Confined Space Guidance for Tunnel Entry

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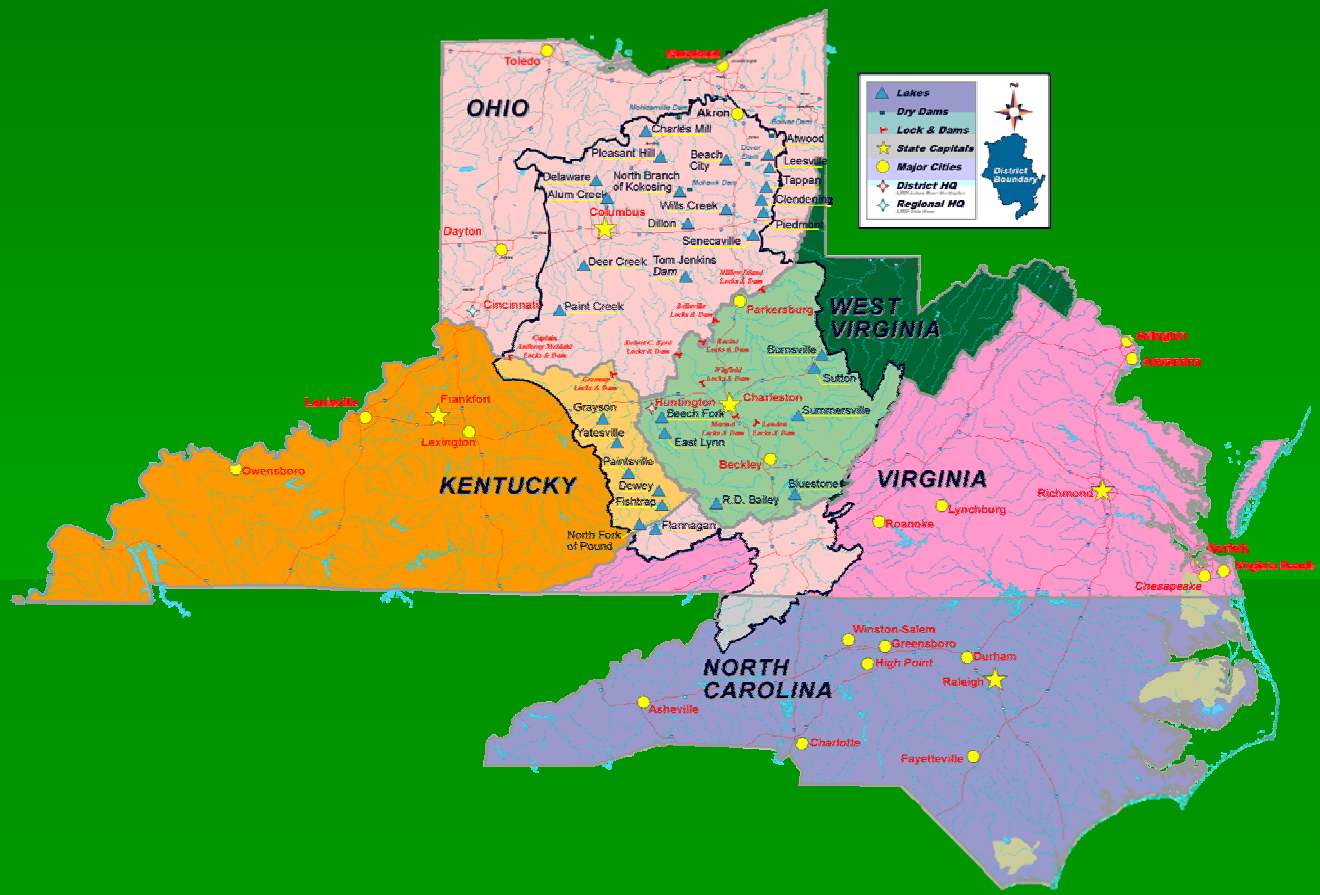
Huntington District Map



Five flood control projects which experience a problem with hydrogen sulfide

- Clendening Lake
- Piedmont Lake
- Tappan Lake
- Leesville Lake
- Atwood Lake

All are in Muskingum Area in northeast Ohio, near New Philadelphia.

Projects experiencing hydrogen sulfide

- Similar structures, all approximately the same age, built in the 1930's
- H_2S odor noticed when lakes are being drawn down from summer to winter pool in the late summer months
- Water drawn from bottom of lake as opposed to middle or top or mixture of water from different levels

Anaerobic atmosphere

- Warmer, less dense surface water layers separated from colder, denser lower layers
- Bottom layers become anaerobic
- Organic material on bottom decomposed anaerobically, producing H_2S and CO
- During draw down, current stirs up sediment on bottom which is then exposed to the atmosphere when water is released

Air sampling

- OSHA PEL 50 ppm for 8-hour shift; 20 ppm as 10-minute ceiling limit
- ACGIH TWA 10 ppm; 15 ppm for short-term limit
- Using impingers, only Clendening was found to have H_2S readings above the ACGIH TWA (19-25 ppm)
- Using direct reading instruments, both Clendening (10-20 ppm) and Piedmont (10-15 ppm) had readings above the ACGIH TWA

Previous tunnel entries

- Entries were made with personnel using direct reading hand-held monitors
- Only once did a monitor alarm (at 20 ppm) and all participants in the tunnel entry exited (Leesville Lake)

Current status

- Project personnel became concerned that the H_2S problem was becoming more pronounced
- Thought these tunnels should be classified as permit-required confined spaces
- This added a whole new dimension to tunnel entry in our District

29 CFR 1910.146 General Industry Standard for Permit-required Confined Spaces

A confined space:

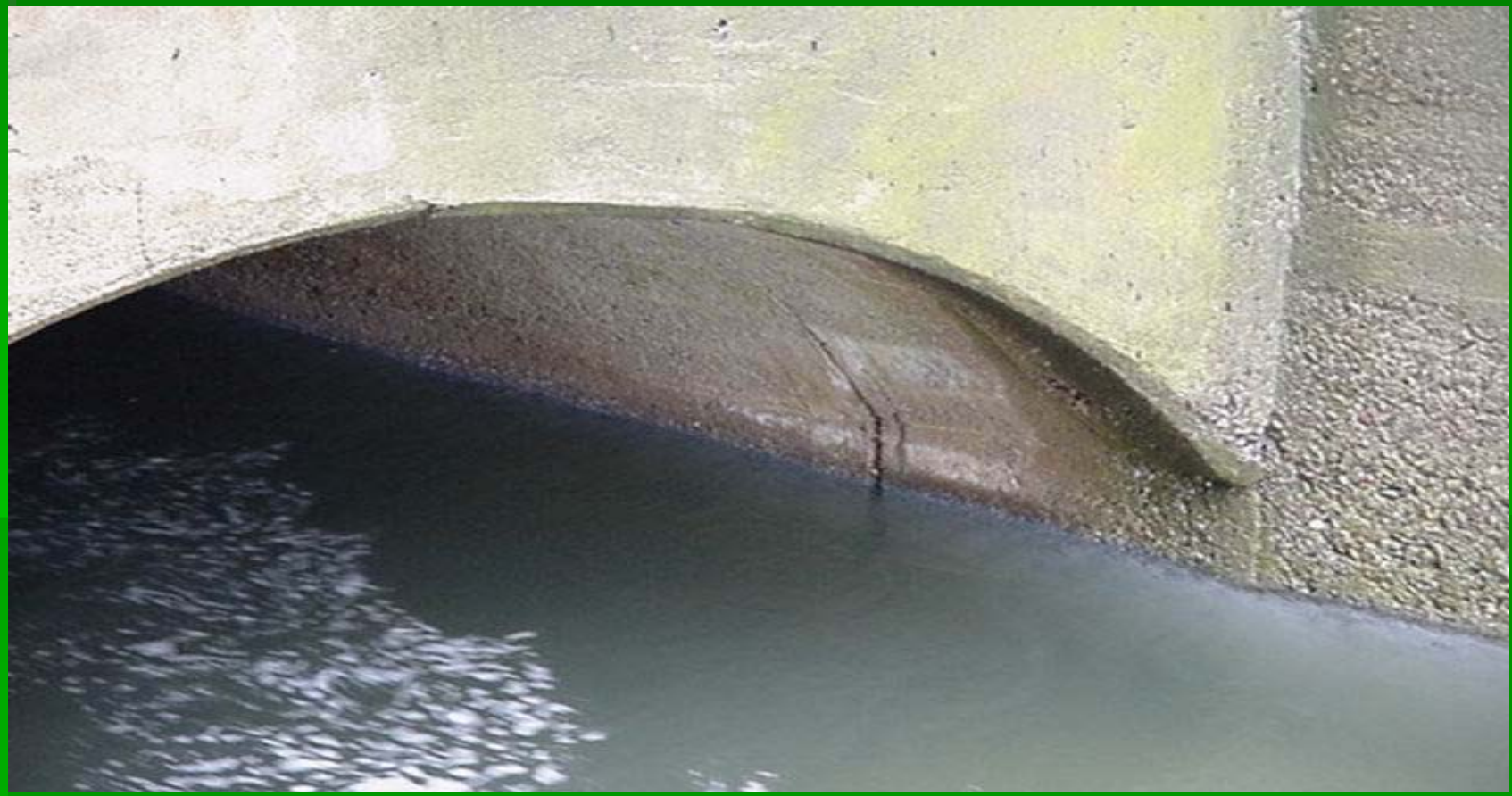
- Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit; and
- Is not designed for continuous human occupancy.

The space must meet all three of these criteria in order to be considered a confined space.

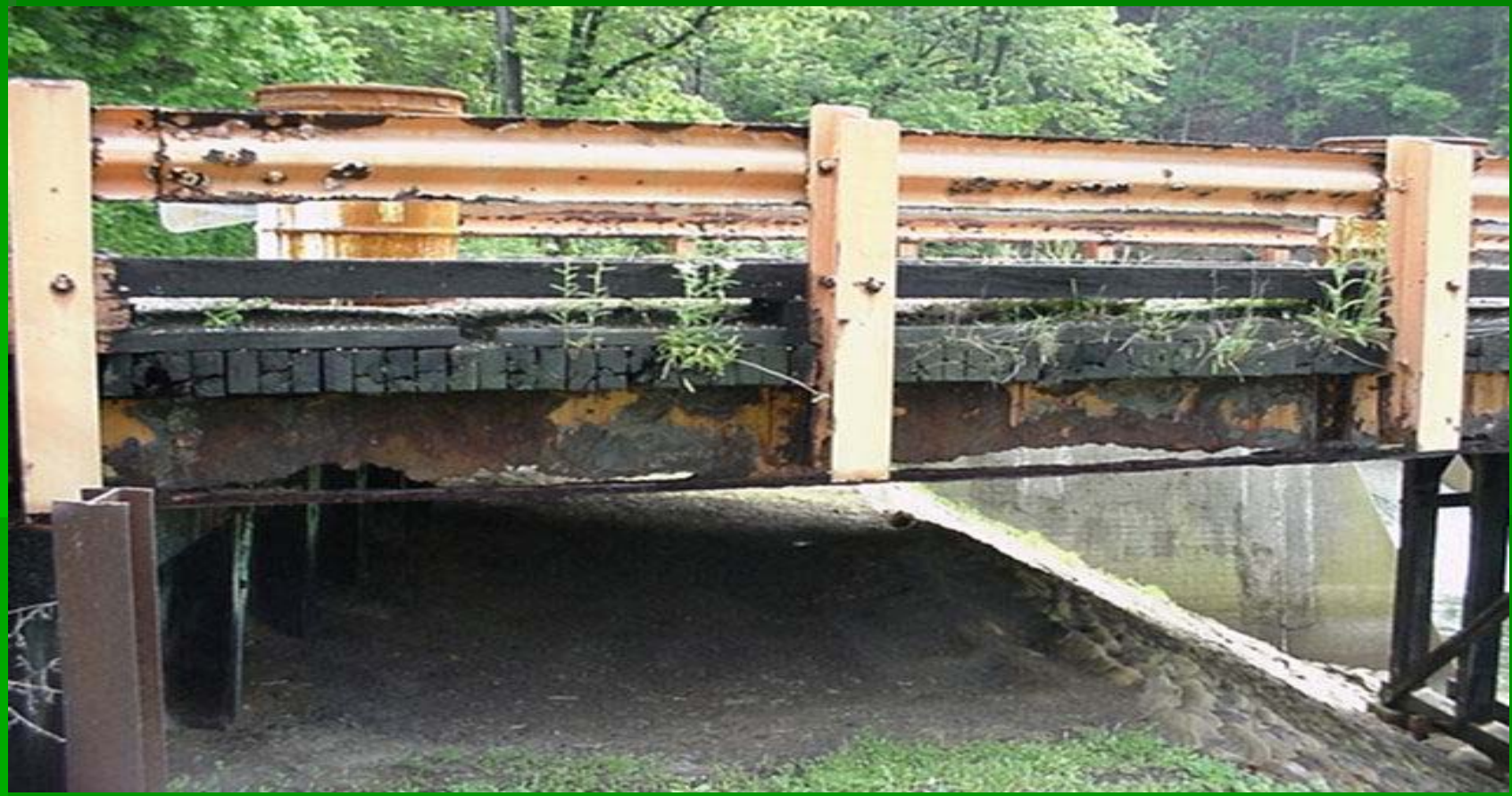
EM 385-1-1, Section 06, adds an additional statement to (b) above

Has limited or restricted means for entry or exit such that the entrant's ability to escape in an emergency would be hindered

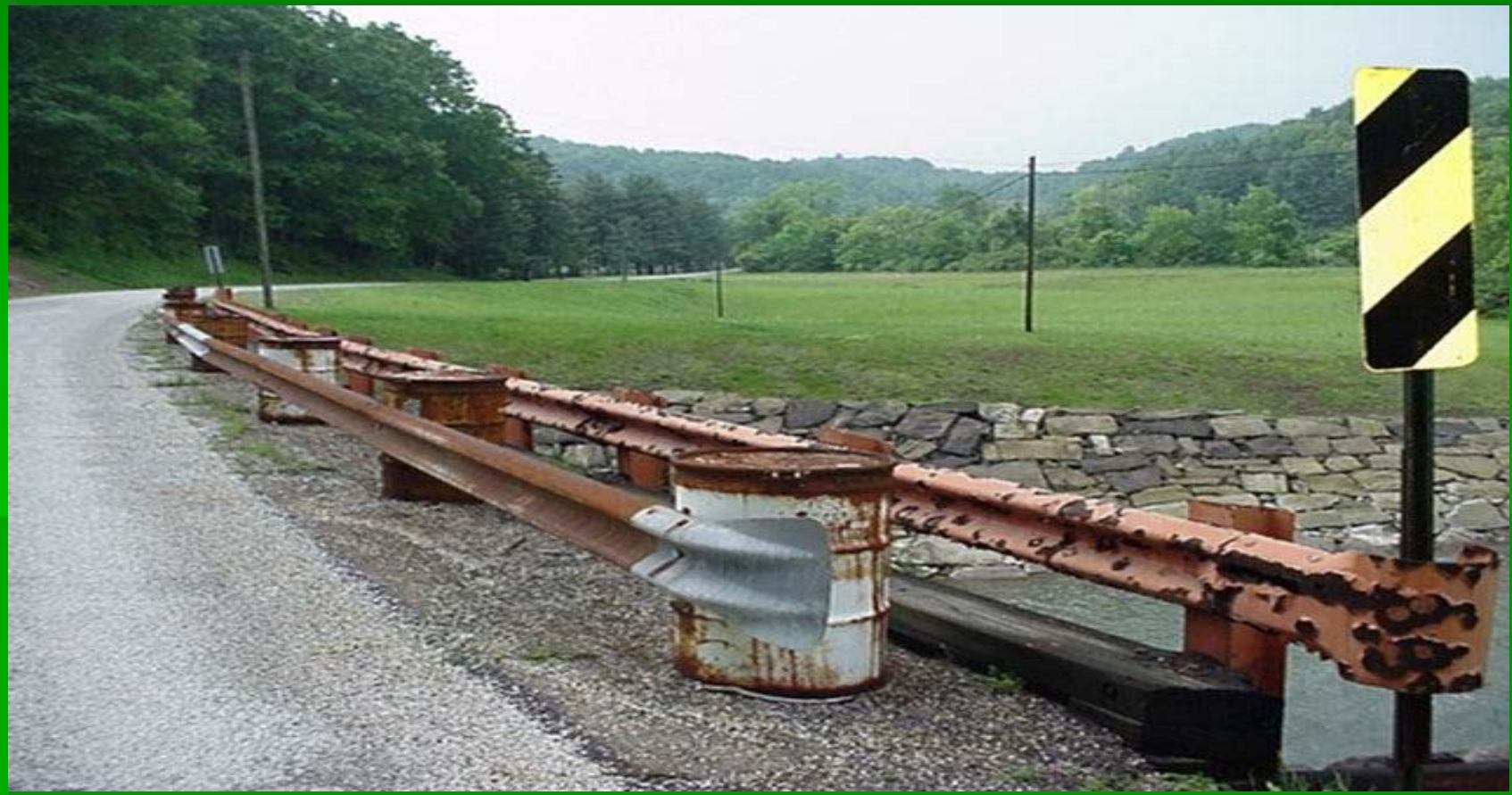
Stilling basin entrance to tunnel at Clendening Lake



Roadway bridge over stilling basin, Clendening Lake



Guardrail on bridge over stilling basin, Clendening Lake



OSHA further defines a permit-required confined space as a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- Contains any other recognized serious safety or health hazard.

Initial concerns addressed at Piedmont, Clendening, Leesville, and Tappan Lakes

- Entrants met for briefing prior to tunnel entry
- Safety considerations were discussed
- Air monitors were calibrated and used during entry
- Radio communication did not work
- After-action: SOP for tunnel entry written

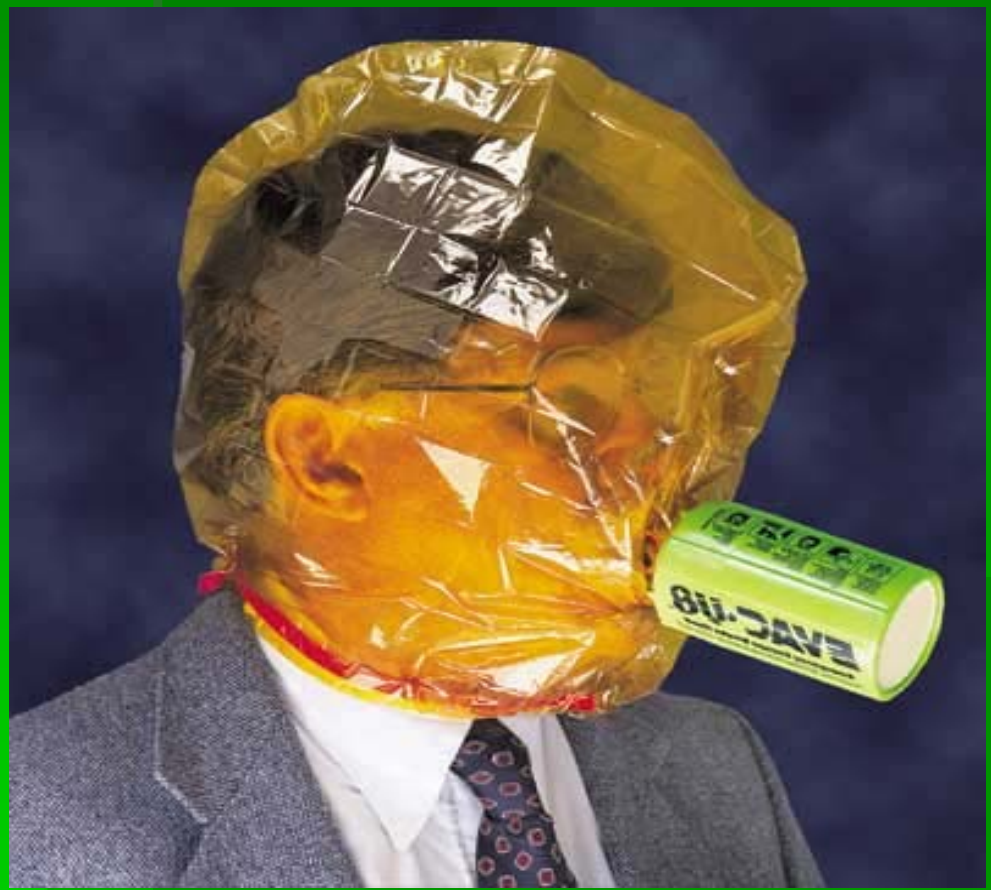
Inspection report compiled by an independent team at Atwood Lake

- Employees did not have adequate training in confined space procedures
- Local volunteer fire personnel were not equipped for rescue/emergency service
- Coordinate entries so that they occur after the water has “turned over”

Several options considered

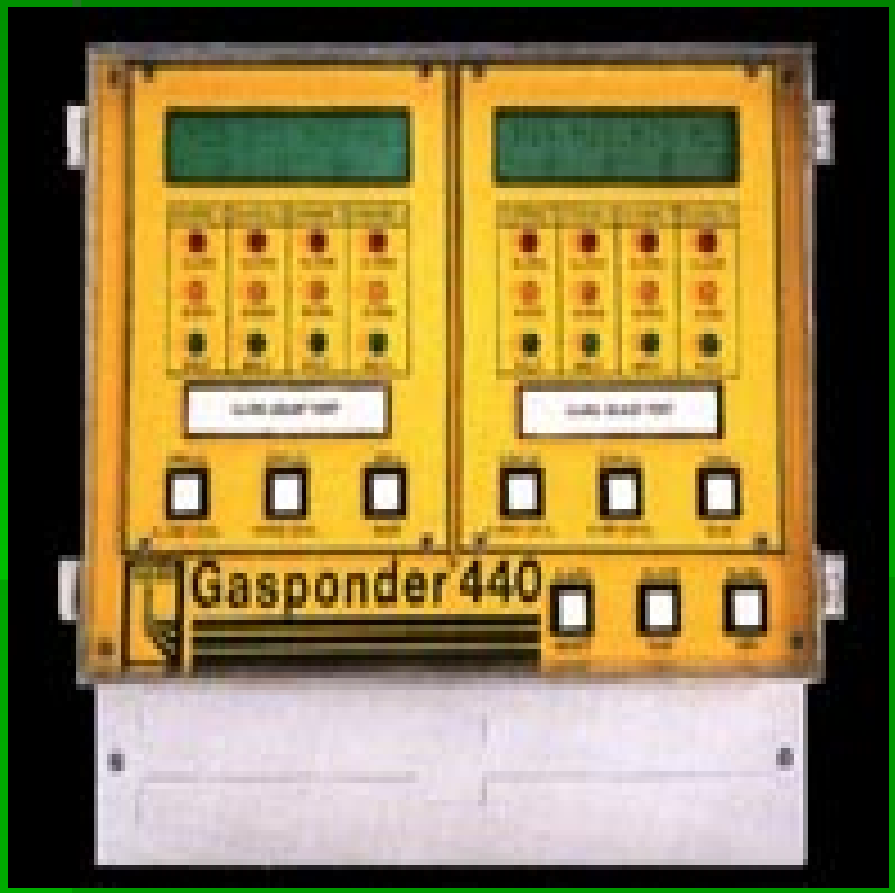
- Evac-U8 Emergency Escape Hood
- Fixed gas detection system
- Full-blown permit-required confined space program

Evac-U8



- Air filtered up to 20 minutes
- Removes toxic gases
- (including H_2S) with catalytic filter
- Compact, 11 ounces
- No special training, i.e., not a respirator
- Five-year shelf life

Gasponder Fixed Gas Detection System



- Modular 4-channel microprocessor-based control center
- Remote sensors as far as 2000 feet from control panel
- Automatic, non-intrusive calibration
- 2-year warranty

Permit-required confined space program

- Appendix to District's Safety & Occupational Health Administration Manual revised; entry permit revised; checklist added
- Memo issued on guidance for confined space entry into tunnels
- Controversy ensued between project personnel and management

A permit-required confined space may be reclassified as a non-permit confined space

- If entry is necessary to eliminate hazards, such entry must be performed in accordance with 29 CFR 1910.146
- If testing during entry demonstrates that there are no hazards, space may be reclassified as a non-permit confined space as long as the hazards remain eliminated
- Air monitoring would continue to be done during the entry

Certification of reclassification must be done to include:

- Date
- Location of space
- Signature of person making determination

Certification shall be available to each employee entering the space

Steps to be completed before entry into permit-required confined space tunnel

- Gates providing protection against engulfment have undergone Hydraulic Steel Structure certification by a professional structural engineer in accordance with ER 1110-2-8.
- Emergency bulkheads placed, service gates opened to allow maximum ventilation.

Steps to be completed before entry into permit-required confined space tunnel

- Lockout/tagout procedures in place to insure that gates/bulkheads cannot be raised while entrants are in tunnel.
- Tunnel initially tested for hazardous atmosphere by individual in Level B personal protective equipment.
- If safe to enter, continuous air monitoring done with at least two air monitors with up-to-date calibration records.

Steps to be completed before entry into permit-required confined space tunnel

- Presence of any hazardous atmosphere shall require immediate evacuation of tunnel.
- Emergency escape hoods to be carried by all entrants; airflow sufficient to allow exit from tunnel
- Thorough JHA completed; all participants trained on hazards and entry procedures prior to entry.

Steps to be completed before entry into permit-required confined space tunnel

- Emergency rescue personnel trained and equipped for rescue; must be available whenever tunnels entered.
- Two members of entry team must be certified in first aid/CPR.

Attendant duties

- Know hazards faced during entry; modes, signs, symptoms, and consequences of exposure.
- Maintain accurate count of authorized entrants in tunnel.
- Remain outside tunnel until relieved by another attendant.
- Communicate with entrants.
- Have ability to summon rescue services.
- Keep unauthorized entrants from entering tunnel.
- Perform non-entry rescue if needed.
- Perform no other duties than monitoring and protecting entrants.

Communication

- Positive means of communication shall be maintained between attendant and entrants.
- Means of communication may be visual, voice, radio, or air horn depending on configuration of tunnel and limitations it presents.

All tunnels posted with sign prohibiting entry by unauthorized persons.

Permit shall be prepared prior to tunnel entry.