Status of WV Rules and Technology Options

Wheeling Jesuit Mine Safety Meeting

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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

ESCAPE!
Four primary gases concern miners after an explosion or fire

**Oxygen** – Minimum levels needed for life support

**Methane** – Combustible watch combustible ranges if too high lowers oxygen

**Carbon Dioxide** – Maximum levels reduces oxygen

**Carbon Monoxide** – maximum levels causes asphyxiation
Combustion combines oxygen in the air with a fuel to create heat, carbon dioxide and water vapor.

Complete combustion is dependent upon excess oxygen in the air.

In a closed area the oxygen available decreases with combustion.

Carbon monoxide production increases when insufficient oxygen.
As blood cells move through the lung they absorb oxygen and release carbon dioxide.

As they move through the body they release oxygen to the cells and absorb carbon dioxide.

If carbon monoxide is present in the lungs it takes the place of oxygen preventing the absorption of oxygen.

As the blood cells move through the body carbon monoxide is not released – cells lack oxygen and cannot get rid of their carbon dioxide.
Carbon monoxide is rapidly absorbed into the blood

Onset of affects begin at saturation levels between 15 and 25%

Levels above 20% for healthy people and 15% if heart or lung conditions generally require hospitalization

Levels above 30% limit the ability for self-protection

Levels above 60% limit cellular oxygen to near minimum for life
Fatal saturation levels vary by person from 30% to 80%
• 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 (O₂): 0.4 l/min
- output of CO₂: 0.4 l/min
- Respiratory quotient: 1.0
- heat emission: 100 W
- humidity emission: 1.5 l/day

( person in a rested mode)
( person in a rested mode)
( uptake of O₂ is equal to CO₂ production)
( constant between 25°C and 30°C)
( person in a rested mode)

Asked for Minimum 48 hours
Got 96 hours plus
Dräger Escape Shelter™
Kennedy Shelter™
Mine Refuge Chamber™
Fresh Air Bay™ & Mine Refuge Chamber™
LifePod™
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

**THE ELECTROMAGNETIC SPECTRUM**

- **Wavelength** (in meters)
- **Common name of wave**
- **Sources**
- **Frequency** (waves per second)
- **Energy of one photon** (electron volts)

- **TTE (ELF – LF)**
- **MF “Parasitic Propagation”**
- **VHF/UHF Mine Entry Waveguide Prop.**
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
- Green: Entry with Radio Coverage
- Red: Radio Coverage Hole

UHF Leaky Feeder Cable systems increases coverage to adjacent entries.

No Coverage
Leaky Feeder Coverage Enhancement

Note: Coverage includes implementation of coverage extension approaches.
"Commercially Available" WiFi Mesh nodes at 2.4 GHz (upper UHF)
Mesh Challenge
Next Generation…Redundancy