From: Russell Breeding
Date: 2/1/2006
Subj.: Underground Mine Personnel Tracking System

In light of the recent mining accidents, a reliable method of tracking personnel and equipment is needed. Time is of the essence in a mining accident, as was evident in the recent accident at the Sago mine, operated by International Coal Group. Accurate location of personnel is critical, as is tracking their movements "real time" as they seek refuge from an accident area. The problem with tracking underground is radio navigation devices, such as GPS, do not function. Alternatives, such as sensor systems used in anti-theft systems, provide coverage limited to "tens of meters" for the best of the active RFID devices. There is no way to discern position ambiguity. This would, at best, be better than nothing.

The InSeT system utilizes MEMS inertial sensing technology for a battery operated personal tracker. The device is wearable, identifies the person to which it is assigned, transmits position of the wearer via wireless telemetry, and requires minimum attention from the wearer. The personal tracker transmits the position of the wearer with telemetry receivers located throughout the mine. This information is relayed to the monitor computer, which employs charting / tracking software to translate the position of the wearer's transmitter to a grid coordinate system location on the large screen monitor. The monitor system is located outside of the underground mine. An observer, looking at the grid, will see the movements of all active transmitters attached to the individuals operating in the mine, with the ability to zoom in on any selected area.

Inertial technology has been employed on nuclear submarines since the 1960s. Inertial navigation does not require any external inputs, i.e. radio navigation satellites or LORAN, and relies on the motion of the sensor to update the position. Recent developments in miniaturization of the inertial sensing components, micro processors and electronic components, and battery technology now make the possibility of a "wearable" device a reality.

The InSeT system is expandable as mining progresses, by the addition of telemetry receivers to the net. All devices and systems will conform to military specifications for operation in a harsh environment. All cables and connectors must conform, as well, to military specifications.

For further information, please contact:

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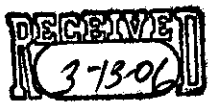
ATTACHMENT



DEPARTMENT OF LABOR
Mine Safety and Health Administration
30 CFR Part 49
RIN 1219-AB44

Underground Mine Rescue Equipment and Technology

AGENCY: Mine Safety and Health Administration (MSHA), Labor

ACTION: Request for information.

(Reference paragraph A.)

A. Rapid Deploy Systems

Rapid deploy systems are systems which are easily transportable for use in mine emergencies and which can be quickly set up to provide emergency service. An example would be a seismic sensing system for detecting movement underground, or an electromagnetic sensing system to detect signals transmitted by trapped miners. These systems may employ advanced technology and may be under development.

1. What kinds of rapidly deployable systems could be used to locate miners who are trapped by a mine emergency?

[The Inertial Sensor Tracking System, from this point forward known as InSeT, is a semi-permanently installed tracking installed in a working mine. The InSeT expands coverage as the progression of the mine continues, and provides real time tracking of personnel and machinery. The installation and accuracy of the system requires accurate geodetic and GPS survey techniques and relies on the technology of Micro-Electro-Mechanical Systems, aka MEMS, inertial sensors. Due to the installation on InSeT in an underground mine, and the continuous operation of the system, it is deployed at all times.]

2. How would such a system work?

[The InSeT system operates on the principle of inertial navigation, which was originally developed, and deployed on, submarines. Inertial navigation does not rely on external sources for input to determine location. The principle of inertial navigation is using accelerometers to measure acceleration, i.e. velocity. When the inertial sensor is set to a known starting point, the accelerometers measure acceleration in three dimensions. These accelerations update the vehicle position from the known starting point. Typically, Latitude and Longitude are used to

provide the coordinates of the vehicle containing the Inertial Navigation System. In the case of the InSeT system, a grid coordinate system is developed, in conjunction with an accurate GPS survey to start the initial layout of the mine in grid coordinates. An underground survey, utilizing Theodolites and setting monument markers, completes the survey. Personnel wireless packs containing an inertial sensor, dedicated micro-processor, and wireless telemetry transmitter transmit position of the wearer of the wireless pack in grid coordinates. Each wireless transmitter pack utilizes a unique identification code, associated with the individual or machine to which it is assigned. Telemetry receivers located inside the mine receive the 900 MHz telemetry signals and transfer the information via Ethernet protocol to a central computer located outside the mine. The position of the personnel and equipment is shown graphically on a large screen monitor. In the event of an emergency, i.e. fire, explosion, roof fall, etc. the exact location of all personnel and equipment is known, in a real time environment. Additionally, with the installation of the redundant, there is a very good likelihood of telemetry reception from the multitude of undamaged receivers. This provides tracking personnel after an emergency, as they seek shelter in other locations. By utilizing Uninterrupted Power Supplies (UPS) and an emergency power generator to keep the computer system alive, personnel tracking will continue well into a mine emergency.]

3. Is the system currently available? If not, what obstacles are there to the development and implementation of this type of system? How long would it take to develop the system?

[This system, InSet, is being proposed for development. Previous obstacles included limited computer processing power, charting software, and the large physical size of inertial sensing instruments. The development of MEMS integrated inertial sensors, small Surface Mount Technology (SMT), and fast powerful LSI based micro-processor chips; in conjunction with vastly improved battery technology is the basis for proposing this type of system for tracking personnel operating in an underground environment.]

[The length of time to develop such a system in not known at this time, however most of the technology is currently available and is a matter of integration into a working system.]

Signed: David G. Dye
Acting Assistant Secretary for
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January 20, 2006