Kimberley Accident - Preliminary Technical Insights

Subsequent to the fatalities which occurred over May 15 - 17, 2006, Teck Cominco sought advice from academic experts at the University of British Columbia and from a technical consulting firm as to the potential underlying causes of the tragedy. Based on inspections of the No. 1 Shaft Waste Dump site, analyses of monitoring station air samples taken shortly after the tragedy and their knowledge of the complex reactions that can occur within covered waste dumps, both groups came to realize that the respiration or "breathing" of the covered dump through the drainage conveyance system to the monitoring station was a likely causal factor. This realization led to research recommendations from University of British Columbia (UBC) and a proposed program from the consulting firm that focused on a respiration phenomenon hypothesis. These recommendations are in the Chief Inspector's report on the accident as posted on the Ministry of Energy, Mines and Petroleum Resources (MEMPR) Website.

The immediate program of technical investigations was approved by the MEMPR and is ongoing. It is being assessed and guided by a technical review committee that consists of independent experts from UBC, staff from both the MEMPR and Teck Cominco and their respective technical advisors. The technical program will continue for some time before definitive conclusions on the causal factors can be made, and industry-wide recommendations for preventative measures can be developed. In the meantime, the committee has prepared this preliminary statement to outline the technical circumstances concerning the accident and the working hypothesis in the continuing investigation.

1. It has not been common practice to monitor air emissions from waste dumps. Measurements of air quality within waste dumps have been made but only for the purpose of investigating the geochemical behaviour of dumps, and not from the context of safety. Those investigations have confirmed the presence of very low oxygen atmospheres within other mine waste rock dumps. However, such internal atmospheres had not been identified as a health and safety risk.

2. The design of the dump cover and of the collection system for drainage flowing from within the dump at Kimberley was done according to current best practices under which the volume of contaminated drainage collected and subsequently conveyed for treatment is minimized. This entails the diversion of surface run-off and/or uncontaminated flows away from the collection system.

3. Drainage effluent monitoring facilities such as that at the No. 1 Shaft Waste Dump are common in the industry world-wide. They serve the purpose of monitoring effluent drainage quality and flow collected from within the waste dump. In the case of the facility at issue, it was enclosed in a shed to ensure year-around monitoring reliability in light of local climatic conditions.

4. The effluent monitoring station had been in use for five years or more without incident and, in fact, was entered by mine personnel the week before the events in question which began on May 15.

5. Air emissions from waste dumps have not been identified as a risk and the air quality in the flow through the collection pipe in the covered drainage channel that connects the

waste dump to the monitoring station was not measured. There was no warning that the air was depleted of oxygen.

6. The following mechanisms and sequences have been proposed to outline the technical circumstances of the events that took place during the period May 15 - 17:

    a. A reclamation program was implemented during 2004 and 2005 with the intention to seal the dump from surface water flows in order to minimize the amount of water contaminated from contact with exposed sulphide mineral surfaces within the dump.

    b. Part of this program involved extending the toe of the dump about 70 metres over the drainage channel that ran along the front of the dump in order to recontour the slope of the dump in preparation for the placement of a soil cover and successful revegetation.

    c. This combination of sealing the dump from water infiltration together with the covering of the drainage channel created unprecedented conditions in which deoxygenated air within the dump was directly connected to the monitoring station allowing entry of this hazardous air into the monitoring station. Essentially, what was previously a very safe situation was inadvertently converted into a dangerous one through the successful sealing of the dump together with the covering of the drainage channel.

    d. Beginning just prior to May 15 and continuing through much of that week, reduced barometric pressure and increased ambient temperature led to a relatively high flow rate of deoxygenated air from the dump into the monitoring station such that, even with the door of the shed fully open, extremely low levels of oxygen were maintained in the air at the floor and sump levels within the shed.

7. It is possible that the above set of conditions may exist elsewhere in the industry that until now have also gone unrecognized. Research is required to fully define the mechanisms of atmosphere movement from within the covered dump. This will be an important contribution to the understanding of other potentially similar risks in the industry. A new design method and operating procedure for these monitoring stations and other related facilities is required in order to eliminate the possibility of another similar accident in the future.

As noted at the outset, the research program on the respiration of the covered dump through the sampling station is ongoing and will be expanded with additional instrumentation to examine atmospheric and other conditions within the dump itself. To date, results are showing periods of outflow comparable to the conditions apparent immediately following the incident and other periods of air flow into the dump. Ambient temperature and atmospheric pressure appear to be factors influencing the direction and velocity of air flow, but the physical mechanisms by which those factors cause outflow have yet to be precisely defined. Generally, warm summer conditions result in outflow while colder temperatures normally lead to air flow into the dump. The investigations will continue under the guidance of the technical review committee until it is possible to be definitive about both the mechanisms involved at this site and the factors that might create similar conditions at other sites.