Project 3 D&D

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D&D Mission Sets and Research Areas

- Adapting COTS-based Intumescent Technologies for D&D Applications (TRL-5 to TRL-7)
  - Incombustible Fixative Coating ISO SRS 235-F PUFF Facility
  - Incombustible Foam Fixatives as "Plugs" to Decommission Piping
  - Passive Thermal Insulators for Waste Packaging

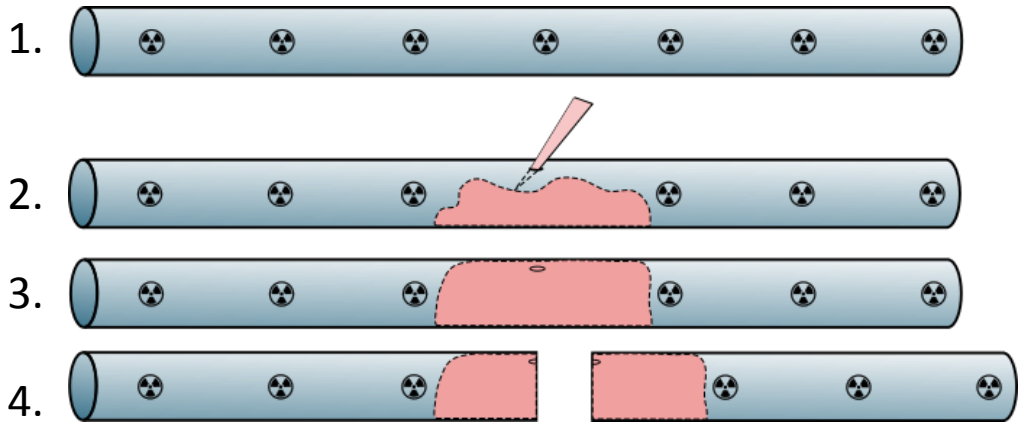
- Empirically quantifying operational performance of fixative technologies
  - Open Air Demolition activities (e.g.: impact and environmental stressors)
  - Safety Basis contingency scenarios (e.g.: fire and extreme heat stressors)

- 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

Application #1: Incombustible Fixatives SRS 235-F Onsite Hot Demonstration

- Down-selected COTS-based intumescent technology successfully deployed in Process Cell #7 and the entry hood of Process Cell #1 at the SRS 235-F PUFF Facility
  - FIU / SRNL / SRS collaborative effort
  - TRL-5 to TRL-7 in 3 years
  - Highlighted in DNFSB 2018 Annual Report
  - Targeting joint (FIU / SRNL / SRS) closeout report in Year 10
  - Engage vendor to open new market for product

Application #2: Intumescent Foams as "Plugs" for Nuclear Pipework



- Concept of Operations:
  - Place fire resistant plugs at strategic cutting points along pipework
  - Serves as a barrier to segregate / trap / immobilize contamination to mitigate potential release while cutting, packaging and storing

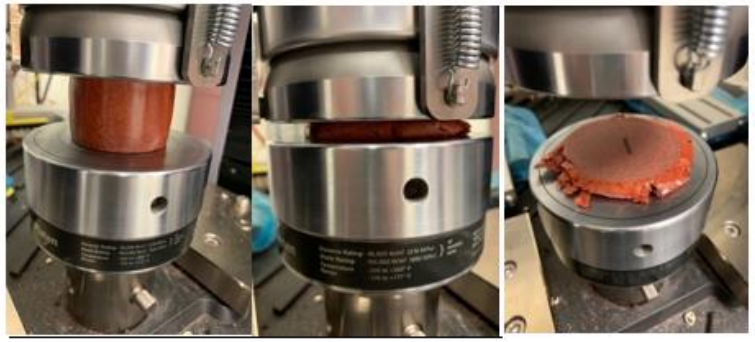
Down-Selection Process Identified Frontrunner

- Mechanical testing performed by DOE Fellow, Tristan Simoes-Ponce, during summer internship at SRNL
- Compression Test:
  - Used best-fit testing protocol ASTM D1621-16.

Intumescent Foam – Cylindrical Samples	Concrete
2169 psi	2500 psi (residential) 4000 psi (commercial)

- 304-SS Pipe Adhesion Test: Initial Trial
  - Up to ≈ 2,800 lb. before foam delaminated from pipe
- Continued to immobilize contamination after exposure to extreme thermal stressors
- Defined operational parameters and additional testing is required

Compression



Pipe Adhesion

Fire Testing

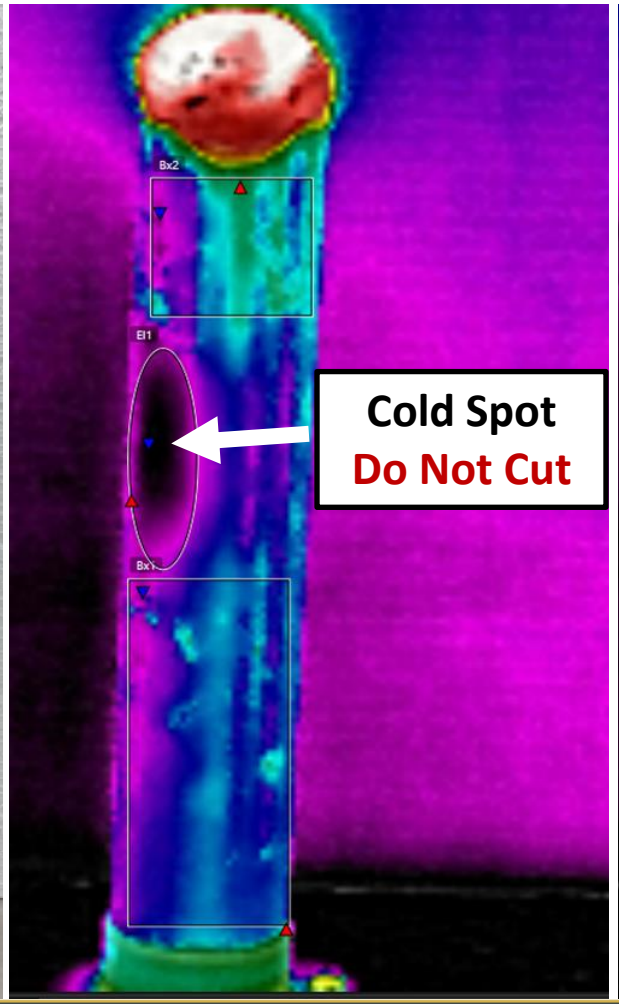
Non-Destructive Evaluation to Determine Uniform Application of Foam Plug

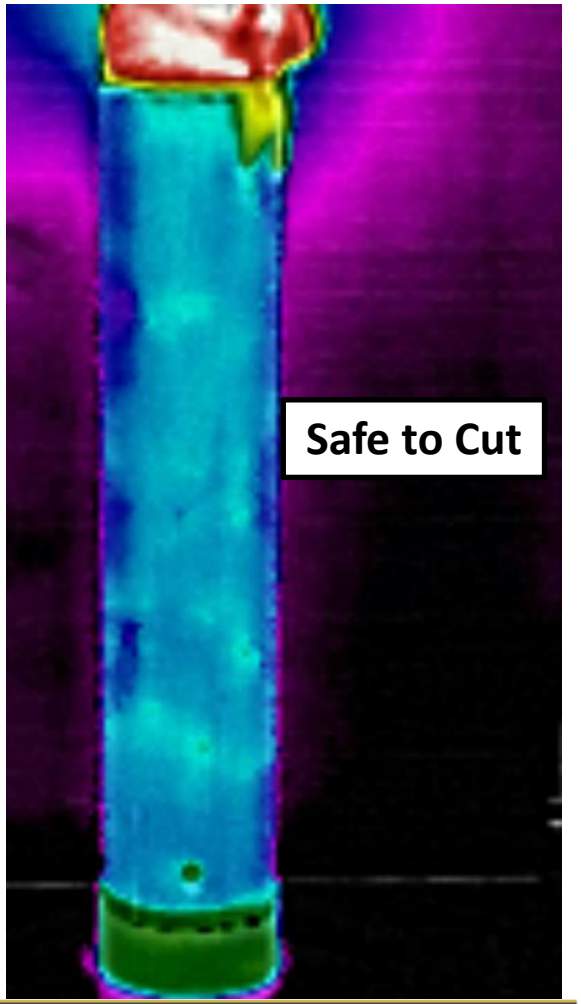
Proof of Concept Experiment #2

FIU Applied Research Center

- **Hypothesis:** Can we combine advancements in thermal imaging systems with understanding of foam curing temperature profiles to identify anomalies in application in 304-SS pipe?

- **Confirmed:** Able to identify anomalies up to 3/8” steel wall thickness.





The Path Forward - Roadmap to TRL-7

TRL-5:

- **Component and/or breadboard validation in a relevant environment**
  - *Proof of concept validated and specific COTS-based technology identified - Completed 2019*

TRL-6:

- **System or prototype demonstration in a relevant environment**
  - *Testing will be focused on refining and validating key operational parameters to support approval by safety basis personnel for an operational test and evaluation - Completed 2020*

TRL-7:

- **System prototype demonstration in an operational environment**
  - *Close collaboration with SRNL and/or INL will hopefully yield an opportunity to apply the foam system in an operational environment in 2021*

Validation:

Fire Resistance
Mechanical Limits
Curing Temperature Limits
Extent of Contamination Immobilization
NDE by Thermography

Increase scale and introduce more challenging operationally relevant scenarios

Collaborate with SRNL and leverage ASTM practices and principals to define the operational requirements

Application #3: Passive Thermal Insulator for Packaging Containers

- Potential applications in mitigating container pressurization of radioactive waste during a fire scenario
- Intumescent Coating: serves as an excellent thermal insulator in initial proof of concept tests
- Next round of testing scheduled for 8 August
- Working with SRNL to refine operational requirements and concept of operations with site personnel

No Coating

Intumescent Coating

Linking Standards Development with Operational Requirements

- Sets foundation for uniformed evaluation of technology performance against defined operational requirements
- 4 x ASTM standards for fixative technologies formally approved to date
- Referenced in Test Plans across DOE EM Complex
- Increased recognition by community on critical role of standards
  - Awarded Best in Track / Paper of Note at WM'19

Empirically Quantifying Fixative Performance Against Operational Stressors

- **Fire and thermal** hazards often receive the most attention as the consequences can be severe and may lead to significant release
- During demolition, **impacts from debris** are unavoidable yet there is no current means of assessing their effects on fixatives
- **Water** is used as a dust suppressant during demolition; however, many polymer fixatives are water soluble or easily delaminate when subjected to water
- Uniform, peer-accepted testing protocols facilitate comparison of performance against these stressors
- Allows for direct A-B type comparisons to be made between fixatives

Example of Thermal Stressor

Example of Water Stressor