Case study: Gas explosions at Pike River coal mine – New Zealand

Initial conditions: The Pike River coal mine is located 46 km NNE of Greymouth on the west coast of South Island, New Zealand. The surface installation and infrastructure was largely complete and had earned an environmental protection award for its sensitive design and implementation (Figure 1).

Figure 1. Surface installations reflect the environmental sensitivity of the area with buildings merging into the forest

The situation underground was in complete contrast to the surface conditions. Underground mining conditions were difficult, primarily due to unexpected geological conditions resulting in serious mine development delays.

There was pressure for premature coal production. Costs had risen above expectations and financial reserves were dwindling rapidly. In order to generate much needed revenue, a production face was developed and trial coal production started; a hydraulic method of mining was being employed. A main fan was installed underground near to an upcast shaft. The shaft had suffered stability problems and was inadequate as a second means of egress for men in the event of an underground emergency. The only viable entry and exit route for the miners was via a 3 km drift.

Gas had not been considered as a potential hazard. During exploration and development no systematic data had been obtained on the gas bearing and emission characteristics of the coal deposit. Only when

gas became a problem was a cursory attempt made at control. Furthermore, electrical equipment in part of the underground mine was not designed and installed to comply with mine explosion protection standards.

Corporate responsibility for occupational health and safety was lacking. The Board of Directors took no active part in health and safety management, deferring to the mine manager on all operational and safety matters. Although there was a safety manager and a safety committee at the mine, both were ineffective. An external study was commissioned which highlighted major safety issues but neither the owners nor the mine manager acted to address any of the safety matters raised. Gas concentrations within the explosive range had been detected on numerous occasions but no action was taken. Due to unprofessional management, staff turnover was high, leaving unexperienced staff and contractors in charge of underground conditions.

The regulatory system had been reformed removing previous stringent, independent oversight of health and safety at mines throughout the country. The government had restructured its mines inspectorate placing greater reliance on mine management to self-regulate their activities. A combination of a high workload and too few qualified mine inspectors meant that underground visits were rare and regulatory enforcement poor.

The problem: On 19 November 2010 an explosion occurred. In the ensuing days, three further explosions and a fire occurred (Figure 2) before the mine atmosphere was made inert and the mine sealed. 29 miners were killed.

Figure 2. Fire at the upcast shaft following the third explosion

The explosion was not immediately detected at the surface, as alarms in the control room were ignored and the emergency services were not called until 40 minutes later. Two survivors emerged at the surface 101 minutes after the event and there was no one there to meet them.

The Police were responsible for the emergency response but had no mining experience. No emergency drills had been carried out at the mine and there was a lack of data from underground to allow the situation to be properly assessed. As the underground risks could not be established, the Mines Rescue Service was not permitted to enter the mine.

Families of the miners and the community were devastated by the loss. The community was very supportive of the affected families but lack of action by the authorities caused annoyance and frustration. The families campaigned for the mine to be re-entered when safe, to recover the bodies of their loved ones. Although mining experts who were providing technical advice to the families believed safe re-entry was feasible, the national mining company to which the mine was eventually entrusted following the collapse of the Pike River Coal Ltd declined to proceed.

The solution: A solution was required to ensure such a tragedy would not be repeated. Root causes lay beyond the mechanics of what happened in the mine.

A Royal Commission was established to determine and report on the cause of the explosions and loss of life, the effectiveness of search, rescue and recovery and the adequacy of the law and its implementation.

The Commission considered that the management of the incident was far from satisfactory due to:

- Slow initial response by mine management in confirming and reporting the explosion.
- Emergency procedures were neither substantive nor rehearsed.
- Police were responsible for incident control but were unprepared and unqualified to manage.
- In the absence of expert leadership and coordination no attempt could be made to safely enter the mine.
- Families of victims were ill-informed and frustrated by lack of action on recovering the bodies.

There were several possible direct causes of the explosions due to a wide range of possible gas emission and accumulation scenarios combined with the potential ignition sources including unprotected electrical equipment. Contributory factors which allowed the hazardous working environment to develop unchecked included:

- Financial difficulties due to delays in the development of the mine arising because of geological problems, leading to a call for production revenue prior to completion of the mine infrastructure and proper addressing of safety issues.
- Inadequate ventilation and gas drainage.
- Lack of experienced staff underground.
- No effective worker participation in health and safety.
- No management action despite repeated high gas concentration warnings.
- Ineffective corporate oversight of health and safety.
- Ineffective government mine safety legislation and enforcement.

The Royal Commission published its report on 5 November 2012 in which 16 principal recommendations were made including:

- Significant changes to New Zealand's health and safety legislation, administration and enforcement were necessary.
- Corporate governance practices should be improved to better manage risks and monitor health and safety compliance within organisations.
- Mine managers should adopt best practice gas control (this UNECE document was cited).
- There should be worker participation in health and safety to provide an additional level of safeguard.

Lessons: The case study demonstrates the importance of having effective, goal-setting regulations supported by inspection and enforcement undertaken by experienced mining professionals. Mine management tasked with delivering production and revenue in challenging situations need an independent check. The responsibility for supervising occupational health and safety performance should start in the Boardroom.

The closure of the Pike River coal mine after the explosion and the failure of the business is a too vivid reminder that accidents are costly and that effective gas management is an absolute necessity in gassy coal mines.