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Collective Protection: How It Has Evolved

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Outline

- *Adsorbers*
- *Filter Units*
- *Transportable CP Systems*
- *Protected Vehicles*
- *Protected Buildings*
- *Airlocks*
- *Entry/Exit Processing*

Evolution of Adsorbent

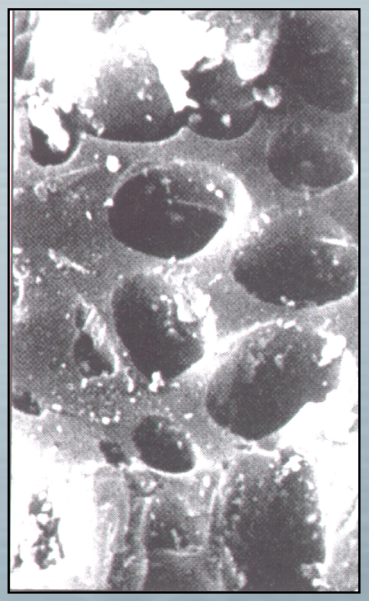
- The impregnated carbon alphabet

A ⇨ B ⇨ AS ⇨ ASC ⇨ ASZM-T

- Development driven mainly by storage-life and service-life shortcomings
- Threat list was static for 50 years despite recurring penetrant concerns.
- Renewed development due to TIC threat.
- Additional TIC capability for masks, but not yet for collective protection.
- Current quandary: which toxic chemicals to filter?

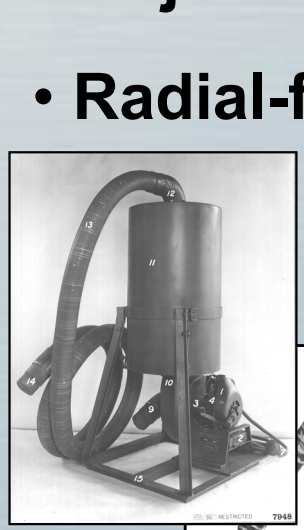
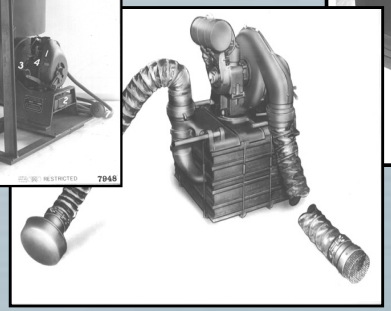
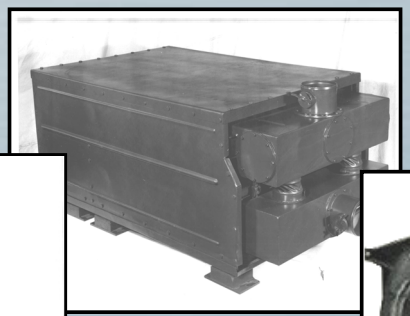
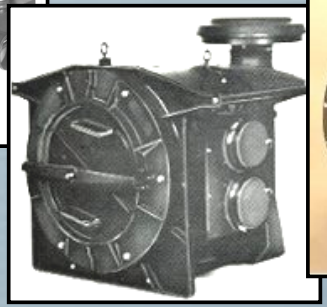
Filtering Small Molecules

- Not physically adsorbed
- First chlorine, then phosgene and hydrogen cyanide.
- Today, less toxic chemicals are the focus, such as ammonia, formaldehyde
- High-energy systems are effective but very high in operating cost.
  - *Catalytic oxidation*
  - *Plasma*
  - *Temperature-swing, pressure-swing*
  - *Power requirements 5 to 10 times greater than M98 set*.



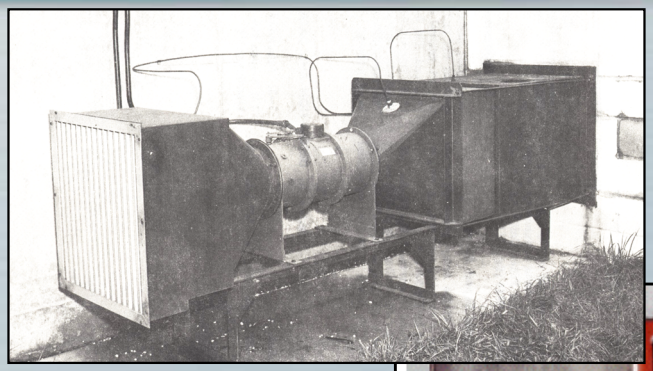
Evolution in CBR Filter Units

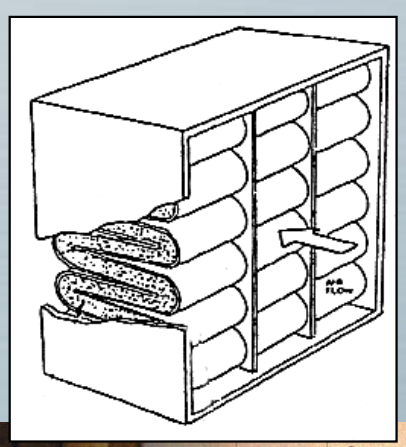
- Filter units are designed for:
  - Space efficiency: maximum surface area per unit volume
  - Modularity
- Sorbent specific to warfare agents, packed beds of 12x30 mesh carbon (>300,000 CT capacity)
- Major change ASC to ASZM-T in 1990s
- Radial-flow to parallel-bed to radial-flow

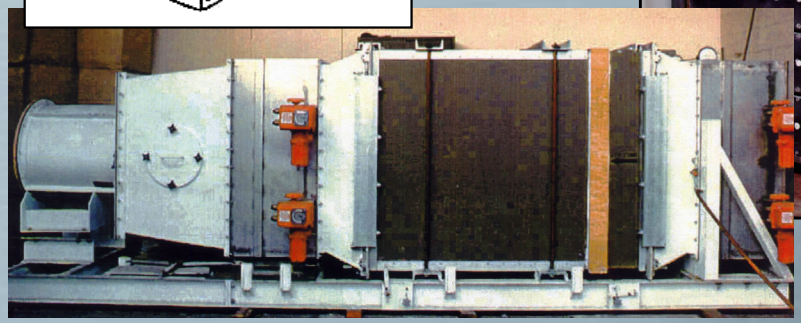





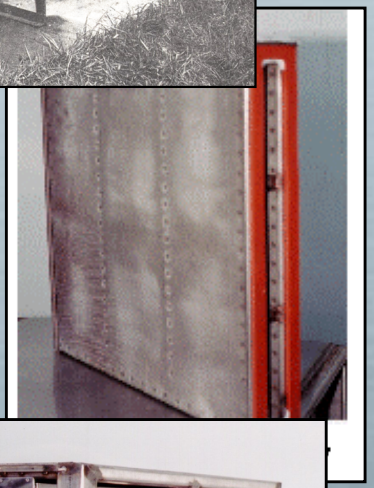
Axial-Flow Configuration, for Space Efficiency

- Parallel Bed
- V-Bed
- Folded Bed

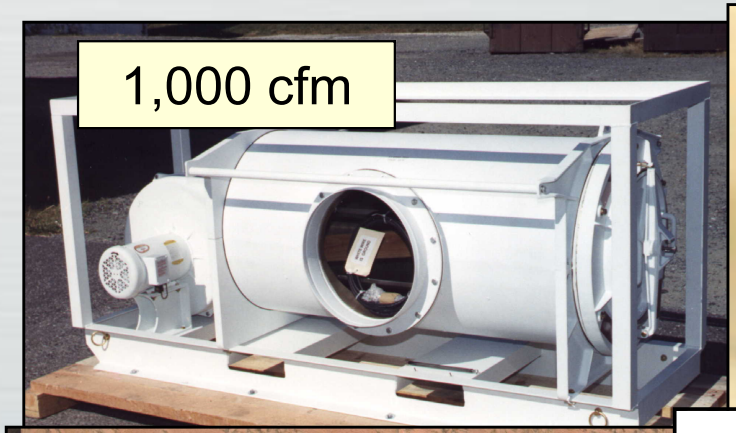


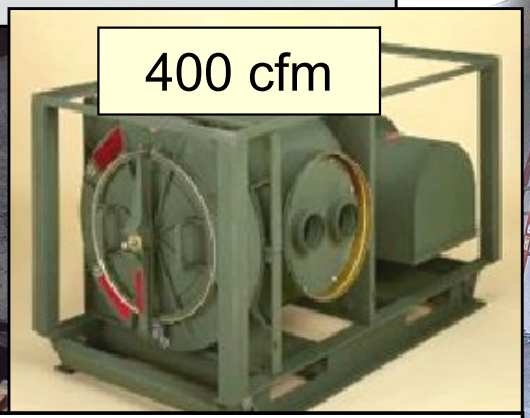


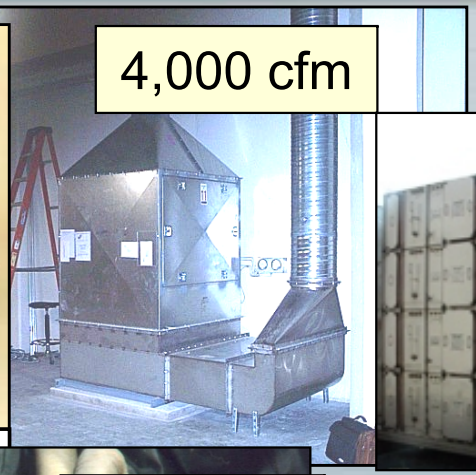


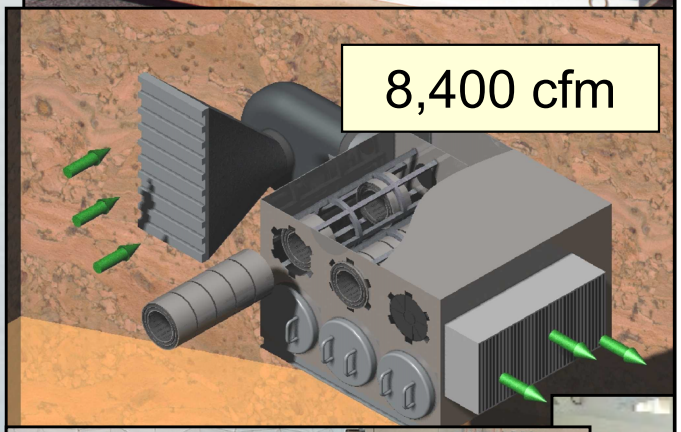


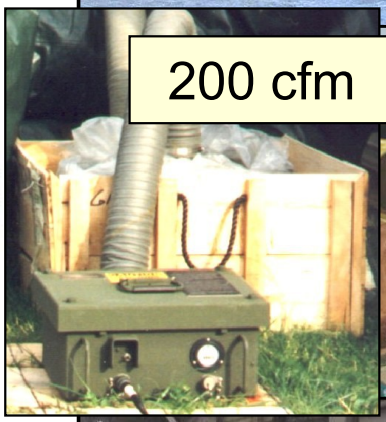
M98 Radial-Flow Set, for Modularity

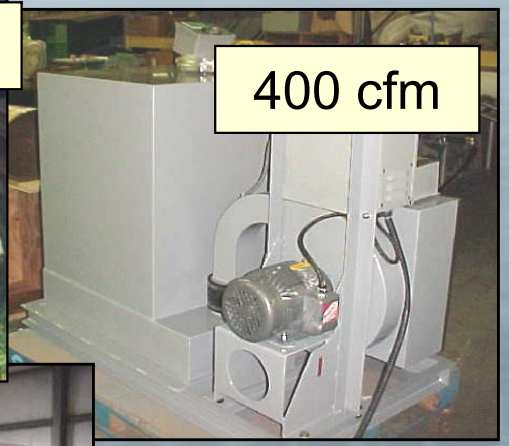


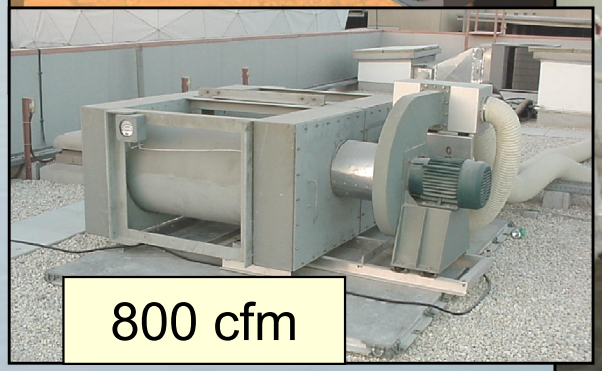


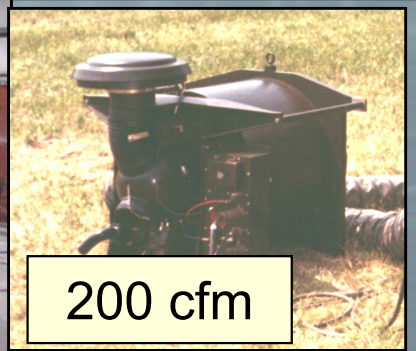






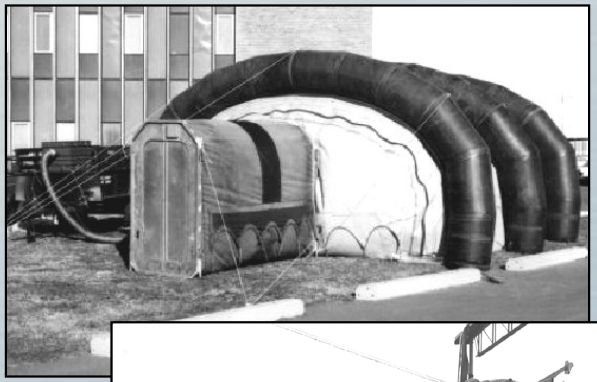




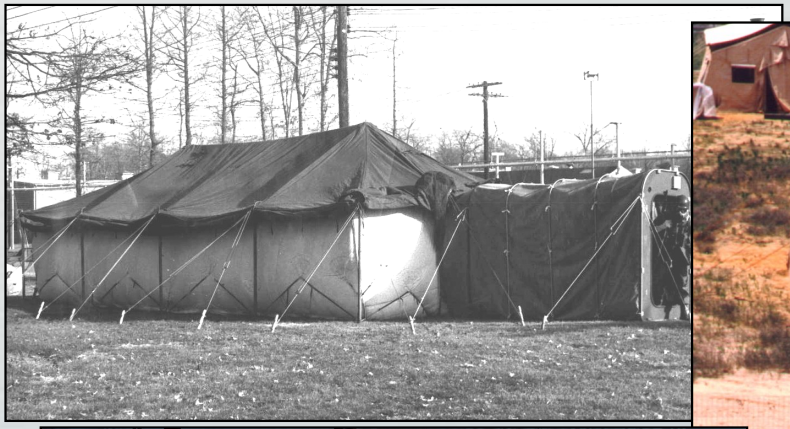


Evolution in Transportable CPE

- Soft shelter development driven by availability of barrier materials with:
  - Good chemical-agent resistance
  - Ease of assembly/sealing
  - Good physical properties
  - Reasonable cost

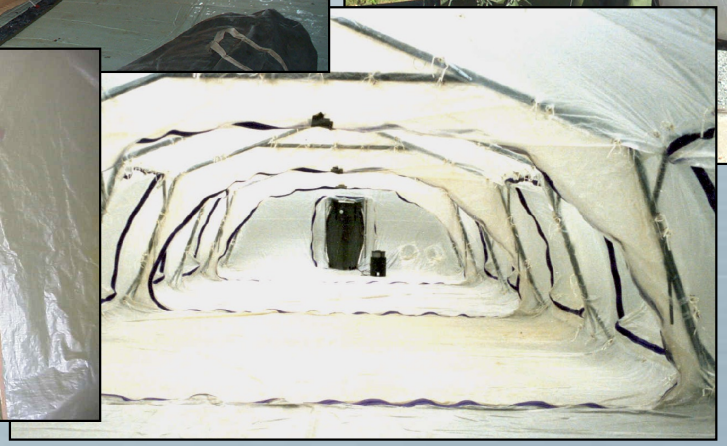


Transportable Liner Systems








M51 Shelter System, type-classified 1971

Shortcomings

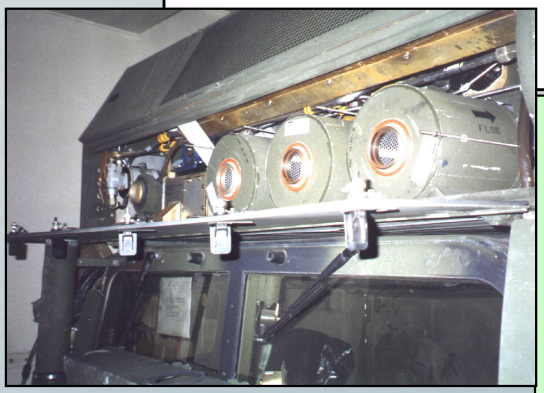
- *No prime mover for system*
- *Difficult to set up, strike*
- *High maintenance*
- *Too small for mission (200 sf)*

Notable Quote:

"Don't send us the M51 Shelter. We don't want it."

-- Chemical Officer, US Army Europe, 1979

Chemically and Biologically Protected Shelter (CBPS)



CBPS improvements over M51

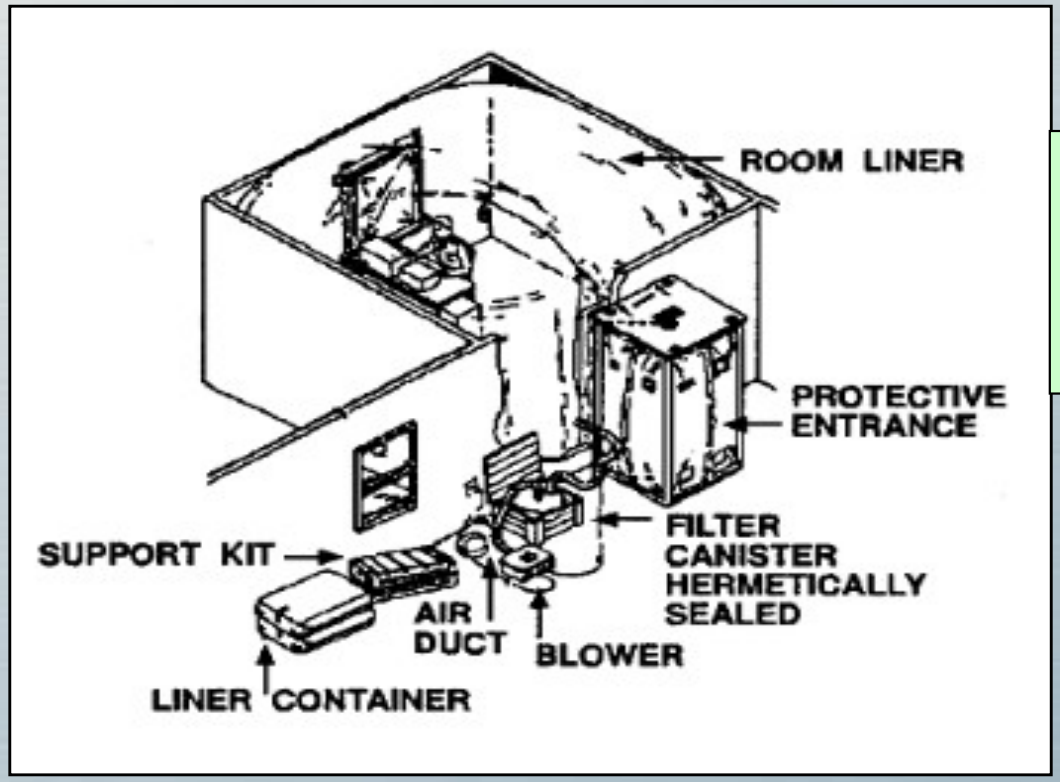
- 50-percent more shelter area
- Much more rapid setup/strike
- Greater configuration flexibility
- System includes prime mover

Lessons Learned, M20 Simplified CPE

- **Environmental control is essential**

  (Filter-Blower unit of M20 and PCPS has 15ºF temperature rise)

- **More flexibility for changing O&O concepts**



Notable Quote:

"You need to push the M20…"

M20 Simplified CPE

- Environmental control is essential
- More flexibility needed for changing O&O concepts

…push it into the ocean."

-- Barry McCafferty,
CG, 24th Infantry, 1991

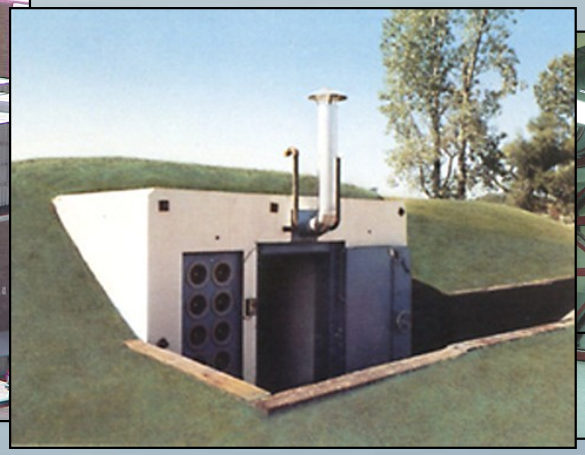
Evolution in Collectively Protected Vehicles

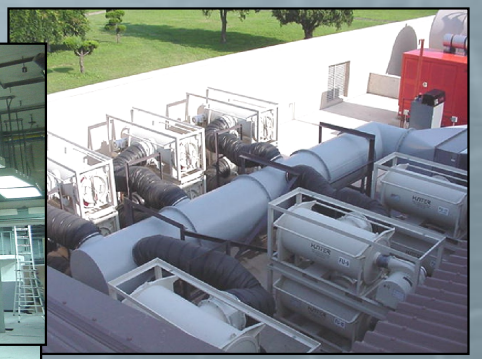
Technical challenges:

- Tight constraints on space, weight, and power
- Air-tightness of crew/ passenger compartment
- Efficient integration with existing air conditioning
- Entry/exit

Evolution in Collectively Protected Buildings

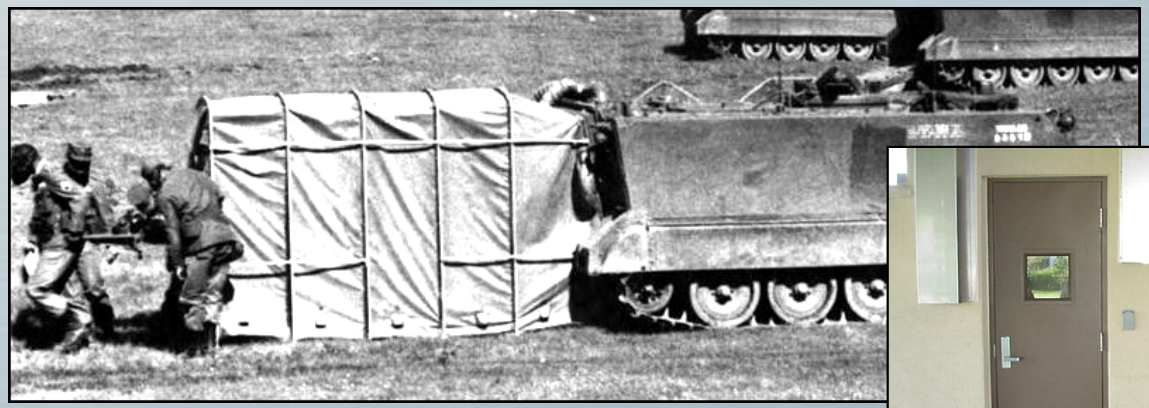
- Most significant change of past 50 years has been from ASC to ASZM-T carbon (affects in-place storage strategy)
- Trend has been away from active (standby) systems to passive (continuously operating).
- Most newer systems have no airlocks and contamination control areas due to changing threat scenarios.
- Newer applications require more air per sq ft. Earliest applications were hardened/underground shelters of very tight construction.



Evolution of Airlocks

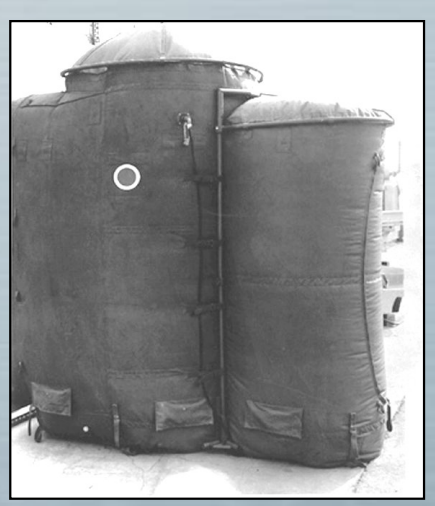
- General approach – purging by dilution with clean air – has been unchanged in 70 years.
- Engineering changes have been to achieve most efficient configuration of enclosure, clean-air source, flow pattern
- Purge flow of most airlocks is vented from shelter.
- Newer airlocks have dedicated filter unit for recirculation or makeup air.

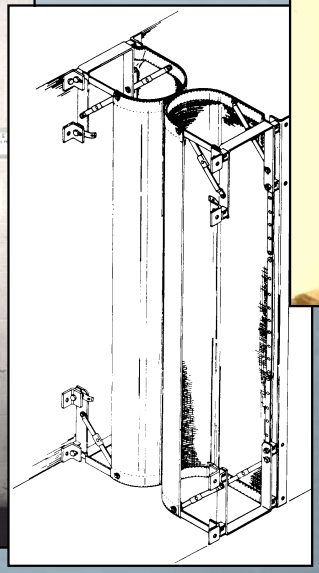


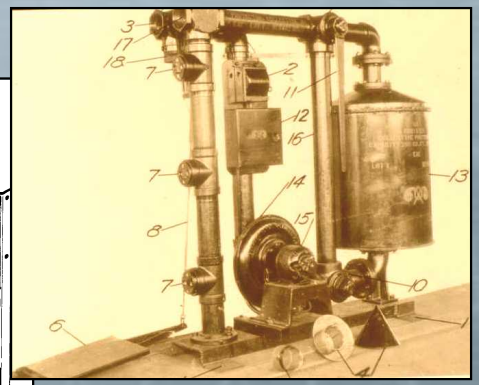
Airlocks

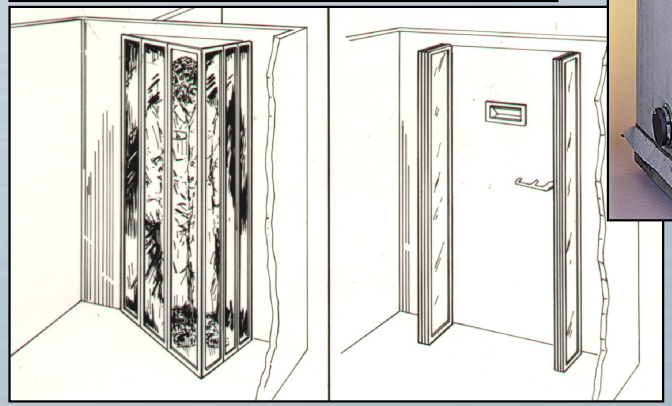
Novel approaches examined:

- Aerosol airlock
- Detection-booth airlock
- Diffusion-control door
- Contamination-avoidance curtain
- High-pressure jets for desorption



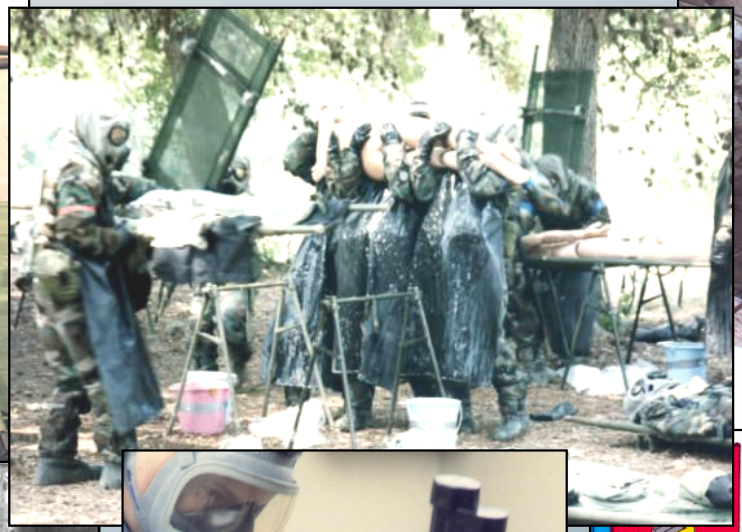


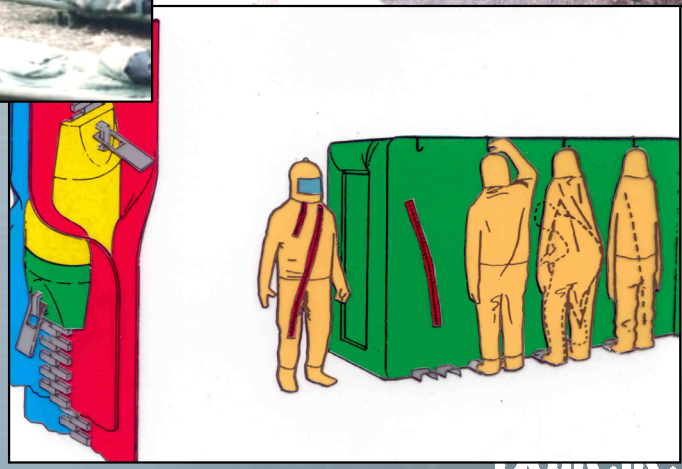




Evolution of Entry/Exit Procedures

- Process is same as it was 80 years ago: "*To enter, remove all outer clothing, particularly shoes*…"
- Most significant development has been real-time detection capability (CAM) – obviating entry/exit processing when there is no contamination.





Indoor Contamination Control Areas

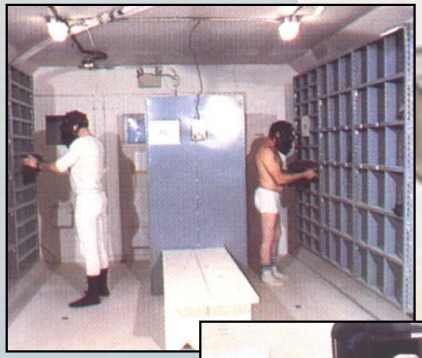
•Advantage: protection from conventional weapons and from environment.

• Require high ventilation rate:

• Outdoor vapor levels may be lower than indoor vapor levels.

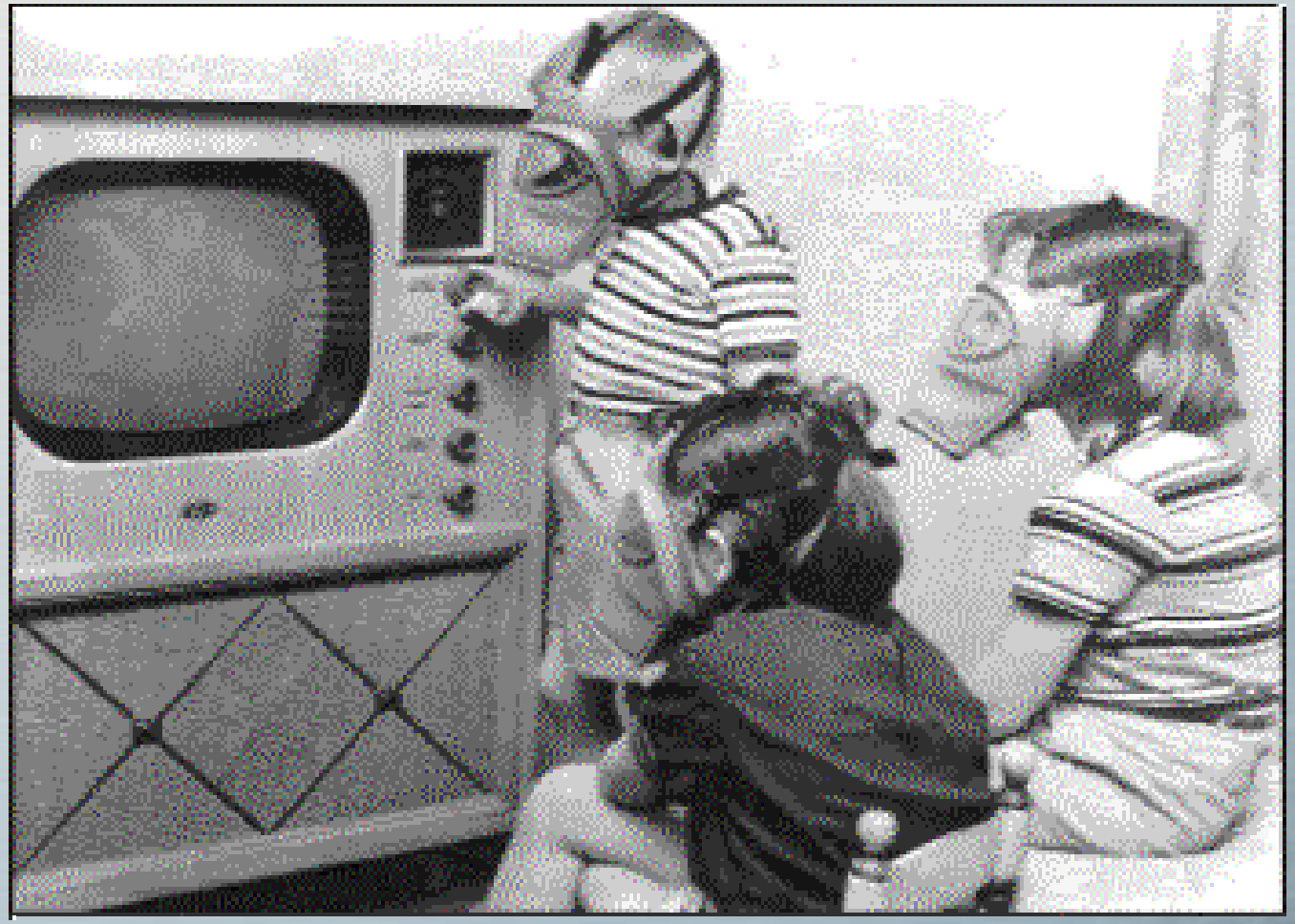
• Built mid-1980s and earlier, indoor CCAs are expensive real estate

• Trend is to open-air CCAs



Summary

- Major advancements in collective protection have been in improved sorbents, improved barrier materials, and real-time detectors for entry/exit.
- Most CP system improvements have resulted from efficient configuration of filters, filter units, shelters, and airlocks.
- Entry/exit and power requirements remain the main constraints.



Questions?