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Mine safety and geophysics

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According to data from the International Energy Agency's and Energy Information Administration's Annual Energy Outlook 2006 and Projections to 2030, global coal consumption is approximately 5.2 billion tons per year and is projected to double by 2030. The coal is used for power generation, steel production, and, more recently, coal-to-liquids conversion. Currently, coal is the only fuel with adequate reserves and spare capacity to meet the world's growing energy demands. As a result, mining companies are operating at almost full capacity, and expansions are underway.

Of course, as companies increase production, the chances of accidents increase. On 6 August 2007, a mine "bump" occurred at the Crandall Canyon mine near Huntington, Utah; six miners were trapped or missing. A mine bump is a massive pillar failure with an explosive force resulting from tremendous overburden pressure from roof rocks. This mine bump registered 3.9 on the Richter scale. Seismologists with the USGS and the University of Utah concluded the event was the result of a mine collapse, not an earthquake. The rescue team found this bump was so intense it blew out some subsurface concrete walls more than a mile away.

Rib supports consisting of 40-ton rock props, chain-linked fence, and steel cables were installed to protect rescue workers. However, another bump occurred on 16 August 2007. Three rescue workers were killed and six injured.

On 5 September 2007, a U.S. Senate committee convened to investigate the accident and discuss ways to prevent future tragedies. Four distinguished figures within the mining industry testified: Richard Stickler, Assistant Secretary, Mine Safety and Health Administration, U.S. Department of Labor; Cecil Roberts, President, United Mine Workers of America; Bruce Watzman, Vice President, Safety and Health, National Mining Association; and J. Davitt McAteer, Vice President, Wheeling Jesuit University – National Technology Transfer Center.

Stickler described the sequence of events, as well as surface and underground attempts to rescue the trapped miners. He also provided a historical background of the mine, including MSHA inspections. He described the retreat mining or pillar extraction method employed and stressed that MSHA had complied with the MINER Act of 2006.

Roberts was firm in his belief that the disaster began on June 3, not August 6, as this was the date the new mine operator submitted a mining plan permit to engage in retreat mining or pillar extraction. Likewise, he believed MSHA's best chance to rescue the miners was not August 6 or 7, but on June 15 when the agency approved the new mining plan. Roberts emphasized that MSHA fell short of complying with the new MINER Act.

Watzman described the challenges the industry faces in response to the MINER act. The NMA solicited feedback from academia, government, industry, and the UMWA to develop a blueprint for achieving zero serious injuries in U.S. coal mines. Measures were underway to improve monitoring, install underground shelters stocked with key supplies, and conduct more safety training.

McAteer, a former Assistant Secretary of Labor, MSHA, has investigated several major mine disasters since 1968 and is noted for his emphasis on prevention and emergency response. McAteer was the only person who recommended the deployment of remote-sensing seismic technologies in deep underground mines susceptible to rock burst or bumps. His testimony included the presentation of a portable seismograph.

Figure 1. *Massive roof fall demonstrates some of the perils in underground working conditions. Mine inspector shows the scale of the problem. (Courtesy from MSHA).*

It is disturbing that only one of the panelists mentioned geophysics, although McAteer cited examples from other countries where the seismic method was being used to monitor microseismic activity in deep mines. It could also be used to detect trapped miners when the seismic energy is strong enough to be detected by near-surface geophones.

It is time to re-examine the role of applied geophysics in mine safety. For one thing, it is good business. According to one estimate, when a longwall mine is shut down, it costs an average of US $1 million per day. Profit margins of most coal companies are small; thus, problems from unexpected subsurface geology, old mine workings, or equipment failure could easily make or break any coal company.

However, there is a more important role that geophysics can play. Some major risks can be more accurately assessed, and lives saved, if innovative, remote-sensing geophysical technologies are properly employed.

Presently, China and the U.S. consume the most coal, with respective annual production and consumption tonnages of approximately 2.0 and 1.1 billion. By 2030, China is projected to consume about 5 billion tons per year. This country plans to build 540 or more coal-fired power plants to meet its domestic energy needs. Currently, the U.S. has about 151 new conventional coal-fired power plants in various stages of development. Coal production is anticipated to reach 1.8 billion tons per year sometime in the next generation. Given that both countries have coal reserves estimated at 200-plus years, coal will continue to be a major factor in meeting their energy needs.

The increased mining activity is, it seems, likely to lead to additional mining tragedies unless innovative technologies—particularly geophysics—are adopted.

Suggested reading. The complete transcript of the 5 September 2007 hearing can be found at www.ussenate.gov. TLE

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