Decline Warning Lights System

BHP Billiton – Cannington Mine

The Problem

The interaction of light and heavy vehicles has long been recognised as a principal hazard. In a dark underground hard rock mine, this hazard is magnified due to a lack of visibility. The inclusion of pedestrians and other workers in confined areas where haul vehicles and light vehicles interact adds additional potential for high consequence incidents.

Various controls Cannington Mine introduced to reduce risks from vehicle interactions underground had limitations. Controls like establishing communication between vehicles were prone to human error, and the mine layout meant that the headlights of mobile equipment were in very close proximity.

Changes to the mine's traffic management plan further minimised mobile equipment / light vehicle interaction in parts of the mine, but Cannington's mine design precluded implementation of engineering controls for the whole of the Mine's decline, therefore the potential for accidents remained.

The Solution

Electrical Technical Officer Jason Lindley believed that these existing controls did not deliver an acceptable level of risk, and began investigations into new controls.

The result is a Decline Warning Lights system, a concept where a set of lights, one red and one green, were installed on decline backs (the roof) at pre-determined intervals to alert light vehicles and pedestrians to the presence of mobile equipment. Transmitters were installed on heavy vehicles to activate the lights as they travel the decline. When a piece of mobile equipment is in operation, its transmitter will trigger red warning lights mounted on the decline backs within a 70-80 metre radius, as seen in figure 1 and 2 and in the supplied video clip. As the heavy vehicle moves out of range, the lights will change to green.

Jason and his team began by brainstorming, conducting desktop studies and web reviews of vendors' offerings and made detailed enquiries. Cannington Mine had previously trialled, or was in the process of trialling similar technologies from other vendors. Jason reviewed the project's key milestones, performance documentation and proposals received from vendors that had previously offered solutions.

The Decline Warning Lights system was developed using a robust product suitable for operating in an underground environment and a number of suppliers were used to develop the system. The system uses radio frequency from transmitters on vehicles, to receivers on the lights. A considerable adaption of technology and understanding of wireless frequencies was implemented to ensure effective operation in areas where signals could not be 'line of sight' and required a move to omni-directional transmitters. Technology however appeared to be the only solution for an early warning system that would prevent dangerous light vehicle / heavy vehicle interaction and which could warn pedestrians of approaching machinery.

The omni-directional radio frequency field propagated around the mobile equipment by the transmitter resulted in activation of warning lights as far behind the mobile equipment as in front. The production unit will be forward biased so that the radio frequency field will propagate further in the forward direction than behind the equipment.

Key milestones in the development of the system included:

- Preliminary research and development to identify robust materials that could be used in the simple design solution commenced in June 2010.
- A prototype was developed and trialled in a 500 metre section of the decline where visibility was especially poor.
- The trial ran for over four months and the prototype received a high degree of acceptance and compliance at the implementation stage. Since installation there have been no incident reports of near misses however it remains difficult to quantify incidents that may have been avoided due to the installation of warning lights.

More detailed acceptance testing and analysis will be performed after installation of the production system in the northern zone.

The prototype uses components that were assembled on site. The mine site is not set up as a high reliability soldering facility so minor problems are anticipated with the longevity of solder joints in the prototype version. A de-bounce circuit will be included, and has been specified for the production model to prevent the warning light flashing between red and green at the outer extremity of the sensitivity range. It was decided that a contract partner could best support the design implementation, and the Decline Warning Lights system was handed over to Cannington's contract partner for implementation.

Current planning is to partner with a vendor to produce a production version of the Decline Warning Lights and implement this in the Northern Zone Mining Block of Cannington Mine in Q3 2012. The Decline Warning Lights system seeks to control high potential risks and reduce occupational exposure to vehicle interaction incidents. It's an engineered early warning system that allows operators to avert potential impact. Previous controls were lower on the hierarchy of control.

Benefits/Effects

The project has resulted in the development of a successful prototype and trial, and has been partnered to a contract partner for development. The Decline Warning Lights system has benefited Cannington Mine in a variety of ways:

- The mine received positive feedback from the crews and early indications suggest that the system was well received. Previous collision avoidance system trials required the installation of new equipment in all underground vehicles. These previous trials generated a low acceptance level due to the audible nature of the warning systems, a lack of reliability in the underground environment and the need to fit all vehicles with transmitters/receivers.
- The system has minimised and prevented unnecessary interaction between mobile equipment, light vehicles and pedestrians as it's able to control the interaction between vehicles, mobile equipment and pedestrians.
- The system is an addition to current collision avoidance measures. While all systems are susceptible to human error, more controls assists in reducing incidents and injury to personnel and assets.
- It has reduced the risk of injury to personnel and damage to equipment and machinery.
- The system has allowed Cannington Mine to form a strong relationship with the contractor.
- The system has greatly supported and enhanced the approved site traffic management plan.
- Installation time was small in comparison to the usefulness in the mining environment.

The cost of the Decline Warning Lights system is estimated at $500,000. As the consequences of unplanned light vehicle and heavy vehicle interaction are almost always fatal, the system is considered a worthwhile investment especially as it protects pedestrian traffic as well.

Transferability

This system could be incorporated into underground hard rock mines, where vehicle interaction presents a risk to personnel and the business. It also has application to any surface operation where there is limited visibility or limited manoeuvrability and a risk of light vehicle / heavy vehicle interaction.

The mine identified issues surrounding collision avoidance and developed a system to support the traffic management plan, which also supports the goal to manage risk faced by employees, contractors and assets.

Innovations

Jason Lindley and his team undertook extensive research to find a system to control vehicle interaction, however there was no comparable product on the market for use in the mining industry.

The team was aware that they needed to come up with a completely new solution as past audible warning systems had a very poor acceptance amongst the workforce.

The Decline Warning Lights system was developed and implemented by the site personnel, and is an original creation that embraces the use of technology to protect lives in a dangerous underground environment.

Figure 1:
Red flashing light indicating the presence of a piece of mobile equipment

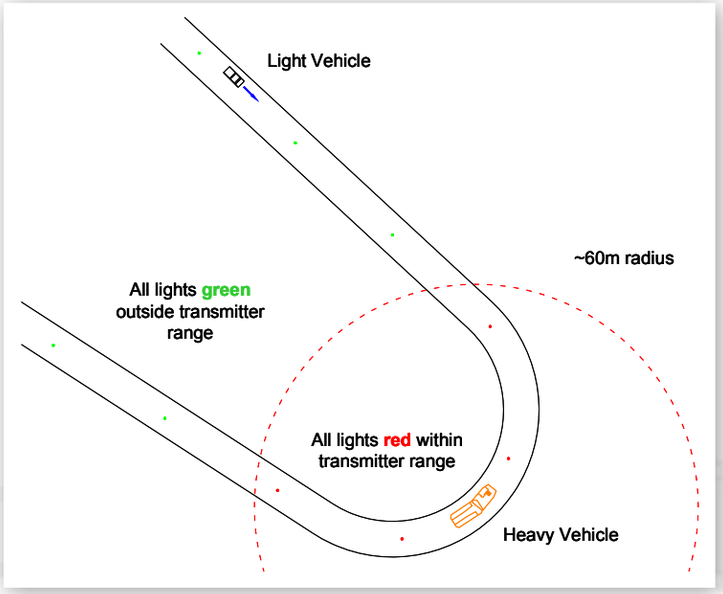

Figure 2:
System components