# Emergency shelters and effect on rescue plans

**3rd International Mine Rescue Conference**

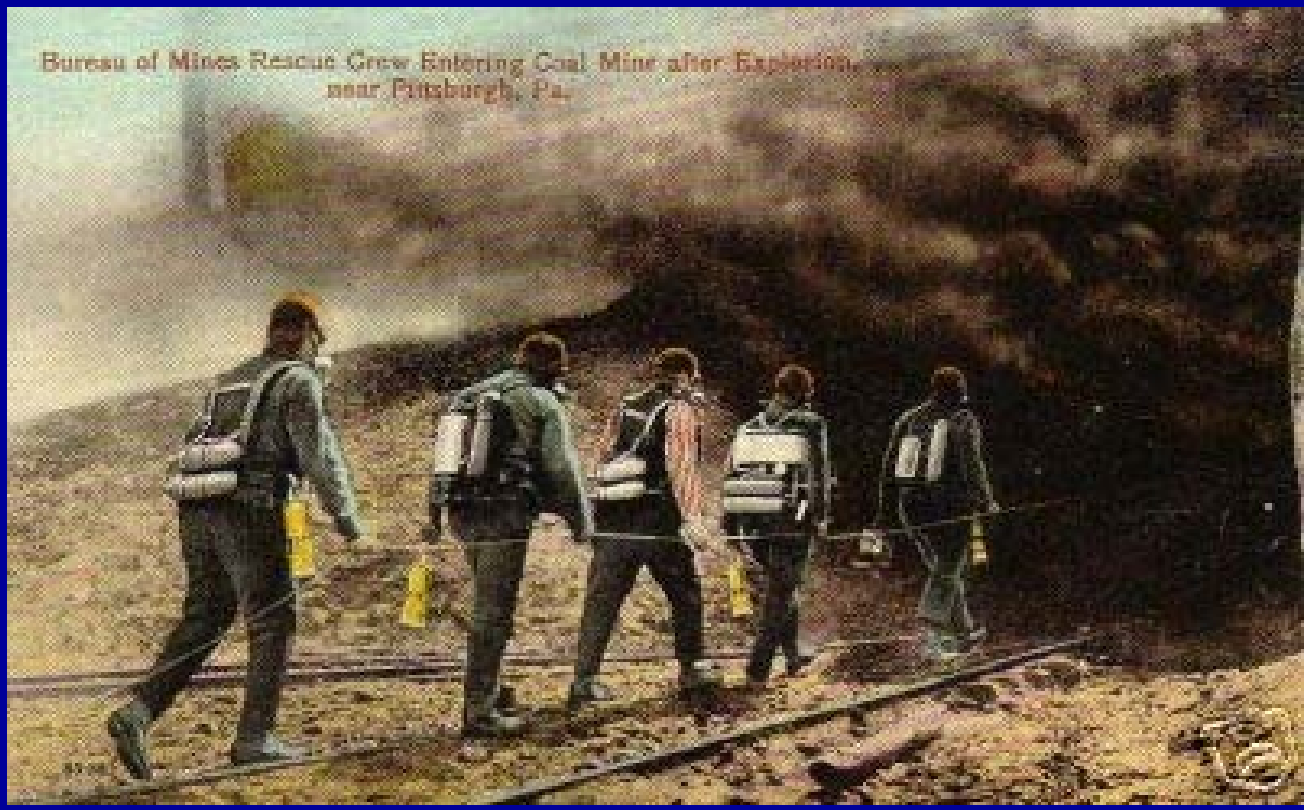
Aug 29th – Sept 1st 2007

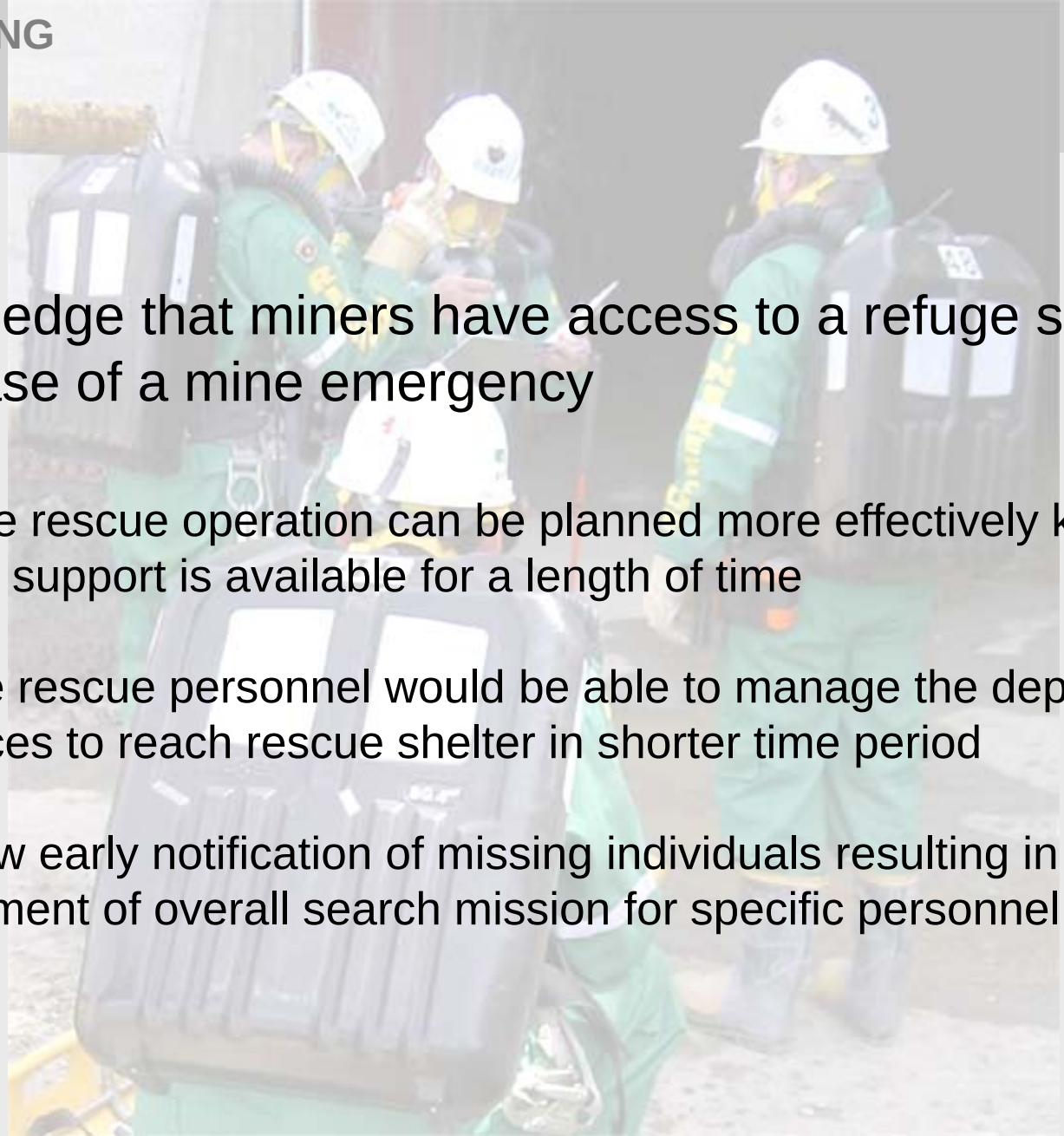

**Draeger Safety Inc.**

Rohan Fernando

Bill Dedig

Kent Armstrong



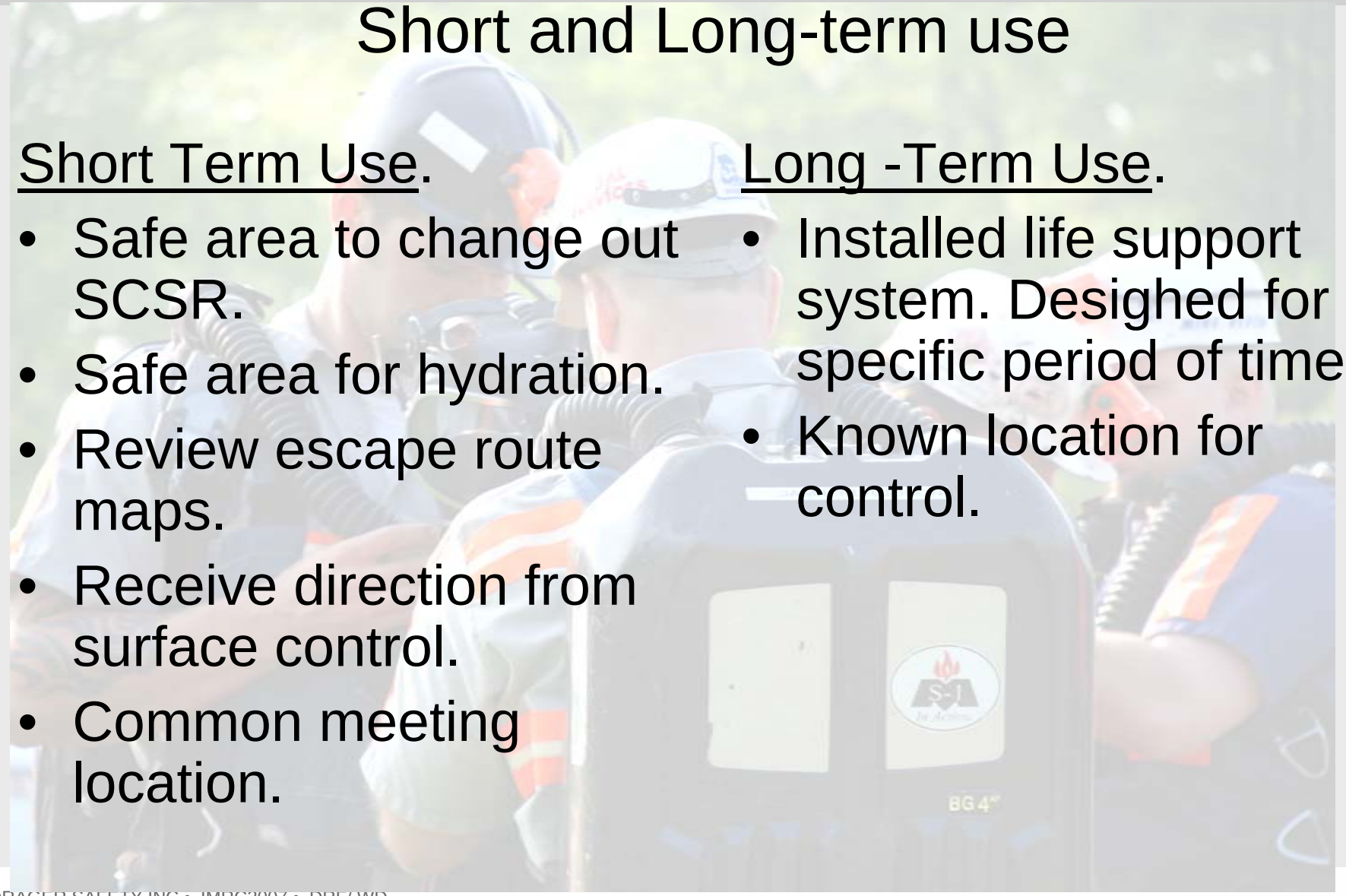
Knowledge that miners have access to a refuge shelter in the case of a mine emergency

- 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

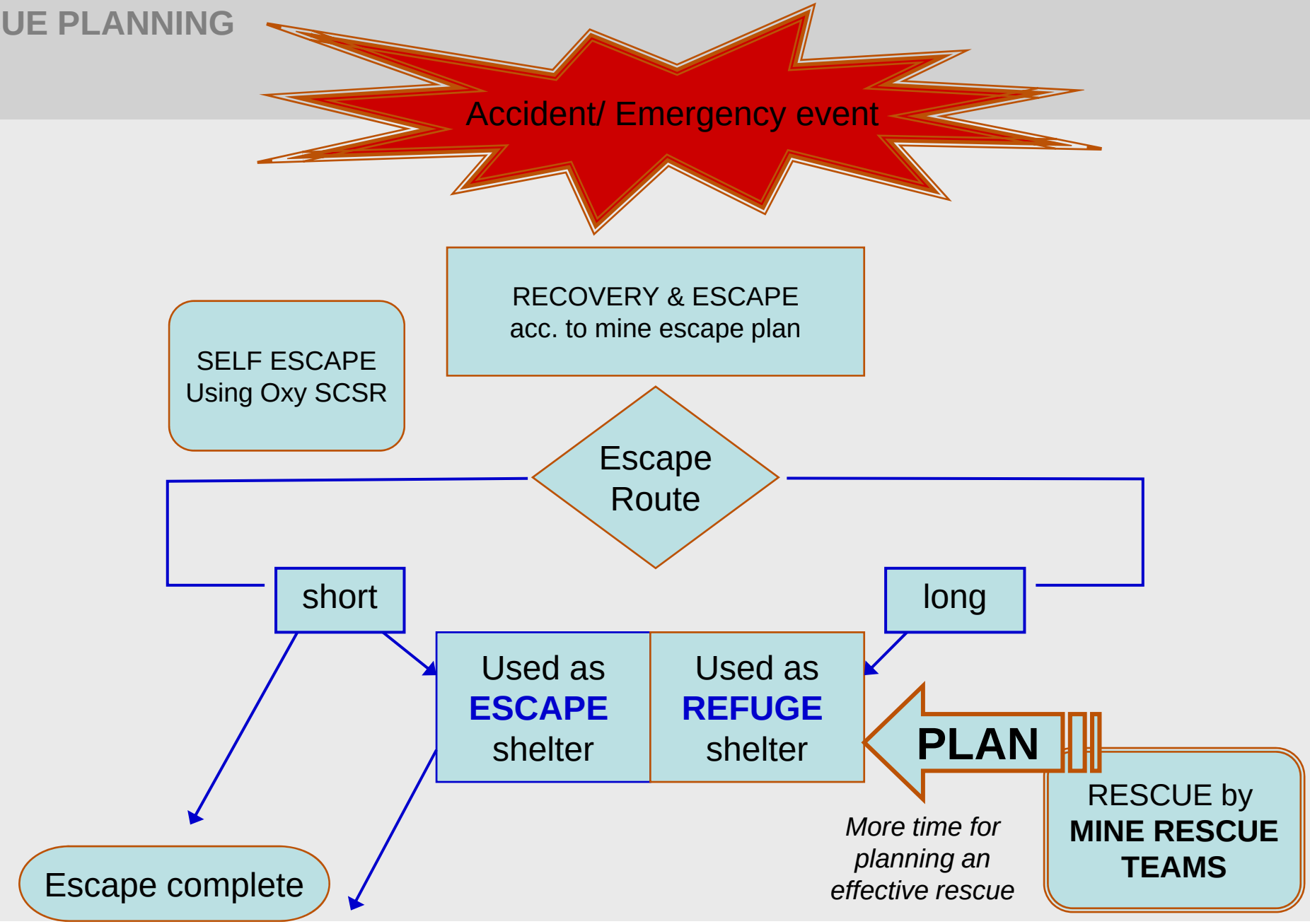


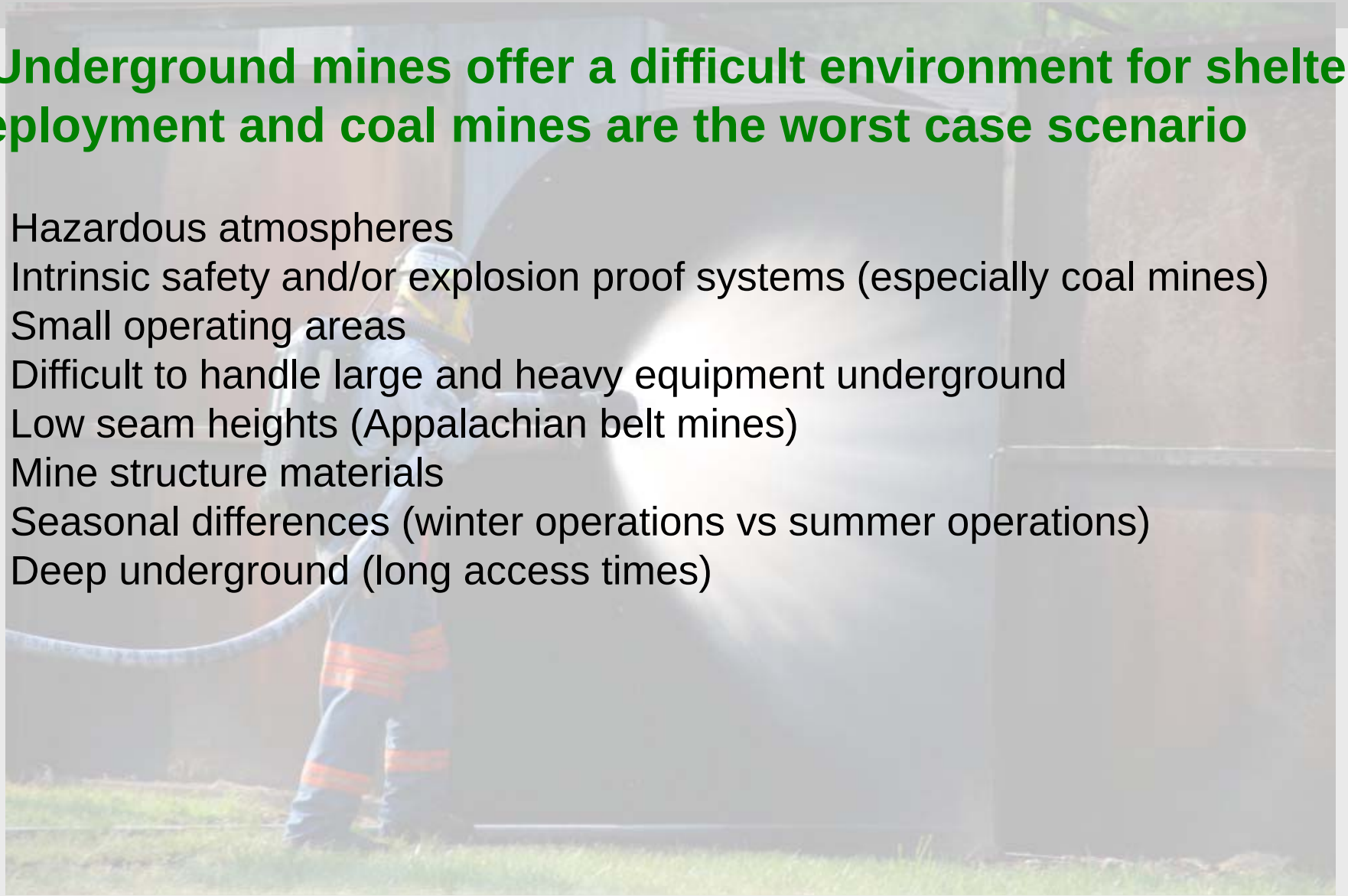
Short Term Use.

- 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. Desighed for specific period of time.
- Known location for control.


Accident/ Emergency event
RECOVERY & ESCAPE
acc. to mine escape plan
SELF ESCAPE
Using Oxy SCSR
Escape
Route
short
long
Used as
ESCAPE
shelter
Used as
REFUGE
shelter
PLAN
RESCUE by
MINE RESCUE
TEAMS
More time for
planning an
effective rescue
Escape complete



## 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)

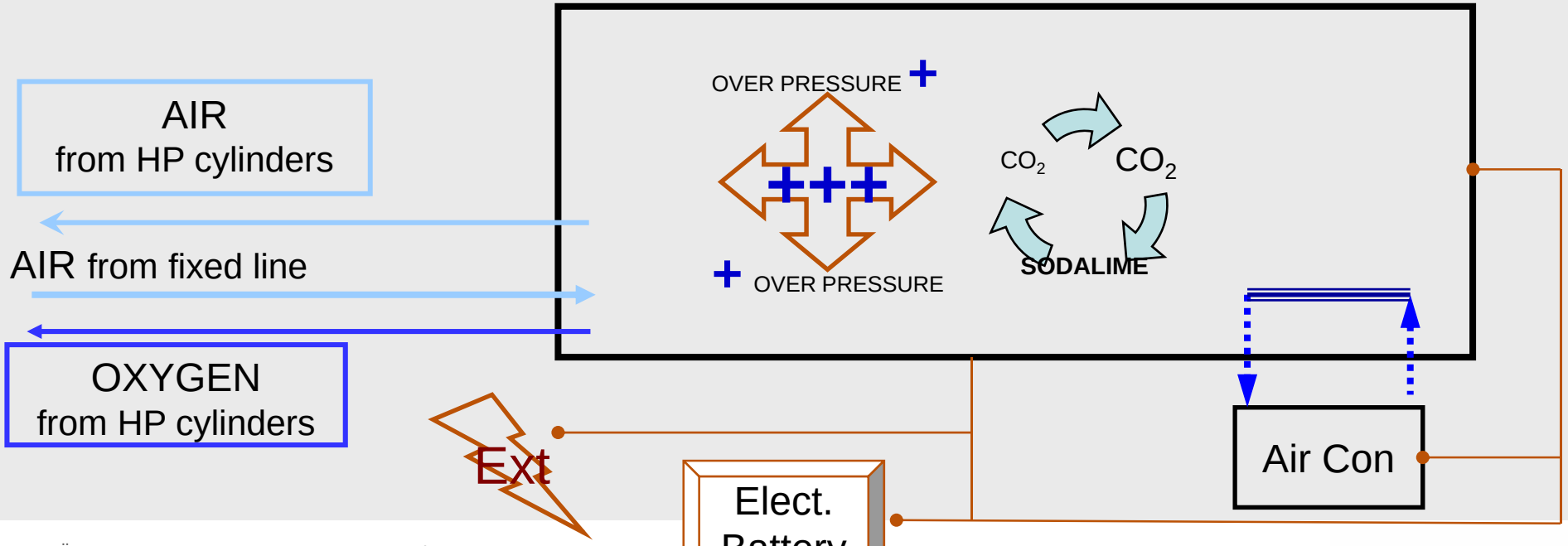
## PROTECTION PRINCIPAL

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%vol > $O_2$ > 22%vol
- Maintaining the Carbon Dioxide level $CO_2$< 1%vol
- **Climate control** to prevent heat and cold stress
- Creating an **overpressure** inside the shelter

THESE ARE THE MAIN LIFE SUPPORT ELEMENTS OF THE SHELTER DESIGN






Dräger safety

# ESCAPE/ REFUGE SHELTERS for MINING
## GENERAL FEATURES


- $CO_2$ scrubber
- Oxygen Supply
- Breathing Air supply
- Air Conditioning
- Alarm/Siren
- Overpressure valves

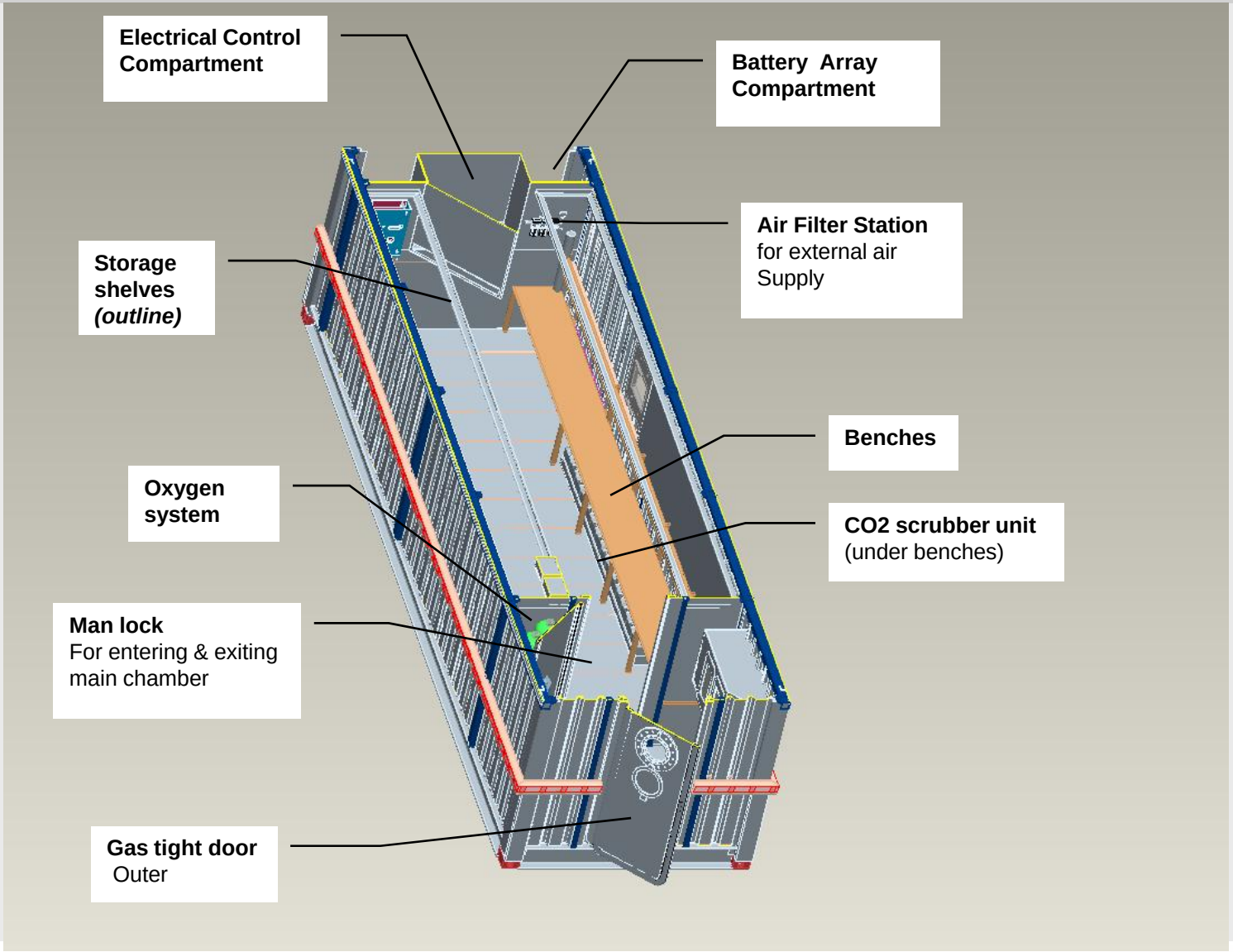
- Entry lock
- Gas tight doors
- External Air Supply
- External Elect. Power
- Battery power supply
- Standard & Emergency Lighting



Dräger safety

# ESCAPE/ REFUGE SHELTERS FOR MINING

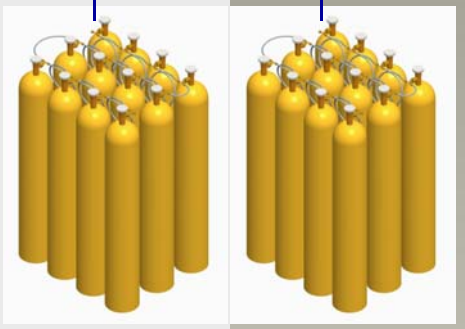
## LAYOUT – 15, 20 MAN

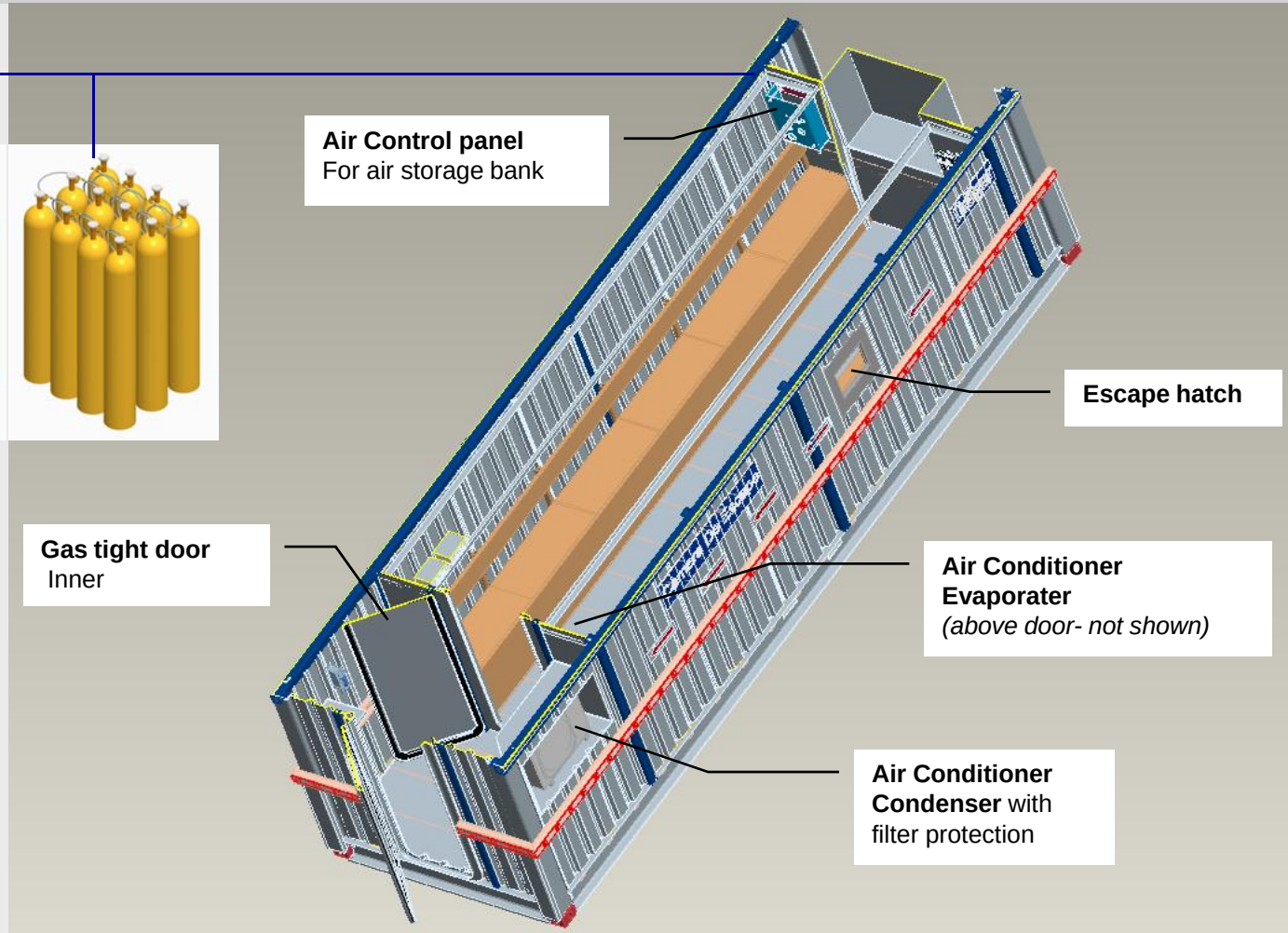


# ESCAPE/ REFUGE SHELTERS FOR MINING

## LAYOUT – 15, 20 MAN

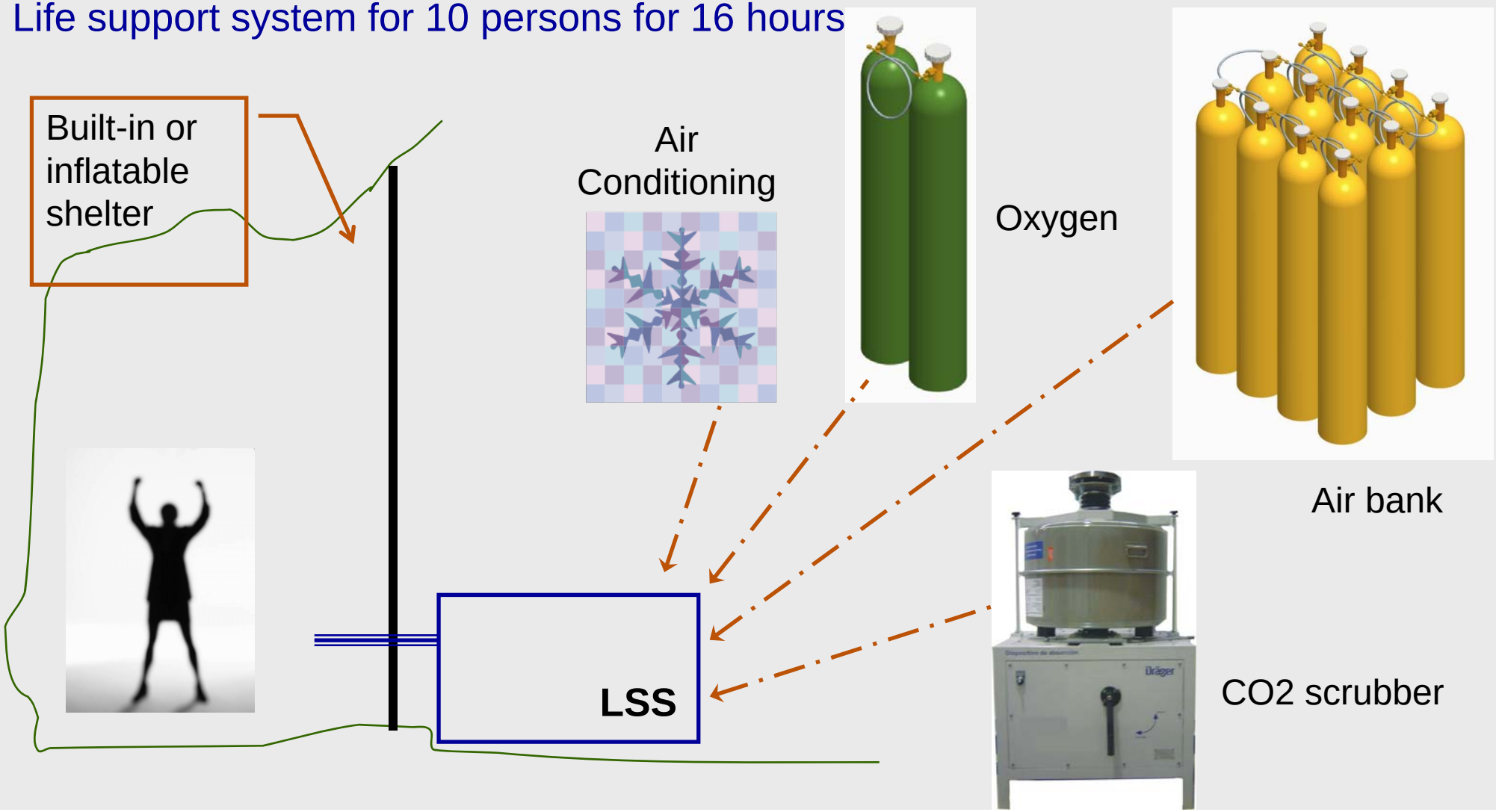
**Air Storage banks**
***(positioned outside, close to the shelter)***





## Shelter KIT

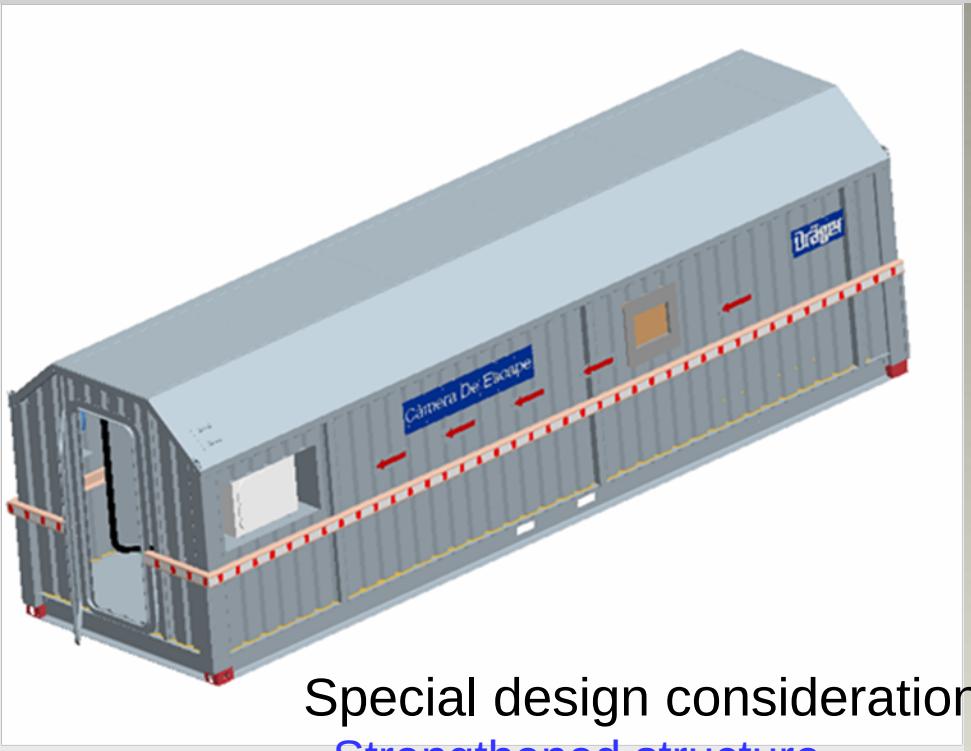
### Life support system for 10 persons for 16 hours

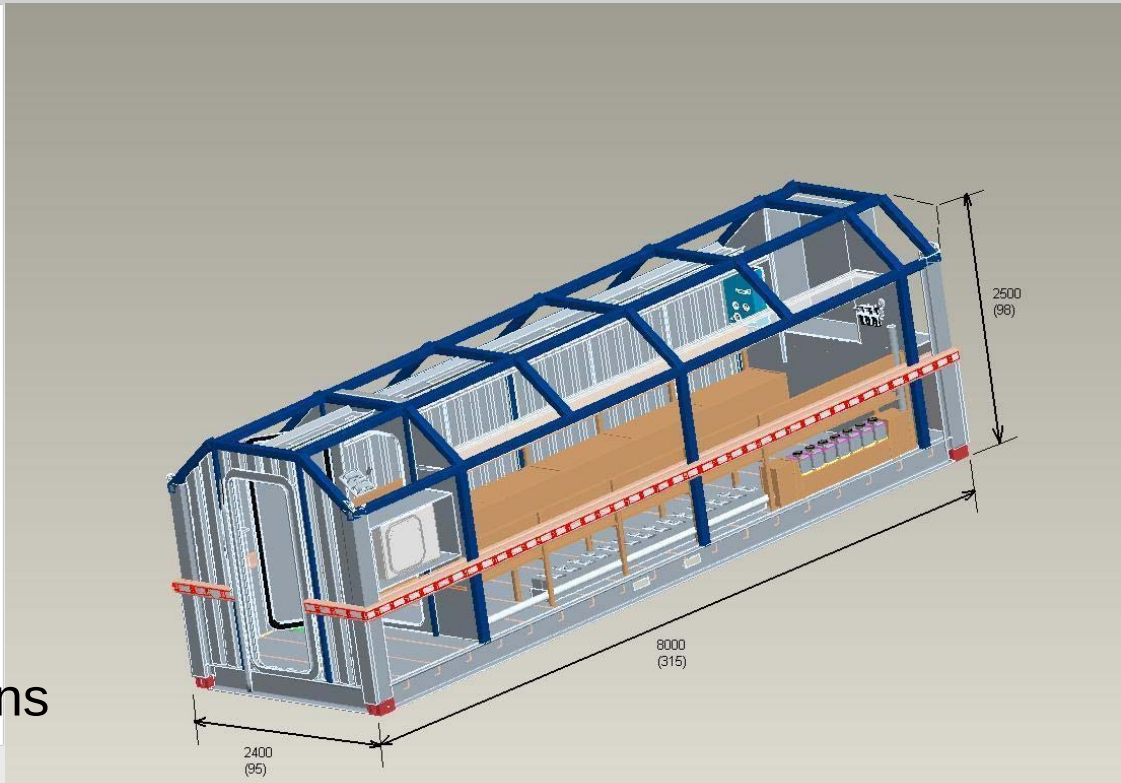





Dräger safety

# 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

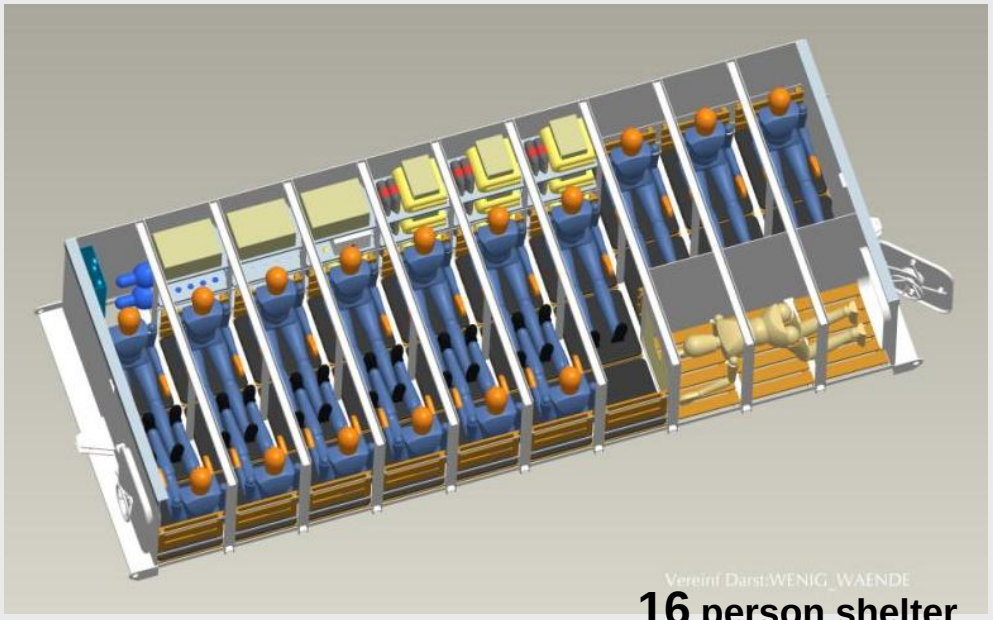


Dräger safety

## LOW SEAM COAL MINES

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

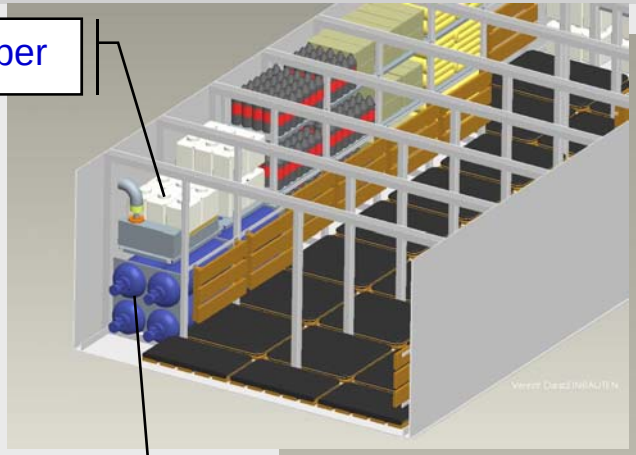
- o shelter length is 20ft and width is 8ft
- o maximum shelter height is 48“
- o for 10 person shelter height min. 36“, weight ~ 8,900 lbs (4.1 mT)
  - – *persons lying down*
- o for 16 person shelter height min. 41“, weight ~ 9,900 lbs (4.5 mT)
  - – *persons sitting up*



**16 person shelter**

**10 person shelter**

# ESCAPE/ REFUGE SHELTERS for MINING



CO2 scrubber

Oxygen cylinders

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

An Airlock (or manlock) is used to enter and exit the shelter

main door

Inner door

Escape door

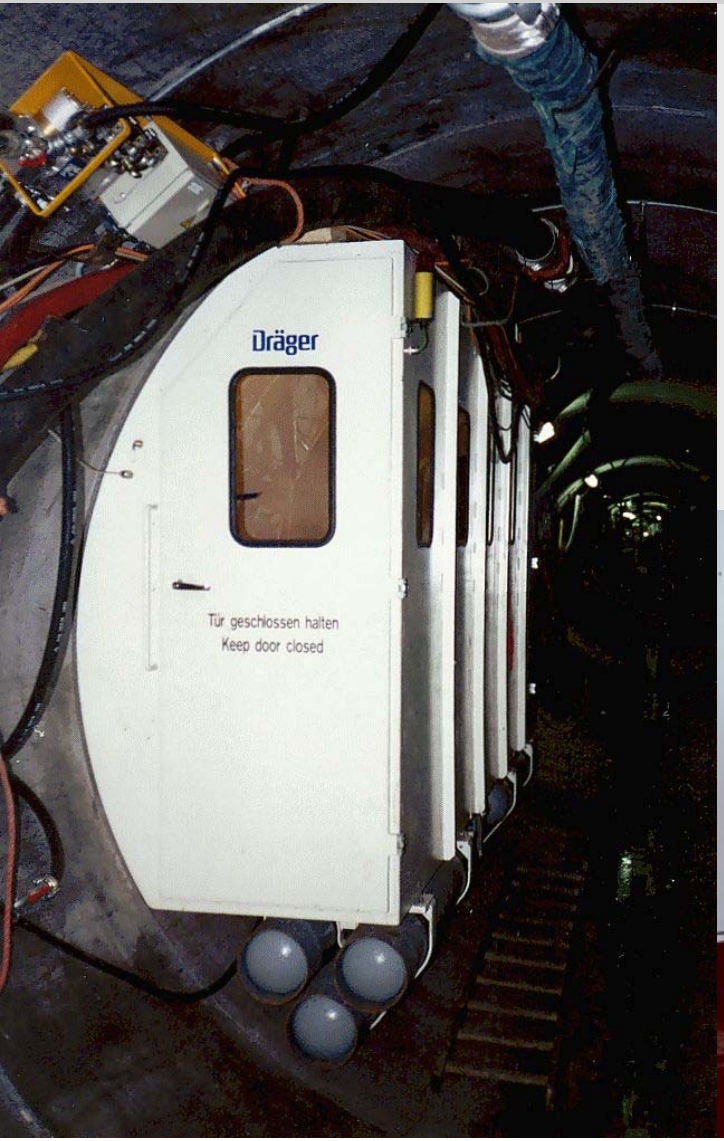
**Positive pressure maintained throughout shelter use**

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



Dräger safety

# ESCAPE/ REFUGE SHELTERS for MINING & TUNNELING




## CUSTOM SHELTER SOLUTIONS





Dräger safety

# ESCAPE/ REFUGE SHELTERS for MINING & TUNNELING


…MORE EXAMPLES





Dräger safety

# 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.

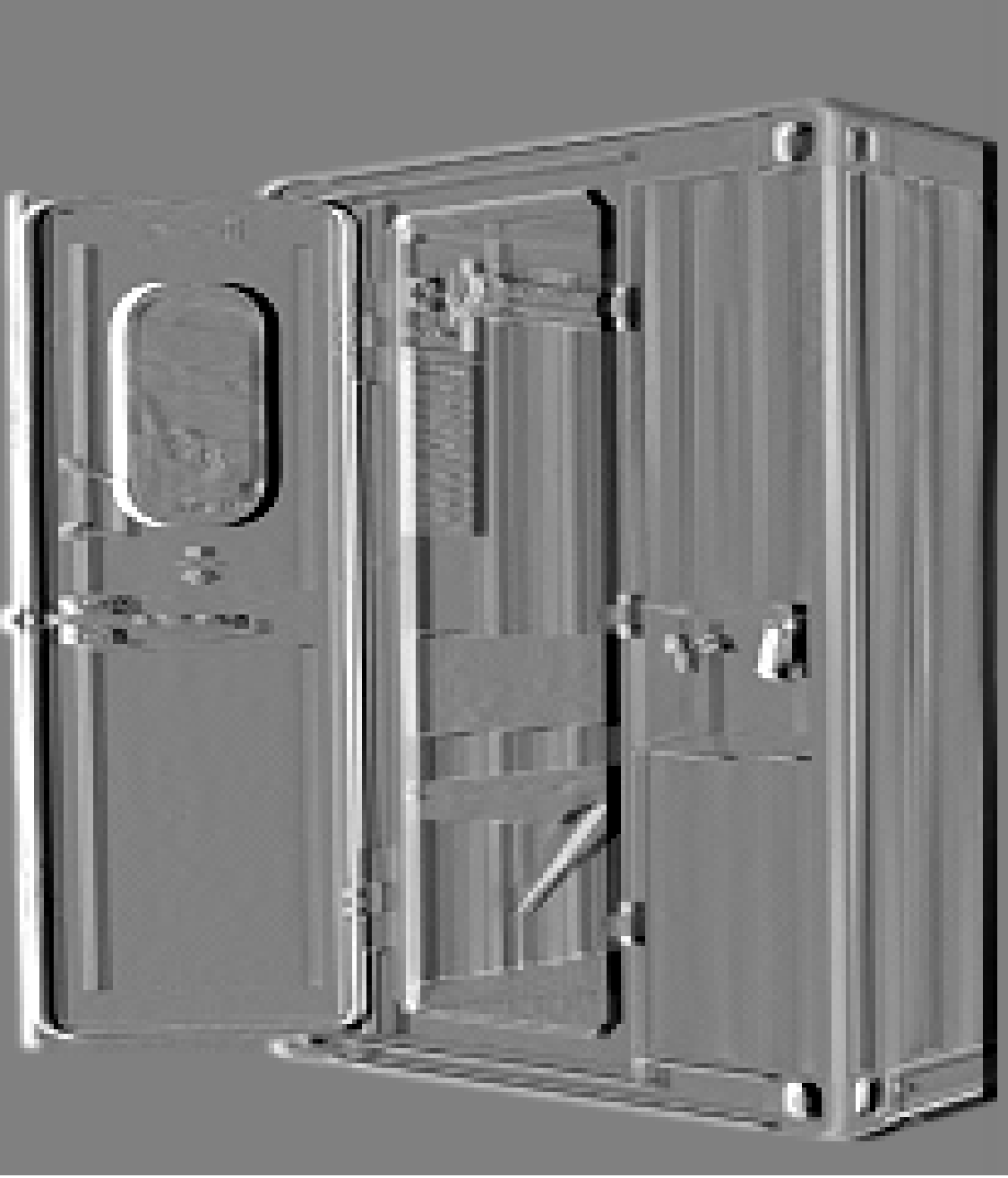
## CONCLUSION

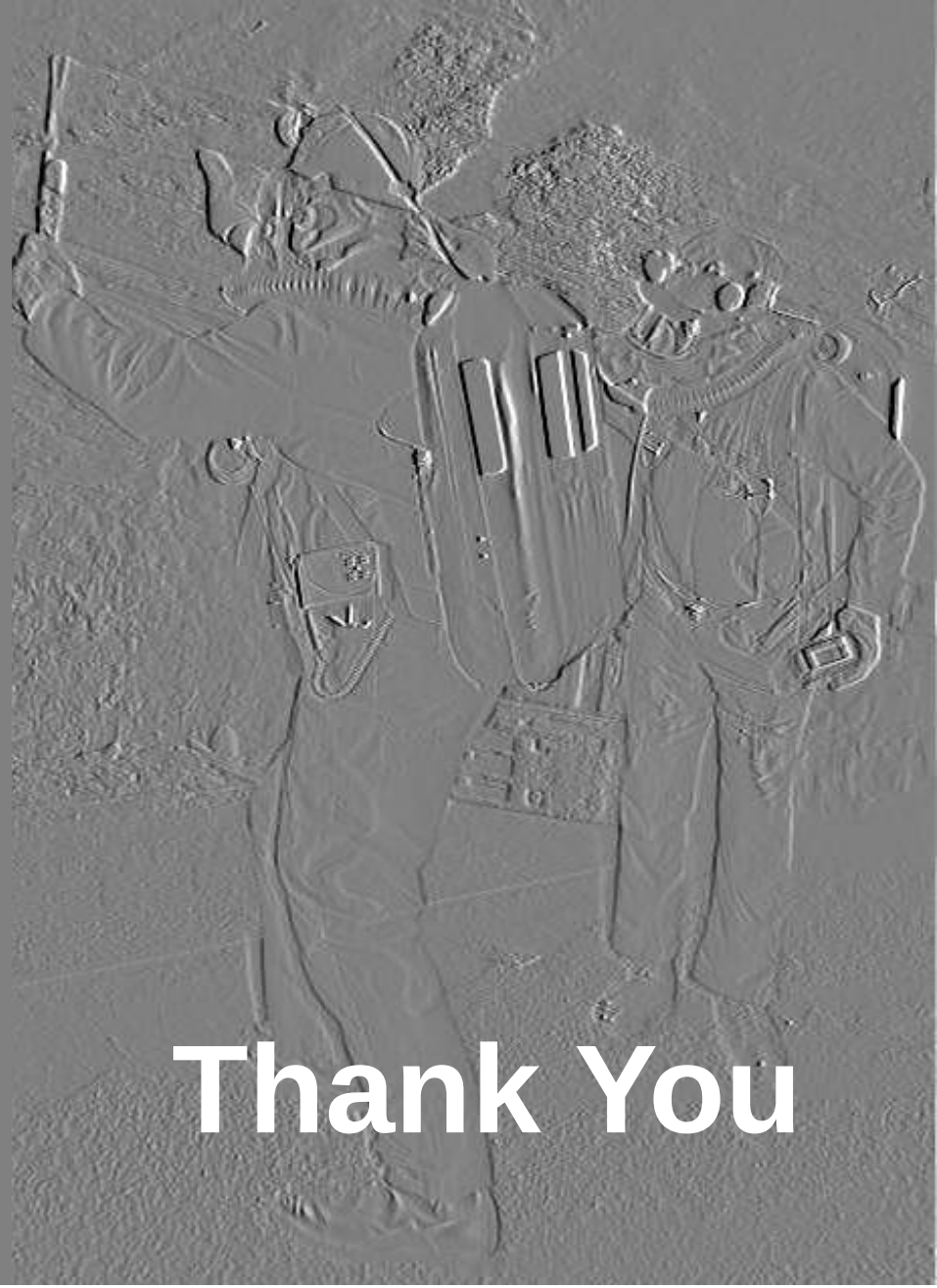
- RECENT ACCIDENTS IN MINES AND TUNNELS SHOWED THAT THE TIME FOR RESCUE OFTEN EXCEEDS 16 HOURS OR MORE

- 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



Dräger safety