Status of WV Rules and Technology Options

ARC
Lexington Meeting

Randall Harris
W. Va. Office of Miners’ Health Safety and Training
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Carbon Monoxide Kills

Symptoms relating to CO concentration

- 50% COHb: Brain Damage - Death
- 45% COHb: Coma and brain damage
- 40% COHb: Collapse
- 35% COHb: Vomiting
- 30% COHb: Drowsy
- 25% COHb: Headache and Nausea
- 20% COHb: Headache
- 15% COHb: Slight Headache
- 10% COHb: None
- 5% COHb: None

PPM CO vs. MINUTES

ESCAPE!
• Provide an alternative to barricading for miners who have tried to escape and couldn't – **SHELTER IS LAST RESORT**

• Within 1,000 feet of working face

• Provide life-support for maximum likely number of miners on section

• Currently approved 6 models from 5 companies with two more in review

• Shelter Plans due 4-16-2007
Structural Requirements

15 PSI Overpressure

300°F Flash Fire
Life-Support Requirements

- Consumption of oxygen ($O_2$): 0.4 l/min (person in a rested mode)
- Output of $CO_2$: 0.4 l/min (person in a rested mode)
- Respiratory quotient: 1.0 (uptake of $O_2$ is equal to $CO_2$ production)
- Heat emission: 100 W (constant between 25°C and 30°C)
- Humidity emission: 1.5 l/day (person in a rested mode)

**Asking for**
- Minimum 48 hours

**Got**
- 96 hours plus
LifeShelter™
Dräger Escape Shelter™
Kennedy Shelter™
Mine Refuge Chamber™
Fresh Air Bay™ & Mine Refuge Chamber™
Mine Safehouse™

PENDING
Communication Challenges
WV §56-4

- Wireless – miner not connected by wire
- Two-way communications to each miner in at least two separate airways
- Tracking each miner in relation to known points prior and in escapeways after
- Operators submit Communication/Tracking Plan by July 31, 2007
- Understand needs and thought through risks
- Survive accident or be quickly repairable
- Communication center operator needs red-hat card
Few Spectrum Options
Through the Earth

Limitations:
- Interference Sources
- Antenna Size
- Knowledge Base
- Safety Understanding
- Bandwidth Limitations
- No Market Base
Mid Frequency

Local Mine Conductor

Signal Propagating along conductor

MF Signal Coupling onto local conductor

MF Signal re-radiating from conductor

Limitations:
- Knowledge Base
- Safety Understanding
- Bandwidth Limitations
- Limited Market Base
Leaky Feeder VHF & UHF

Legend
- Entry with Radio Coverage
- Radio Coverage Hole

UHF Leaky Feeder Cable systems increases coverage to adjacent entries
Leaky Feeder Coverage Enhancement

Note: Coverage includes implementation of coverage extension approaches
Wi Fi

"Commercially Available" WiFi Mesh nodes at 2.4 GHz (upper UHF)
Mesh Challenge
Next Generation…Redundancy

Dual Feed Base Station Radio

Dual Feed Base Station Radio

Reversible Amplifiers

Normal Traffic Flow

Emergency Traffic Flow