Venture Design Services – MineTracer Miner Location Monitoring System

General Information:

MineTracer is a wireless tracking system designed specifically for use in underground mines. The coverage area is dependent upon the installation but ranges from 100% track/travel entry and work area coverage to zonal coverage. In the event of an accident, Venture Design Services reports that the system operates on battery power continuously for at least 48 hours after the loss of AC power in the mine. The system has been approved by MSHA for compliance with Title 30 Code of Federal Regulations, Part 23.

- MineTracer consists of Subnet Controllers, Wireless Access Points (WAPs), and Mobile Tags.
- WAPs are located at spacings of several hundred feet depending on roof height and entry undulations. Every few seconds, mobile tags worn by miners communicate with WAPs within range.
- WAPs transmit location data wirelessly via neighboring WAPs to an area Subnet Controller.
- Each Subnet Controller collects wireless data from as many as 75 WAPs and transmits data to the mine office via 12 gauge twisted pair wire backbone. Subnet Controllers are connected to a backbone wire loop to the mine office.
- The location of each miner is displayed on a map and in tabular form on a computer in the mine office.
- Miner location is updated every 20-30 seconds; system settings can vary the update period.
- In a typical mine, Venture Design estimated that two to five Subnet Controllers would be needed to support several miles of entries monitored by the WAPs.
- Communication on the backbone loop is bi-directional so if the loop is broken in an accident, location information is redirected to the mine office through an alternate route.
- MineTracer is built upon the IEEE 802.15.4 wireless communication standard and uses low-power 10mW digital radios operating in the UHF band.
- The mine office is notified immediately in the event of any WAP or network failure.

Pros:

- MineTracer can accurately track miners to an approximate accuracy of 75 feet and display their location via a graphical user interface on a mine map at the mine office.
- Signals are sent from the Mobile Tags to the Subnet Controllers through the WAPs wirelessly.
- The only wired components of the system are the interconnection of the Subnet Controllers and the backhaul connection to the surface. These can be hardened in various ways or routed through boreholes to decrease vulnerability.
- MineTracer can remain functional for at least 48 hours after loss of mine power in the event of an emergency.

Cons:

- Wireless WAPs must be installed every few hundred feet.
- MineTracer signals cannot "hop." Each WAP must report to its preceding WAP. If one WAP is disabled, all WAPs communicating with that particular Subnet Controller downstream are also disabled.
- The system is not fully wireless in that it includes a cable connection between the subnet controllers and also to the surface.

MineTracer Installation at Big Branch

Members of MSHA's Communications and Tracking Committee visited the Southern WV Resources Big Branch Mine in Logan, WV on February 29, 2008 to observe the performance of the Venture Design MineTracer Miner Location Monitoring System. This system was issued MSHA Approval No. 23-A080001-0 on January 23, 2008.

The Big Branch Mine is referred to as a belt mine. It is not actively producing but is used to transport material from one mine to another. The mine height at Big Branch ranges between 6 and 7 feet and the entries are 19.5 feet wide.

The system installed at Big Branch at the time consisted of 5 sub-networks each with 20 - 25 wireless access points (WAPs). The WAPs were installed approximately every 150 feet.

The system has the capability to send signals from the surface to underground and from underground to the surface by way of message buttons on the tags. These signals cause strobes on the WAPs to flash. Flashing or solid lights among three different colored bulbs can define different signals or messages. A flashing

yellow light represents a Miner Alert. A solid yellow light means the dispatcher has acknowledged the alert. A flashing red light means to evacuate immediately. A solid red light means to prepare to evacuate.

System Demonstration

The intent of the visit was to evaluate the performance of the MineTracer System. The display of the mine map was observed as well as the tracking system operation on the graphical user interface (GUI) at the mine office. The display depicted each of the WAPs as installed, and the installation was overlayed on the mine map. Each tracked person was displayed on the screen next to the WAP to which they were most closely associated. The system updated the location of all underground personnel every 15 seconds. MineTracer options included varying the update period, remotely removing line power from the system, and displaying each miner's location history. The mine dispatcher indicated that the system had become invaluable and that, as one of the mine's EMTs, it would also be greatly beneficial in responding to an emergency.

Prior to traveling underground, the mine removed power from the subnet for evaluation. The WAPs display their power usage via a red LED light for operating from mine power, or a blue LED when operating under battery power.

WAP and Tag Communication Ranges

After confirming the system was operating under backup power, the range of the WAPs was evaluated. The WAP retained reliable communication with the network to a distance of 370 feet. The system could communicate at greater distances, but the signal was not reliable. A tag was carried away from the last WAP in the network to evaluate the range of the mobile transponders (tags) while an investigator watched the display. The tag lost communication with the network at a distance of 270'. The operation of the strobe light signaling system was also verified during the demonstration.

These observations suggest a maximum WAP range of 370' and a maximum tag range of 270' in these specific mine conditions.