Project 3 D&D

Derek Gabaldon (DOE Fellow)

DOE-FIU Science and Technology Workforce Development Program

Applied Research Center

Florida International University

Project 3 D&D Mission Sets and Research Areas

- Leveraging ASTM International's E10.03 Subcommittee to develop standards and testing protocols for D&D technologies
  - Foundation for a "standards-based" technology test and evaluation program

- Adapting COTS-based Intumescent Technologies for D&D Applications
  - Incombustible Fixative Coating ISO SRS 235-F PUFF Facility
  - Incombustible Foam Fixatives as "Plugs" to Decommission Piping

- Empirically quantifying operational performance of fixative technologies
  - Open Air Demolition activities (e.g.: impact and environmental stressors)
  - Safety Basis contingency scenarios (e.g.: fire and extreme heat stressors)

Scope/Objective

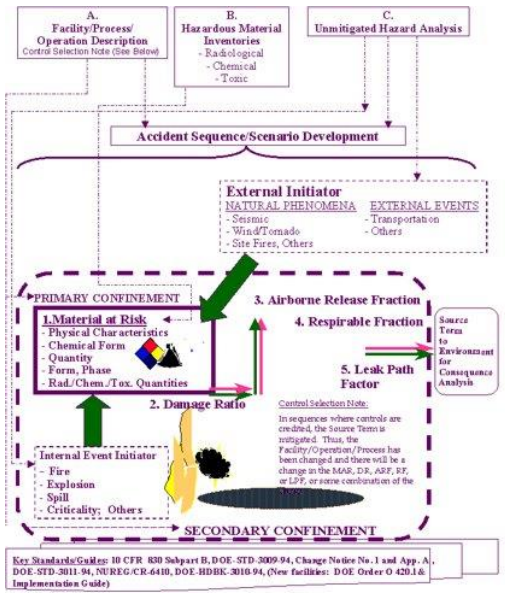


Table 1. Types of Accidents (and Frequencies) Summarized

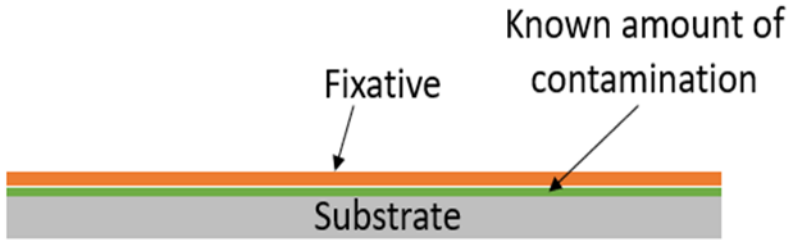
DOE Site/Facility	Fire Events	Explosion Events	Loss of Confinement (Spill) Events	Natural Phenomena Hazards	Other Events
RFETS Bldg 440	• ***1,200 Drum Fire (EU)*** • ***15 Crate Fire (U)*** • Truck Fire (EU)		• LLW Repack Spill (U) • Drum Spill (A)	• ***Earthquake Collapse (U)***	• ***Aircraft Crash (EU)***
RFETS Bldg 664	• ***3 Drum Fire (U)*** • ***15 Crate Fire (U)*** • *336 Drums + 72 Crates Fire (EU)* • Truck Fire (EU)		• *Multi-Container Drop*	• ***Earthquake Collapse (U)***	• ***Aircraft Crash (worst-case) (EU)*** • ***Aircraft Crash (realistic case) (EU)***
SRS APSF	• *Accountability Msmt. Room Fire (U)*	• *Explosion in Repackaging Area (A)*		• *Seismic Induced Full Facility Fire (U)*	
SRS HB-Line	• Full Facility Fire (EU) • Full Facility Fire & Secondary Events (EU) • ***Intermediate Fire (U)*** • ***Intermediate Facility Fire & Secondary Events (EU)***		• Spill (A)	• Earthquake with Secondary Events (EU)	
SRS Bldg 235-F	• Fire – Best Case (U) • Fire – Worst Case (U)			• Design Basis Earthquake (EU)	
SRS SWMF	• ***TRU Pads - Internal Culvert Drum Fire (U)***	• ***TRU Pads - Culvert Explosion (U)***	• TRU Pads - High Energy Vehicle Impact (EU) • ***TRU Pads - Dropped Steel Box (A)***	• TRU Pads -Tornado (EU)	• 634-7E Buried Waste Helicopter Crash (EU)
Hanford WRAP Facility	• *4 Drum Fire (U)* • *Single Drum Fire in Glovebox (U)*	• ***Drum Explosion with 4 Drum Fire (U)*** • *Single Drum Explosion in Glovebox (U)*	• Solid Waste Box Failure (A)	• ***Design Basis Earthquake (U)*** • Beyond DBE (EU)	
INEEL RWMC	• *Vehicle Fire (U)*	• *Drum Explosion (A)*	• *Box Spill (A)*	• Design Basis Earthquake (U)	
LANL RAMROD Facility	• Small Fire (A) • Medium Fire (EU) • Large Fire (EU)	• Small Natural Gas Explosion (A) • Large Natural Gas Explosion (EU)	• Coring Glovebox Spill (A)	• Design Basis Earthquake (U)	• Aircraft Crash (EU)

Note: Scenarios in *Italics* are risk dominant events, based on Risk Class I or II for the collocated worker. ***Bold Italics*** denotes that it is also risk dominant for the public.

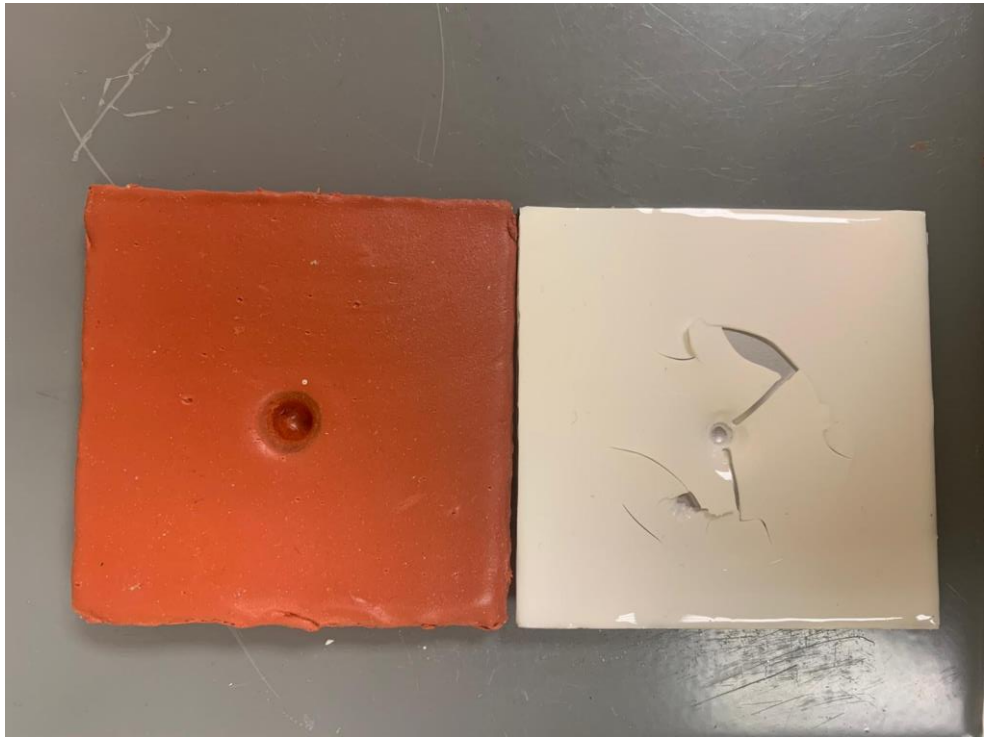
- Contamination release is a major concern, especially during decommissioning and deactivation processes
- One current focus is quantifying potential positive effects of COTS fixative coating technologies to mitigate contamination release under various stressors
  - Impact
  - Thermal
  - Water
- We have begun testing fixatives under impact stress per the ASTM D2784 standard test method

Approach

- To quantify positive effect in mitigating contamination release due to impact, we will:
  - Contaminate steel coupon samples with known amount of Cesium Chloride (surrogate contaminant)
  - Apply fixative coatings to required thickness
  - Strike coupons using impact tester within a sealed housing
  - Collect released contamination using air sampler into filters
  - Use ICP-MS to quantify the amount of Cesium, in the surrogate, collected and compare to initial known amount



Results/Discussion

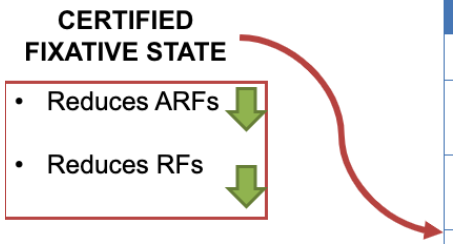


A coupon coated with FireDam (left) showing no failure next to a coupon coated with PBS (right), which failed upon impact

- Impact tests were performed on PBS and FireDam to get baseline figures (with no surrogate contamination)
- Impact testing of FireDam shows promising results with no failure at maximum load (320 in-lb)
- PBS begins to fail at 56 in-lb
- A layering method may be the optimal method for mitigating contamination release

Conclusions

- Baseline measurements for performance of COTS fixative technologies under impact stress is under way
- FireDam seems to remain effective under impact stress
- A layering method is proposed to achieve optimal effectiveness in mitigating risk of contamination release



Contaminant Form	Impact ARF / RF	Thermal ARF / RF
Gas / Vapor	1.0 / 1.0	1.0 / 1.0
Powder	3e-4 / 0.5	1e-2 / 1e-3 (reactive compounds)
Liquid	4e-5 / 0.7	1e-3 / 1.0
Metal / Solid	No significant airborne release is postulated for this accident configuration.	Variable / 0.7 (Plutonium) Variable / 1.0 (Uranium)

Future Work

- Continue to perform baseline tests
- Perform impact tests of fixative coatings on contaminated substrates
- Perform tests with contaminated substrates in sealed container and collect released contaminants
- Use ICP-MS to quantify release of contamination
- Populate Fixative Coatings matrix to compare coatings and assess which option is best for mitigating risk under operational stressors

Fixative Coatings					
	PBS	FireDam	FD + PBS	ABC	ArmorSeal
Impact (ASTM D2794 320 in-lb)	✗	✓			
Elongation (ASTM D522)	✓		✓		
Cracking (ASTM D522)	✓		✓		
Thermal (NRC 10 CFR 71.73 1475 °F for 30 mins.)	✗	✓	✓	✗	
Water Immersion (NRC 10 CFR 71.73 3 ft. depth for 24 hours)		✓			
Other Environmental Tests					

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