confined to the administration of a register of certificate holders.
15. In keeping with New Zealand's devolved system of industry training, the coal industry itself has largely determined workforce skill standards through the work of EXITO. In addition to setting the curriculum and assessment requirements for regulated safety roles in mines, EXITO has worked with employers to develop national qualifications for quarrying and mining industries both above and below ground.¹² Overall the mining sector's qualifications appear reasonably extensive and have a strong focus on health and safety.
16. Although there are undoubted benefits to the industry itself leading the development of skill standards, there should also be regulator oversight of workforce competency.
17. The current model, in which skill development and setting is carried out by the industry body largely in isolation from government, has not provided sufficient quality assurance. The regulator and the industry need to have utmost confidence in the qualifications competency and training framework.

A more rigorous curriculum and assessment process

18. The regulator should adopt a greater leadership role in the sector to produce a competent, well-trained workforce. This will require closer working relationships between the regulator, EXITO, training providers and employers.
19. No regulator can oversee the qualifications and training framework in isolation. The Australian experience is that regulators can have an important oversight role through improving working relationships with industry and training providers. Queensland's mine safety law and regulation provides for a tripartite advisory committee, which recognises, establishes and publishes the competencies that qualify a person to perform health and safety duties under mining law.¹³ New Zealand needs to align itself with these practices.
20. Work should begin as soon as possible on reviewing the content of the curriculum. The scope of the review should be guided by the safety critical roles defined in the new regulations and by benchmarking New Zealand unit standards with Australian equivalents. As well as technical competency, the curriculum needs to ensure competency in key general management skills, including communication, planning and risk management. Foreign-

trained geologists, electrical engineers and other specialists should undertake New Zealand-specific training to acclimatise them to local conditions.

21. To confirm that training is effective, the regulator and EXITO should review and update final assessment processes for management and supervisory roles. These processes should align with Australian practices and include oral examinations to assess theoretical knowledge and its practical application. This is common practice in Australia's leading mining states.¹⁴
22. The assessment should be conducted once the required unit standards and practical experience have been gained. Independent oral examinations for the statutory manager, key technical roles and supervisors should be the norm. The regulator should monitor the implementation by employers and providers of basic industry training, including supervision of new and/or inexperienced workers.

Public funding for industry training

23. In the challenging environments typical of high-hazard industries health and safety training cannot be separated from other training needs. Existing skill standards and qualifications reflect this. The coal industry, in partnership with EXITO, has driven the development of standards that contain strong health and safety themes.¹⁵ In high-hazard sectors, industry training with a strong health and safety emphasis is essential.
24. The government is presently reviewing its industry training policy.¹⁶ The commission recommends that, for high-hazard sectors, funding is available for training with a strong health and safety emphasis.¹⁷ This includes funding for short health and safety courses that are a regulatory requirement. Such courses contribute to the achievement of wider vocational qualifications. Taxpayer provided resources for industry training are substantial.¹⁸

Alignment with international standards

25. The labour market for skilled and experienced mine managers, specialists and workers is global. To maintain a qualified and competent mining workforce in New Zealand, skill standards and industry training need to be generally aligned with international standards and practice. Close alignment with Australian standards makes sense, owing to the dominance of the Australian mining sector and the free flow of capital, skilled mining personnel and technologies across the Tasman.
26. Ensuring ease of labour market movement across borders should not be at the expense of minimum standards. New Zealand officials should therefore work in partnership with Australian regulators and standard setters to ensure qualifications, skill standards and industry training are robust and comparable on both sides of the Tasman. This should help the New Zealand mining sector to compete with Australia for skilled labour and expertise.
27. Existing processes developed by EXITO to assess the competency of overseas workers recruited to New Zealand mines require strengthening. There should be no scope for any 'back door' entry into labour markets because of inconsistent regulatory and administrative requirements between the two countries.
28. As part of this strengthening work the regulator should collaborate with Australian counterparts to develop joint Australia-New Zealand accreditation processes. The goal would be a consistent approach to examining competency of candidates seeking appointment to safety critical management, technical and supervisory positions. A joint Australia-New Zealand board of examiners should certify competency in safety critical roles.
29. Whatever trans-Tasman model is adopted, it must provide greater assurance that workers from third world countries have equivalent competencies to those required in Australia and New Zealand.

Working with Australia

30. An important part of the cross-jurisdictional work in the Australian safety framework is 'competency support' for the industry. This work involves the development of a standard set of competencies for safety critical mining roles identified in state legislation, reaching agreement on how those competencies are demonstrated, and identifying a process that allows states to implement the agreed national standards in a manner consistent with their respective legislation.¹⁹

31. To capture the benefits of 'competency support' for industry, New Zealand officials need to develop a close working relationship with leading state mining regulators, including relevant advisory committees and boards of examiners, to achieve the following goals:
- regulatory alignment with respect to competency requirements and qualifications, including supervision requirements for uncertified staff holding statutory roles;
 - benchmarking the consistency of New Zealand and Australian unit standards developed by respective industry training organisations;
 - developing a detailed New Zealand mining training standard comparable to Queensland's Recognised Standard 11: Training in Coal Mines 2010; and
 - working towards the development of joint accreditation processes including an Australia-New Zealand board of examiners.

Occupational health and safety consultants

32. Specialist consultants and firms have an important role to play in the New Zealand occupational health and safety system. The advice of health and safety professionals has been shown to contribute positively to corporate safety performance.²⁰
33. In the United Kingdom recent reforms have resulted in the establishment of an occupational safety and health consultants' register, which enables consultants who have met certain standards to market themselves accordingly. Registered consultants must abide by a code of conduct, provide sensible and proportionate advice, hold professional indemnity insurance and be committed to continuing professional development.²¹
34. Similarly, the Australian Safety Institute operates a registered safety professional scheme that certifies members' professional competence.²² The OHS Education Accreditation Board also verifies courses offered in Australia to ensure they are based on strong scientific and technical concepts and delivered by competent instructors.²³
35. In 2006 the National Occupational Health and Safety Advisory Committee (NOHSAC) raised concerns about the capability of occupational health and safety consultants in New Zealand.²⁴ Similar concerns were raised by others during subsequent reviews. The government's National Action Agenda 2010–13 adopted a specific priority to strengthen the competency framework for health and safety professionals.²⁵
36. There is no research showing the magnitude and scope of competency problems, but submissions to the commission by a leading health and safety consultancy highlighted the low level of formal qualifications required, while a leading academic in 'human factors' noted that anyone can claim 'experience' as the basis for calling themselves a health and safety professional.²⁶
37. Raising the professional standards of health and safety consultants is important and should be part of the regulator's work programme. This work should be led by the regulator and involve the Accident Compensation Corporation (ACC), leading consultants, academics and relevant professional organisations and tertiary training providers.²⁷ Consideration should be given to the merits or otherwise of greater industry self-regulation and co-regulation with government. Requirements for continuing professional development should be defined.

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.

ENDNOTES

¹ Health and Safety in Employment Act 1992, s 13.

² Health and Safety in Employment (Mining Administration) Regulations 1996.

³ SafetyWise Solutions Pty Ltd, Incident Investigation Reference Guide, Issue 4, October 2010, section 7, p. 5.

⁴ Health and Safety in Employment (Mining Administration) Regulations 1996, regs 8, 15.

⁵ Department of Labour, Pike River Mine Tragedy 19 November, 2010: Investigation Report, [2011], DOL3000130010/240, paras 5.8.5–5.8.6.

⁶ Coal Mining Safety and Health Regulation 2001 (Qld).

⁷ Australian Department of Resources, Energy and Tourism, National Mine Safety Framework, 16 August 2012, <http://www.ret.gov.au/resources/mining/framework/Pages/default.aspx>

⁸ National Mine Safety Framework Steering Group, National Mine Safety Framework: Implementation Report, 2008, CAC0170/19.

⁹ *Ibid.*, DOL4000010005/45–48, paras 178–92.

¹⁰ Health and Safety in Employment Act 1992, s 13.

¹¹ Robin Hughes, transcript, pp. 248–50; Kevin Poynter, transcript, p. 2995.

¹² Extractive Industry Training Organisation, Adding Value to Industry Training with On-job Training and National Qualifications, pp. 7–12; Extractive Industry Training Organisation, Extractive Sector Industry Training Plan, 2009–2011, pp. 6–8. Both available at: <http://exito.org.nz/industry-info/extractive>; See also: <http://www.industrytraining.co.nz/OurTraining/Industry+Courses/Surface+++Underground+Mining.html>

¹³ Coal Mining Safety and Health Act 1999 (Qld), s 76 (Functions of committee), s 80 (Appointment of members).

¹⁴ For New South Wales see: <http://www.resources.nsw.gov.au/safety/consultation/coal-competence-board/qualifications>

¹⁵ Extractive Industry Training Organisation, Adding Value to Industry Training, pp. 7–12; Extractive Industry Training Organisation, Training Plan, 2009–2011, pp. 6–8. Both available at: <http://exito.org.nz/industry-info/extractive>

¹⁶ Ministry of Education, Review of Industry Training, 2012. <http://www.minedu.govt.nz/NZEducation/EducationPolicies/TertiaryEducation/PolicyAndStrategy/ReviewIndustryTraining.aspx>

¹⁷ Tertiary Education Commission, Determination of Design and Funding Mechanism, 2012, paras 30–31. <http://www.tec.govt.nz/Documents/Ministerial%20determinations/determination-ITF-ITO-MA-2012.pdf>

¹⁸ Actual expenditure for industry training in 2011–12 was \$109 million, well below the appropriation of \$129m: <http://www.treasury.govt.nz/budget/2012/ise/v2/ise12-v2-pia-tered.pdf>

¹⁹ The minister of energy and resources is currently a full member of the Council of Australian Governments' Standing Council on Energy and Resources. The Standing Council is responsible for overseeing this work.

²⁰ A.P. Smith and E.J.K. Wadsworth, Safety Culture, Advice and Performance, Report Submitted to the IOSH Research Committee, 2009, p. 9, http://www.iosh.co.uk/books_and_resources/published_research.aspx#Research

²¹ Occupational Safety and Health Consultants Register, About OSHCR, <http://www.oshcr.org/page/AboutOSHCR>

²² Safety Institute of Australia Ltd, How to Become an RSP, 2012, <http://www.sia.org.au/membership/safety-professional>

²³ Australian OHS Education Accreditation Board, About the Australian OHS Education Accreditation Board, 2012, <http://www.ohseducationaccreditation.org.au/about.aspx>

²⁴ Allen & Clarke Policy and Regulatory Specialists Ltd, Occupational Health and Safety in New Zealand (NOHSAC Technical Report 7), 2006, p. 65, <http://ohsnetnz.org.nz/documents/NOH11098TechRep7Web.pdf>

²⁵ Department of Labour, Review of Workplace Health and Safety Strategy for New Zealand to 2015: Summary of Written Submissions, 2009, p. 15; Department of Labour, National Action Agenda 2010–2013, March 2011, DOL0020010015/9.

²⁶ Impac Services Ltd, Submission by Impac Services Ltd to Phase 4 of the Pike River Royal Commission, 9 March 2012, IMP0001/8; Kathleen Callaghan, witness statement, 23 March 2012, FAM0058/7, para. 34.

²⁷ New Zealand's leading professional organisations include the New Zealand Institute of Safety Management and the New Zealand Safety Council. Impac Services Ltd and Massey University offer degree level qualifications.



Emergency Management

- + Improving the emergency response
- + Improving emergency equipment and facilities

Improving the emergency response

Introduction

1. Despite the commendable efforts of those involved, the emergency response at Pike River experienced substantial problems, many of which can be traced back to inadequate planning and the lack of testing of emergency management plans. Adequate planning ensures an efficient response to emergencies. Regular exercises allow emergency plans and facilities to be tested, along with the understanding of workers and responders. This, in turn, provides opportunities to learn and improve systems. A full range of exercises, from desktop simulations to national responses, should be undertaken.

Emergency response management – legal requirements

2. The Health and Safety in Employment Act 1992 (HSE Act) requires employers to develop procedures for emergencies that may arise at work. They must also provide employees with ready access to information about what to do during an emergency.¹ There are no express requirements for workplaces to test their emergency procedures or for emergency procedures to be audited.
3. The Health and Safety (Mining – Underground) Regulations 1999 do not specify what should be included in an underground mine's emergency procedures. The MinEx Health and Safety Council (MinEx) *Guidelines for Emergency Preparedness in Mines and Quarries* do provide significant detail regarding the development of an emergency preparedness plan and what it should include. The *Code of Practice on Underground Mines and Tunnels*, issued by MinEx, also contains guidance on emergency response, including documenting, testing and reviewing the fire control and emergency response system.
4. The Fire Service Act 1975 requires owners of 'relevant buildings' to have evacuation schemes that enable safe and quick evacuation from a fire.² The Fire Safety and Evacuation of Buildings Regulations 2006 set out what should be included in such a scheme, including a requirement for six-monthly (at least) trial evacuations.³
5. The requirement for an evacuation scheme applies to relevant buildings above ground at an underground mine operation, but nothing similar is specified for the more hazardous, underground parts of the operation.

Serious failings at Pike River

6. There were failings in Pike's emergency preparedness. The existence of industry guidelines plainly did not make up for the lack of detailed legislative and regulatory requirements. Although Pike River had an emergency response management plan (ERMP), it did not adequately contemplate a catastrophic event underground and it had not been reviewed or sufficiently tested. Underground, there were minimal emergency exercises and no practices that simulated emergency conditions. That was in contrast to the regular trial evacuations of surface buildings. Pike intended to improve this when it reached steady state production.

The Australian approach

7. Queensland and New South Wales take a more prescriptive approach to emergency preparedness in coal mines. Consequently, their legislation and regulations impose much more detailed requirements on underground coal mine operators.⁴ Several of those requirements are included in the industry guidelines issued by MinEx.

8. In Queensland, a coal mine's site senior executive is required to develop and implement a safety and health management system, which must be in place before the mine can operate. That system must provide for managing emergencies at the mine. The emergency management system must include, among other details, provision for 'carrying out emergency exercises, including testing the effectiveness of the emergency management procedures and the readiness and fitness of equipment for use in an emergency' and 'auditing and reviewing the emergency exercises'.⁵
9. Queensland has also issued *Recognised Standard 08: Conduct of Mine Emergency Exercises*, which has the same status as an approved code of practice. It replaced an earlier standard, which had been implemented following the inquiry into the Moura No. 2 explosion. The inquiry recommended that '[e]mergency procedures should be exercised at each mine on a systematic basis, the minimum requirement being on an annual basis for each mine'.⁶
10. Queensland's *Recognised Standard 08* was developed and reviewed by the mining inspectorate, mining industry and unions. It sets out a hierarchy of exercise types:
 - Level 1 – state level exercise. One mine is selected each year for an unannounced practical exercise testing the emergency response system and the response of external services.
 - Level 2 – major mine site exercise. A whole of mine exercise undertaken by all mines at least once per year to test the emergency response system, including effective communication with external services.
 - Level 3 – minor mine site exercise. A practical exercise undertaken by each crew at the mine at least once per year to ensure all workers are familiar with the mine emergency response or evacuation plan.
 - Level 4 – supporting exercises. A desktop/semi-practical exercise undertaken periodically to test ability, and provide theoretical training, in emergency response.

The standard sets out the required frequency, objectives and scope of each exercise, and who should be involved. It requires the Level 1 to 3 exercises to be audited and sets out the criteria. Results of Level 1 exercises are disseminated to the industry.

11. In the foreword to the standard, Chief Inspector Gavin Taylor writes: 'Exercises in withdrawal and first response are a vital part of the safety framework of any coal mine and lead to the opportunity for learning, the sharing of information and opportunity for continuous improvement. Learning from the mistakes of these exercises will encourage all persons employed in the industry to be better prepared should we ever be challenged in real life'.⁷
12. The commission endorses that statement. Lessons learnt from the emergency response to the Pike River tragedy would have been better learnt from planned exercises. If there had been exercises as required under Queensland's framework, Pike's emergency facilities and the implementation of its ERMP should have been improved. The problems integrating the company's plan with the system used by the police and emergency services would have become apparent. The lack of a second means of egress in an emergency would have been highlighted.

Conclusions

13. The current regulatory approach to emergency planning for underground coal mines in New Zealand is unsatisfactory. An approach similar to Queensland's should be introduced, with a mandatory requirement for an ERMP to be in place before operations can begin. The plan should address all potential emergencies, including catastrophic events, should be part of the company's safety management system and should be approved by the company's board and senior management. The plan should include a comprehensive self-rescue plan, including the emergency facilities and training needed, and should be based on best practice specific to the mine's physical features. The plan should be auditable and tested regularly through the use of emergency exercises. When activated, the plan should be capable of seamless integration with emergency agencies.

14. There is value in New Zealand mining industry personnel, including mines rescue services and the mining inspectorate, attending Level 1 emergency exercises in Queensland to gain experience in effective multi-agency responses to major emergencies. Representatives from Solid Energy New Zealand Ltd and the New Zealand Mines Rescue Service (MRS) have attended such exercises in the past. It would also be sensible to invite Queensland and New South Wales mining industry personnel to attend multi-agency response exercises in New Zealand.

Police self-review

15. The police reviewed their performance in the search, rescue and recovery operation.⁸ The purpose was to critically examine the operation, reinforce what was done well, highlight areas for improvement and record actions and techniques for further plans and training. The police found 15 things that went well, including identifying and safely managing risks, effectively developing and actioning most parallel planning and successfully implementing welfare support plans. The review does not appear to have identified a number of problems that were highlighted during the commission's hearings, including the transfer of key decisions away from experts at the mine site, the lack of early planning on survivability and the slow risk assessment process.

Multi-agency responses

16. Emergencies at underground coal mines involve considerations and dangers that are not seen above ground. The lack of formal arrangements and training with other agencies for dealing with a large-scale emergency at an underground coal mine impacted badly on the emergency operation at Pike River.

2009 review

17. The New Zealand Search and Rescue Council's 2009 review of search and rescue training in New Zealand observed:

A consistent but simple theme emerged from the review and consequently pervades this report. It is widely, perhaps universally, acknowledged across the [search and rescue] sector that the prime area of deficiency, and therefore the target for improvement, is the inter-relation of parties while engaged in [search and rescue] activity. While there are direct training implications for improving [search and rescue operation] outcomes there are, first, some fundamental requirements for organisations to better communicate, share their expertise and resources, plan and train together and commit to working together with goodwill.⁹
18. The truth of those comments is demonstrated by the difficulties experienced during the emergency response at Pike River. Had there been planning and training with the agencies involved, the multi-agency response would have been better co-ordinated and organised. A better decision-making structure would have been in place. People would have understood each other's roles better and the many experts gathered at the mine could have been used more effectively.

Cave Creek

19. The Commission of Inquiry into the Cave Creek tragedy in 1995 recorded the need for co-ordination between rescue organisations on the West Coast.¹⁰ It recommended that 'the government initiate and implement appropriate steps to institute a combined regional disaster and trauma plan for the West Coast' and that 'such a process should invite and involve wide participation from every relevant rescue and trauma care organisation or party'. The plan was to provide for, among other elements, '[u]nambiguous overall leadership, including the prior resolution of all likely conflicts, and the co-ordination of services' and an 'overall programme of continuous education and training aimed at maintaining a co-ordinated overall response'.¹¹
20. The lessons of Cave Creek were not heeded as far as underground coal mining was concerned. The 2005 *West Coast Civil Defence and Emergency Management Group Plan* did provide for mine emergencies and anticipated that police

would be the lead agency, supported by Urban Search and Rescue (USAR), local rescue teams, the New Zealand Fire Service (NZFS) and the MRS. However, the 2010 edition of the plan does not contain a similar provision nor does it specifically address the MRS.

Co-ordinated incident management system (CIMS)

21. Pike River showed the need to make a plan for responding to large-scale emergencies at underground coal mines involving multiple fatalities, and for it to be tested. Part of that plan will involve defining the incident management structure, which should use the CIMS framework. CIMS is used by all the main emergency agencies in New Zealand and it is based on sound principles.¹² It is also similar in its principles to Queensland's mine emergency management system (MEMS), except that CIMS is generic rather than being targeted to a particular industry. Their basic structures are the same (see Figures 32.1 and 32.2 below), with the main difference being the use in MEMS of mining terminology.

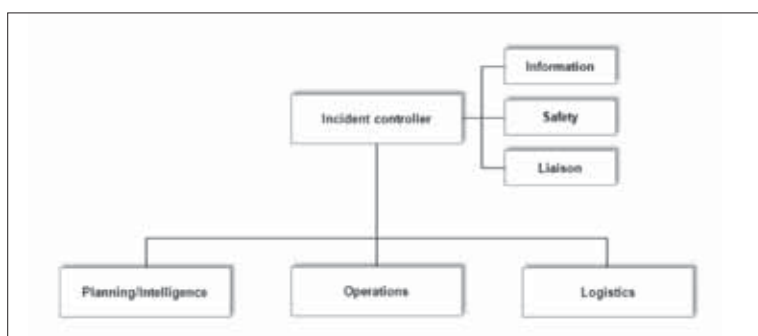


Figure 32.1: Co-ordinated incident management system¹³

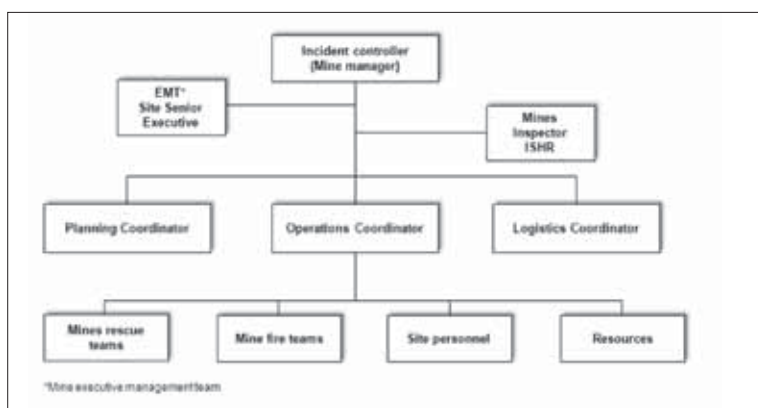


Figure 32.2: Queensland mine emergency management system¹⁴

22. A large-scale incident at an underground coal mine will require an emergency response that involves not just the mine and the MRS, but also other agencies and organisations. CIMS outlines a framework for co-ordinating such responses and ensuring all agencies are working toward the same goal. The key to the CIMS framework is that it sets out a common structure and principles that will be recognised and understood by all the responding agencies. That should allow for much greater inter-agency co-ordination and communication.
23. CIMS needs to be updated in light of the lessons learnt from the Pike River tragedy. It needs to reflect the potential for both private enterprise and individuals to be involved in an emergency response. The police and emergency services are currently reviewing CIMS. That review should include the mining industry and the MRS as participants. A meeting convened by the MRS in December 2011 was attended by the Department of Labour (DOL), the police, the NZFS, the MRS and mining industry representatives. The attendees are committed to meeting again after this report is released.

Lead agency

24. The CIMS manual defines the lead agency as the 'organisation with the legislative or agreed authority for control of an incident.'¹⁵ The NZFS manual describes the lead agency as having jurisdiction over an incident and as the agency

that contributes the incident controller.¹⁶ There is no legislation or agreement giving any particular entity authority over large-scale underground coal mine emergencies. Given that absence, it could be expected that the police have authority as part of their general emergency management function.

25. On 19 November 2010, Pike assumed initial responsibility for control of the incident. Soon after their arrival, the police took control, with no dispute from Pike. Some participants, including Solid Energy, were surprised to see the police in charge. Having witnessed the emergency response at Pike River, Solid Energy say they would control the response to an emergency at one of their mines but would work closely with the police and other organisations.¹⁷ The difference between Solid Energy's expectations and those of the police and the NZFS emphasise the need for planning and, in the absence of legislative authority, the conclusion of a memorandum of understanding between all parties.
26. The NZFS had already realised there was scope for disagreement over the lead agency. Their manual notes that jurisdiction may not be easily determined at complex incidents. It recommends moving immediately to a co-operative approach, assuming multi-agency jurisdiction with multi-agency support. That is said to be 'the most complete application of the CIMS philosophy'.¹⁸ The NZFS manual correctly identifies the problem, but the recommended solution is not sufficiently clear.
27. The underlying problem is the definition of lead agency and its relationship with the incident management team (IMT). There is scope for conflict between the two roles. That was demonstrated at Pike River. In taking control as lead agency, the police understood they were to appoint the incident controller, establish the IMT and be responsible and accountable for the response (including in a fiscal sense). A principal plank of their submissions was that, if they were fiscally responsible, the police had to maintain control of the emergency response. That is an understandable view.
28. But it is not consistent with the principles of CIMS, which focuses on co-ordination. The IMT co-ordinates the management of an incident. In a multi-agency response, the IMT will usually include personnel from more than one organisation, who 'take off their uniform[s]' and act collectively.¹⁹ Each agency retains its own vertical command structure, but operates within the overall strategic direction of the IMT. Those propositions, taken from the NZFS manual, recognise that strategic control of the response lies with the IMT and the incident controller, not the lead agency.
29. Given the lack of advance planning and the likelihood that the response operation would be lengthy, it was appropriate for the police to assume the role of lead agency. The problems began when the police decided to fill all the roles in the IMT with their own members, including that of the incident controller. That meant the key decision-makers lacked necessary technical expertise. The CIMS manual does not require the incident controller or IMT members to be appointed from the lead agency. It provides that the incident controller role may be reassigned to another person if necessary.
30. The issues exposed during the Pike River emergency response should be urgently reviewed. CIMS may require change, but the critical need is for the organisations involved to agree in advance how CIMS is to be implemented in a large-scale mine emergency.

Incident management team (IMT)

31. The IMT is at the heart of CIMS. It is led by the incident controller and includes three functional members, each heading one of the planning/intelligence, operations and logistics groups. Depending on the size and complexity of the incident, the incident controller may also be supported by an information officer, a safety officer or a liaison officer.²⁰
32. In a multi-agency response to a large-scale emergency at an underground coal mine, a good IMT should be:
 - expert and trained – it should include people who have expertise and training in managing and co-ordinating emergency responses using CIMS and people who have underground coal mining expertise;

- capable of marshalling and using all available expertise;
- capable of responding to changing circumstances;
- flexible – decisions should be made as and when needed, and should be reviewable; and
- limited in size to a manageable number of members through the use of subcommittees headed by the three functional members.

Incident controller

33. The membership of the IMT, including the incident controller, should be reviewed and changed if necessary as circumstances develop.
34. The incident controller leads the IMT and is responsible for approving co-ordinated incident action plans formulated by the IMT. The incident controller needs to be skilled in incident management and have experience and training in CIMS. He or she must have the authority and mana to lead the response and approve the co-ordinated incident action plans. The incident controller should be physically present at the incident control point with the rest of the IMT. For major incidents there need to be alternates appointed to the position so that fatigue is avoided.
35. In general, incident controllers may not need expertise in the particular environment where the emergency has occurred. In the case of underground coal mines, which are a unique environment, with their own set of risks, the incident controller needs to understand underground coal mines and mining. The incident controller requires a sufficient level of mining knowledge to assess the risks involved, the merits of taking a particular action and to anticipate how a situation might develop.
36. It is useful to compare the structures in Queensland and New South Wales. In Queensland, the incident controller is the mine manager, and in New South Wales, the mine operator or delegate is responsible for managing and controlling the emergency, with oversight from the mines inspectorate. In both states the police are involved, but they do not take control. Simulated emergency exercises are run annually in both New South Wales and Queensland to train and test multi-agency responses using the structures each has developed.
37. The police and the NZFS considered that a member of an agency expert in emergency response should be the incident controller.²¹ That agency would likely be the police. DOL supported the incident controller being a member of the police.
38. Having reflected on the response at Pike River, the police say their incident controller would make all decisions, including the critical decisions related to sealing and re-entry of the mine. Here, the incident controller would be supported to make those critical decisions with trigger action response plans (TARPs).²² In the case of a decision to seal, confirmation from the coroner that life is extinct would act as the TARP. In other words, a police incident controller could not approve the sealing of the mine until such confirmation is received from the coroner.²³ The commission does not agree that such confirmation from the coroner is necessary. It adds nothing substantive to the determination that would already have been made by the experts onsite. Indeed, the coroner's confirmation would necessarily be based on their assessment.
39. Solid Energy, the MRS and the families of the men say the incident controller should be someone with mining expertise.²⁴ That is consistent with the approach of Queensland and New South Wales. The commission agrees. To that end, it would be beneficial to maintain a list of approved people with mining expertise. The incident controller for any emergency on a similar scale to Pike River would be drawn from that list and would likely be whoever could respond first to the emergency. Should the incident controller need to be replaced, the chief inspector of mines should have the power to appoint someone else from the list.
40. Police employees are prohibited from acting under the direction, command or control of a person who is not authorised by law to direct, command or control the actions of the police.²⁵ This does not prevent an incident controller being someone other than a member of the police: the police retain their own internal command structure and agree to act in accordance with the incident action plan they helped to draft.

Planning/intelligence

41. Planning of activities must include risk assessment. Risk assessments for responding to underground coal mining emergencies should be done by people with mining expertise. All risk assessments should be urgently reviewed onsite at the incident control point by people with mining expertise who understand the activities being described and the risks involved. Reviews of risk assessments should not go through several layers of bureaucracy, as occurred at Pike River.
42. The planning/intelligence group should therefore comprise people from the affected mine and other experts. A database of such experts could be developed in advance, so that they can be called upon without delay. The planning/intelligence group should also include members expert in emergency response, such as the police. Planning meetings would generally involve the group's personnel and a representative from each of the operations and logistics teams.²⁶
43. Before being approved, incident action plans developed by the planning/intelligence group will be discussed by the incident controller with the three group managers (planning/intelligence, operations and logistics). The manager of the planning/intelligence group should have mining expertise.

Operations

44. The operations group should comprise people from the mine and the MRS. There will likely also be personnel from other non-mining agencies, such as the police. The operations manager should have mining expertise.
45. In a rescue attempt, the only personnel to enter the mine will be members of the MRS. That means the MRS retains its power of veto over any decision to re-enter the mine if it considers it unsafe to do so. That point is not reached until the incident controller has approved the re-entry attempt.

Logistics

46. Everyone involved in the Pike River emergency agreed that the police performed the logistics function very well. The commission agrees. The police contribution was invaluable in ensuring the necessary logistical support. The police are the best agency to continue leading the logistics function.

Support roles

47. As mentioned in paragraph 32, the incident controller may need to appoint additional support people to deal with information, safety and liaison. The information officer handles media inquiries and releases information to the media. The liaison officer liaises with other agencies and other people with an interest, including the families of victims. These appointments allow the incident controller to focus on leading the emergency response.
48. The incident controller can also appoint a safety officer, who monitors safety and develops measures for ensuring the safety of the personnel involved in the response. In an underground mine emergency, the mines inspector could perform the safety role. In addition to the mines inspectorate, Queensland's MEMS includes the industry safety and health representative appointed by the union.

Communication with families

49. As discussed in Chapter 17, 'The families of the men', the commission received much evidence from the families about communications with them during the search and rescue, including the length of time taken to be notified their men were missing. The quality and timeliness of communications has the ability to either help or hinder families trying to cope with the potential loss of their loved ones. Poor communication is likely to cause further distress.

Identification and notification of those missing

50. Formal notification to next of kin cannot be done until the identity of those missing has been confirmed. It is crucial that the mining company keeps accurate records of the whereabouts of its workers to enable personnel on the surface to quickly and reliably confirm who is still in the mine during an emergency.

51. Formal notification to all next of kin should follow very soon after that confirmation is made. Details of emergency contacts for all workers at the mine should be kept and regularly updated. The company should proactively check emergency contact details with its workers, rather than expecting the workers to update details when they change.
52. There should also be more than one emergency contact provided for each worker. Assistant Commissioner Gary Knowles explained, by way of example, that the New Zealand Police have a rigorous next of kin process for their employees. Several contacts are listed, for example Assistant Commissioner Knowles has provided his life partner, parents, and another person that can contact those people.²⁷
53. Including more than one contact provides an alternative in case the preferred first contact cannot be reached. It would also assist in other situations where a particular contact is no longer current, for example, a partner was listed but the relationship has come to an end. Workers should be able to include whoever they feel is important enough in their life to be their emergency contact and who will be able to disseminate the information to others affected. The list should indicate who is the preferred first contact.
54. The ERMP should identify who will be responsible for formally notifying next of kin. Following minor incidents in a workplace it is normal for an employer to contact next of kin, but in a major emergency where workers are dead or missing that responsibility might more appropriately lie with the police. The police are accustomed to speaking with next of kin following serious injury or death as part of their normal duties. They are therefore better equipped to deliver the news in a compassionate and appropriate manner.

Ongoing communication

55. While notification is made only to listed next of kin, ongoing communication of progress and developments should be provided to a much wider range of people. The Cave Creek commission of inquiry recommended the police appoint a victims' families liaison officer 'charged with the responsibility of making as much appropriate information as possible available to those whom the officer concludes are genuine enquirers with an interest greater than that of the public generally' and that those genuine enquirers be 'kept up to date with the victim's progress, recognising the need to allay natural fear and anxiety as much as possible'.²⁸
56. Recognising that the police made great efforts in establishing victims' families liaison processes and that liaison officers were assigned to the families at Pike, the commission repeats the Cave Creek recommendations that information be made available to those who are genuine enquirers. The process to establish who is or is not a genuine enquirer needs to be relatively swift, and easy for those affected, to ensure information can be shared as soon as possible.
57. The company's ERMP should address communication with family members, including the process for providing information to them and the appointment of family liaison officers. Information provided to the family members needs to be objective and based in evidence. At all times they should be presented with the known facts, no matter how difficult that may be. This requires careful presentation of the information.

Recovery operations

58. In Chapter 17, 'The families of the men', the commission noted that recovery of the remains was complex and eventually became the subject of a deed between the government and the new owners of the mine, Solid Energy.²⁹ The families sought recommendations from the commission regarding who should be responsible for recovery of remains.
59. Under section 19 of the Coroners Act 2006, the coroner has the exclusive right to custody of any body, from the time a death is reported to the coroner until such time as the coroner authorises release of the body to family members. It follows that while a body is unrecovered, the coroner retains the exclusive right to custody. However, that does not make the coroner responsible for effecting recovery of the body. Section 18 of the act assumes that ordinarily the police will undertake recovery and to that end, the police have a right to custody of the body, but neither they nor anyone else is made responsible by the act for undertaking recovery.

60. At Pike River, the police led the recovery operation until 9 March 2011 when control of the mine was passed to the receivers subject to an understanding that, if re-entry became feasible, the police would assume responsibility for 'recovery efforts and preservation of evidence'.³⁰ This accorded with the practice in New South Wales and Queensland, where mining companies lead mine stabilisation and recovery operations in association with mines rescue service, police and others. Following the sale of the mine, Solid Energy became responsible for recovery but on the terms defined in the deed.
61. The real source of the families' frustration was the delay and lack of progress, not confusion over who was responsible for body recovery. Police leadership, followed by a hand-over to the receivers, was well known. The commission considers it can make only some limited observations in this context:
- Families are very vulnerable after an underground mine disaster, particularly while remains are unrecovered;
 - Body recovery may in some cases present insurmountable difficulties on account of technical, safety and fiscal considerations;
 - It is of paramount importance that the families are kept informed, but the information supplied must be accurate and measured; and
 - The involvement of the government resulted in a carefully defined arrangement for body recovery.

Mines rescue in New Zealand

Functions and powers

62. Mines rescue is a specialised area of search and rescue, carried out in New Zealand by the MRS. The MRS was originally established in 1930, following the recommendations of the inquiry into the Dobson mine explosion, to provide an emergency service to the coal mining industry. Since 1993, it has operated as a charitable trust, the New Zealand Mines Rescue Trust (MRS Trust).
63. The Mines Rescue Trust Act 1992 does not confer any functions, powers or immunities on the MRS or the MRS Trust. Despite that, the MRS maintains an emergency response capability and offers training services to the extractives industry. It maintains three brigades (Huntly, Rapahoe and Stockton) manned by voluntary personnel who ordinarily work at coal mines.
64. Under the act the MRS Trust collects levies from coal mine owners, who in return receive core services from the MRS, including immediate response to emergencies and services for non-urgent incidents or events. The MRS also provides services to non-levy paying organisations on a charge-out basis.

The Australian approach to mines rescue

65. Mines rescue agencies in Queensland and New South Wales perform similar functions to the MRS, but the legislative approach is different. Under the New South Wales Coal Industry Act 2001, registered companies are approved to carry out the functions specified in the legislation.³¹ Coal Services Pty Ltd (CSPL) is an approved company.
66. Mines Rescue Pty Ltd, a wholly owned subsidiary of CSPL, provides mines rescue services in New South Wales. Its primary function is to respond to underground incidents but it also has a 'pivotal role' in training, including mines rescue training, response and emergency procedures, confined space training, contractor induction and annual refresher courses.³²
67. As an approved company, CSPL can appoint inspectors who have broad powers of entry to search premises and to take photographs and records. Inspectors can require people to answer questions and produce records. It is an offence to refuse to answer questions, give false or misleading answers, fail or refuse to produce documents, or otherwise obstruct the inspector.³³

68. The Coal Industry Act 2001 also established the New South Wales Mines Rescue Brigade, which provides a mines rescue service for underground coal mines, under the control and direction of the approved company. The company is required to determine, for each underground coal mine, the number of people who must be available for mines rescue; the number and kinds of breathing apparatus and other rescue equipment the mine must provide; and the space and facilities the mine must make available to store that equipment. Mine owners are required to allow brigade members to attend official training and emergencies.³⁴
69. Queensland's legislative approach differs from that in New South Wales but the purpose is the same. The Coal Mining Safety and Health Act 1999 provides for the accreditation of corporations to provide mines rescue services. The functions of an accredited corporation include helping a coal mine operator to provide mines rescue capability and providing underground mines rescue training programmes.³⁵ Those services are provided in Queensland by Queensland Mines Rescue Service Ltd (QMRS), a registered non-profit company.
70. Coal mine operators must provide a mines rescue capability for the mine and the mine cannot be operated if it does not do so. Mines rescue capability is defined in the Coal Mining Safety and Health Act 1999 and relates to the provision of suitable numbers of trained people and maintained equipment for the mine. Coal mine operators are also required to have a mines rescue agreement with QMRS for their coal mine. Mines rescue agreements for underground coal mines provide for QMRS to help the coal mine operator.³⁶ The contents of a mines rescue agreement are specified by the Coal Mining Safety and Health Regulation 2001 (Qld).
71. Accredited corporations must have an operational inertisation capability.³⁷ QMRS maintains the jet inertisation unit and a team to operate it. They were mobilised to inertise the Pike River mine.
72. The inquiry into the explosion at Moura No. 2 in Queensland identified ways to improve the effectiveness of mines rescue. These included formally recognising the training role of the mines rescue service and adequately resourcing it to fulfil that role; including it in risk evaluation exercises at mines; requiring mines to provide the service with up-to-date mine plans; requiring mines to supply, on request, plans showing the location and status of surface boreholes; and conducting periodic reviews of mine disaster control arrangements.³⁸

Insufficient legislative base

73. The functions and powers of the MRS should be properly provided for and defined in legislation. This should include a requirement to provide the MRS with mine plans and ERMPs, to help the MRS plan its responses and ensure a mine is adequately prepared for an emergency.
74. Other emergency response agencies, such as the NZFS, have a limitation of liability for any damage caused by actions done in good faith during rescue operations.³⁹ Such a limitation should also be provided to the MRS.

Funding of the MRS

75. The Mines Rescue Trust Act 1992 sets levies at 40c per tonne of coal for underground coal mines and 20c or 10c per tonne of coal for open cast coal mines, depending on whether they have previously been operated as underground coal mines.⁴⁰ Those rates were set in 1992 and have never been amended. There is no provision for the rates to be adjusted for inflation.
76. There is a shortfall for the MRS between the levies received and the level of funding required. The MRS has been bridging the gap by providing chargeable services to non-levy paying coal mines.⁴¹ However, their response to the Pike River emergency was costly and required an amount disproportionate to the levies paid by Pike. Pike had paid little because its coal production was minimal. The adequacy and fairness of the current funding model should be considered as part of a review of the Mines Rescue Trust Act.

Relationship with other agencies

77. Between 2000 and 2010, the MRS responded to approximately 84 emergency callouts, including the Pike River explosion. The incidents ranged from spontaneous combustion and emergencies involving loss of life in

underground coal mines, to assisting the NZFS with large fuel spills and responding to the derailment of a coal train in the Kaimai tunnel. Not all of these incidents required an emergency response from other agencies.⁴²

78. On 8 March 2006, both the MRS and the police responded to an emergency at the Black Reef mine, near Greymouth, involving an inrush of water and the death of one worker. The MRS was the lead agency, supported by the police. Both the MRS and the police had concerns about the management of this incident. The MRS was concerned that the police did not understand the underground environment and the dangers involved. Following a debriefing with the MRS, Greymouth police staff visited the mines rescue station and Spring Creek Mine to familiarise themselves with a coal mine and the role of the MRS. An emergency callout plan was developed.
79. The Black Reef emergency and the response of the MRS and the police to the goaf fall at the Roa mine later that year resulted in an improved relationship between the two, which the police say has continued.⁴³ However, that applied only to the police on the West Coast. There was no formal relationship between the MRS and the police, or any other search and rescue agency, at a national level.⁴⁴ Police at national headquarters had little understanding of the role of the MRS, even though the police were making the critical decisions during the search, rescue and recovery operation at Pike River.⁴⁵
80. DOL inspector Michael Firmin gave evidence that he visits the MRS at least once a year, but there was no formal relationship between DOL and the MRS. DOL had made no arrangements with the MRS as to how the two would interact in an emergency. Kevin Poynter had brought up the need to develop a management process but nothing had been done before the explosion at Pike River.
81. In its submissions, the MRS stated '[a] more beneficial relationship between the Australian and New Zealand mines rescue teams may also be achieved by [the MRS] developing strategic alliances with rescue services in Australia.'⁴⁶ The commission agrees.

Recommendation 13:

Emergency management in underground coal mines needs urgent attention.

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

Recommendation 14:

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

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

Recommendation 15:

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

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

ENDNOTES

¹ Health and Safety in Employment Act 1992, ss 6(e), 12(1).

² Fire Service Act 1975, s 21B.

³ Fire Safety and Evacuation of Buildings Regulations 2006, sch 3, cls 2, 5.

⁴ See Coal Mining Safety and Health Regulation 2001 (Qld), cls 35, 149; Coal Mine Health and Safety Act 2002 (NSW), s 47; and Coal Mine Health and Safety Regulation 2006 (NSW), cl 45.

⁵ Coal Mining Safety and Health Regulation 2001 (Qld), cl 35.

⁶ Queensland Warden's Court, Wardens Inquiry: Report on an Accident at Moura No 2 Underground Mine on Sunday, 7 August 1994, 1996, CAC0152/64.

⁷ Queensland Government, Recognised Standard 08: Conduct of Mine Emergency Exercises, 25 June 2009, EXH0028/4.

⁸ New Zealand Police, National Criminal Investigations Group, Operation Pike Debrief Report/Minutes and Key Recommendations, 21 March 2012, SOE.020.00002.

⁹ T. Preston, Improving Search and Rescue Outcomes through Interagency Collaboration and Training: A Review of SAR Training in New Zealand, March 2009, p. 3.

¹⁰ Commission of Inquiry into the Collapse of a Viewing Platform at Cave Creek near Punakaiki on the West Coast, [Report], 1995, Department of Internal Affairs, CAC0086/62.

¹¹ Ibid., CAC0086/63.

¹² In addition to the evidence of the police and New Zealand Fire Service, the commission received submissions on the CIMS framework, including criticism of the emergency response at Pike River from Alan Thompson. Mr Thompson has worked in large incident management teams in Australia and the United States, and has been part of responses operating under the CIMS framework in New Zealand.

¹³ New Zealand Fire Service Commission, The New Zealand Coordinated Incident Management System (CIMS), 1998, NZFS0001/18.

¹⁴ Adapted from Kenneth Singer, witness statement, 25 August 2011, SIM0002/11.

¹⁵ New Zealand Fire Service Commission, The New Zealand Coordinated Incident Management System (CIMS), 1998, NZFS0001/34.

¹⁶ New Zealand Fire Service Commission, 'Integration with CIMS', in New

Zealand Fire Service (NZFS) Incident Management – Command and Control Technical Manual, May 2011, NZFS0003/7–9.

¹⁷ Barry Bragg, witness statement, 23 August 2011, SOL384003/28, paras 86–87.

¹⁸ New Zealand Fire Service Commission, 'Integration with CIMS', in New Zealand Fire Service (NZFS) Incident Management – Command and Control Technical Manual, May 2011, NZFS0003/10.

¹⁹ Ibid., NZFS0003/8, para. 2.2.12.

²⁰ In some circumstances, CIMS contemplates the use of a response co-ordinator sitting above the incident controller. The role of the response co-ordinator is addressed in Chapter 16, 'Search, rescue and recovery', paras 25–26 and is not discussed further here.

²¹ Simon Moore, transcript, pp. 5344–45; Michael Hall, witness statement, 27 March 2012, NZFS0021/9, 12 paras 24–26, 36.

²² TARPs are predetermined plans describing actions to be taken in response to defined events.

²³ New Zealand Police, Supplementary Submissions on Behalf of the New Zealand Police: Search, Rescue and Recovery (Topics 13–20), 20 April 2012, POLICE.SUBS.00063/2–5, paras 1.1–3.4. The chief coroner advised the commission that there is no statutory authority to issue life extinct certificates. In practice, medical practitioners provide life extinct certificates to the coroner to confirm a death where a coronial inquiry is indicated. The issue of the certificate at Pike appears to be the only occasion on which a coroner has issued a life extinct certificate. See Letter, A. Neil MacLean to James Wilding, 28 June 2012, CAC0162.

²⁴ Submissions of Garth Gallaway for the MRS, transcript, p. 5354; Submissions of Craig Stevens for Solid Energy New Zealand Ltd, transcript, p. 5470; Submissions of Richard Raymond for the families of the men, transcript, p. 5561.

²⁵ Policing Act 2008, s 30.

²⁶ Letter, Alan Thompson to Royal Commission on the Pike River Coal Mine Tragedy, 21 September 2011, THO0006/2.

²⁷ Gary Knowles, transcript, pp. 2112–13.

²⁸ Commission of Inquiry into the Collapse of a Viewing Platform at Cave Creek near Punakaiki on the West Coast, [Report], CAC0086/56.

²⁹ Deed Relating to Body Recovery at the Pike River Coal Mine, 17 July 2012, SOL0503445.001.

³⁰ New Zealand Police, Pike River Coal to Implement Mine Stabilisation Plan, 9 March 2011, SOE.003.00104/1.

³¹ Coal Industry Act 2001 (NSW), s 9.

³² Coal Services Pty Ltd, Institutional Report and Evidence of Coal Services Pty Limited (CSPL) (In relation to Phase 2), 6 July 2011, CSP0001/4 paras 6.2-6.3.

³³ Coal Industry Act 2001 (NSW), ss 25–27, 32.

³⁴ *Ibid.*, ss 33–34, 36, 43.

³⁵ Coal Mining Safety and Health Act 1999 (Qld), ss 227, 232.

³⁶ *Ibid.*, ss 221–23, 225–26.

³⁷ Coal Mining Safety and Health Regulation 2001 (Qld), cl 175.

³⁸ Queensland Warden's Court, Wardens Inquiry: Report on an Accident at Moura No 2, CAC0152/76.

³⁹ Fire Service Act 1975, s 43.

⁴⁰ Mines Rescue Trust Act 1992, s 7.

⁴¹ New Zealand Mines Rescue Trust, Brief of Evidence of New Zealand Mines Rescue Trust for Evidence Relating to Phase 4 of the Pike River Royal Commission, 5 March 2012, MRS0300/13.

⁴² New Zealand Mines Rescue Trust, NZ Mines Rescue Callout History 2000–2010, 31 December 2010, MRS0004.

⁴³ Allyson Ealam, witness statement, 1 July 2011, POLICE.BRF.16/6.

⁴⁴ New Zealand Search and Rescue, New Zealand Search and Rescue Structure, 2009, <http://www.searchandrescuecouncil.org.nz/nzsar-structure>

⁴⁵ Michael Firmin, transcript, pp. 610–16.

⁴⁶ New Zealand Mines Rescue Trust, Brief, MRS0300/19.

Improving emergency equipment and facilities

Introduction

1. As part of a good emergency management system, a mine should have equipment and facilities available that, in an emergency, can assist both the workers underground and those responding to the event. The first priority in an underground coal mine emergency is for workers to self-escape, that is, escape by their own efforts. Few workers in underground coal mines have been saved by external mines rescue teams following fires or explosions. Rescue teams should not enter a mine without evidence that the atmosphere is safe.

The miners

2. Provision for workers underground to self-escape should include:
 - early warning systems;
 - breathing devices such as self-rescuers and compressed air breathing apparatus (CABA);
 - changeover stations, fresh air bases or refuges;
 - a usable second means of egress;
 - navigation aids such as smoke lines and signage;
 - vehicular or mechanical means of exit; and
 - a communication and personnel location system.
3. What was provided at Pike has been considered earlier in the report. This chapter considers whether the regulatory framework, including other codes and guidance, contains sufficient requirements for self-escape facilities. Queensland's requirement for an emergency management system includes a specification that it provides for self-escape from the mine in an emergency. New South Wales also sets out, in regulations, the minimum contents of the emergency management system. These types of requirements are absent from the New Zealand regulatory framework, which has only a few specific provisions relating to emergency facilities.

Early warning systems

4. Early warning systems should be capable of detecting the first signs of fire or explosion and alerting workers so that they can evacuate through smoke-free escapeways. Underground coal mines need a means of continuously monitoring carbon monoxide and methane levels. Should these gases be detected at levels indicating a risk of fire or explosion, workers should be evacuated. In terms of the risk posed by methane, workers would need to be evacuated well before the concentration of methane reached its explosive range. Waiting until methane levels reach that range (5 to 15% of air) is too late. Gas monitoring systems should be designed to detect trend changes in concentration of gases and to alert workers to those changes. Trigger action response plans (TARPS), which describe actions that must be taken in response to defined events, should be the basis of this system and workers need to understand what to do at particular action points. Workers evacuating during an emergency must be able to monitor the atmosphere as they leave the mine.
5. There is insufficient provision for gas monitoring in underground coal mines in New Zealand. At the very least, there needs to be better guidance about where monitors should be located. The Queensland and New South Wales regulations are much more prescriptive about gas monitoring systems and the location of monitors. The New

Zealand regulations currently only require continuous monitoring at a face when a person is present, whereas the Queensland and New South Wales regulations ensure monitoring at or near a place where coal is being extracted even in the absence of workers. New Zealand should adopt an approach similar to that of Queensland and New South Wales. Underground coal mine atmospheres should be monitored continuously.

Breathing devices

6. If an emergency in an underground coal mine causes the ventilation system to stop functioning or the atmosphere becomes filled with toxic gases following a fire or explosion, all survivors underground need ready access to equipment that will provide oxygen and restrict their exposure to a toxic atmosphere.
7. New Zealand does have requirements relating to the provision and maintenance of, and training in the use of, suitable self-rescue units, but again Queensland's regulations are much more thorough and also include provisions for other breathing apparatus. Queensland expressly prohibits anyone entering an underground mine without a self-rescuer, without having been trained in its use, without having examined the self-rescuer and if not physically capable of using the self-rescuer.¹



Figure 33.1: Example of a self-contained self-rescuer

8. There should be a mandatory requirement for underground coal mines in New Zealand to include both CABA and self-rescuers in their self-escape equipment. It is best practice to include CABA. They allow for more flexible escape strategies than self-rescuers, including the ability to assist injured personnel and to fight minor fires. Self-rescuers would remain the 'at-hand' breathing device, worn on the belt at all times and immediately available. They can be used during an emergency to enable escape to a safe place, where CABA is stored. Once there, workers would be able to remove their self-rescuers and strap on CABA units. Strategically located compressed air exchange stations should be available to recharge CABA.



Figure 33.2: Man wearing compressed air breathing apparatus (CABA)



Figure 33.3: Recharge station for compressed air breathing apparatus

9. There is a need for better guidance regarding the use and provision of self-rescuers, particularly in terms of training, though it would not necessarily have to be in the form of regulations. New South Wales provides detailed guidance on self-rescuers in Applied Guidelines (MDG 1020), which have the same status as approved codes of practice. Training needs to be conducted under simulated emergency conditions.

Changeover stations, fresh air bases and refuges

10. Changeover stations, fresh air bases (FABs) and refuges are places within a mine where survivors can more safely change from one self-rescuer to another, or to another type of breathing unit. Having a specific location to change

breathing devices minimises the exposure of survivors to a toxic or oxygen-deficient atmosphere where one breath can be fatal. The effectiveness of any of these facilities in an emergency will depend on the standard to which the facility is built and maintained.



Figure 33.4: Strata Worldwide coal refuge chamber

11. The use of refuge chambers in underground coal mines as part of an overall escape strategy was considered by one of the task forces established after the inquiry into the Moura No. 2 explosion. The task force's report noted that workers changing over their self-rescuers 'should be able to do so in a safe manner'.² It set out a preference for refuge chambers or changeover stations to 'be supplied with a respirable atmosphere and means of communication to the surface so that people can plan their escape and change from one self-rescuer to another in safety'. The task force believed the escape system 'should be mainly designed so that miners have a safe place to assemble'. Although it is best to focus on providing assistance to escape, the task force said it must be recognised that there may be injured workers who cannot escape but may be able to reach a place of safety.³
12. Queensland subsequently introduced a requirement for underground coal mines to include, in their safety and health management system, provision for self-escape from the mine or a part of it to a place of safety.⁴ The system must be developed through a risk assessment, which must consider, among other things, the number and location of changeover stations and refuges.⁵ Refuge chambers are not routinely installed in Queensland underground coal mines partly because coal mine fires can burn indefinitely in the presence of very low levels of oxygen, which could prevent rescuers from entering the mine. Refuge chambers are, however, commonly available in metalliferous mines in Australia.
13. The United Kingdom requires the owner of every mine to provide, where necessary, safe havens or facilities for the exchange and recharge of self-rescuers.⁶ New South Wales has also included detailed guidance on changeover stations and refuges in MDG 1020. Canada, South Africa, Japan and the United States have also regulated the installation of refuge chambers.⁷
14. In contrast, there is no express legal requirement for underground mines in New Zealand to have a changeover station, an FAB or a refuge. There is also no guidance recommending the use of any of these facilities or the minimum standards to which they should be built and maintained.
15. The variability in any mine's design and state of development means prescriptive requirements governing the provision of changeover stations or refuges are inappropriate. However, there should be a requirement for a mine to consider the need to provide changeover stations or refuges. There should be guidance about when changeover stations or refuges are required, the standards to which they should be built and maintained, and what each should contain. This would assist mine operators to know the minimum standards such facilities should meet in order to be truly considered a changeover station or refuge, and provide a basis for an inspector to assess the adequacy of the facility.

Second means of egress

16. The requirement for a usable second means of egress is a fundamental aspect of underground mining worldwide. Legislation enshrining this requirement in overseas countries followed mining disasters in the United States and United Kingdom, where miners died after their only means of escape became impassable. The need to have at least two outlets separate from each other is also recognised in the Health and Safety in Employment (Mining – Underground) Regulations 1999.
17. Providing truly suitable and sufficient means of egress, and particularly more than one egress, is so important that a mine should know exactly its obligation and the inspectorate should have no qualms about enforcing that requirement. The suitability and sufficiency of a means of egress should be considered against the workers' ability to exit during any possible emergency, as well as during normal conditions. Evacuation through the second means of egress should be tested regularly. At least one of the egresses needs to allow exit by vehicles or other mechanical means.
18. The development of a second means of egress should be a priority for every mine. It should be constructed as soon as the development of the mine permits and should be in place before panel production begins.

Navigation aids

19. In an emergency, there may be reduced visibility in the mine and those underground may be disoriented and under extreme stress. A mine should provide aids that will enable workers underground to reach changeover stations or refuges and leave the mine quickly and easily. These can include smoke lines, walking canes and the use of fluorescent signage and markers. Such aids must be strong enough to survive an emergency.
20. There are no express legal requirements for an underground mine in New Zealand to have smoke lines or life lines, or any other emergency navigational aids. There is at least some, though not entirely sufficient, guidance in the MinEx Health and Safety Council (MinEx)'s *Industry Code of Practice on Underground Mines and Tunnels*. It says that the emergency management system should provide, where practicable, for paths of egress to be marked 'so that persons who are not familiar with a route can safely travel it in conditions of poor visibility'.⁸
21. Queensland requires underground coal mines to consider selecting and marking escape routes,⁹ New South Wales requires an underground coal mine's emergency management system to include 'the marking of paths of egress so that people can safely travel on them in conditions of poor visibility'.¹⁰
22. In the United Kingdom, the Health and Safety Executive (UK HSE) has issued guidance that escape routes out of the mine should be clearly marked and points to the use of emergency way-finder beacons for use in low visibility.¹¹ The UK HSE has also issued guidance that safe havens should be easy to locate and special 'sensory' measures should be taken to identify them when visibility is limited.¹² It gives, as examples, fluorescent way-finding roadway markers and directional life lines.
23. New Zealand's lack of legal requirements or guidance on navigational aids issued or approved by the regulator is not consistent with best practice. Underground coal mine operators should be required to mark the paths to self-escape facilities and equipment, including exits and changeover stations or refuges. The markers must be easily seen in low visibility conditions.

Vehicular means of exit

24. During an emergency, it is critical that workers are able to make their way out of the mine as quickly as possible. The most efficient way to do so is in personnel transport vehicles, provided they are available and can be started. The use of motorised transport was a 'significant factor' in the survivors of the first explosion at Moura No. 2 managing to escape from the mine.¹³ Vehicles also allow for quick evacuation of injured workers.
25. There are no express legal requirements for underground mines in New Zealand to have vehicles available for use in an emergency evacuation, except that at least one outlet must have a 'mechanical means of entry and exit'.¹⁴ The MinEx *Industry Code of Practice for Underground Mines and Tunnels* does state that a fire and general emergency

system, where practicable, should provide for '[s]ufficient types and numbers of transport or alternate escape means, in combination with escape equipment, to allow the safe evacuation of persons.'¹⁵

26. In New South Wales, a coal mine's emergency management system is required to have provisions for the treatment and transport of sick or injured people and, in respect of the underground parts of the mine, sufficient transport or alternative means of escape to allow safe evacuation.¹⁶ MDG 1020 sets out detailed guidance regarding transport: '[p]rovision of high speed vehicular escape or equivalent must always be a primary object of any emergency escape system.'¹⁷ MDG 1020 also advises that systems relying on long walks through difficult conditions should be remedied.
27. It is best practice for underground coal mines to have personnel transport vehicles available to evacuate a mine during an emergency. In general, all mines should be expected to have vehicles available, although they may not be needed in small mines where leaving on foot is easier and quicker.
28. The Moura No. 2 inquiry recommended the formation of a group to examine and report on various emergency escape facilities, including the role of motorised transport.¹⁸ Following extensive research and trials in Queensland, a standard flameproof diesel personnel carrier has been modified so that it can operate in compromised visibility, and in an atmosphere deficient in oxygen and rich in methane. The vehicle's special features include proximity sensors, a navigation system for operating in zero visibility and a medical breathing system. Queensland's Safety in Mines Testing and Research Station (SIMTARS) and the National Institute of Occupational Health and Safety (NIOSH) in the United States are collaborating to refine the self-rescue features so that such features can be built into all personnel transport vehicles at a mine. As soon as self-rescue capable personnel transport vehicles are commercially available, mines should be required to provide enough to rapidly remove workers from an underground mine in the event of a fire or explosion.

Communication and personnel location system

29. The provision of adequate communication devices, capable of surviving emergency events such as explosions, ensures that workers underground can raise the alarm with the surface and with other workers, and can advise surface personnel of the status of workers underground and their planned escape route. A communication system allows those on the surface to guide workers underground towards the best way out of the mine. This is especially important if a particular route could lead workers into danger. Communication and personnel location devices are also beneficial when workers cannot get out of the mine on their own. In such situations, surface rescue teams can be directed straight to the survivors without having to undertake a time-consuming search of the mine.
30. In New Zealand there are no express legal requirements for the provision of communications systems in underground mines, either during an emergency or in normal operating conditions. There is guidance in the MinEx code for suitable means of communication to be provided and maintained in specified areas.¹⁹
31. Queensland, by way of contrast, does have express legal requirements for the provision of a telephonic communication system in underground coal mines, including that it have an adequate back-up power supply. It also specifies where the communication devices must be located in the mine.²⁰ Queensland's Recognised Standard 08: Conduct of mine emergency exercises includes the requirement for mines to have an effective means of communication with surface control, and specifies their locations. The United Kingdom also requires mines to establish and maintain 'communication systems to enable assistance escape and rescue operations to be launched.'²¹
32. The technology for communications and personnel location devices is improving. Most Queensland underground coal mines have installed certified PED systems developed by Mine Site Technologies. They provide wireless through-the-earth communication and can be used both as an emergency and as a day-to-day system.²² Three of Queensland's underground coal mines use the Northern Light Technologies wireless messenger system, which provides for two-way communication between workers underground and the surface and includes a built-in personnel tracking system.



Figure 33.5: Northern Light Technologies two-way messenger system²³

33. Alternative communications systems include leaky feeders. Leaky feeders are not wireless and so require cables to be hung from the roof throughout the mine. Underground workers are provided with intrinsically safe walkie-talkies, which allow for two-way communication.
34. All underground mines should have an adequate communications system that allows effective contact between miners underground and the surface during an emergency. New Zealand should keep abreast of the development of effective personnel location systems. As reliable and suitable systems become available, mine operators should also be required to install these.

Conclusions

35. There is inadequate coverage of self-rescue facilities in the mining health and safety regulations. Only four aspects are addressed and even those are not entirely satisfactory.²⁴ Many self-rescue requirements are not covered by regulations or other guidance material.
36. A fresh start is required. New regulations requiring underground coal mines to develop a health and safety management system should include a requirement that the system contain a comprehensive emergency response management plan. That plan should cover the facilities and training required to support self-rescue.

The emergency responders

37. While providing self-escape facilities should be the priority, an underground coal mine should also be able to assist the rescue operation. That includes being able to measure the atmospheric and physical conditions underground and, once it is established that there are no survivors, to promptly seal the mine and prevent further explosions.

Understanding the atmospheric conditions

38. No mines rescue team will enter an underground coal mine without adequate knowledge of the atmospheric conditions so that they can accurately predict when and for how long they can safely go underground. Although there are legal requirements in New Zealand relating to gas monitoring in underground mines during normal operating conditions, there are no express requirements for mines to have facilities or equipment that will help to establish atmospheric conditions during an emergency. There are also no relevant guidelines.
39. An underground coal mine's emergency management system should consider how the atmospheric conditions of the mine will be monitored and understood after an emergency such as a fire or explosion. This means installing a tube bundle system as well as the real-time monitoring system. Following the Moura No. 2 explosion, the use of tube bundle systems became the norm in Queensland and now all underground coal mines in the state have both systems.
40. A tube bundle system can be more useful than real-time monitoring devices after an explosion or fire, as the analysis components on the surface remain intact and can continue analysing the mine atmosphere. This is because if the

tube bundle equipment in the mine is damaged, tubes can be connected to the surface infrastructure and lowered down boreholes into the mine. Gas drawn from the mine through the tube bundle system can also be subjected to further analysis and interpretation, using gas chromatography.

41. A gas chromatograph from the Mines Rescue Service (MRS) rescue station in Rapahoe and the two chromatographs brought over by SIMTARS were used to analyse gas samples obtained from the mine during the search and rescue operation. Having more than one chromatograph available provided a degree of comfort in the accuracy of results. It would also have been convenient to have had a mobile laboratory available to assist with analysis of results on site. The inquiry into the explosion at the Kianga No. 1 mine in Central Queensland in 1975 recommended: 'All mines have available at short notice the means of analysing the air samples obtained while dealing with an out-break of fire below ground. This end may be accomplished by either mobile laboratories or laboratories established in each mining locality.'²⁵ The regulator and the MRS should consider obtaining and maintaining a mobile gas laboratory that could be available at short notice.

Understanding the physical conditions

42. It is also important during a search and rescue operation to understand the physical condition of the strata in the mine. Fires and explosions can weaken bolts put in place to hold up the roof, leading to roof falls in the mine. Much time and effort was expended at Pike obtaining robot cameras to examine the mine's drift, only for these to experience difficulties. Equipment suitable for use in assessing the physical environment underground should be identified and trialled before another mine emergency occurs.

Inertisation and sealing facilities

43. Following a fire or explosion, it may become necessary to seal the whole mine. Early inertisation can prevent further explosions and loss of the whole mine. It can also make any recovery operations easier and more likely.
44. There are no express legal requirements for underground mines to provide facilities that will ensure efficient and safe inertisation and sealing in an emergency. The *MinEx Industry Code of Practice on Underground Mines and Tunnels* does recommend that a mine's fire control and general emergency system cover rapid and effective sealing of the mine or a section of the mine if the fire or other emergency conditions cannot be controlled by other means.²⁶
45. Queensland requires the underground coal mine site senior executive to ensure that each entrance from the surface to the underground mine is capable of being rapidly sealed. At least one of the entrances must have an airlock and the mine, when sealed, must have facilities that allow safe use of inertisation equipment.²⁷ The inquiry into the Moura No. 2 explosion highlighted the need to be able to inertise a mine following an explosion. Its recommendations led the Queensland Mines Rescue Service to obtain an inertising system and train a team to use it.



Figure 33.6: Inertisation connection facilities

46. New South Wales also requires coal operations to include, in the emergency management system, provision for 'the rapid and effective sealing of the mine (while at the same time allowing for re-entry to the mine)²⁸
47. New Zealand's underground coal mines should be required to make sufficient provision for emergency mine sealing and inertisation. This includes constructing airlocks and docking stations.

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 to support 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.

ENDNOTES

¹ Coal Mining Safety and Health Regulation 2001 (Qld), cl 159.

² M. Jakeman, 'Developments in Self Escape and Aided Rescue Arising for the Moura No. 2 Wardens Inquiry: A Special Report by the Joint Coal Industry Committee from Queensland and New South Wales', in N. Aziz (Ed.), *Coal 1998: Coal Operators' Conference*, University of Wollongong & the Australian Institute of Mining and Metallurgy, 1998, p. 735, <http://ro.uow.edu.au/cgi/viewcontent.cgi?article=1228&context=coal>

³ *Ibid.*, p. 736.

⁴ Coal Mining Safety and Health Regulation 2001 (Qld), cl 168(1).

⁵ *Ibid.*, cl 168(2)(d).

⁶ *Escape and Rescue from Mines Regulations 1995 (UK)*, reg 10(1)(b).

⁷ Industry & Investment NSW, Mines Rescue Working Group and Mine Safety Operations Division, *Guideline: MDG 1020 Guidelines for Underground Emergency Escape Systems and the Provision of Self Rescuers*, MDG 1022 Guidelines for Determining Withdrawal Conditions from Underground Coal Mines, *Guidelines for In-seam Response Using CABA for Events When Life is at Risk*, October 2010, p. 27, http://www.resources.nsw.gov.au/__data/assets/pdf_file/0005/419522/MDG-1020.pdf

⁸ MinEx Health and Safety Council, *Industry Code of Practice: Underground Mining and Tunnelling*, October 2009, MINEX0005/39.

⁹ Coal Mining Safety and Health Regulation 2001 (Qld), reg 168(2)(e).

¹⁰ Coal Mine Health and Safety Regulation 2006 (NSW), reg 45(b)(vii).

¹¹ United Kingdom Health and Safety Executive, *Guidance and Information on Escape from Mines*, 2001, p. 13. <http://www.hse.gov.uk/pubns/priced/escape-mines.pdf>

¹² United Kingdom Health and Safety Executive, *Guidance and Information on the Role and Design of Safe Havens in Arrangements for Escape from Mines*, 2007, p. 5, <http://www.hse.gov.uk/pubns/mines08.pdf>

¹³ Queensland Warden's Court, *Wardens Inquiry: Report on an Accident at Moura No 2 Underground Mine on Sunday, 7 August 1994*, 1996, CAC0152/67.

¹⁴ Health and Safety in Employment (Mining – Underground) Regulations 1999, reg 23(2)(d).

¹⁵ MinEx Health and Safety Council, *Industry Code of Practice*, MINEX0005/39.

¹⁶ Coal Mine Health and Safety Regulation 2006 (NSW), regs 45(a)(ii), 45(b)(viii).

¹⁷ Industry & Investment NSW, Mines Rescue Working Group and Mine Safety Operations Division, *Guideline*, p. 25.

¹⁸ Queensland Warden's Court, *Wardens Inquiry: Report on an Accident at Moura No 2*, CAC0152/67.

¹⁹ MinEx Health and Safety Council, *Industry Code of Practice*, MINEX0005/12–13.

²⁰ Coal Mining Safety and Health Regulation 2001 (Qld), reg 176.

²¹ *Escape and Rescue from Mines Regulations 1995 (UK)*, reg 8(1).

²² Mine Site Technologies Pty Ltd, *Mine Site Technologies - Mining Communication Solutions*, 2012, <http://www.mining-technology.com/contractors/communications/mine-site>

²³ Northern Light Technologies, *Messenger: Not Just a Cap Lamp!*, <http://www.nltinc.com/cap-lamp-systems/messenger/>

²⁴ Health and Safety in Employment (Mining – Underground) Regulations 1999, regs 15, 22–24.

²⁵ Queensland Warden's Court, *Wardens Inquiry: Report on an Accident at Kianga No. 1. Underground Mine on Saturday, 20th September, 1975*, p. 18, <http://mines.industry.qld.gov.au/assets/inspectorate/kianga.pdf>

²⁶ MinEx Health and Safety Council, *Industry Code of Practice*, MINEX0005/39.

²⁷ Coal Mining Safety and Health Regulation 2001 (Qld), reg 156.

²⁸ Coal Mine Health and Safety Regulation 2006 (NSW), reg 45(b)(x).



Appendices

- + **Appendix 1:** Conduct of the inquiry
- + **Appendix 2:** The commission's operations and structure
- + **Appendix 3:** Commissioners' biographies
- + **Appendix 4:** List of participants
- + **Appendix 5:** Counsel representing
- + **Appendix 6:** List of issues (as at 28 April 2011)
- + **Appendix 7:** Policy phase questions
- + **Appendix 8:** Deputies reports on methane – extracts

Conduct of the inquiry

Establishment of the commission

On 29 November 2010, Prime Minister John Key announced the decision to establish a Royal Commission on the Pike River Coal Mine Tragedy. Its function was to investigate the tragedy and provide a report to the governor-general.

Cabinet approved the terms of reference and appointments to the commission on 13 December 2010 (CAB Min (10) 45/11). Justice Graham Panckhurst was appointed the commission's chair with David Henry and Stewart Bell appointed as commissioners.

The commission was given broad terms of reference (see Volume 1) that required it to examine and report on the causes of the explosions, and the consequent loss of life, as well as the adequacy of the regulatory regime, its administration including the mines inspectorate and the search, rescue and recovery operation.

Biographies of the commissioners are available in Appendix 3.

The establishment of the commission coincided with parallel inquiries undertaken by the coroner, the Department of Labour and the police.

By the end of December 2010, two barristers, James Wilding and Simon Mount, were appointed as counsel to assist the commission. A third, Kerryn Beaton, was appointed in May 2011.

The commission's executive director (Anne Carter) began work on 1 January 2011 (until 17 May when a new executive director – Vanessa Johnson – took over the role). The commission was initially Christchurch-based and moved into offices there in January 2011. The Canterbury earthquake on 22 February 2011 forced relocation to Wellington in early March, which delayed the commission's work.

Participation, process and procedure

The commission established processes and procedures tailored for the needs of the inquiry. Its terms of reference, and the parallel criminal investigations, posed special challenges.

Participation

An expression of interest process was used to identify intending participants. During January 2011 advertisements seeking expressions of interest were placed in New Zealand and Australian newspapers.

By the nominated date, 18 February 2011, over 60 expressions of interest had been received.

The expressions of interest were categorised into groups, and applicants given 'standing' – the ability to participate in the inquiry – at three different levels:

1. **Parties** – those who had a substantial and direct interest in the subject matter of the inquiry.
2. **Interested persons** – entities or people who satisfied the commission that they had an interest in the inquiry over and above that of the general public.
3. **Witnesses/submitters** – people who did not fall into the above categories but were likely to have evidence or information relevant to an aspect of the terms of reference.

Expressions of interest continued to be received throughout the life of the commission. By the end of the inquiry, 110 participants, some of them organisations representing multiple individuals, had been accorded standing.

The list of participants is available in Appendix 4.

Process

On 5 April 2011 the commission conducted a preliminary hearing in the Greymouth District Court to outline its intended approach to the inquiry and to allow for input from participants. Before the hearing the commission issued a minute that described its intention to divide the inquiry into four phases and included a provisional list of the issues the commission intended to focus on.

After the preliminary hearing the provisional list of issues was revised. The final list of issues is in Appendix 6.

The four phases as finally constituted were:

Phase One – Context covered mining law and practice, the interaction of mining law and other law, the New Zealand mining inspectorate, and the geography, conception, approval, design and development of the Pike River mine.

Phase Two – Search and rescue covered all aspects of the search, rescue and recovery operation, including the immediate cause of death of the 29 men, with a focus on what should be changed for the future.

Phase Three – What happened at Pike River? focused on the cause of the explosions, the company's operational, management and governance practices, and the regulatory oversight provided by the mining inspectorate at Pike River.

Phase Four – Policy aspects involved submissions relating to the whole inquiry:

- comparison of mining law and practice and environmental considerations in New Zealand and overseas;
- consideration of the future shape of the New Zealand mining inspectorate; and
- a comparison of overseas models.

Preliminary hearing 5 April 2011

On, 4 April 2011, the eve of the hearing, the commission met representatives of the families of the 29 men. This gave the commissioners and other members of the commission an opportunity to mix with and meet family members before the first hearing.

During the hearing, the commission outlined the procedures it planned to follow and received feedback from participants. It then finalised its processes and drafted rules of procedure designed to facilitate the conduct of the inquiry.

Evidence

Participants were invited to file evidence and relevant documents in tranches, reflecting the four phases of the inquiry. This written evidence was the primary source of information used to respond to the terms of reference. It was, however, supplemented in a number of ways.

The commission's analysts evaluated the written evidence and, where required, it was supplemented by additional evidence provided on request, or sometimes in response to compulsion notices or written questions by the commission. In addition approximately 90 interviews were conducted by the commission's investigator or counsel assisting, including several in Australia with experts, consultants and others who had knowledge relevant to the inquiry.

The commission used two Australian experts to help analyse and interpret information on such issues as gas analysis, mine rescue plans, best practice health and safety systems and some others.

The commission also met with Australian experts to discuss the explosion, and with and representatives of government agencies in relation to policy.

The written evidence received by the commission was assessed to determine who should be called to give oral evidence at the public hearings. Witnesses were selected according to criteria that included the significance of the evidence, whether it conflicted with other evidence and whether it might adversely affect the interests of anyone.

The written evidence was made available electronically to participants,¹ as were the commission's practice notes, minutes and hearing plans. Participants could access, through a secure website, the 'core' documents identified by the commission as crucial to participation in the hearings. They could also request access to documents or all evidence by way of an electronic 'briefcase' of documents from the commission's Summation evidence management system.

Communications

From the outset, the commission felt it essential that its process and progress were open to the scrutiny of the media and the public. Transparency was promoted in various ways.

The commission's public website <http://www.pikeriver.royalcommission.govt.nz> was its key channel to New Zealanders and people overseas and a regular e-newsletter also provided updates to the public. The public hearings were a further focal point; there was media access throughout the hearings, which were live streamed over the internet.

Family liaison and assistance for employees and contractors

The commission ensured that the families of the 29 men were informed about the progress of the inquiry. Counsel representing the families facilitated this, often following liaison with their counterparts, counsel assisting the commission.

The Focus Trust, a Greymouth organisation that provided services and support to the Pike River families, was another key liaison point for feedback from and communication with the families.

As with other participants, families received official communications from the commission and had access to information and evidence on the secure website. They also had access to the commission's public website, and many chose to receive the commission's e-newsletter.

Two lawyers, Kathryn Dalziel and Lisa Hansen, were appointed to provide information and advice to assist employees and contractors at Pike River to participate in the commission if they wished to do so.

Procedure

The commission's procedural requirements were notified by the electronic distribution of minutes, practice notes and hearing plans to all participants. These were also publicly available.

A minute contained information relating to procedure, hearings, evidence and many applications of participants.

A practice note set out the commission's rules of practice and requirements in relation to filing evidence, the conduct of the public hearings and obtaining access to the secure website, among other matters.

A hearing plan provided advice of the witnesses to be called at the public hearings and related details.

On 16 August 2011 the commission held a conference with counsel to discuss Phase Three due to issues arising from the concurrent Department of Labour and police investigations.

In total, 15 minutes and four practice notes were issued. These were made available on the commission's public website.

¹ Allowance was made for a small amount of suppressed or confidential evidence.

² Ibid.

Hearings



Figure A.1: The commission in session at Greymouth District Court

All the oral hearings were held in Greymouth, the community most directly affected by the tragedy. It was also the most convenient location as numerous witnesses were West Coast residents, as were many of the family members who regularly attended the hearings.

Hearings provided an opportunity to clarify or shed new light on evidence gathered. They also provided a forum for evidence to be aired in the public domain – sometimes for the first time since the tragedy occurred.

The commission sat for 51 hearing days, including the preliminary and final submissions hearings, over a period of 12 months.

Venue

The Greymouth District Court provided a convenient and appropriate hearing venue. With an average of 40 family members and members of the public attending each day, the need to refer to documents, video and image files, and the requirement to accommodate the commission, counsel for participants and the media, the court building had the necessary space, technology and parking.

The commission thanks the Ministry of Justice and the Greymouth District Court staff, particularly Cassandra Jones, who was registrar during the hearings, for their role in facilitating the hearings and supporting the commission.

Arrangements

Information technology – desktop monitors, on-screen projection and specialised document management software – used in the hearing room allowed counsel, the commissioners and the witnesses to view and call up evidence from documents filed with the commission.

Daily transcripts prepared by the Ministry of Justice’s National Transcription Service were available from the commission’s website by 6:00pm on the day of each hearing. More than 5700 pages of transcript were generated during the hearings. The speed and quality of this service were invaluable.

Hearings were live streamed over the internet by TVNZ and TV3 News. A media centre and access to a pool media feed from the hearing was provided within the courthouse to media representatives. Media who attended the hearings were, on application, also provided with copies of the witness statements and access to key documents.

The commission acknowledges the commitment from media organisations to coverage of its work. It also appreciates the contribution of TVNZ and TV3 in providing a pool media feed and live streaming from the hearings, and that of the New Zealand Press Association and The Press for providing pool media photography.

Witnesses

Fifty-one people appeared as witnesses at hearings in Greymouth, including a number of experts, family members and Pike workers who travelled from overseas to appear. Options for video-conferencing were available but not used.

All witnesses had a prepared witness statement. They took an oath or affirmation before giving evidence. Some read their evidence in full; others were led through it. Witnesses were questioned by counsel assisting and, with leave, by counsel representing other participants. The commissioners also asked questions.

Ten suppression and management orders were made by the commission during the public hearings. Eight remained in place at the end of the inquiry.

Under the Commissions of Inquiry Act 1908 witnesses had the right to decline to answer questions to avoid self-incrimination. The commission scheduled witnesses and ordered the phases in an endeavour to limit the need for claims of privilege. Some witnesses exercised their right to not answer certain questions.

Twenty-six compulsion orders were issued under provisions of the act.

DATE COMPULSION ORDER ISSUED	WHO	PURPOSE
20 April 2011	Pike River Coal Ltd, Dipak Agarwalla, John Dow, Arun Jagatramka, Sanjay Loyalka, Stuart Natrass, Raymond Meyer, Antony Radford, Surendra Sinha, Peter Whittall, Gordon Ward, Douglas White, Michael Lerch, Graeme Duncan, Denis Wood, James Ogden	To obtain information and copies of documents
12 May 2011	Douglas White	Appear as witness
2 June 2011	John Dow	Appear as witness
9 June 2011	Neville Rockhouse	Appear as witness
15 July 2011	Department of Labour	To obtain information gathered by the department in pursuance of its statutory powers
4 August 2011	Stephen Ellis	Appear as witness
27 October 2011	Stuart Natrass	Appear as witness
10 November 2011	Antony Radford	Appear as witness
6 December 2011	Petrus (Pieter) van Rooyen	Appear as witness
15 December 2011	Graeme Duncan	Appear as witness
13 February 2012	Robb Ridl	Appear as witness

Figure A.2: Compulsion orders issued

Phase One – Context

Hearing dates: Monday 11 July to Friday 22 July 2011

Phase One examined the New Zealand regulatory environment, the mining inspectorate and the geography, conception, approval, design and development of the mine.

Five chronologies summarising information from some of the more than 30,000 documents received in evidence during this phase were prepared by the commission and distributed in advance to participants and the media and made available to the public on the commission's website.

These chronologies covered the following topics:

1. New Zealand Mining and Coal Production Profile
2. Pike River Coal Ltd: Permits, Access Arrangement and Resource Consents
3. Pike River Coal Ltd: Financial/Company
4. Pike River Coal Ltd: Board, Management and Workforce
5. Pike River Coal Ltd: Mine Development.

Twelve witnesses gave evidence over 10 sitting days.

The following witnesses were called:

- Dr Donald Elder, Chief Executive Officer, Solid Energy New Zealand Ltd
- Dr Jane Newman, Geologist, Newman Energy Research Ltd
- Robin Hughes, former Chief Inspector of Coal Mines
- Henry (Harry) Bell, former Chief Inspector of Coal Mines
- Alan Sherwood, Senior Geologist, Ministry of Economic Development
- Robert Robson, Manager Petroleum and Minerals Policy, Ministry of Economic Development
- Colin Dall, Consents and Compliance Manager, West Coast Regional Council
- Craig Jones, Community Relations Officer (Concessions), Department of Conservation
- Mark Smith, Director, West Circle Ltd, contracted to Department of Conservation
- James Murphy, Workplace Health and Safety Policy Manager, Department of Labour
- Michael Firmin, Health and Safety Inspector, Department of Labour
- Peter Whittall, Chief Executive Officer, Pike River Coal Ltd (in receivership).

Phase Two – Search and Rescue

Hearing dates: Monday 5 September to Friday 23 September 2011

Phase Two examined the search, rescue and recovery operation at Pike River. Twenty-seven witnesses gave evidence over 15 sitting days.

The witnesses called were:

- Nigel Hughes, Detective Senior Sergeant, New Zealand Police
- Mattheus Strydom, former Electrician, Pike River Coal Ltd
- Daniel Rockhouse, former miner, Pike River Coal Ltd

- Douglas White, former General Manager, Pike River Coal Ltd
- Neville Rockhouse, former Safety and Training Manager, Pike River Coal Ltd
- Glenville Stiles, trainer contracted to New Zealand Mines Rescue Service
- John Taylor, Project Investigations Manager, Solid Energy New Zealand Ltd
- Adrian Couchman, former Safety Training Co-ordinator, Pike River Coal Ltd
- Daniel Duggan, former Control Room Officer, Pike River Coal Ltd
- Grant Nicholls, Assistant Commissioner, New Zealand Police
- Gary Knowles, Superintendent, New Zealand Police
- Darren Brady, Manager, Safety in Mines Testing and Research Station (SIMTARS), Queensland
- Timothy Whyte, Industry Safety and Health Representative, Construction, Forestry, Mining and Engineering Union, Australia
- Seamus Devlin, State Manager, New South Wales Mines Rescue, Australia
- James Stuart-Black, National Manager, Special Operations, New Zealand Fire Service
- Stephen Ellis, Statutory Mine Manager, Pike River Coal Ltd
- Susan (Lesley) Haines, Deputy Chief Executive, Labour Group, Department of Labour
- Trevor Watts, General Manager, New Zealand Mines Rescue Service
- Lauryn Marden, family
- Tara Kennedy, family
- Sonya Rockhouse, family
- Carol Rose, family
- Martin Palmer, family
- Richard Valli, family
- Bernard Monk, family
- Craig Smith, General Manager, Underground Mines, Solid Energy New Zealand Ltd
- Peter Whittall, Chief Executive Officer, Pike River Coal Ltd (in receivership).

Phase Three – What happened at Pike River?

Hearing dates: Monday 14 November to Thursday 24 November 2011,

Monday 5 December to Friday 9 December 2011, Wednesday 8 February to Friday 17 February 2012

Eighteen witnesses gave evidence over 22 sitting days.

The November 2011 hearing examined the performance of the mines inspectorate and hydro mining at the mine. All Phase Three hearings examined systemic issues.

The witnesses called were:

- Michael Firmin, Health and Safety Inspector, Department of Labour
- Kevin Poynter, former Health and Safety Inspector, Department of Labour
- Alan Cooper, Practice Leader, Health and Safety Practice Development, Department of Labour
- Dr Kathleen Callaghan, Director, Human Factors Group, Faculty of Medicine, University of Auckland

- David Stewart, Mining Consultant, Minserv International Ltd
- Craig Smith, General Manager, Underground Mines, Solid Energy New Zealand Ltd
- Masaoki Nishioka, Consultant, Seiko Mining and Construction Ltd
- George Mason, former Hydro-Mining Co-ordinator, Pike River Coal Ltd
- Stephen Wylie, Deputy, Pike River Coal Ltd (in receivership).

On 10 November 2011 the Department of Labour laid charges under the Health and Safety in Employment Act 1992 against Pike River Coal Ltd (in receivership), VLI Drilling Pty Ltd (Valley Longwall) and Peter Whittall. The commission considered it inappropriate to require Mr Whittall to provide further evidence while he awaited determination of the charges.

The December 2011 hearing examined Pike River Coal Ltd's health and safety systems and safety culture.

The witnesses called were:

- Adrian Couchman, former Safety Training Co-ordinator, Pike River Coal Ltd
- Albert (Alan) Houlden, former leading hand, McConnell Dowell Constructors Ltd
- John Dow, former Chair, Pike River Coal Ltd
- Neville Rockhouse, former Safety and Training Manager, Pike River Coal Ltd.

The February 2012 hearing examined the immediate causes of the first explosion on 19 November 2010.

The witnesses called were:

- Brett Murray, General Manager, National Services and Support, Department of Labour
- David Reece, Australian mining consultant and expert adviser to the Department of Labour
- Anthony Reczek, Australian electrical engineering consultant and expert adviser to the Department of Labour
- Douglas White, former General Manager, Pike River Coal Ltd
- Petrus (Pieter) van Rooyen, former Manager, Technical Services, Pike River Coal Ltd.

Phase Four – Policy aspects and submissions

Phase Four covered submissions on all phases and policy issues, in particular mining-related issues, and search and rescue practice, which, in light of the Pike River tragedy, require a changed approach.

The commission posed a series of questions (see Appendix 7) on which it sought the input and views of participants.

The final submissions hearing held in April 2012 allowed participants to express their views on policy matters in a public forum.

The commission also consulted government agencies in New Zealand as it developed its policy perspectives and recommendations.

Final submissions

Hearing dates: Monday 2 April 2012 to Wednesday 4 April 2012

The commission received final written submissions from participants on all factual questions, and in relation to policy

aspects and recommendations. Those who wished to speak to their written submission did so at a final public hearing in Greymouth.

Sixteen participants spoke in support of their written submission through counsel or a spokesperson:

- Certain directors, officers and managers of Pike River Coal Ltd (in receivership)
- Coal Association of New Zealand (supported by Straterra Inc)
- Department of Conservation
- Department of Labour
- The families of the Pike River deceased
- McConnell Dowell Constructors Ltd
- MinEx Health and Safety Council New Zealand
- Ministry for the Environment
- Ministry of Economic Development
- New Zealand Amalgamated Engineering, Printing and Manufacturing Union.
- New Zealand Council of Trade Unions
- New Zealand Mines Rescue Service
- New Zealand Police
- Neville Rockhouse, former Safety and Training Manager, Pike River Coal Ltd
- Solid Energy New Zealand Ltd
- Douglas White, former General Manager, Pike River Coal Ltd.

A judicial review

On 18 July 2012 certain former directors and officers of Pike applied to the High Court at Wellington (CIV-2012-485-1441) to judicially review decisions of the commission not to reconvene the public hearings to hear evidence from new witnesses and not to permit access to the final report before it was given to the governor-general. Prior access was sought to protect fair trial rights in relation to a pending prosecution. The applicants also sought an interim order to prevent delivery of the report before the judicial review applications were determined.

The application was dismissed.

The final report

The terms of reference required the commission to report by 31 March 2012. An extension to 28 September 2012 was sought and granted on 7 February 2012 (CAB Min (12) 3/1). A further extension to 30 November 2012 was sought and granted on 27 August 2012 (CAB Min (12) 30/7)

The initial extension was required largely to enable additional evidence to be received and taken into account from the parallel inquiries conducted by the Department of Labour and the New Zealand Police. This, including an investigation report by the Department of Labour, became available to the commission in late 2011, after charges were laid and the further evidence was publicly examined, particularly at the hearing in February 2012. The further extension was to accommodate the judicial review application and consequential resourcing implications.

The commission records its appreciation to both the Department of Labour and New Zealand Police for their co-operation in making available evidence obtained in their investigations.

The commission's operations and structure

Role of the public sector

The commission operated independently of government but relied on government agencies for support. Funding of the commission was through the Department of Internal Affairs. The department provided information technology and administrative support in Wellington, including moving the office from Christchurch, and Greymouth. The Ministry of Justice made the Greymouth District Court available for the hearings, and worked closely with the commission secretariat on arrangements for each hearing session. The National Transcription Service provided daily transcripts of proceedings. Other government agencies supported the commission by seconding people.

Structure

The core commission team needed legal, analytical, information management, communications and administrative support to ensure an efficient inquiry process. A team of 14 people employed either on secondment or on contract, full time and part time, supported the three commissioners in their work.

The secretariat

An executive director led a secretariat consisting of two administrative support staff, three policy analysts, a legal analyst, an information officer, an investigator, a communications adviser and a legal secretary.

The executive director worked with the Department of Internal Affairs and the commissioners to establish operational aspects of the commission and to ensure its administration met public sector requirements.

The executive director's key responsibilities included employing and managing staff, managing the budget and financial accountabilities, managing risk, managing relations with stakeholders and other interested parties, and family liaison.

The executive director role was filled by a Department of Internal Affairs senior manager for five months during the set-up phase, including relocation to Wellington. A permanent replacement executive director was appointed on secondment from Inland Revenue from May 2011 until the completion of the commission's work, including its disestablishment in November 2012.

Analysts were charged with reviewing, analysing and evaluating the tens of thousands of documents submitted to the inquiry. Their key responsibilities were analysing and summarising evidence, liaising with counsel assisting and co-ordinating and engaging experts as required to supplement, analyse or interpret the information the commission had to consider.

An information officer was employed to manage the evidence database, ensure security of the documents held by the commission, make them available electronically, and manage the transfer of all the commission's records to Archives New Zealand at the end of the inquiry under the provisions of the Public Records Act 2005.

A former senior police officer was employed as an investigator. He examined evidence, briefs and transcripts and identified missing information, interviewed witnesses, helped to prepare some witness statements, supported counsel assisting with hearings preparation, and was available to any participant without legal counsel or intending witnesses who needed help providing information to the commission.

Karyn Basher – Senior Legal Analyst	Ruth Locker – Executive Administrator
Anne Carter – Executive Director	Jim McNicholas – Senior Analyst
Sue Duffy – Executive Administrator	Meirwen Pride – Information Officer
Julie Hooper – Secretarial support	Ellen Spear – Legal Secretary
Anna Hughes – Communications Advisor	Neville Stokes – Investigator
Katherine Ivory – Senior Analyst	Emily Su’a-Dunn – Executive Administrator
Vanessa Johnson – Executive Director	David Williment – Senior Advisor
Lynley Jones – Information Officer	Sandi Wilson – Legal Secretary

Figure A.3: Secretariat over the life of the commission

Counsel assisting

Three barristers were appointed as counsel assisting the commission. Their task was to represent the public interest and facilitate the commission’s work. Their role included making opening statements at hearings, providing advice and liaising with participants and other counsel, facilitating the provision of evidence, resolving procedural issues and examining witnesses at hearings. They were assisted by the legal analyst who also worked with the commission’s analyst team during the policy phase.

Recruitment

The Department of Internal Affairs provided people to support the setting up of the commission, including an executive director and communications support. Inland Revenue, the Department of Internal Affairs, the Department of Corrections and the Crown Law Office provided four people on secondment. Others were contracted to the commission.

Operating principles

The commission’s structure, its operating model and its way of working had to contribute to its independence, integrity and credibility. Its aim was to be fair, open, thorough, but also expeditious, professional and accessible. Wherever possible, the commission tried to use efficient, appropriate and economic processes.

Risk and financial management

The commission established a number of tailored frameworks, policies and processes that adhered to sound risk and financial management practices and reflected the size of the team and the short life of the commission.

The risk management framework

The commission’s short-term nature brought with it an abundance of risks and issues. The commission adopted a risk management framework based on the AS/NZS ISO 31000:2009 standard, ensuring the identification of likely risks, their potential impact and the associated mitigations. Risk and issues registers were developed, reviewed and updated for the preparation and running of the public hearings, information technology and the more general conduct of the inquiry. The executive director facilitated the risk management process involving all commission personnel. Risks were reviewed with commissioners on an agreed timeframe based on the severity of the risk.

Related interests and conflict of interest framework

The commission’s framework followed that of the Australian 2009 Victorian Bushfires Royal Commission. The existence of a related interest was not grounds for an automatic exclusion from the commission. The appropriate mitigation and management strategy depended on the nature of the related interest disclosed.

Financial management

Separate funding was approved by the government. It was difficult to estimate the funds needed until the commission had had time to consider its terms of reference and its processes. Cabinet approved initial appropriations³ of \$0.456 million for the commissioners' fees and \$1.169 million for costs associated with the commission for the 2010/11 financial year only, and authorised ministers to approve additional funding to cover the rest of the commission.

Further appropriations of \$7.298 million for the commission were approved to cover the entire cost of the commission. This covered the costs for the commission itself as well as the costs of subsequent Cabinet decisions to fund legal representation for the families of the deceased miners, and legal assistance to the employees of, and contractors to, the Pike River Coal Mine, for which total provision of \$2.541 million was allowed.

In March 2012, Cabinet agreed to the commission's request for an extension of its reporting date with an associated increase in funding of \$1.577 million, bringing the total approved cost to \$10.500 million including the cost of legal representation for the families of the deceased miners, and legal assistance to the employees of, and contractors to, the Pike River Coal Mine.

The commission managed expenditure directly related to it, but funding for counsel for the families was managed by the Department of Internal Affairs and the Crown Law Office.

Information management and technology and access to information

The commission ensured the flow and management of information and evidence between participants and the commission was efficient, user-friendly and cost-effective.

Information technology

The commission needed a system that could cope with large amounts of data and numbers of documents, allowed simultaneous users and desktop access across two locations, allowed data and documents to be shared with external users, was secure and allowed information to be identified as confidential, could be used with courtroom presentation software, and was cost-effective.



Figure A4: Secure website home page

³ The Treasury, 'Explaining Key Concepts: Appropriations', In Putting It Together: An Explanatory Guide to New Zealand's State Sector Financial Management System, 2011, http://www.treasury.govt.nz/publications/guidance/publicfinance/pit2011/07.htm#_tocAppropriations. Appropriations are legal authorities granted by Parliament to the Crown or an office of Parliament to use public resources. Most appropriations are set out in appropriation acts presented as part of the government's budget package. They satisfy a requirement in the Constitution Act 1986 that the Crown cannot spend public money except by or under an act of Parliament. Appropriations are limited to a maximum level of spending, to a particular period, and to uses set by the scope statement (see Chapter Four). Appropriations are required for all expenses and capital expenditure.

Relying on the existing network infrastructure supported by the Department of Internal Affairs, the commission bought an off-the-shelf evidence management system, AD Summation iBlaze. A secure website using existing departmental technology was used to share information and documents with participants.

This meant the commission could store over 2000 core documents in a safe environment that was easily maintained, accessible and secure. Participants received password-protected access, which allowed them to see evidence received and examined by the commission and looked at during public hearings.

The commission worked with the Department of Internal Affairs and Archives New Zealand on the archiving of its records. The department's information technology network and expertise included ongoing maintenance and desktop support services.

Access to information and evidence

By the end of the inquiry, the commission's evidential database contained over 67,500 documents, including graphs, maps, photographs, plans, spreadsheets and multimedia files. Decisions were needed about what would be accessible, and by whom.

Participants had to feel confident that the commission would use information received for the purposes of its inquiries. All those who accessed documents from the commission, other than publicly available information, were subject to an implied undertaking of confidentiality.

Three principles governed any release of information:

1. Information was provided to the commission for the purposes of its inquiries.
2. The commission would be open with its information wherever possible.
3. Release of any information, public or restricted, should not interfere with the commission's ability to inquire.

Accommodation

The commission and staff worked from offices in Wellington and from the Greymouth District Court when hearings were in session.

Commissioners' biographies

Hon. Justice Graham Panckhurst (Chair)

Hon. Justice Graham Panckhurst is a senior High Court judge based in Christchurch since his appointment in 1996. His judicial experience extends to all aspects of the High Court's work and has included presiding over a number of high-profile trials.

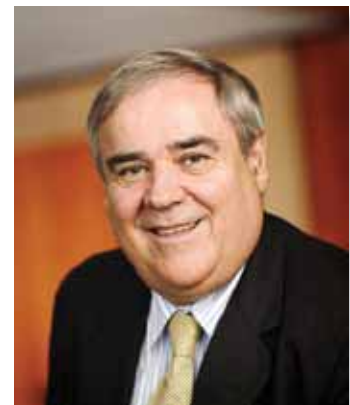
He has a wealth of legal experience, having been the Crown Solicitor for Canterbury and the West Coast from 1985 to 1992, before practising as a barrister and becoming a Queen's Counsel in 1994. Justice Panckhurst is also a West Coaster by birth, and has both acted in and presided over cases heard in Greymouth over many years.



Stewart Bell PSM

Stewart Bell, from Australia, is Commissioner for Mine Safety and Health for Queensland and Deputy Director-General of the Safety and Health Division of the Queensland Department of Natural Resources and Mines, which includes the Coal and Metalliferous Mines, Explosives and Petroleum and Gas Inspectorates and the Safety in Mines Testing and Research Station (SIMTARS). He is also responsible for the regulation of the mining, explosives and petroleum and gas industries and the strategic research agenda for SIMTARS.

Mr Bell has over 25 years' experience in all aspects of mine safety, and has published widely on health and safety in mines. He also has international work experience in several countries, including India, China, New Zealand and Australia.



David Henry CNZM

David Henry has held a number of public sector positions, including Chief Executive/Commissioner of Inland Revenue and Chief Executive/Commissioner of the Electoral Commission. He has also run his own management consultancy business advising public and private sector clients in New Zealand and overseas. Mr Henry was appointed a Companion of the New Zealand Order of Merit in 1999.



APPENDIX 4

List of participants

PARTIES	INTERESTED PERSONS	WITNESSES/SUBMITTERS
Department of Conservation ⁴	Gary Campbell	Accident Compensation Corporation
Department of Labour	Coal Association of New Zealand	Air New Zealand Ltd
Families of the deceased	Coal Services Pty Ltd	Stanley Alder
Ministry for the Environment	Buller District Council	Australasian Tunnelling Society
Ministry of Economic Development	Grey District Council	Lindsay Arthur
New Zealand Amalgamated Engineering, Printing and Manufacturing Union Inc.	McConnell Dowell Constructors Ltd	Hon. Max Bradford
New Zealand Police	Mines Rescue Trust	Harry Bradshaw
Pike River Coal Ltd (in receivership)	MinEx Health and Safety Council	Simon Breeze
	National Rural Fire Authority	Buller Conservation Group
	New Zealand Coal & Carbon Ltd	Paul Caffyn
	New Zealand Council of Trade Unions	Dr Kathleen Callaghan
	New Zealand Fire Service Commission	Aaron Campbell
	New Zealand Fire Service	Dr Murry Cave
	New Zealand Defence Force	Professor Dave Cliff
	New Zealand Oil & Gas Ltd	Centre for Occupational Health and Safety Research
	New Zealand Public Service Association	Construction, Forestry, Mining and Energy Union
	Pike River Contractors and Suppliers Group	Kevin Curtis
	Current or former employees/officers/contractors of Pike River Coal Ltd	Paul Douglas
	Rockwell Automation (NZ) Ltd	Alan Eastergaard
	Royal Forest and Bird Protection Society of New Zealand Inc.	Bill Evans
	Solid Energy New Zealand Ltd	Peter Ewen
	Straterra Inc	Peter Fairhall
	Tai Poutini Polytechnic	Dave Feickert
	URS New Zealand Ltd	Focus Trust West Coast (Kathryn Leafe)
	Valley Longwall International Pty Ltd	Harry Gair

⁴ Including the minister of conservation and director-general of conservation.

PARTIES	INTERESTED PERSONS	WITNESSES/SUBMITTERS
	West Coast Regional Council	William Gardner
	West Coast Rural Fire Authority	Charles Gawith (Newmont Waihi Gold)
		Stuart Gorrie
		Dr Robin Griffiths
		Glen Grindlay (Newmont Waihi Gold)
		Kevin Hague MP
		Hawcroft Consulting International Pty Ltd
		Glen Heldberg
		Robin Hughes
		Impac Services Ltd
		Institution of Professional Engineers New Zealand
		Brian Jackson
		Mark Levene
		Andrew Loader
		Major (Rtd) W.H. McGunnigle
		John Menzies
		John Mildren
		Minserv International Ltd
		Gerard Morris
		New Zealand Society for Risk Management
		Newman Energy Research Ltd
		Te Kotahitanga Ngarimu
		Erik Nielsen
		NZX Ltd
		Mick O'Donoghue
		Oceana Gold (New Zealand) Ltd
		Kenneth Palmer
		PCS Investments Nominees Ltd
		Ronald Pearson
		David Penney
		Jeremy Penrice
		D.G. Peterson
		Queensland Mines Rescue Service
		Dr Stuart Rabone
		Harry Rayner
		William Rennie
		Dr Leonard Richardson
		Brian Robinson
		Alan Ross

PARTIES	INTERESTED PERSONS	WITNESSES/SUBMITTERS
		John Rowland
		Yves Sabatier
		Safety in Mines Testing and Research Station (SIMTARS)
		Robert Tait (Friends of the Earth New Zealand)
		Benson Taylor
		William Taylor
		Robert Terry
		Alan Thompson
		David Titheridge
		Basil Walker
		Robert Wiltshire

APPENDIX 5

Counsel representing

NAME OF PARTICIPANT	COUNSEL
Dipak Agarwalla, Surendra Sinha, Arun Jagatramka and Sanjay Loyalka	Michael Morrison
Gary Campbell	Philip Hall, Kerry Cook
Coal Services Pty Ltd (Mines Rescue Division)	Brian Latimour
Matthew Coll	Gregory King
Alexander Colligan	
Rem Markland	
Russell Smith	
CYB Construction Ltd (formerly Chris Yeats Builders Ltd)	Brian Nathan
Department of Conservation	Kristy McDonald QC, Cameron Mander, Aedeon Boadita-Cormican, Anthea Williams, Tim Smith
Department of Labour	
Ministry for the Environment	
Ministry of Economic Development	
Families of the deceased	Nicholas Davidson QC, Richard Raymond, Jessica Mills, Colin Smith
McConnell Dowell Constructors Ltd	Grant Nicholson, Sarah-Lee Stead, Sophie Gilmour
Minserv International Ltd	Jonathan Forsey
Gerard Morris	David Butler
Terence Moynihan	Gregory King
New Zealand Amalgamated Engineering, Printing and Manufacturing Union Inc.	Nigel Hampton QC, Rowan Anderson, Andrew Little
New Zealand Coal & Carbon Ltd	Sam Hetherington, Edward Bayley
New Zealand Council of Trade Unions	Peter Cranney
New Zealand Defence Force	Major Steve Taylor
New Zealand Fire Service Commission	Karen Clark QC, Robert Buchanan
New Zealand Mines Rescue Service	Jonathan Forsey, Garth Gallaway, Emily Whiteside
New Zealand Oil & Gas Ltd	Tim Stephens, Nina Blomfield
New Zealand Police	Simon Moore SC, Katherine Anderson, Kirsten Lummis
Certain directors, officers and managers of Pike River Coal Ltd (in receivership)	Stacey Shortall, Anna Rawlings, Rachael Schmidt-McCleave, Paul Radich, Andy Glenie, Duncan MacKenzie, Alison Gordon, Iva Rosic, Luke Barrington
Pike River Coal Ltd (in receivership)	Mike Colson, Fiona Tregonning
Pike River Contractors and Suppliers Group	Gregory King
Queensland Mines Rescue Service	Matthew Mallett
Antony Radford	Stephen Hunter, Angela Goodwin
Dr Leonard Richardson	Desmond Wood
Neville Rockhouse	James Rapley, Ian Kearney

Rockwell Automation (NZ) Ltd	John Billington QC, Peter Woods, Lisa Taylor
Solid Energy New Zealand Ltd	Craig Stevens, Adam Holloway
Tai Poutini Polytechnic	Garth Gallaway, Emily Whiteside
URS New Zealand Ltd	Adrian Olney, Desley Horton
Valley Longwall International Pty Ltd (VLI)	Pheroze Jagose, Richard May
Petrus (Pieter) van Rooyen	Paul Mabey QC
Gordon Ward	Justin Smith
Douglas White	John Haigh QC, David Jones QC, Bridget Smith, Billy Boyd

List of issues (as at 28 April 2011)

Background

1. This is the list of issues for the Royal Commission on the Pike River Coal Mine Tragedy. The aim of the list is to identify the main issues which the commission presently considers it will need to evaluate in order to address its Terms of Reference.
2. The list is provided for the assistance of parties, interested persons and potential witnesses and submitters. An inquiry is not a court case. The commission is not able to determine legal rights and liabilities. Its responsibility is to inquire into and report upon the tragedy, and make recommendations for the future. There are no pleadings by which issues are identified. The Terms of Reference broadly define the subject matter of the inquiry, but the commission must determine the issues which need to be assessed and answered to enable it to provide its final report.
3. The commission will review the list from time to time. A revised list (or lists) may be issued during the course of the inquiry. Accordingly, the list is not intended as a constraint upon the evidence or submissions which persons may wish to provide to the commission.
4. The commission intends to conduct the inquiry in four phases and the list of issues reflects this division. Generally, the issues are listed by reference to one term of reference. However, some issues may be relevant to more than one term of reference. Issues are not repeated on this account. The manner, and order, in which issues are listed does not reflect their relative importance or the weight they may be given. The drafting of the issues is intended to be neutral, so as to simply identify the relevant area of interest. They should be read in a broad, and non-limiting, manner.

Interpretation of the List

The following terms have the meaning indicated unless otherwise stated:

‘the incident date’ means 19 November 2010;

‘mining’ means underground coal mining and related operations;

‘the mine’ means the Pike River Mine, both the underground and the above ground elements;

‘the company’ means Pike River Coal Limited;

‘DoL’ means the Department of Labour;

‘ToR’ means Term of Reference;

‘H&S’ means health and safety;

‘the selected countries’ means those countries selected as comparators for the purposes of ToR(h); and

‘mining law requirements’ means the legal requirements identified in ToR(e).

Phase One – Context

The contextual phase comprising the New Zealand regulatory environment; the interaction of mining law and other law in New Zealand; the resourcing and implementation of mining law in New Zealand (ToR(e),(f) and (g)). The geography, conception, approval, design and development of the mine.

The regulatory requirements and recognised practices in New Zealand (ToR(e))

- 1.1 The background history of the New Zealand mining industry.
- 1.2 The history of mine explosions which have caused multiple fatalities in New Zealand and the details of any recommendations from inquiries into those events.
- 1.3 The legal requirements and recognised practices which governed mining in New Zealand pre-1992.
- 1.4 The policy considerations which prompted the enactment of the Health & Safety in Employment Act 1992 and the subsequent mining regulations in 1996 and 1999.
- 1.5 The legal requirements which governed mining as at the incident date.
- 1.6 The recognised practices (including codes of practice, guidelines, advisories, notices, and instructions issued by regulatory authorities and other organisations) which applied as at the incident date.

How New Zealand mining requirements and practices interact with conservation, environmental and other legal requirements (ToR(f))

- 1.7 The identification and description of any conservation, environmental and other legal requirements which:
 - (a) apply to the Pike River Coal Mine or the land on which it is situated; and
 - (b) interact with the mining law requirements and recognised practices identified in ToR(e).
- 1.8 The manner and extent to which those conservation, environmental and other legal requirements interact with the mining law requirements and recognised practices identified in ToR(e).

Resourcing for, and the administration and implementation of, mining law and practices in New Zealand (ToR(g))

- 1.9 The identification of the New Zealand regulatory agencies responsible for the administration and implementation of the laws and recognised practices that apply to mining and to mining land.
- 1.10 The nature and extent of the resources provided to these regulatory agencies.
- 1.11 The organisational structures of these regulatory agencies; including the lines of responsibility and accountability, delegations and the job descriptions and performance agreements of relevant personnel.
- 1.12 The operational methods of these regulatory agencies; including how they administer laws and practices, their strategies, priority setting, outcomes, outputs, performance measures, resource allocations, work programmes, risk management, internal audit and self review, internal reporting and external reporting systems.

The conception, approval and development of the mine

- 1.13 The conception of the development of the mine including any external reports obtained by the company.
- 1.14 The geography and geology of the area where the mine is situated.
- 1.15 The consent and approval process, including the terms and conditions sought by or imposed by external agencies.
- 1.16 The chronology of interactions between the external agencies and the company concerning the mine development.
- 1.17 The history of the design, development and construction of the mine and associated systems, including bore hole placement, drilling and the information yielded.
- 1.18 The state of development and layout of the mine as at the incident date, including all plans of the mine prepared to that time.

Phase Two – Search and rescue

The cause of the loss of life. The search, rescue and recovery operations. (ToR(b) and (d))

The cause of the loss of life

- 2.1 The likely injuries suffered by the men.
- 2.2 The cause(s) of the deaths of the men.
- 2.3 The likely timing of their deaths.

The search, rescue and recovery operations

- 2.4 The chronology of events and actions from the time of the first explosion to the present time.
- 2.5 The opportunity (if any) for the men to have taken steps towards self-rescue, including:
 - (a) the company's rescue plan in the event of an explosion;
 - (b) the equipment and resources available to the men; and
 - (c) the training provided to them.
- 2.6 The content of any emergency response plans of the company, and of other organisations which were in place at the incident date.
- 2.7 The extent to which such response plans:
 - (a) were tested and remedial action taken;
 - (b) were able to be deployed when the tragedy occurred; and
 - (c) proved adequate in the course of the occurrence.
- 2.8 The extent of the information available to the company and the external entities involved in the search, rescue and recovery operation in the period following the first explosion; including information as to the atmosphere, the location of the men and their work activities in the mine before and around the time of the first explosion.
- 2.9 The respective roles played by the company and external entities in the search, rescue and recovery operations.
- 2.10 The reasons for the division of roles, including any relevant legislative provisions.
- 2.11 The liaison and decision making processes which were adopted in the course of the operations, including the expert advice received by the company and external entities.
- 2.12 The decisions reached and whether these were made in a clear and timely manner.
- 2.13 The human and physical resources available for the purposes of the search, rescue and recovery operations.
- 2.14 The qualifications, experience and training of the organisations and individuals involved in the search, rescue and recovery operations.
- 2.15 The measures taken in an endeavour to stabilise the atmosphere within the mine.
- 2.16 The extent, if any, to which the search, rescue and recovery operations were impacted by the:
 - (a) geography of the mine and its environment;
 - (b) design of the mine;
 - (c) systems in the mine; and
 - (d) information and equipment provided by the company.

- 2.17 The measures taken in an endeavour to regain full or partial access to the underground reaches of the mine.
- 2.18 The comparison between this search, rescue and recovery operation and:
- (a) previous similar operations in New Zealand;
 - (b) previous similar operations in other countries; and
 - (c) international best practice.
- 2.19 The nature of the search, rescue and recovery processes employed in other similar hazardous environments.
- 2.20 The communications with the families of the men during the search, rescue and recovery operations.

Phase Three – What happened at Pike River?

The cause of the explosions. The company's operational and management practices. Regulatory oversight. (Terms of Reference (a) (c) and (g)).

The immediate cause of the explosions

- 3.1 The hazards, flammable gas and coal dust present in the mine immediately prior to and at the time of the incident.
- 3.2 The locations of the men within the mine and their activities at the time of the incident.
- 3.3 The likely ignition source.
- 3.4 The cause of the subsequent explosions.

The company's management and operational practices

Management

- 3.5 The company's general management structure and systems in relation to decision-making (including responsibilities, accountabilities and delegations).
- 3.6 The company's management systems for:
- (a) identifying and managing risk; and
 - (b) ensuring compliance with mining law requirements and recognised practices.

Mine systems

- 3.7 The systems in place at the mine at the incident date for:
- (a) achieving adequate ventilation;
 - (b) testing air quality and temperature;
 - (c) effecting methane drainage of the coal seam;
 - (d) preventing the ignition of combustible matter;
 - (e) preventing the occurrence of spontaneous combustion;
 - (f) controlling and testing for the presence of flammable gas;
 - (g) monitoring the safety of equipment and electrical systems; and
 - (h) maintaining communications between the men underground and those on the surface.
- 3.8 The systems in the mine and whether these:
- (a) met legal requirements;

(b) complied with recognised practices; and

(c) were subject to periodic review.

3.9 The location, design and construction of the mine and whether these factors:

(a) affected the level of operational risk; and

(b) if so, the steps taken to manage that risk.

H&S Systems

3.10 The methods adopted by the company:

(a) to implement, monitor and review H&S practices in the mine;

(b) to test the understanding, preparedness and ability of persons engaged at the mine to implement H&S systems and plans; and

(c) to amend such practices, systems and plans as required.

3.11 The training, qualifications, experience and performance of the managers and certificated employees appointed by the company pursuant to the Health and Safety in Employment (Mining Administration) Regulations 1996.

3.12 The methods adopted by the company:

(a) to ensure the reporting and recording of H&S events and concerns; and

(b) to take action in relation to and record the response to such events and concerns.

3.13 The level of compliance achieved by the company, employees, contractors and others in relation to H&S requirements and recognised practices.

3.14 The company's record in relation to responding to any notice or direction received from a regulatory agency.

Employees/contractors

3.15 The methods adopted by the company to ensure that employees and contractors:

(a) were involved in the design, operation and review of the H&S systems and plans;

(b) were provided with training in relation to H&S in the mine;

(c) were competent in meeting H&S requirements; and

(d) communicated H&S events or concerns to an appropriate officer.

3.16 The steps taken by the company to:

(a) engender an appropriate organisational culture in relation to the reporting of H&S events and concerns; and

(b) respond to such reports.

3.17 The experiences in relation to H&S of persons who worked or were engaged at the mine.

H&S impediments

3.18 The effect (if any) upon the company's development, implementation and review of H&S initiatives arising from:

(a) difficulties associated with the location and design of the mine;

(b) financial problems;

(c) production delays; and

(d) other external factors.

3.19 The effect (if any) upon the achievement of H&S outcomes at the mine arising from:

- (a) issues relating to the recruitment of experienced personnel;
- (b) the terms and conditions of the employment of the men and the terms of engagement of contractors;
- (c) the work practices in the mine of the employees and contractors; and
- (d) incentives or disincentives (if any) to which employees and contractors were subject.

External oversight of H&S at the mine

3.20 The methods employed by the regulatory agencies to facilitate and enforce compliance by the company with legal requirements and recognised practices:

- (a) in the pre-production period; and
- (b) during production.

3.21 The content of instructions, and any other materials, provided by regulatory agencies to the company for its guidance in achieving regulatory compliance.

3.22 The content of any complaints made to the regulatory agencies concerning H&S issues at the mine.

3.23 The content of communications (formal and informal, including warnings, notices and directions) between the regulatory agencies and the company concerning H&S issues at the mine.

3.24 The response of the company to such communications or complaints.

3.25 The mechanisms (if any) including any memoranda of understanding, which existed between the regulatory agencies to ensure:

- (a) that relevant information pertaining to the mine was exchanged and shared; and
- (b) that any issues in relation to H&S at the mine were the subject of appropriate action.

3.26 The interactions and communications between the regulatory agencies and the company, and between the agencies, on and after the date of the incident.

3.27 The content of any performance reviews or external audits of regulatory agencies as a result of the tragedy.

3.28 The content and trend of H&S statistics in New Zealand since 1992, both in general and in relation to mining.

Phase Four – Policy aspects

The comparison between New Zealand and the selected countries in relation to:

- (a) mining regulatory requirements and recognised practices;
- (b) their interaction with conservation, environmental and other legal requirements; and
- (c) the resourcing for, and the administration and implementation of mining law and practice (ToR(h))

(Note: The New Zealand position was considered in Phase One – issues 1.1. to 1.12. The issues which follow are framed to identify the situation in the selected countries so that the comparative evaluation with NZ required under ToR(h) may be undertaken.)

The regulatory requirements and recognised practices that govern mining in the selected countries; and the comparison to New Zealand.

International

- 4.1 The selection of other countries to be used as comparators – ‘the selected countries’.
- 4.2 The identification and description of the mining law requirements and recognised practices in the selected countries that govern:
 - (a) underground coal mining and related operations; and
 - (b) H&S in underground coal mining and related operations.
- 4.3 The historical background to the requirements and practices, and the policies underlying them.
- 4.4 The effect of any changes in the regulatory environments.
- 4.5 The proposals (if any) for change in the future direction of the regulatory requirements and recognised practices.

Comparison

- 4.6 The comparative evaluation of mining law requirements in New Zealand and in the selected countries. How mining requirements and practices interact with conservation, environmental and other legal requirements in the selected countries; and the comparison to New Zealand.

International

- 4.7 The identification of any conservation, environmental and other legal requirements which apply to mining or to land on which underground coal mining occurs in the selected countries.
- 4.8 The manner and the extent to which those conservation, environmental and other legal requirements interact with the mining law requirements and recognised practices (as identified in issue 4.2) in the selected countries.

Comparison

- 4.9 The comparative evaluation of the extent of interaction (if any) in New Zealand and in the selected countries. Resourcing for, and the administration and implementation of, mining law and practice in the selected countries; and the comparison to New Zealand.

International

- 4.10 The identification of the regulatory agencies responsible for the administration and implementation of the laws and recognised practices that apply to mining and to mining land in the selected countries.
- 4.11 The nature and extent of the resources provided to the agencies in the selected countries.
- 4.12 The organisational structures of the agencies in the selected countries, including the lines of responsibility and accountability, delegations and the job descriptions and performance agreements of relevant personnel.
- 4.13 The operational methods of the agencies in the selected countries, including how those agencies administer laws and practices, their strategies, priority setting, outcomes, outputs, performance measures, resource allocations, work programmes, risk management, internal audit and self review, internal reporting and external reporting systems.

Comparison

- 4.14 The comparative evaluation of the resourcing provided, and administration and implementation practices, in New Zealand and in the selected countries.

Policy phase questions

Mining regulation and recognised practices

Comparators

1. The commission is minded to use the Western Australia, New South Wales and Queensland regulatory structures (including the National Mine Safety Framework established by a steering group on behalf of the Standing Council on Energy and Resources) to provide a comparison for the regulation of the New Zealand underground coal mining industry ('mining industry'). Nonetheless, are there other countries or states which should also be used as comparators?
2. What are the significant features or principles of these overseas regulatory structures that worthy of consideration?
3. Are there particular features of the New Zealand mining environment and industry that need to be taken into account in making a comparative evaluation against overseas regimes?

The nature and form of regulatory arrangements

4. Aside from the Health and Safety in Employment Act 1992 (HSEA), what additional regulatory arrangements are needed in relation to the mining industry?
5. With reference to the form of the mining industry regulatory arrangements,
 - (a) At what level, and when, is prescriptive regulation appropriate?
 - (b) What type of regulatory arrangements (regulations, approved codes of practice, codes of practice and industry standards) are most appropriate?
 - (c) Should a 'safety case' requirement or components thereof be included as an aspect of the mining industry regulatory arrangements?
 - (d) If so, what form of requirement is appropriate and should the safety case be subject to review, or approval, by the regulator or an independent third party?
6. Do the employee participation provisions in Part 2A of the HSEA require improvement and, if so, in what respects?

The establishment of regulatory arrangements

7. Who should have primary responsibility for establishing and updating the mining industry regulatory arrangements for:
 - (a) occupational H&S; and
 - (b) prospecting, exploration and mining permits?
8. Accepting the need for tripartite involvement, which bodies or individuals should participate in the drafting and review of the mining industry regulatory arrangements, and how can this best be achieved?
9. Generally, would there be advantages in greater co-operation, co-ordination and sharing of expertise with Australia and its states in relation to the regulation of the mining industry? If so, how might a closer relationship be achieved? Would there be any disadvantages?

The interaction between mining regulation and recognised practices and other (including conservation and environmental) legal requirements.

1. How do overseas jurisdictions manage the interface between mining and other legal requirements (including conservation and environmental) with reference to:
 - (a) the permitting of prospecting, exploration and mining activity; and
 - (b) occupational safety and health?
2. Should applicants for prospecting, exploration and mining permits be assessed as to their capacity (financial, managerial and technical) to develop the mine proposal and to do so in a safe manner?
3. If so, how should this assessment be carried out, by whom and should there be a sharing of information between regulators?

The resourcing and administration of the regulators of mining law and practice

1. Are there overseas jurisdictions, other than those used for the mining regulation and recognised practices comparison, which should be used in the comparative assessment of the New Zealand regulator? What are the significant features of these overseas regulatory agencies?
2. Is the concept of a High Hazards Unit announced in August 2011 to provide H&S regulatory services to the extractives, geothermal and petroleum sectors supported? Are there views concerning:
 - (a) the funding of the unit;
 - (b) the organisational structure (copy annexed); and
 - (c) any other aspects of this development?
3. What are the required features of a modern and effective regulator of the New Zealand mining industry including its:
 - (a) position or situation (unit in a department, standalone etc);
 - (b) organisational structure, personnel, technical expertise and training;
 - (c) financial resourcing and the source of such funding;
 - (d) key relationships with the industry, unions, employees, contractors, industry associations and overseas agencies;
 - (e) operational role (balance between advice, compliance and enforcement) and operational methods;
 - (f) policy role and responsibilities; and
 - (g) involvement in search, rescue and recovery operations?

APPENDIX 8

Deputies reports on methane – extracts

CAC014517

Instances of methane recorded in "CH610 Aux Fan Shaft methane" graphs, Deputy Statutory Reports and Deputies Production Reports (30 September to 19 November 2010)

Date	"CH610 Aux Fan Shaft methane" graph readings (CAC0112 & CAC0112B) No peaks over 1.25%	Deputy Statutory Report (CAC0115 & CAC0115A)			Deputies Production Report Comments (CAC0116 & CAC0116A)
		Actions taken regarding deviations from face checklist	Flammable Gas in general body of air	Action taken for detection of flammable gas above allowable limits	
19/11/2010			Day: 3.5 % in area 1 West 2R C hdg DAO.001.02943	Day: layering outby of Roadheader keep venturis on to disperse CH ₄ DAO.001.02944	Day - B (B hdg): Gas trip. High CH ₄ - gas bag in lower drainage hole Gas trip (approx 10am -11am) Gas trip - High CH ₄ - hard to move Elect to recal - waiting for gas to arrive Recal ABM - power up machine & complete mega bolts (approx 11am -12.15 pm) Cutting - continuous CH ₄ Trips move blower to floor CH ₄ seems to be coming from floor. Megabolting. DAO.001.02568
18/11/2010	No peaks over 1.25%				Back - C (C HDG): Tripped on CH ₄ Had to wait for elect to come to fix it DAO.001.02565
17/11/2010	~5.25pm: over 1.25% CAC0112B/21	N/S: >1.0% in area B west DAO.001.02938		N/S: CH ₄ layering in roadway (RH) DAO.001.02940	
16/11/2010	No peaks over 1.25%		A/S: >+ % in area B west DAO.001.02926	Day: Bad layering out by of Roadheader +5% in roof cavities put up 2 venturis to disperse gas, leaking from top stand pipes DAO.001.02930/2	Day - B (Rh A heading): [approx 10:15] cutter head continuously tripping on CH ₄ [approx 1:30] gas problems from in seam boreholes DAO.001.02558
15/11/2010	~10.25am: over 1.25% ~11.25pm: over 1.25% CAC0112B/19		Day: +5 % in area A hdg + B hdg DAO.001.02914		A - C (not stated): High CH ₄ in cavities in road Install lime brattice High CH ₄ in cavities DAO.001.02559
14/11/2010	No peaks over 1.25%		D/S: >1.25 % in area North 1 west DAO.001.02911	D/S: ventilation very poor, u/manager and I at 12.30pm removed half the brattice from temp regulator at 3 C/T and rendered all gasses harmless (P1B1 monitor panel & North & West) DAO.001.02911	
13/11/2010	No peaks over 1.25%				

CAC0145/8

Instances of methane recorded in "CH610 Aux Fan Shaft methane" graphs, Deputy Statutory Reports and Deputies Production Reports (30 September to 19 November 2010)

Date	"CH610 Aux Fan Shaft methane" graph readings (CAC0112 & CAC0112B)	Deputy Statutory Report (CAC0115 & CAC0115A)			Deputies Production Report Comments (CAC0116 & CAC0116A)
		Actions taken regarding deviations from face checklist	Flammable Gas in general body of air	Action taken for detection of flammable gas above allowable limits	
12/11/2010	~00:30am: over 2.5% ~1.15pm: over 2.5% ~9.50pm: over 1.25% CAC0112B/16	D/S: Headings in north gassing out due to poor ventilation, repaired stoppings & regulated a bit less air through monitor panel had 30 m ³ /s now 22m ³ /s DAO.001.02907/2		D/S: CH6/W1 found gassed out - no roaded heading until fans are set up and running again DAO.001.02907/2	
				Back: A heading north B heading north no roaded. Gassed out. These headings were taking too much air when the Aux fans were turned off could not fit ABM or CM because of CH ₄ levels were too high so I took down the brattice leads and let the places gas out. CO reading taken in bleeder road A=21m ² V=1.4m/s, CO ppm 0 DAO.001.02910	
11/11/2010	No peaks over 1.25%		Day: 1.5+% in area A north DAO.001.02900	Day: Had fan trip Couldn't power up fan Rob Duncan fixed problem at DCB with the aid of mx4 gas detector degassed heading following pike river SOP use CM fan to degas as A heading holded through. Blanket end open by gurgler to give full suction. Kept air flow going. DAO.001.02900	Day - A (West AHD6): [approx 1:00] fan trip degas [approx 2:45] fan trip degas DAO.001.02546
				Back: Valley Longwall free venting high levels of CH ₄ through their gas drainage manifold on arrival this valve should have been turned off before those guys left their rig. Layering out by of roadheader venturi to disperse. DAO.001.02903	Back - B (A Hdg): Arrive face - Elec to purge ABM CH ₄ high - working to improve ventilation. Blower fan sending .8% CH ₄ from 6 cut thru Shut blower off CH ₄ down Enclosure purged & machine ready to cut DAO.001.02548
			N/S: 2.0% in area VLD Stub DAO.001.02905		B/S/B (A Hdg): cutting - high gas tripping head no water - pipe busted, recalibrate CH ₄ sensor, set airmove up back bye DAO.001.02549

CAC0145/9

Instances of methane recorded in "CH610 Aux Fan Shaft methane" graphs, Deputy Statutory Reports and Deputies Production Reports (30 September to 19 November 2010)

Date	"CH610 Aux Fan Shaft methane" graph readings (CAC0112 & CAC0112B) No peaks over 1.25%	Deputy Statutory Report (CAC0115 & CAC0115A)			Deputies Production Report Comments (CAC0116 & CAC0116A)
		Actions taken regarding deviations from face checklist	Flammable Gas in general body of air	Action taken for detection of flammable gas above allowable limits Specific safety issues	
10/11/2010	No peaks over 1.25%		<p>Afternoon: +2% CH₄ Ahdg 1west 2R DAO.001.02896</p> <p>Back: +5% in area A heading DAO.001.02897</p> <p>N/S: 1.5% in area A heading north DAO.001.02899</p> <p>Day: 1.3% in area Aheadng DAO.001.02888</p>	<p>Afternoon: General body of air in last through road varies between 0.8% and 1.1% CH₄. Gas from drill stub3 (Valley Longwall) and A heading is passed onto ABM. Leakage on gas drainage line in Ahdg1West2R adding to gas problems in heading. Minimized gas leakage around standpipe with rags and wooden wedges. DAO.001.02896</p> <p>Back: 2 boreholes in face in roader header place top hole making gas put 7 gas bags in in hole gas flow dropped slightly DAO.001.02897</p>	<p>B/S - B (A Hdg): [approx 6:15] power out; degassing cutting gas issues keeps tripping head installing gas bags recalibrate gas sensors DAO.001.02543</p> <p>Night - C (A Hdg): To much CH₄ at ABM Elect tested CH₄ on ABM sensor CH₄ is about .8 DAO.001.02545</p>
9/11/2010	No peaks over 1.25%			<p>Afternoon: Inspection at monitor 0.2% CH₄ DAO.001.02889</p>	<p>Back - B (A hdg): Ready to cut CH4 high/trip - unable to clear Move blower close to face Unable to clear CH4 [approx 6:30] - main fan off - power off - men to fresh air [approx 7] fans running Hdg degassed Enter Hdg CH4 still too high to start up Waiting to recalibrate ABM Gas guard fault High CH4 [approx 8:00 to EOS] DAO.001.02537</p>
			<p>N/S: 1.5% in area A-B xc North DAO.001.02891</p>		
8/11/2010	No peaks over 1.25%	<p>Day: Sparky had to recalibrate sensors DAO.001.02877</p>	<p>Day: gas holes leaking got it down to 0.7 - 1% after working on stone pipes (A Heading) DAO.001.02877</p> <p>afternoon: Continue to block gas drainage lines dilute gas to pick up [illegible] to degass face - install typhoon fan DAO.001.02884</p>	<p>Back: ABM gassed out at SOS due to borehole interesection (North/South) DAO.001.02883</p>	<p>Back - B (1Hdg 1 West): Assess gas drainage holes - reseal holes Shut off forcing fan - CH₄ lower => power up ABM raise head CH₄ workable. Electrician to recal gas guard - gear outside [approx 5:45 - 8:15] continuous CH₄ trips ABM pass CH₄ drainholes CH₄ - head and general body is now ok DAO.001.02528</p>

CAC0145/10

Instances of methane recorded in "CH610 Aux Fan Shaft methane" graphs, Deputy Statutory Reports and Deputies Production Reports (30 September to 19 November 2010)

Date	"CH610 Aux Fan Shaft methane" graph readings (CAC0112 & CAC0112B) No peaks over 1.25%	Deputy Statutory Report (CAC0115 & CAC0115A)			Deputies Production Report Comments (CAC0116 & CAC0116A)
		Actions taken regarding deviations from face checklist	Flammable Gas in general body of air	Action taken for detection of flammable gas above allowable limits	
7/11/2010	No peaks over 1.25%				
6/11/2010	No peaks over 1.25%	D/S: 1.9% in area ABM DAO.001.02872	D/S: Stub has been left at present. Ventilation changes & blocking of exposed bore holes needed. 0.2% CH ₄ in roadway behind ABM DAO.001.02872		
5/11/2010	No peaks over 1.25%	D/S: 5% in area A heading face (ABM) DAO.001.02867	D/S: intersected boreholes, ran bull hoses to gas drainage line set up typhoon fan and venture fan and plugged holes for next shift. DAO.001.02867		Day - C (A): NO PRODUCTION - ran out bull Hoses for gas drainage to gas line. Night shift had hit gas hole at face. Put up vent tubes behind ABM. Stone dusted face. High CH ₄ , Supplied ABM up. Deputy and Chris stayed with ABM Getting the gas down from borehole. The rest of us went to roadheader. Chris put up and air fan at face DAO.001.02520
4/11/2010	~1.30pm: 2.5% CAC0112B/8	Night: 1.5% in area A heading stub DAO.001.02863	Backshift: high gas levels as gas holes exposed (A heading west ABM Panel 2) DAO.001.02869	Backshift: We are in a heading with gas holes exposed from nightshift we are on backshift why was RH place being run instead of ABM place to get gas under control (Day Shift). Why didn't we cut A Heading Road way instead of D52 so valley longwall could have used this as a drill stub and then we wouldn't have to cut through these gas hole put me and my men at risk working in [illegible] to keep gas clear to cut and expose hole more (A heading west ABM Panel 2) DAO.001.02869	Night - B (not noted): gas trip DAO.001.02516 Night/B (Rh001): cutter head tripping out on CH ₄ , extended vent cans DAO.001.02518 not noted (A6-B6): [between approx 1.30 - 3.15] 3 gas trips recorded DAO.001.02504 [this record is undated but there is a note reading 3 Nov days/shift?]
3/11/2010	No peaks over 1.25%				
2/11/2010	No peaks over 1.25%				A - A (A/hdg): 4:30 gas guard trip on R/H continue to pump face out DAO.001.02501

CAC0145/11

Instances of methane recorded in "CH610 Aux Fan Shaft methane" graphs, Deputy Statutory Reports and Deputies Production Reports (30 September to 19 November 2010)

Date	"CH610 Aux Fan Shaft methane" graph readings (CAC0112 & CAC0112B) No peaks over 1.25%	Deputy Statutory Report (CAC0115 & CAC0115A)			Deputies Production Report Comments (CAC0116 & CAC0116A)
		Actions taken regarding deviations from face checklist	Flammable Gas in general body of air	Action taken for detection of flammable gas above allowable limits	
1/11/2010			Night: 1.3% in area drill stub 3' +5% in area A1B1XC DAO.001.02846	Night: regular inspection using ITX gas detector, poor ventilation in D53 all air going to ABM. A1B1 gassed out loaders blocking air coal stowage [checking or choking?] air cannot circulate. DAO.001.02846	

