

## **What to consider in the event of entrapment in a mine**

To begin, it should be noted that while “entrapment” from either a cave-in or an inundation of water is rare, it is nonetheless possible. In the summer of 2002, we all watched anxiously to see the rescue of the nine miners trapped for 77 hours in the Quecreek Mine in Somerset, PA.

As a matter of reference, the survival issues that I’ll be discussing here will pertain to a coal mine. Entrapment in a coal mine would present the worst-case scenario due to its environment being more confined than a typical hard rock mine.

I’ll be addressing the following issues:

- What every miner needs to know
- How much oxygen is enough
- How the trapped miners can communicate with the rescuers

### **What every miner needs to know.**

First and foremost, you must have a good understanding of the entire mine. More than just a knowledge of the portion of the mine that you travel to each day, you need to know the layout of the entire mine.

Beginning with traveling from point A to point B, this may not be the most desired route when attempting exit from the mine after disaster strikes.

In a small mine, it’s fairly simple – what you see is pretty much what you get. One way in and out with another possible exit being the fan shaft.

In larger mines, however, this will require more study. It’s not unusual for a large mine to have 5 or more locations with a means of exit.

### **Know your routes of escape.**

As required by law, each section must have at least two visibly marked escapeways, one of which can be a return airway. When these escapeways approach the mains, decisions may be in order. For example, as you’re walking out, you reach the point where turning in one direction will follow the path on which you’d normally ride, day after day. But you’ve been told that trouble lies in this direction, what should you do? What’s in the opposite direction? Can you reach the surface going in that direction?

Just because it’s not the normal way out, it doesn’t mean it’s not the best way out, especially following a disaster.

Another thing a miner should know is where they are in the mine with reference to sea level. We all can recognize either going uphill or downhill. But can you judge this when the traveled grade is slight. This information can be found on the mine map where elevations are noted throughout the entire mine. There are minimum requirements for

the location and spacing of marked elevations, but suffice to say it's very easy to find and identify this information.

Recalling the Quecreek accident, the miners that were ultimately rescued were in a section with the highest point in the mine, and it happened to be on the inby side of where the water broke in. Pretty lucky if you ask me.

But imagine this, what if they had not only the high point where they were, but an area higher in elevation just a short distance outby and left of where the water entered? Would it have been fool hardy or wise to travel into the onrushing waters? Knowledge of the mine, the mine map and escape routes is the key to success.

### **How much Oxygen (O<sub>2</sub>) is enough?**

When references are made to "normal air", it talks about, pure, dry air at sea level. Normal air is mainly comprised of approximately 78% Nitrogen, 21% Oxygen, 0.9% Argon, and 0.03% Carbon Dioxide

At rest, an individual requires the amount of Oxygen found in 1 cubic yard of normal air per hour to sustain life.

When escape is cut off, or when barricading to keep out toxic gases is considered, the amount of area provided for those trapped should not be left to guess work.

To calculate what a crew of 7 will require per day is as follows:

Each miner needs 24 cubic yards per day  
The crew needs 7 x 24 cubic yards = 168 cubic yards

The amount of air in a given area can be calculated thusly:

The mine entry is 5 feet high and 20 feet wide.  
 $5' \times 20' = 100$  square feet

The length of the entry chosen is 80 feet  
 $80 \text{ feet} \times 100 \text{ square feet} = 800$  cubic feet

One cubic yard is equal to 27 cubic feet, therefore:  
 $800 \text{ cubic feet} \div 27 \text{ cubic feet} = 29.63$  cubic yards of air

Clearly, more is better! This is enough area to sustain the crew of 7 for a little more than 4 hours.

Hard rock miners gain an advantage over coal miners where mined entries are up to 40 feet high and 30 feet wide.

Another point concerning barricading or situations where miners are sealed in airtight. Miners should space themselves out in the sealed area and someone should periodically stir the air to eliminate the buildup of Carbon Dioxide.

While this sounds pretty dismal, you can rest assured that every effort will be taken to supply at least air in the period immediately following disaster. Determining who is unaccounted for through the check-in, checkout system, along with a basic knowledge of exactly where the trouble is and where the miners normally work helps to speed this along.

The last section, dealing with communications between the miners and the rescuers on the surface deals mainly with drilling a borehole (36 in.), and providing the option of either lowering rescuers to the affected miners or bringing the trapped miners out using a rescue capsule.

### **How the trapped miners can communicate with the rescuers**

In the mid 1970s, the Mine Safety and Health Administration, the federal agency which oversees mine safety under the Dept. of Labor, developed a system to locate trapped miners through seismic signaling. Elements of this system are described below:

#### **MEO EQUIPMENT AND CAPABILITIES**

##### **SEISMIC LOCATION SYSTEM**

The seismic location system (Figure 3) is truck-mounted and is capable of detecting and locating the source of seismic vibrations produced by trapped miners. Miners may generate seismic signals by pounding on mine surfaces such as the roof, floor, or ribs. These signals are detected by sensors installed either on the surface or underground. The system is capable of detecting signals at a range of 1500 feet, and can monitor approximated 1 square mile over most mines (depending upon terrain). Helmet stickers (Figure 4) describing how to signal have been distributed to all miners in the United States. The system is highly mobile, and can be airlifted.



## **MINI-SEISMIC SYSTEM**

The Mini-Seismic System (Figure 5) is a simplified version of the larger seismic location system. It has very limited capabilities; however, since it was designed to be very portable. It can be installed in difficult installations situations, such as in underground environments, and for use in building collapse rescue efforts. The Mini-Seismic System was used to help locate several survivors in rescue efforts after the Mexico City earthquakes in September, 1985.

## **TV PROBE SYSTEM**

The MEO TV Probe System (Figure 6) is a self-contained system consisting of two complete permissible TV probes. Each probe has a remote focus, a zoom lens, and remote iris adjustments. The truck is equipped with winch system, electric generator, dual monitoring consoles, and a video-tape capability. The system is air transportable and capable of operating to depths of 1500 feet.

**Disclaimer:** The questions raised throughout the above are not intended to imply that there is only one right answer. Incidents must be examined case by case. The questions raised here are merely to point out that the miner should periodically look beyond the box.