Savannah River Site Supplied-Air Suits

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Savannah River Site (SRS)

- Department of Energy site
- Constructed in the 1950’s to support the U.S. defense programs
- Less recognized missions
  - Neutrino first discovered
  - Had first nuclear reactor operated by computer
  - Produced Pu-238 used as heat sources for deep space missions
  - Radioisotopes for nuclear medicine and research
- In addition to continuing the support of our defense program
  - Radioactive waste solidification – borosilicate glass and grout
  - Mixed waste soil remediation programs
  - Radioactive waste tank cleaning and closure
  - Hydrogen fuel cell technology
- http://www.srs.gov/general/about/history1.htm
SRS Overview Of Supplied-Air Suits

- What is a supplied-air suit
- Discuss the SRS suit
- Describe suits in DOE facilities circa 1984 - LA-UR-84-846
- Current suit use in DOE facilities as of 2007
- Discuss unique considerations applicable to using suits
- Future
What Is A Supplied-Air Suit

- Currently defined by DOE-STD-1167-2003
  - Constructed for entire body
  - Primarily protects breathing zone
  - Normally also protects skin depending on the contaminant
  - Air supplied to head and preferably to body
  - Includes hoses, attachments, and accessories
  - Addresses user program

- Not a NIOSH certified hood taped to garments
History of the SRS Supplied-Air Suit

- First documented use in 1960’s
- Initially used for tritium - migrated to use in other facilities
- Initially 6-mil PVC
- Various versions & modifications
  - One-piece and two-piece
  - Improved durability & tritium protection with 12-mil PVC
  - Welding addressed with welding helmet features
  - Improved comfort with vortex tubes and ‘ice barrels’
  - Improved tritium protection with Saranex®
  - Addressed fall protection
  - Reduced cross contamination with shells or oversuits
SRS 12-mil Supplied-Air Suit

- Single use
- Two-Piece
  - 12-mil PVC top and pants
  - 20-mil PVC viewing area
- Airflow of 16-24 cfm
- Air distributed to helmet and pants
- Can be used with a vortex tube or ice barrel
- Typically worn with 2 pair of coveralls over Level D clothing
SRS Tritium Suit

- Single use
- Two-Piece
  - 9-mil top and pants
    - Chlorinated polyethylene
    - Saranex®
    - Polyester scrim
    - Layers bonded with ethylene vinyl acetate
    - 40-mil PVC viewing area
- Superior breakthrough and permeation characteristics for tritium
Key Steps In The Production Of The SRS Suit
Suit In Use And Process Of Removal
Opportunities For Improvement With SRS Suits

- Air Distribution System issues
- Material change (PVC to alternative) to eliminate pinholes
- Improved cuff design (sealed versus stitched)
- Reduce noise level
## Suit Status In DOE Facilities 1984

**LA-UR-84-846**

<table>
<thead>
<tr>
<th>User If Listed Manufacturer</th>
<th>Style</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocky Flats</td>
<td>2-Piece 12-mil PVC</td>
<td>1-Piece in use</td>
</tr>
<tr>
<td>JJ Avery</td>
<td>6 CFM 20K APF</td>
<td>Half mask respirator during doffing</td>
</tr>
<tr>
<td>SRS</td>
<td>2-Piece 6-mil PVC</td>
<td>Upgraded &amp; now available in 4 styles</td>
</tr>
<tr>
<td>Rich Industries</td>
<td>6 CFM 10K APF</td>
<td></td>
</tr>
<tr>
<td>LANL</td>
<td>2-Piece 6-mil PVC</td>
<td>2 versions with different air distributions</td>
</tr>
<tr>
<td>Fab Ohio</td>
<td>6 CFM 10K APF</td>
<td></td>
</tr>
<tr>
<td>Oak Ridge</td>
<td>2-Piece 6-mil PVC</td>
<td></td>
</tr>
<tr>
<td>Fab Ohio</td>
<td>8 CFM 10K APF</td>
<td></td>
</tr>
<tr>
<td>Rich Industries</td>
<td>1-Piece 20-mil PVC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6-CFM 10K APF</td>
<td></td>
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# Current Status In DOE Facilities

<table>
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<tr>
<th>Facility</th>
<th>Description</th>
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</table>
| SRS      | 4 suit styles with various sizes & features  
Annual usage currently ~3,500  
Peaked at 67,000 in 1990 |
| LANL     | Uses SRS suit |
| Idaho    | Using a suit that evolved at Rocky Flats after the 1984 report  
APF limited to 1,000 |
| Y-12     | Supplied-air suit used for product protection |
Unique Considerations In Designing Suits

• **Major design consideration**
  - Avoid creating $O_2$ deficient or elevated $CO_2$ condition
    - Air Off results in 19.5% $O_2$ in less than 20 seconds
    - Air Off results in 16% $O_2$ 40-70 seconds depending on conditions

• **Address loss of air**
  - Unassisted removal
  - Built in ‘escape’ cartridge
  - Egress air
    - SRS breathing air systems typically provide 5 minutes

• **Assigned Protection Factor**
  - Historically 10K within DOE
Unique Considerations In Designing Suits

- **Volume of air required may impact breathing air systems**
  - 4 - 10 CFM for NIOSH approved masks & hoods
  - Much higher volume may be required for suits to address cooling or protection factor
- **Donning & removal**
  - One-piece
  - Two-piece
  - Typically requires additional person
- **Body Types**
  - Height
  - Girth
  - Inseam
Unique Considerations In Designing Suits

- Suit materials - PVC - is a balancing act
  - In cold weather PVC films become rigid and can break
  - In hot weather PVC films may sag and distort vision

- Self-extinguishing characteristics
  - Acceptable suit materials DO burn
    - Self-extinguish when flame is removed
    - Film does not drip during burn
Unique Considerations In Designing Suits

• Noise levels
  – Higher than hoods
  – Suit design affects noise level
    • Location of where air enters suit
    • Higher air volume generally increases noise

• Heat Stress
  – Air may need supplemental cooling

• Chemical Permeation

• Additional equipment
  – Hard hats
  – Communication devices
  – Body harness
Unique Considerations In Designing Suits

• Suits MUST be designed with use of harness in mind
  • Workers should not don harness over suit
  • Improper use may result in reduced APF
  • Improper use may affect how fall arrest operates
FUTURE

- DOE facilities beyond SRS expressing interest in using suits
- PAPR Suits
- Efforts beyond DOE
  - ASTM
  - NIOSH