Vehicle Proximity System

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Problem

Heavy vehicle and light vehicle collisions are well known and studied hazards in underground mines. Numerous control mechanisms exist throughout the mining industry, however incidents continue to occur.

Factors, such as limited visibility from heavy vehicles and confined workplaces, contribute to situations in which it is likely that collisions will occur. Additionally, given the relative size differential between heavy and small vehicles, it is likely that collisions may go unnoticed by the operators of heavy vehicles, contributing to the consequences of the incident.

Higher risks occur when loading or trucking operations occur in the main decline or access ways of a Mine. For example;

- At main intersections in the Mine.
- When tramming material across a main haulage drive.
- On curving inclines.
- When there are multiple vehicles in a confined area of the Mine.

At the Pasminco Underground Mines, the importance of good traffic management was recognised and a number of control mechanisms exist. However, over a relatively short period during 1999 and 2000, the mines suffered a spate of serious vehicle related incidents. While there were no fatal accidents, the increased prevalence of these incidents warranted immediate action.

As a consequence of this, it was decided by the Executive General Manager of Mining, that a taskforce consisting of Managers, Supervisors and Operators, be established and given the directive of advising on ways to reduce the number of vehicle incidents that were occurring at the Underground Mines.

Solution

In identifying a "best practice" solution to this issue, a formal risk assessment was undertaken to identify the best means for better controlling the situation.

The taskforce identified three key areas of investigation:

- The standardisation of protection systems (such as vehicle lighting, strobes etc).
- Methods of enforcing the existing systems and procedures.
- The use of technology to provide a heavy vehicle proximity warning device.

While the standardisation of protection systems and the improvement in enforcement methods have been introduced, it is the use of technology to prevent collisions that is the focus of this presentation.

The "technological" solution described in this presentation is currently on extended trial at the Pasminco Broken Hill Mine.

Engineers from Tecom Australia Pty Ltd along with Engineers, Operators, Management and Training/Safety personnel of Pasminco's Broken Hill Mine, developed a system that provides a visual and audible warning, to the operator of a heavy vehicle, that a smaller vehicle is in its "vicinity".

Utilising RF active tag transmitters fitted to the smaller light vehicles, which emit at random intervals a unique ASCII coded message, we were able to establish an individual ID for the 100 vehicles (both Pasminco and Contractor) used in the underground environment. The random emission intervals greatly reduces the risk of RF data corruption due to conflicting signals from multiple tags within the defined read range of the system. The tags are permanently connected to the vehicle battery by a fused link with a current drain of approximately 2 milliamperes. This ensures that the vehicle can be read even if left parked and unattended in the Mine.

Two tag check stations were located within the Mine, one on 3 level where the light vehicles leave and re-enter the Mine, and one on 21 Level at the Fuel bay where all vehicles underground must return at some point. This enabled the operator of the light vehicle to establish his tag was functioning and would be registered by the heavy vehicle.

Two methods were adapted:

- A light was turned on at the 3 Level reader informing the driver that he had been read.
- A large digit display was use at 21 Level allowing the operator to read his own unique code number

The trial has shown that the digital display method has far more acceptance from the operators of the light vehicles due to its positive ID reading.

In fitting RF receivers and liquid crystal touch screens to the heavy vehicles (one LHD and two dump trucks) we were able to alert the operator to the presence of up to five light vehicles at a time within his workspace. The cabin mounted touch screen provides a visual warning to the operator of a light vehicle, but also individual vehicle ID's. This warning can be accepted (stopping the alert) or ignored, either way the vehicle ID remains on display until that vehicle has left the vicinity of the heavy vehicle.

Each heavy vehicle was also fitted with its own RF active tag; this established a self-check method for the heavy vehicles. Alerting the operators to the failure of the Vehicle Proximity system, which then would require immediate attention.

The receiving units fitted to the heavy vehicles also give us the ability to log data on-board and/or transmit this data over an existing radio network within the mine. This data provides information on when the light vehicle entered the work space, when the vehicle left the work space and when, if at all, the operator acknowledged the presence of the light vehicle.

From tests carried out in the underground environment we were able to establish reliable read ranges of up to 80 metres in a straight incline and up to 50 metres around corners. (A critical design requirement for Broken Hill due to numerous intersections within the mine).

Benefits

While the system is in final stages of its trial, the benefits are measured through the anecdotal comments of the operators who are using the system. Such comments include:

- "My biggest fear when bogging from a stope is running over someone and not knowing about it. This system lets me know when someone is around"
- "We know they are there before we see their lights"
- "This would have prevented most of the recent accidents that have occurred"

Although the system has been primarily installed for safety reasons, the components of the system are ideally suited to be used as an "on-board vehicle monitoring system" and interest has been shown by CAT to integrate this system into their engine management system.