Communication, Tracking & Breathing Technology

...What are the options?

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Outline

Communication, Tracking…

• Current Mine Communication Devices
• MINER Act requirements
• What’s available now
• Technology Gaps
• Activities to help provide the technology
Outline (cont)

Breathing Technology…

- Current SCSRs
- MINER Act requirements
- SCSR Training
- Activities to help provide the technology
Current Mine Communication Devices

- Telephones
- Pager Phones (Loudspeaking Telephones)
- Handheld 2-way radios
- Leaky Feeder Systems
These systems rely on in-mine cables & components...

...that can be destroyed in a disaster
The MINER Act

...Communications and Tracking

✓ General Requirements
Post-Accident Communications

MINER Act
At a minimum, provide for a redundant means of communication with the surface for persons underground, such as secondary telephone or equivalent two-way communication.

Program Policy Letter
When hardwired systems are used to meet the MINER Act requirement for redundant communication between surface and underground personnel, wires should be routed through separate entries or boreholes continuous to the surface.
**MINER Act**

Provide for above ground personnel to determine the current, or immediately pre-accident, location of all underground personnel.

Any system so utilized shall be functional, reliable, and calculated to remain serviceable in a post-accident setting.

**Program Policy Letter**

Until post-accident tracking technology becomes commercially available and MSHA approved, MSHA will accept a dispatcher system, or equivalent system, that has as a function the tracking of persons underground.

A dispatcher system should track location of personnel in writing, on a map, or electronically, for the duration of the shift.
The MINER Act

...Communications and Tracking

☑ Specific Requirements for “within 3 years”
Post-Accident Communications

MINER Act
Within 3 years, Provide for post accident communication between underground and surface personnel via a wireless two-way medium.

Program Policy Letter
MSHA interprets the term “wireless”, as used in the MINER Act, to mean that no wired component of the system exists underground where it may be damaged by fire or explosion.

Post-accident communication technology would be considered acceptable if, based on its location in the mine and the history of mine explosions and fires in the mine, it is likely to withstand the event intact.
MINER Act

Within 3 years,Provide for an electronic tracking system permitting surface personnel to determine the location of any persons trapped underground.
What’s Available Now?
Communication Systems Tests

Mine Emergency Communication Systems Partnership
Criteria for Selecting Systems for Testing

- Systems that do not rely on a wire back-bone to operate
- Various types of technology are represented
- Evidence of sufficient development
Systems Tested

- Rajant
- Time Domain/Concurrent Technologies
- Geosteering
- Innovative Wireless Technologies
- Kutta Consulting
- Transtek
- Vital Alert (Withdrew)
Pre-Test Facts

• All prototypes

• First coal mine test for most systems – the many challenges of a mine environment was not expected by the vendors
Test Process - evaluation criteria

- For in-mine communications
  - Line-of-site
  - Non-line-of-site
  - Interference

- For through-the-earth communications
  - Depth of penetration

- For in-mine tracking
  - Ability to track
Preliminary Test Results

- Most systems limited to 1000-2000 ft. Line-of-site communications

- Exception – MF system provided >5387 ft. non-line-of-site voice communication (>11,600 ft. in a 2nd test)

- One vendor achieved 270 ft. TTE voice communication
## Preliminary Test Results

<table>
<thead>
<tr>
<th></th>
<th>In-mine, Line-of-sight range (ft)</th>
<th>Through-the-earth range (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rajant</td>
<td>1500</td>
<td>N/A</td>
</tr>
<tr>
<td>Time Domain/Concurrent Technologies</td>
<td>2000</td>
<td>N/A</td>
</tr>
<tr>
<td>Geosteering</td>
<td>1000</td>
<td>270 (Beacon)</td>
</tr>
<tr>
<td>Innovative Wireless</td>
<td>1800</td>
<td>N/A</td>
</tr>
<tr>
<td>Kutta Consulting</td>
<td>&gt;11600 (was non-line-of-site)</td>
<td>631 (Text)</td>
</tr>
<tr>
<td>Transtek</td>
<td>N/A</td>
<td>270 (Voice)</td>
</tr>
</tbody>
</table>
Investigate PED installations at:
- Peabody Air Quality and Twentymile Mines
- Consol Blacksville and Robinson Run Mines
- BHP San Juan Mine (only surface-installed antenna in the US)

Traveled to Australia to investigate TRACKER installation
PROS AND CONS OF PED

• Pros:
  – Can send evacuation instructions to miners in early stages of fire
  – Can be retrofit for Koehler, NLT and MSA cap lamps
  – System can be deployed in emergency by arranging surface loop antenna

• Cons:
  – Underground antenna could be compromised in fire or explosion
  – Reports of some areas where signals can’t be received (shadow zones)
  – Can interfere with existing mine systems
  – Communications limited to one-way
  – No confirmation that message has been received
PROS AND CONS OF TRACKER

• **Pro:** Can provide last known location of miner before loss of power

• **Cons:**
  – Cannot provide precise location of personnel
  – System will become non-operational upon loss of power
What are the Technology Gaps?

- Limited in-mine range requires significant in-mine components & infrastructure
- Through-the-earth communication has limitations
- Ability to be Intrinsically Safe
- Systems are prototypes
Activities to help provide the necessary technology

- Mine Emergency Communications Systems Partnership
- Emergency Supplemental Appropriations Bill
- Other Activities
Mine Emergency Communication Systems Partnership

Conduct in-mine tests on systems
Emergency Supplemental Appropriations Bill

• $10M to push promising technology to the mines
  – Funding to be administered by NIOSH through outside contracts
  – Divided between communications & tracking, SCSRs, refuge chambers
Funding Targets Areas...

- Harden existing communications systems
- Hybrid communications technology
- New communications systems
- New tracking systems
Harden existing communications systems

- Protect cables and components
  - Armor or conduit
  - Burying
- Enhance system
  - Loop-Around
Hybrid Systems

- During normal operations, function using existing communication systems
- In an emergency, use the same wireless components to function in another mode that has greater chance of survival
  - Example: Leaky feeder for normal operations and medium frequency in an emergency, using the same portable radio
Other Communication System Issues

- Interoperability
- Interference
- System safety
Actions...

- Award contracts for development & demonstration projects
- Continue to test promising technology
- Award contracts for research issues
- Share information through Partnership & NIOSH Web site
Breathing Technology
MSHA/NIOSH Approved SCSRs

- Ocenco EBA 6.5
- Draeger OXY-K Plus
- CSE SR-100
- MSA Life Saver 60
- Ocenco M-20
The MINER Act

...Breathing Technology
MINER Act

Emergency supplies of breathable air for individuals trapped underground sufficient to maintain such individuals for a sustained period of time

In addition to the 2 hours of breathable air per miner required by the emergency temporary standard, caches of self-rescuers providing in the aggregate not less than 2 hours per miner to be kept in escapeways from the deepest work areas to the surface at a distance of no further than an average miner could walk in 30 minutes

Program Policy Letter

MSHA interprets “caches of self-rescuers providing in the aggregate not less than 2 hours per miner to be kept in escapeways” to mean that one-hour of oxygen per miner should be provided at each SCSR storage location in each escapeway.
## Distances for SCSR Storage Locations

<table>
<thead>
<tr>
<th>Average Seam Height (in.)</th>
<th>Distance in Feet (30 min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crawl – less than 40</td>
<td>2173</td>
</tr>
<tr>
<td>Duck Walk – 40 to 50</td>
<td>3328</td>
</tr>
<tr>
<td>Walk Head Bent – 51 to 65</td>
<td>4415</td>
</tr>
<tr>
<td>Walk Erect – more than 65</td>
<td>5738</td>
</tr>
</tbody>
</table>
Post-Accident Breathable Air

MINER Act

Provide for:

A maintenance schedule for checking the reliability of self-rescuers, retiring older self-rescuers first, and introducing new self-rescuer technology, such as units with interchangeable air or oxygen cylinders not requiring doffing to replenish airflow and units with supplies of greater than 60 minutes, as they are approved by the Administration and become available on the market.

Training for each miner in proper procedures for donning self-rescuers, switching from one unit to another, and ensuring a proper fit.

Program Policy Letter

Specify a schedule for opening, initiating the breathing cycle, and establishing operational reliability for a representative number of SCSR units on an annual basis.

Provide for replacement of retired SCSRs with technologically advanced SCSRs as they become commercially available and are approved for use in mines.
SCSR Training ...

• Hands On Switchover Training

• Care and Maintenance of SCSR
Switchover Training

- A process with steps that are universal regardless of model of SCSR
- Incorporates elements of the “3+3” donning procedure
- Packaged on a single DVD
Switchovers Assessed

Photos: Ocenco, Inc.
Care and Maintenance of Self-Contained Self-Rescuers

Training for miners about...

- How to properly conduct daily and 90 day inspection
- How to care for an SCSR
- Criteria for removing an SCSR from service
Components of the package ...

- Instructor’s guide
- Videotape
- CBT module
- Hands-on component
- Hardhat sticker
- Screen saver
Emergency Supplemental Appropriations Bill - Funding Targets Areas...

- Hybrid Technology Self Rescue Respirators
- Dockable SCSRs
- New Materials / Systems Designs
Hybrid Self Rescuers

Combination SCSR and FSR Respirator – once life support capacity of SCSR part is expended, device switches into FSR mode, filtering out CO from ambient air

• Technology required:
  – FSR Mode
    • Traditional Technology → Hopcalite to convert CO -> CO₂ (high inhaled gas temp)
    • New Technology → use CO Oxidation Catalysts (reaction at lower temp)
  – When/How to switch from closed- to open-circuit operation
    • Sensing CO & O₂
    • Switching → Mode of Operation
Dockable SCSR

Dockable Short & Long Duration SCSR – Belt wearable short duration unit whose duration can be repeatedly extended by coupling new life support canisters on to it

– Additional Canisters Coupled to an SCSR
  • Eliminates Multiple Donning
  • Allows for Smaller, Lighter Carried SCSR

– This type of unit is allowable under interpretations of current MSHA regulations (30 CFR Part 75.1714) which permits a 10/60 SCSR
Schematic Dockable SCSR

SHORT DURATION SCSR

COUPLED SHORT AND LONG DURATION SCSR
New Materials / Systems Designs

- Treatments
  - Catalytic Coatings
  - Pelletizing
- Pressure Vessels — Carbon Cylinders
- User Interface Concepts — Hoods
- Packaging Sealed Foil Pack
  - Hermetically Sealed Chemicals
  - Exchangeable Packs
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