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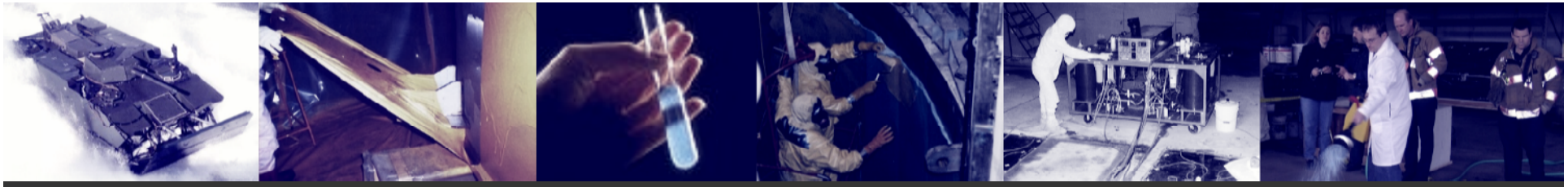
Polymer Technologies for the Lockdown and Removal of Radioactive Contamination

Jayne Shelton
Isotron Corporation

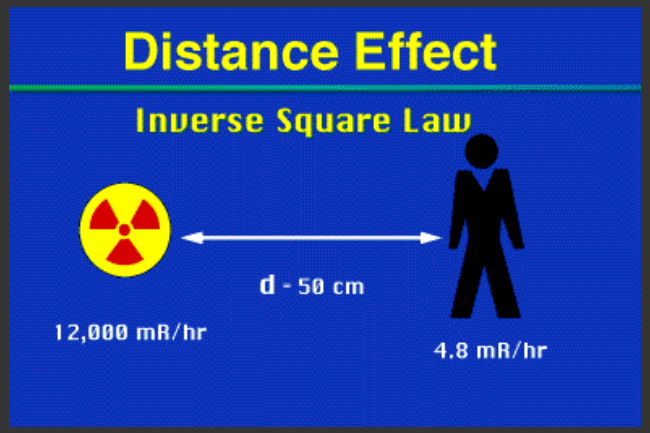
1443 N. Northlake Way
Seattle, WA 98103
(206) 632-0173
Fax: (206) 260-7014
http://www.isotron.net



Contamination vs. Radiation

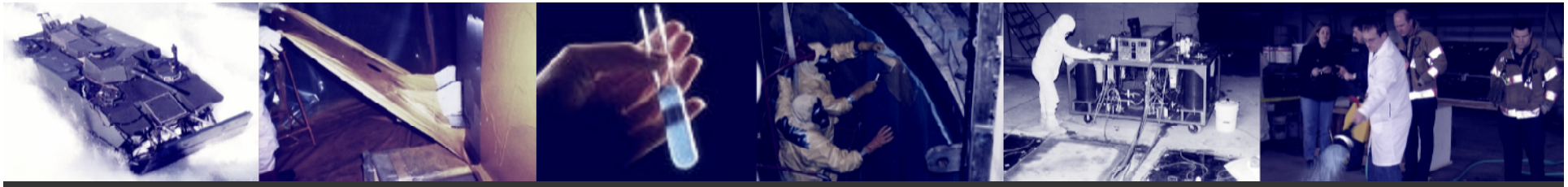
Contamination	Radiation

• Mobile
  ▪ Watersoluble ions
  ▪ Windborne dust
• Intimate contact (d=0)
• Ingestible radiation
	• Ionizing radiation damage to cells
	• Intensity drops with inverse square
	• Acute or chronic doses

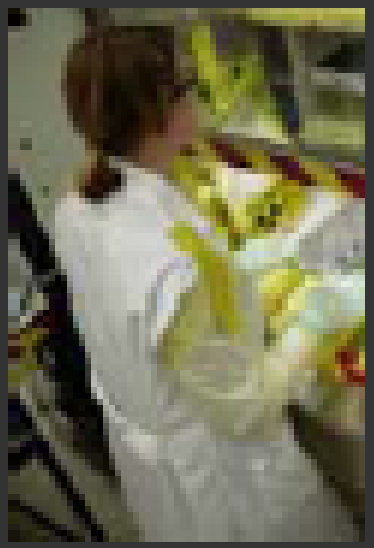


Source: Univ. of Penn.

Contamination must be suppressed immediately, whereas radiation can be dealt with in a longer timeframe.



Radiation Shielding & PPE



Jayne working in hot hood at INL.

Nuclide	Type
Cs-137	beta/gamma
Sr-90	beta
Co-60	beta/gamma
Ru-106	beta
Pu-239	alpha

Possible spent fuel rod inventory.

Jayne training in rad PPE.

Personnel distance and contact time can be controlled.

Isotron Strippable Coating ConOps

EVENT

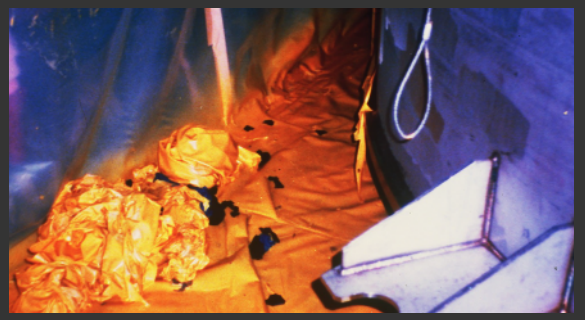
Immediate Response
Contaminant Lockdown

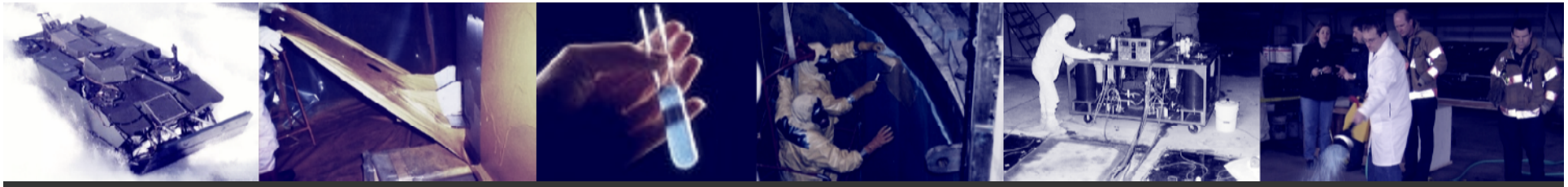
Personnel Protection

Personnel Decon

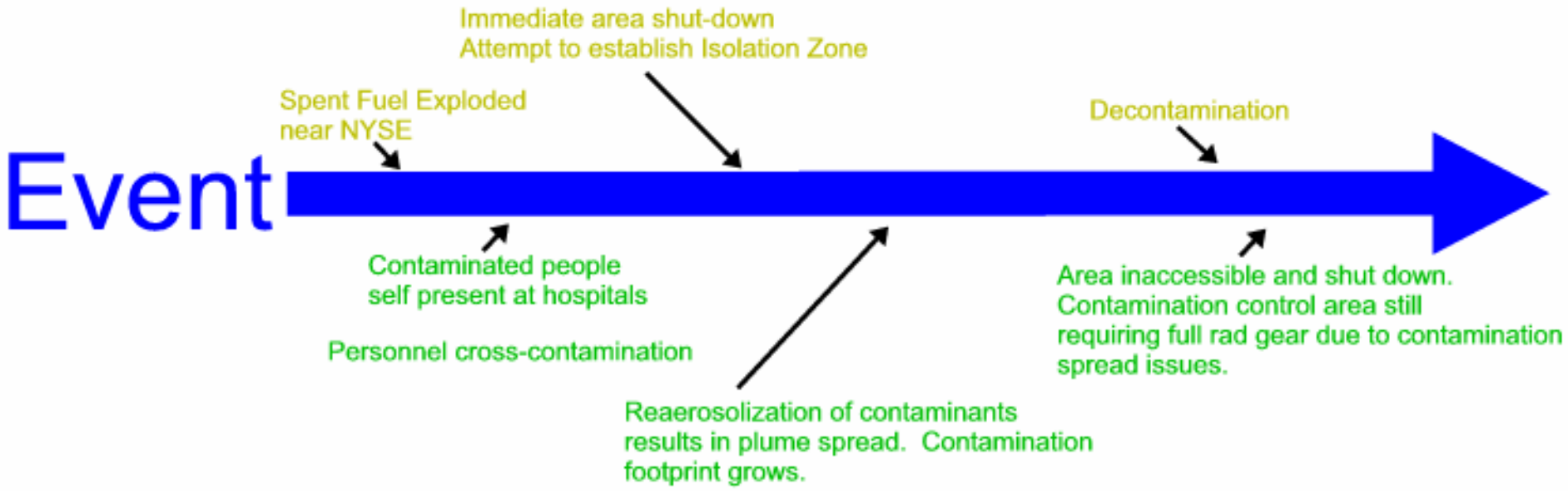
Decontamination

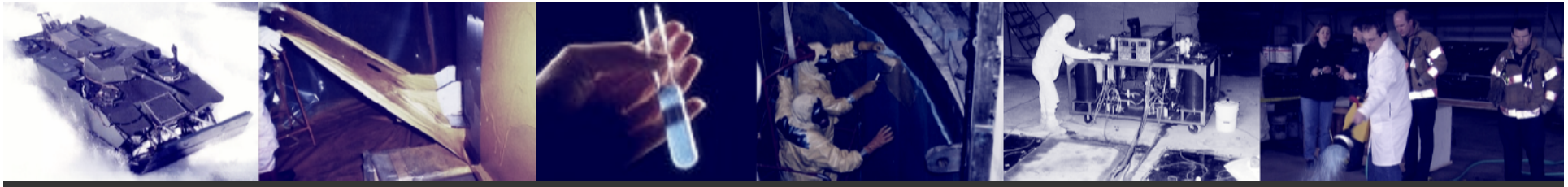
Disposal





ConOps Vision Timeline - Before





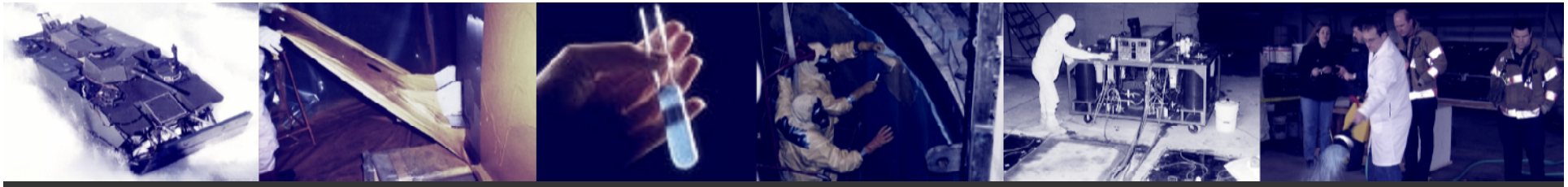
Importance of Plume Mitigation

TOPOFF 2 Terrorism Response Exercise May 2003 in Seattle, WA

Mock contamination from dirty bomb detected within c. 4 hours at San Juan Islands

Foot long stick of Co exploded at Manhattan would contaminate 1,000 sq. km, three states (NY Times, 2004)

Satellite image of Puget Sound.



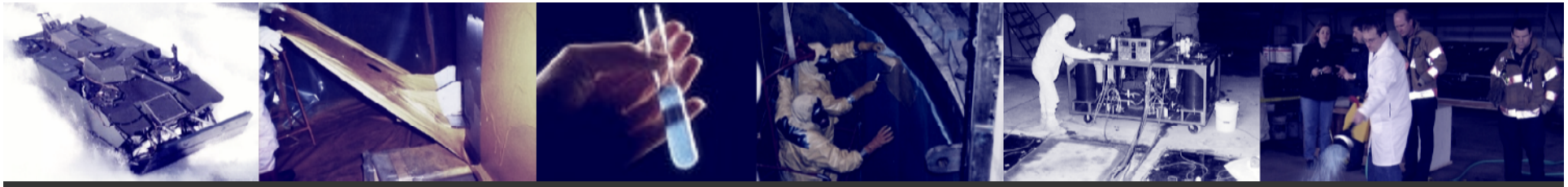
ConOps: Immediate Post-Event Activity

Wide area application of IsoFIX lockdown polymer

- Particulate lockdown
- Application from a distance

Isotron lockdown application with hydroseeder prevents personnel contact.

Pilot-scale testing in Seattle.

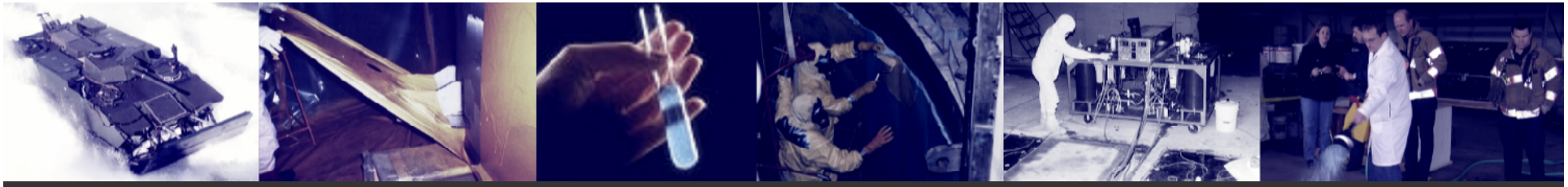


IsoFIX Lockdown Polymer Key Features

- Sprayable, elastomeric, removable polymer media
- Prevents transport by rain, wind, traffic

Once applied, the coating is easily and quickly peeled.

Pilot-scale demonstration of IsoFIX with SFD.

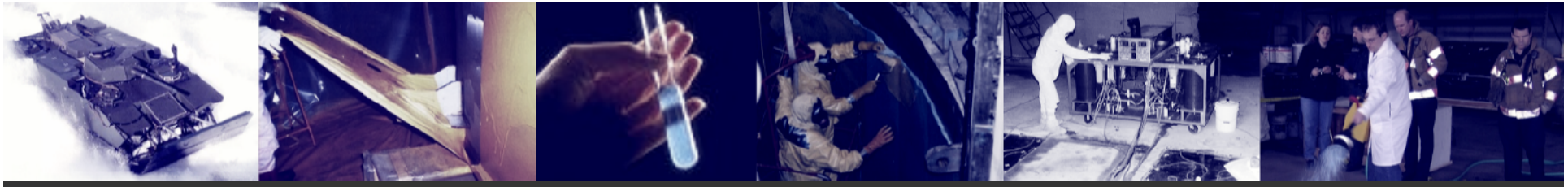


IsoFIX Lockdown Polymer Dust Suppression

Helipad dust suppression in Richland, WA.

Airborne lockdown immediate, full polymer properties within 13h

Helicopter dust suspensions cause personnel contamination (Chernobyl)

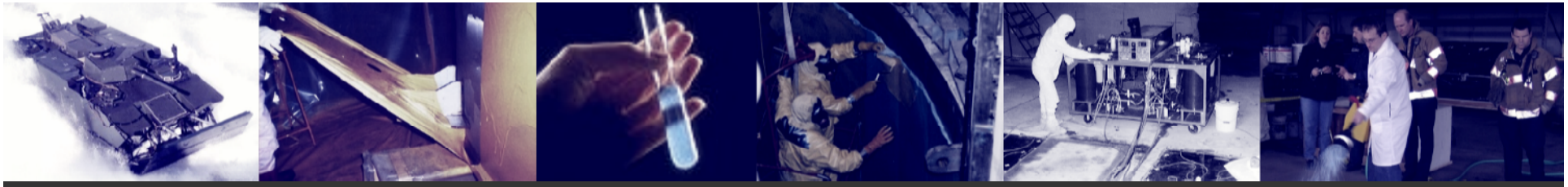


IsoFIX dust suppression trials in Richland, WA (2005)

56,000 lb. brush truck

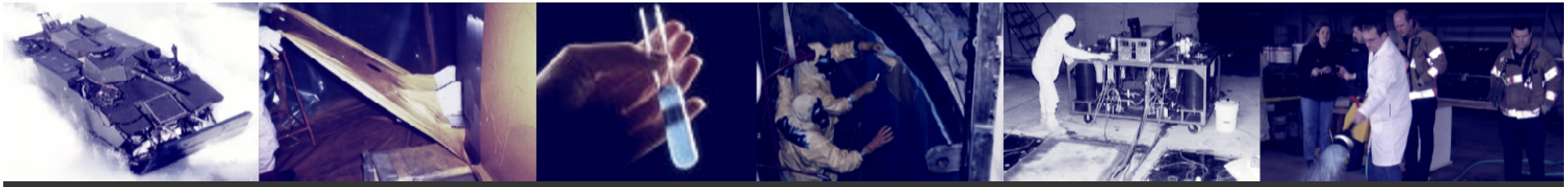
Treated section of ground did not break or lose integrity after brush truck test.

IsoFIX withstands foot traffic, emergency ground vehicles



Advantages of IsoFIX Lockdown

- Contamination footprint contained
- Cross-contamination eliminated
- Critical operations may resume (NYSE)
- Personnel contamination is reduced
- Removable media to facilitate downstream decontamination



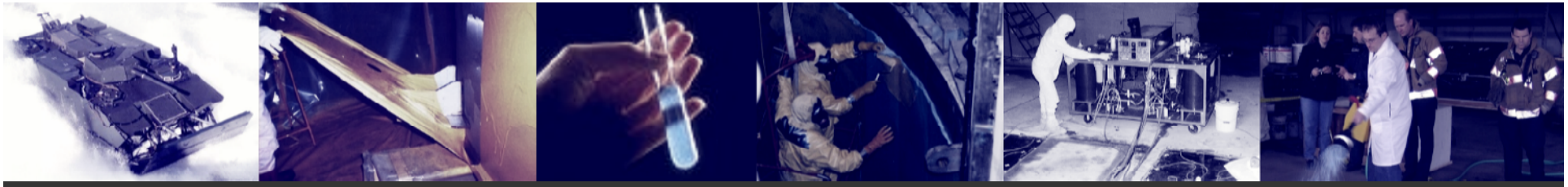
ConOps: Recovery & Reoccupation

Source: JZPhotos.com

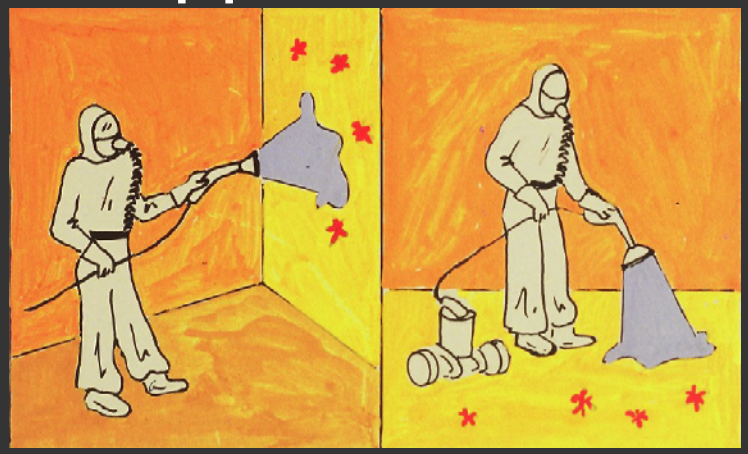
How clean is clean?

DARPA SPO Radiation Decontamination Program, in collaboration with DHS, set performance criterion at 1 mSv/yr at 1m (near background)

Attain level at over variety of surfaces, materials



ConOps: Strippable Decon Coatings

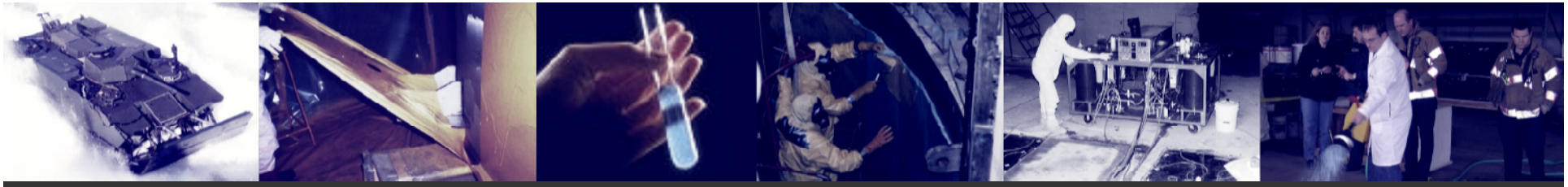


Step 1. Survey suspected areas and determine decon needs

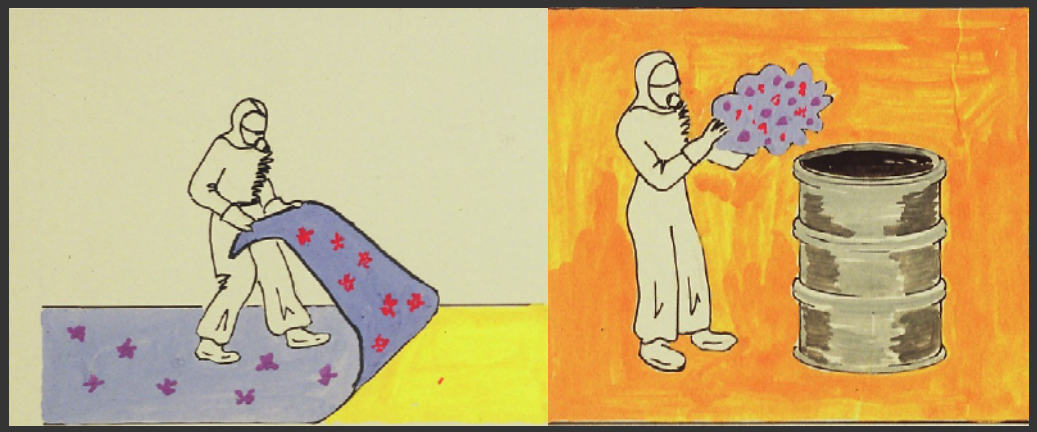
Step 2. Remove IsoFIX lockdown coating

Step 3. Apply optimal decon coating

- conventional spray equipment
- 3 m^2 coverage per gallon
- 400 m^2/hr per spray pump



Strippable Decon Coatings (cont'd)

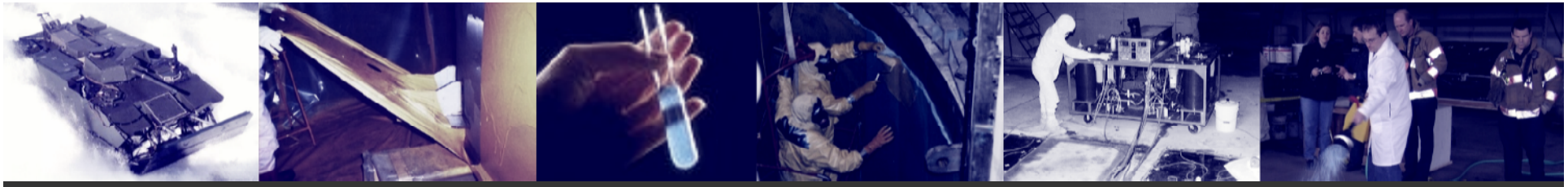


Step 4. Remove decon coating

- Peelable, no equipment necessary
- 150 m^2 per man-hr

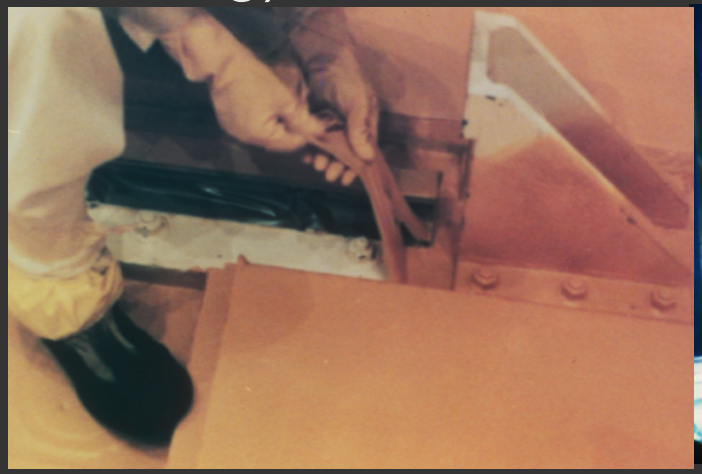
Step 5. Transport to appropriate waste facility

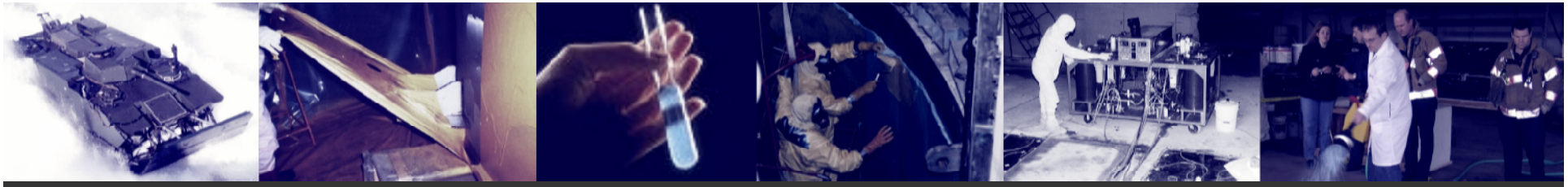
- Solid waste disposal
- Compression ratio of waste on order of 50% (worst case scenario)



Real World Performance of Strippable Decon Coatings

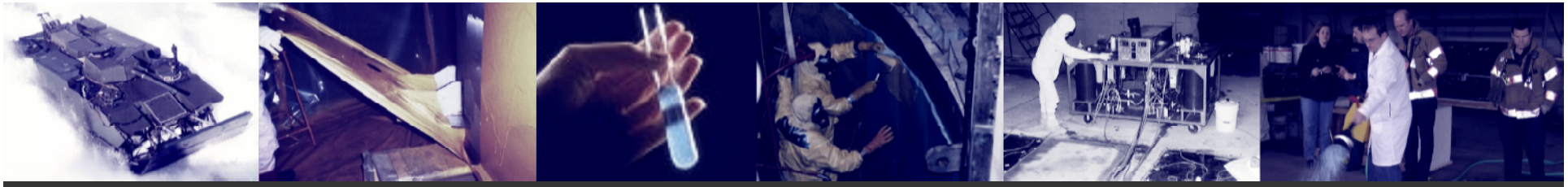
- Low man hours (Nine Mile NPP)
- Quick return to operations (3 Mile Island)
- Removable from complex surfaces
- Simultaneous locks down and decons (as opposed to scabbling)





Highlights of ConOps Vision via Strippable Lockdown & Decon

- Expedient deployment to reduce personnel radiation exposure
- Cross-contamination avoidance
- Facile removal w/o resuspension risk
- Solid waste disposal (low-risk/low-cost)



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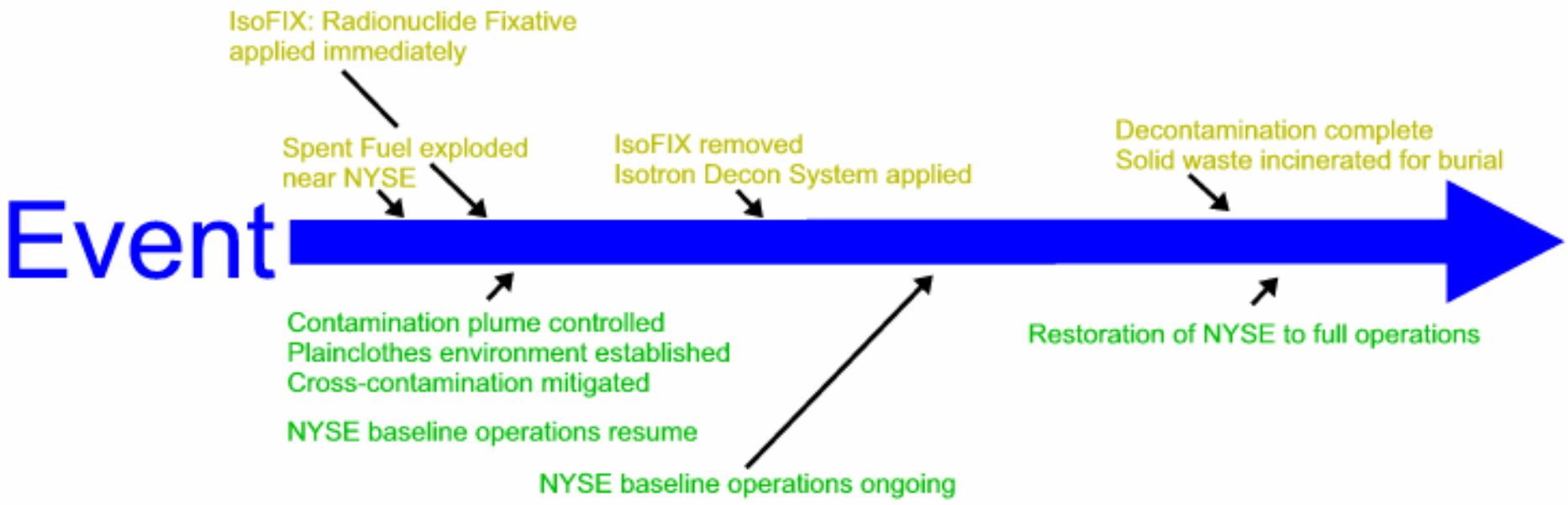
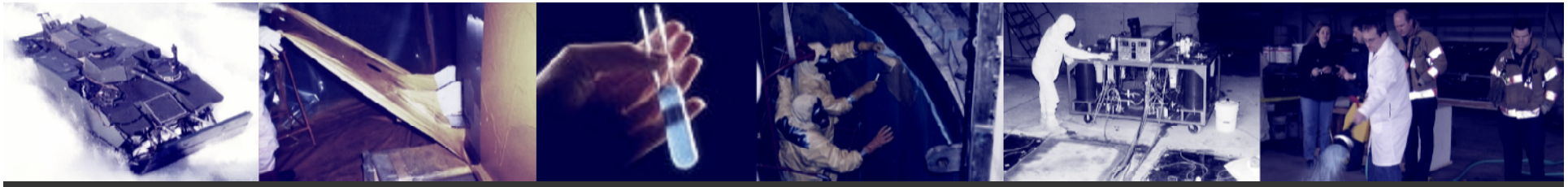
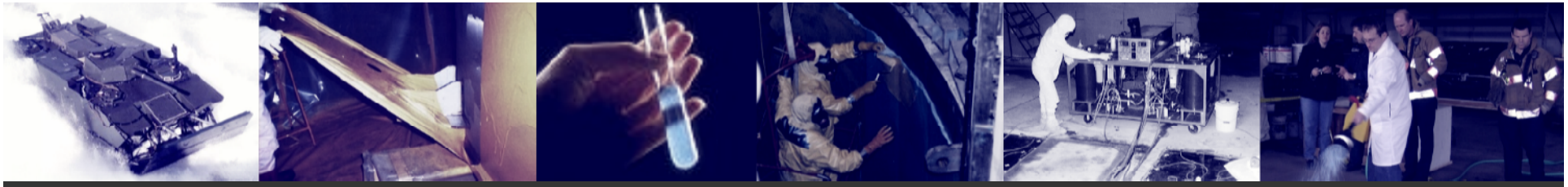




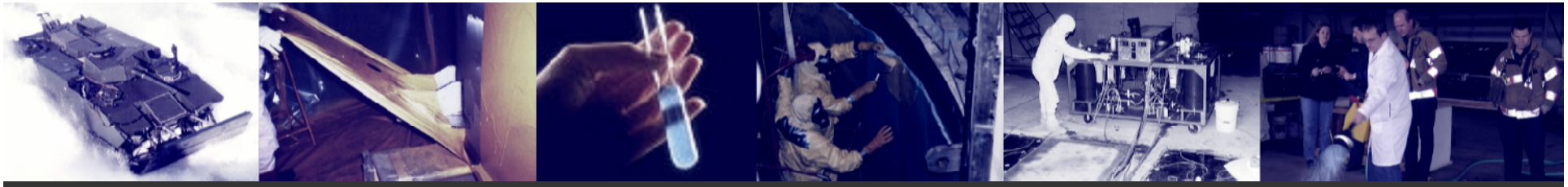
Strippable Coating Products & Experience

- **Isolock-300**
  - Anti-contamination and surface decontamination for reactor cavity
  - Designed for immersion service
  - Deployed at: Houston Power and Light, Nine Mile, Oyster Creek
- **Isolock-HP**
  - Designed for high cross-section “hot” particle capture
  - Deployed at Arizona NPP
- Isolock-VB (HSARPA)
  - Vapor barrier portion of 2-step TIC Neutralization and Removal System
  - Wide area application system
- IsoDEF™ (CB Barrier System)
  - The first expedient shelter coating designed for barrier protection from chemical, biological and radiological contaminants
  - Demonstrated in live chemical agent trials in Czech Republic (HD Threat)
  - Currently in TRE Evaluation by JPEO CoIPRO



Acknowledgements

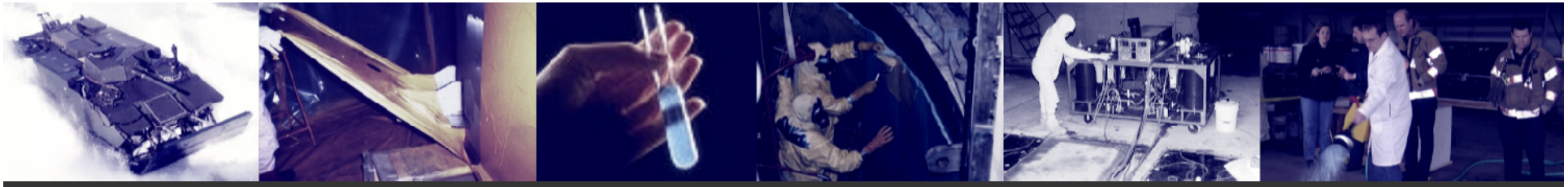
- Radionuclide Fixative Technology development is sponsored by the Technical Support Working Group under contract W91CRB-04-C-0021
- Radionuclide Decontamination Program is Sponsored jointly by DARPA and DHS under contract HR0011-04-C-0050



Isotron®

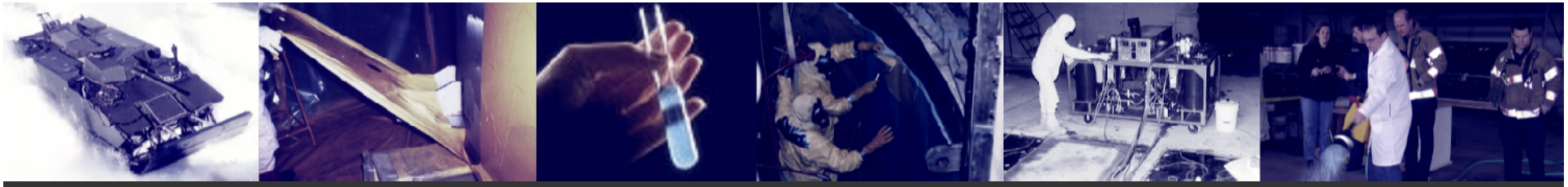
Advanced Polymer Composites

http://www.isotron.net



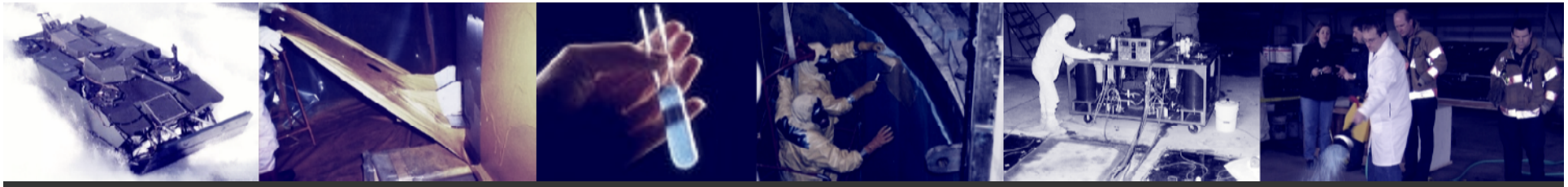
Safety &Toxicity of IsoFIX System

- Water-based Coating System
  - Non-flammable solution
  - Pre-mixed solution poses low health risk during application; mitigated by donning proper PPE
- Overall Environmental Impact
  - IsoFIX is waterborne and low VOC
  - No residue is left behind after removal



Safety &Toxicity of Decon Coating System

- Water-based HASPs
  - Non-flammable solution
  - Pre-mixed solution poses minuscule health risk during application; mitigated by proper PPE
- Solvent-based DTS
  - Flammable solution - proper ventilation needed to reduce flammability limit of air
  - PPE should include solvent respirators
- Overall Environmental Impact
  - Solvent-based DTS is based on VOC-exempt solvent (acetone)
  - HASP is waterborne and contains no VOC
  - No residue is left behind after removal of the strippable film



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  - Deployed at: Houston Power and Light, Nine Mile, Oyster Creek
- Isolock-HP
  - Designed for high cross-section “hot” particle capture
  - Deployed at Arizona NPP
- **IsoFIX / HeloTRON (Technical Support Working Group)**
  - Radionuclide and particle contaminant countermeasures
  - Designed for emergency service to “lock down” contaminants during S&R activities
  - Dual use as dust palliative for temporary helicopter landing sites
  - Removable on demand via peeling OR dissolution
  - System was deployed at field scale with TSWG, Seattle Fire Department and US Marine Corps oversight on May 13, 2005
- “Orion” System (DARPA Radiation Decontamination Program)
  - Deals with decontamination of dirty-bomb materials from common building surfaces
  - Complete decontamination system leverages strippable coatings to facilitate removal and transport of contaminants
  - Phase I demonstration completed April, 2005
- Isolock-VB (HSARPA)
  - Vapor barrier portion of 2-step TIC Neutralization and Removal System
  - Demonstrated for use on: NOx, HSO4, Cyanide, Ammonia, Ethylene Oxide and Cyclohexane remediation
  - Phase I effort will be complete June, 2005
- **IsoDEF™**
  - The first expedient shelter coating designed for barrier protection from chemical, biological and radiological contaminants
  - Demonstrated in live chemical agent trials in Czech Republic (HD Threat)
- Other systems developed by Isotron Team:
  - SprayPoly*: Asbestos control system
  - ALARA-1146*: First-generation radionuclide decon coating designed immediately following Three Mile Island accident.