Emergency shelters and effect on rescue plans

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Knowledge that miners have access to a refuge shelter in the case of a mine emergency

- Mine rescue operation can be planned more effectively knowing that life support is available for a length of time
- Mine rescue personnel would be able to manage the deployable resources to reach rescue shelter in shorter time period
- Allow early notification of missing individuals resulting in deployment of overall search mission for specific personnel.
PORTABLE CHAMBER, BENEFITS TO MINE RESCUE

- Known location for assembly and accountability
- Communication to surface or fresh air base from chamber.
- Planning for mine evacuation from chamber by mine rescue can be done safely.
- Knowledge of miners condition.
- Knowledge of external conditions
Short and Long-term use

**Short Term Use.**
- Safe area to change out SCSR.
- Safe area for hydration.
- Review escape route maps.
- Receive direction from surface control.
- Common meeting location.

**Long-Term Use.**
- Installed life support system. Designed for specific period of time.
- Known location for control.
RESCUE PLANNING

Accident/ Emergency event

SELF ESCAPE
Using Oxy SCSR

RECOVERY & ESCAPE
acc. to mine escape plan

Escape Route

short

long

Used as ESCAPE shelter

Used as REFUGE shelter

PLAN

Escape complete

More time for planning an effective rescue

RESCUE by MINE RESCUE TEAMS
Underground mines offer a difficult environment for shelter deployment and coal mines are the worst case scenario

- Hazardous atmospheres
- Intrinsic safety and/or explosion proof systems (especially coal mines)
- Small operating areas
- Difficult to handle large and heavy equipment underground
- Low seam heights (Appalachian belt mines)
- Mine structure materials
- Seasonal differences (winter operations vs summer operations)
- Deep underground (long access times)
Refuge shelters need to offer protection to the users by creating a respirable, liveable atmosphere inside an enclosed space.

Protection is ensured by:

- Maintaining the Oxygen level in the range $19\% \text{vol} > O_2 > 22\% \text{vol}$
- Maintaining the Carbon Dioxide level $CO_2 < 1\% \text{vol}$
- Climate control to prevent heat and cold stress
- Creating an overpressure inside the shelter
ESCAPE/ REFUGE SHELTERS for MINING

GENERAL FEATURES

- CO2 scrubber
- Oxygen Supply
- Breathing Air supply
- Air Conditioning
- Alarm/Siren
- Overpressure valves

- Entry lock
- Gas tight doors
- External Air Supply
- External Elect. Power
- Battery power supply
- Standard & Emergency Lighting
ESCAPE/ REFUGE SHELTERS FOR MINING
LAYOUT – 15, 20 MAN

- Air Filter Station for external air Supply
- Battery Array Compartment
- Electrical Control Compartment
- Storage shelves (outline)
- Oxygen system
- Benches
- CO2 scrubber unit (under benches)
- Man lock For entering & exiting main chamber
- Gas tight door Outer
ESCAPE/ REFUGE SHELTERS for MINING
Shelter KIT

Life support system for 10 persons for 16 hours

- Built-in or inflatable shelter
- Oxygen
- Air bank
- CO2 scrubber
- Air Conditioning

LSS
ESCAPE/ REFUGE SHELTERS for MINING

SHELTERS FOR BLASTING ENVIRONMENTS

Special design considerations
- Strengthened structure
- Angled surfaces to deflect blast forces
- Two-way relief valves for positive & negative pressure loads
- Internal fixtures on vibration mounts

Operating considerations
- Located in a protected area away from the direct blast wave path
- Frequent inspections
ESCAPE/ REFUGE SHELTERS for MINING

LOW SEAM COAL MINES

Special requirements to meet WV Legislative rule Title 56 series 4-8 and MSHA PIB # P07-03

- shelter length is 20ft and width is 8ft
- maximum shelter height is 48"
- for 10 person shelter height min. 36”, weight ~ 8,900 lbs (4.1 mT)
  - persons lying down
- for 16 person shelter height min. 41”, weight ~ 9,900 lbs (4.5 mT)
  - persons sitting up
An Airlock (or manlock) is used to enter and exit the shelter.

Positive pressure maintained throughout shelter use.

Heat transfer analysis confirmed active cooling was not required for WV UG mine environment.

Food, water, soda lime cartridges, first aid kit etc.

CO2 scrubber

Oxygen cylinders

Escape door

Inner door

main door
ESCAPE/ REFUGE SHELTERS for MINING & TUNNELING

CUSTOM SHELTER SOLUTIONS
ESCAPE/ REFUGE SHELTERS for MINING & TUNNELING

...MORE EXAMPLES
RESCUE PLANNING

Portable Refuge Chambers, Coal

- Chamber can be advanced closer to working face as production advances.
- Chambers can be designed to suit individual mining environments.
- Chambers can be relocated into new development or production area’s.
Portable Refuge Chambers, Metal/Nonmetal

- Portable Refuge Chambers in new development area’s can reduce cost.
- Can be designed to suit individual mining environments.
- Portable refuge chambers can be moved closer to working face as development advances.
- When development is finished chamber can easily moved to new working area.
REFUGE SHELTERS FOR MINING
WHY DRAEGER SHELTERS WITH EXTENDED SURVIVAL TIME?

CONCLUSION

• RECENT ACCIDENTS IN MINES AND TUNNELS SHOWED THAT THE TIME FOR RESCUE OFTEN EXCEEDS 16 HOURS OR MORE

• KNOWLEDGE THAT MINE SURVIVOURS HAVE LIFE SUPPORT FOR SOME TIME HELPS TO PLAN AN EFFECTIVE RESCUE OPERATION

• TECHNOLOGY USED IN SHELTERS MUST BE EASY TO OPERATE

• A TRUE REDUNDANT LIFE SUPPORT SYSTEM IN SHELTER DESIGN IS NECESSARY
Thank You