Integrated Underground Management Information Monitoring and Control System for Gold Mines in South Africa

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ABSTRACT

With the introduction of the new "Health and Safety Act" in South Africa, Information Systems and Resource Management will play a vital role in the successful implementation of risk identification and risk management to ensure "Prevention - Not Reaction". Large numbers of open pit mines use computer based production management information and control systems, however this cannot be said for underground mines. Advances in digital communications have allowed the development of such systems for underground operations. Consequently a fully integrated system was developed for gold mines in South Africa to monitor and control all production resources such as ore and waste, equipment, men and material. Two large South African gold mines are currently in the process of being equipped with fully integrated systems of which the underground communication infrastructure will cover more than 250 kilometers.

INTRODUCTION

The primary objective for the introduction of transport management systems in the South African deep hard rock mines (using underground rail transport) is to improve productivity and to create "break-through" cost savings which make the projects totally self-funding.

In addition to the system configuration (control centre, mobile and stationary field computer systems, driver consoles, communication infrastructure and tracking systems) this paper discusses a centralised transport management system in operation and attention is furthermore given to various productivity improvement and safety features.

SYSTEM CONFIGURATION

The system consists of the following main elements:

Control Centre with a central computer and attached data terminals to provide the Dispatcher with a variety of real-time system screens for monitoring and controlling the underground operation. The central computer analyses, stores and displays real-time information and allows communication with the loco drivers as well as dispatcher inter-action with the system.

Mobile Field Computer System mounted on the locos and consisting of a driver console and a hub. This sub system provides the communications interface between the locos, the loco operator, and the Driver Console, featuring a touch sensitive LCD screen. The Console is user programmable and can display any configuration of driver input keys and can operate in any language.

Mobile or Stationary Hub which contains all necessary on-board communications hardware, including a micro-processor control board, a data radio, a power supply, a packet radio and an RF tag reader.

Communication Infrastructure with two data and three voice channels.

Track-Tag Sub System consisting of RF transponder tags used at loading boxes, weigh bridges, tips and along haulage ways to locate and track the locos and RF tags installed in head lamps to locate and track men. In addition, this sub-system consists of tag readers mounted in mobile hubs for the locos or stationary hubs in the lamp room, shaft entrances, and at strategic places along haulage ways.

CENTRALISED TRANSPORT MANAGEMENT IN OPERATION

Every morning tramming and production staff meet and, according to the production plan and box priorities and train, box, and tip status, draw up a daily tramming schedule.

The Tramming Shift Boss enters his schedule on the terminal. The system immediately updates all data bases and automatically allocates trains to boxes on a priority basis.

Dispatchers operate the central computer and report to the tramming shift boss. Their primary function is to accept or reject exceptions and to communicate with the drivers.

The central computer automatically assigns trains during the shift. The dispatcher can override the system using different screens which run continuously for his viewing and interaction. Some of the screens available are:

Firstly, the **Transaction Screen** which displays in real-time all transactions and allows transactions to be viewed as they occur in the mine.

Secondly, an **Exception Screen** to display exceptions, such as downs and delays, which must be accepted or rejected by the dispatcher for the system to process or ignore the event.

Thirdly, the **Loco Route Screen;** a real-time, line graphics display that allows the dispatcher to continuously monitor the status and locations of all Ready, Delay, and Standby loco's.

Lastly, the **Master Keypad Screen,** used to access other programs; for example to generate reports and change data.

A few events can be used to demonstrate how the system and the operator help the Tramming Shift Boss to better manage the shift:

If a box is hanging, the system automatically assigns the train to one of the available boxes based on the priority list, thus minimising idle time.

Whenever a train Down occurs it appears on the exception screen, and the system generates a work order.

Shift change is time-window based. The system evaluates the feasibility of a round trip, based on average trip times, prior to making the assignment.

SYSTEM FEATURES

The system allows effective centralised rail transport management and embraces the following features:

Tracking; monitoring and control of trains; tracking of men, material and rock; automatic dispatching, monitoring and control of material cars; crew scheduling; driver access control; on-board signalling; loco speed control; operational maintenance tracking; automatic battery bay and scheduled maintenance assignments; underground attendance clocking; underground paper-less requisitioning; logging of all transactions; comprehensive reporting; worker shaft clearance; risk management and numerous other safety features.

CONCLUSION

The use by underground mines of computer-based mine management systems is a reality. Due to productivity improvements and savings, the implementation of such systems can be self-funding. Risk identification, risk management and safety in general will be enhanced to a large extent with the implementation of underground management systems.