Lessons from Pike River – Part 1

In this edition of *The Legal Lounge* I summarise the findings of the Royal Commission of Inquiry on the tragic accident at the Pike River Coal Mine, which occurred on Friday 19 November 2010, and claimed the lives of 29 men. While not an aviation related accident, the findings detail a myriad of safety and management failures, and regulatory gaps, that cumulatively lead to what was otherwise a preventable accident. In this respect it provides a point of comparison, and basis upon which to draw lessons, that may be applied in the aviation context.

What happened

On Friday 19 November 2010 at 3.45pm there was an underground explosion at the Pike River Coal mine. Two men who were in the stone access tunnel (the drift) to the mine were initially overcome, but recovered and were able to escape the mine. The Commission was satisfied that the 29 men who were in the pit bottom area of the mine died either immediately from the blast, or shortly afterwards from the toxic atmosphere. Subsequent blasts removed any remaining hope of a rescue operation. To date the bodies have not been recovered from the mine, which remains sealed.

Why it happened

Immediate cause

The immediate cause of the tragedy was a large methane explosion. Methane is found naturally in coal, but is explosive only when diluted to within the range of 5 to 15% in volume of air.

While the Commission acknowledged that a number of potential ignition sources could have sparked the explosion, it concluded that there was a failure to properly manage methane levels and control methane in the mine, and that this and other systemic issues ultimately lead to what was otherwise a preventable accident.

Underlying causes and contributing factors

When tracing through the Royal Commission report findings in a chronological order, the following picture emerges:

1. Deficient Regulatory Approvals process

- Between 1992 – 2005, Pike River Coal Company Ltd explored and then acquired the necessary authorisations for the mine, including a mining permit, an access arrangement and resource consents
- The Department of Conservation and local government authorities properly carried out their functions in granting resource consents and access arrangements to the land, but had no mandate to consider mine health and safety management issues
- The Ministry of Economic Development issued the mining permit in 1997. In doing so its primary focus was on the economic benefits to New Zealand.

- MED did not fully apply the criteria set out in its coal policy programme, which included requirements to check the experience of the applicant and its proposed mining methods, to ensure these represented good mining practice.

- The MED did not specifically consider health and safety implications as part of the permit process, and did not liaise with the Department of Labour on this aspect.

The combined effect of this was that no regulatory agency looked at the health and safety implications of the proposed mine before the green light was given to proceed.

The Commission noted that under the previous legislative regime in existence prior to 1992, a specialist coal mine inspectorate administered all aspects of mining, from reviewing applications for exploration and mining licences, and inspecting the mine once it was developed. It therefore had a hand in the safety of the mine from its inception, and one which would have been all encompassing.

It is apparent that the separation of the functions among the various agencies under the new model had allowed a significant regulatory gap to emerge, in which mine safety management procedures were not required to be assessed prior to government approval for mining activities to commence.

2. Mine development - inexperienced and under resourced

In 2005 the Pike board management decided to proceed with development of an underground mine (open cast mining was considered uneconomic). The previous owner NZOG sold down its controlling interest through an initial public share allocation of $85 million to fund development costs. Development costs were initially estimated at $124 million, but the company anticipated that it would be producing a million tonnes of coal per annum by 2008.

The mine consisted of two mine infrastructure areas at pit bottom south and pit bottom stone, joined at a junction by a drift (2.3km tunnel), with two surface-to-mine shafts nearby – the main ventilation shaft, and the slimline shaft, at the bottom of which was a so-called fresh air base.

However, the company's research and knowledge of the geology prior to development was poor, which significantly hindered development of the mine. In particular, the existence of a downthrust between faults, called a graben, which created a zone of sandstone instead of coal, significantly slowed construction of the drift and mine access roadways to the junction point. The bottom section of the main ventilation shaft also collapsed during construction and a bypass had to be built to reconnect to the upper part of the shaft. The first coal sales were delayed until 2010 as a result, and the mine had netted only 42,000 tonnes by the time of the accident.

Development costs had also skyrocketed, with Pike raising further capital of $140 million from shareholders in 2010. It was seeking a further $70 million at the time of the accident, and had borrowed $66million from NZOG.

The Commission noted that in November 2010 Pike was still in start-up mode and considerably behind development schedule, and now under considerable financial pressure to raise coal production.

3. Mine management and culture problems

There were constant management changes at Pike over the years. This included six mine managers in the 26 months before the explosion, as well as significant change in other management positions. Throughout 2010 senior management at the mine, and the Board, were heavily focused on developing and commencing hydro coal production, which was an uncommon and highly specialised mining method, but was expected to net much greater and faster returns. However, associated risks were not properly assessed and the Commission found that clear signs of the increased risk of an explosion were either not noticed or not responded to. Concerns raised by some staff and contractors about rising methane levels, or other problems in the mine, appeared to have been largely ignored by executive management.

The workforce was also characterised as comprising of a high level of inexperienced and diverse staff, some with inadequate on-going training; lax control of health and safety management of contractors; and a culture of workers bypassing safety devices on mining machinery so work could continue regardless of the presence of methane.

4. Inadequate ventilation and methane management systems

An effective mine ventilation system is essential to enable fresh air intake into the working areas of the mine and the return of foul air out of the mine; and to ensure that the air flow is guided in a way that prevents the mixing of intake and return air.

A decision by Pike management to place the main ventilation fan underground at the bottom of the ventilation shaft had never been done before, and was found to be a major error. The Commission found that the executive management and board failed to adequately assess the risks, and that, despite opposition from a ventilation consultant and some staff, the decision was not reviewed.

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

The system to manage methane levels in the mine was also seriously deficient. Methane levels were managed through the ventilation system, and some pre-drainage of the coal seam from in-seam boreholes. However, the boreholes were primarily to map the limits of the coal seam and were not designed for pre-drainage. A gas pipeline was installed to vent methane from the boreholes to the surface. By April 2010 the pipeline could not cope, and after serious concerns were raised, gas consultants were engaged and advised that the pipeline required urgent upgrading. As a stopgap measure methane was 'free vented' into the mine's return airway to be handled by the ventilation system. The upgrade of the pipeline was put on hold, and free venting of large volumes of methane continued up to the time of the explosion. Free venting is no longer recognised as normal practice in underground mines.

Fixed sensors that reported methane levels to the control room were too few, and many were not well situated. Key sensors were also broken at the time of the explosion or were unable to reliably detect methane levels. No fixed sensors were reporting to the surface from the bottom pit areas of the mine. However hand held detectors were also used, and readings noted in shift reports.

Methane sensors attached to machinery were generally well maintained, and calibrated to trip power at a set methane level. Constant tripping on some machines led to the bypassing of sensors by some workers.

Notwithstanding its limitations, the monitoring system showed there were serious methane management problems. After hydro mining began in September 2010, high readings – many dangerously high – were recorded most days. Hydro mining uses a water jet to cut the coal face and requires expert design of the mining panel and equipment. Operators must be trained to follow a set cutting sequence and to direct the water jet to avoid the undue disturbance and release of methane. Despite teething problems in September 2010, including sections of the roof in the mine goaf (the cavity behind the longwall) collapsing, and despite being advised that the risk of a major roof collapse could not be excluded, a decision was made to extend the width of the extraction area in October 2010 by 50 per cent. On 30 October a significant roof collapse did occur, causing a pressure wave that took out the stopping in the hydro cross-cut intended to separate intake and return air. Hydro mining continued into November without the reassessment of the risk of further roof falls in the goaf. Spikes in the methane levels continued to be recorded in the weeks leading up to the explosion. This information was not properly assessed and the response to increased warning signs of an explosion risk was inadequate.

5. Other possible factors

Underground mines are required to have a restricted zone where all electrical equipment must be incapable of sparking an explosion. While the mine was strictly compliant, unprotected electrical equipment was located immediately on the right hand side of the restricted zone line in most of the bottom pit south working area. Investigations are continuing into whether this, or another electrical cause or machinery failure could have initiated the explosion, but answers will depend on gaining entry to the mine.

The Commission also highlighted a number of concerns about the lack of adequate regulatory oversight, and inadequate mining regulations, which will be discussed in the next edition of *The Legal Lounge.* I will also summarise the key recommendations of the Royal Commission, which may potentially have broader implications, including for the aviation industry.

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