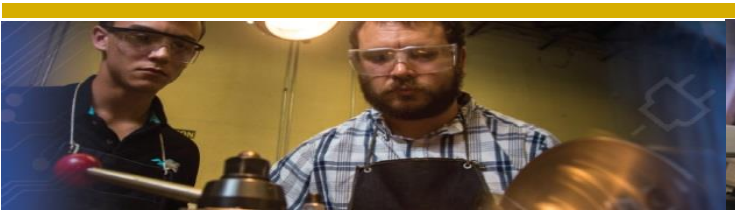
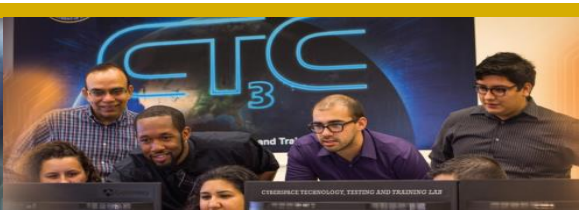
Project 3 D&D

ARC Staff: Joseph Sinicrope, Mellissa Komninakis, Thomas Donoclift, Kexin Jiao, Leo Lagos
SRNL Collaborators: Connor Nicholson, Jennifer Wohlwend, **Tristan Simoes-Ponce**
DOE Fellows: **Tristan Simoes-Ponce**, Joshua Nunez, Derek Gabaldon, Philip Moore

FLORIDA INTERNATIONAL UNIVERSITY





Project 3 D&D Portfolio: Guiding Tenets for Research Project Selection

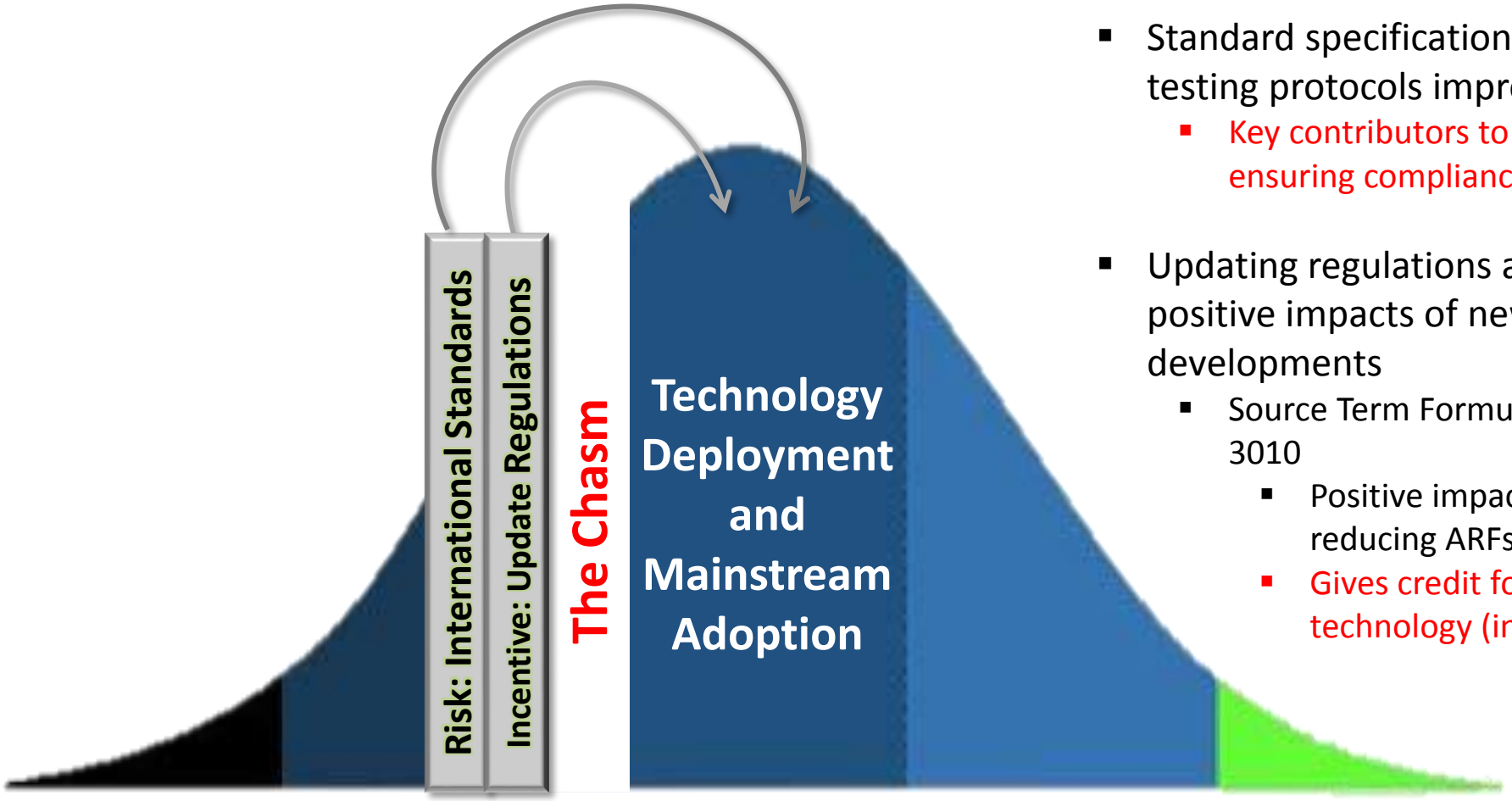
- **High profile mission sets / challenge areas (Pull)**
  - SRS 235-F Risk Reduction Program (mission set)
    - DNFSB compliance
  - Open Air Demolition (challenge area)
    - Response to a release incident
- **Employ a Holistic Solutions Approach**
  - Depth vs breadth
  - Not just about the “box / technology”
  - MUST address the critical enablers (e.g.: standards) and institutional barriers (e.g.: approved tool list, handbook update, etc.)
- **Technology deployment mindset**
  - Focus on COTS technologies
  - 3-5 year timeline from concept to hot demo / deployment
  - ROI / value creation occurs when technology is adopted and operationally deployed
- **Fill critical test and evaluation gaps**

Research Activity #1: Incombustible Fixatives SRS 235-F PUFF Onsite Hot Demonstration

FIU Applied Research Center

- 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
  - Concept to operational T&E in 3 years
  - Highlighted in DNFSB 2018 Annual Report
  - Targeting joint (FIU / SRNL / SRS) closeout report in 2021
    - Re-enter entry hood of Process Cell #1 to obtain thickness measurements
    - Baseline w/control coupons to determine impacts of Pu-238 on fixative material
    - Further characterize FD coating (impact, water immersion, water pressure testing, etc.)
  - Engage vendor to open new market for product

Two Strategic Takeaways from FD Hot Demo that Improve Technology Deployment Probability: Mitigate Risk (Develop Standards) and Increase Incentive (Update Regulation)

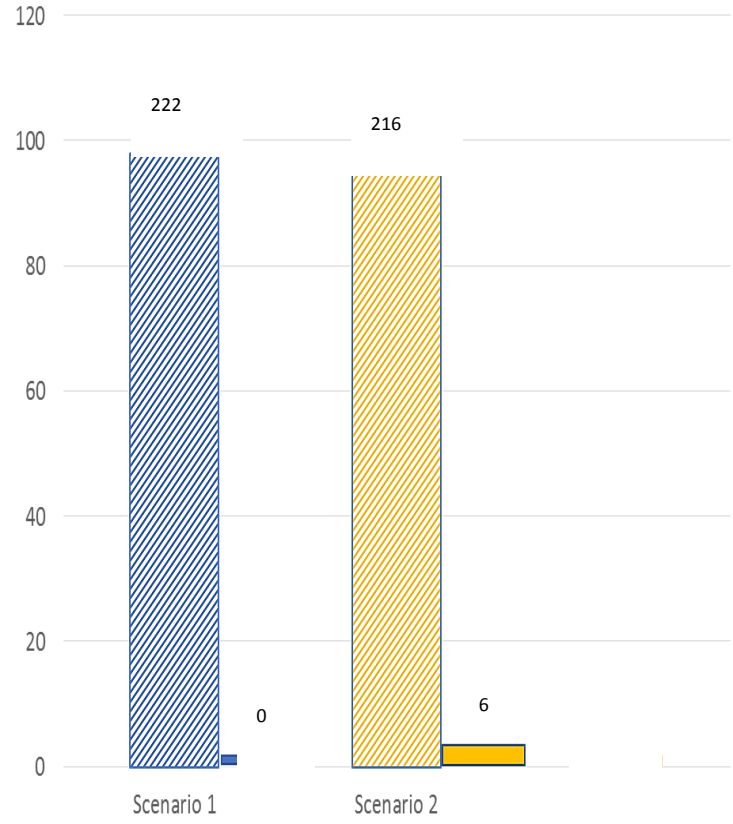


- Standard specifications and uniform testing protocols improve trust
  - Key contributors to reducing risk and ensuring compliance
- Updating regulations accounts for positive impacts of new technology developments
  - Source Term Formula in DOE-HDBK-3010
    - Positive impact of fixatives on reducing ARFs and RFs
    - Gives credit for using the technology (incentive-seekers)

Critical Role of Standards in Facilitating Technology Acceptance

- Choose between the two technologies based on the given information:
  - Technology 1: Fixative intended to stabilize residual radioactive material when exposed to fire. $0.75 / square foot.
  - Technology 2: Fixative intended to stabilize residual radioactive material when exposed to fire. $0.75 / square foot. Met ASTM E84, NFPA 701, and UL723 fire test standards.

- Choose between the two technologies based on the given information:
  - Technology 1: Fixative intended to stabilize residual radioactive material when exposed to fire. $0.75 / square foot.
  - Technology 2: Fixative intended to stabilize residual radioactive material when exposed to fire. $1.00 / square foot. Met ASTM E84, NFPA 701, and UL723 fire test standards.



Empirically Confirm Fixative Technology Impacts on ARFs and RFs and Update DOE-HDBK-3010

FIU Applied Research Center

CERTIFIED FIXATIVE STATE

- Reduces ARFs
- Reduces RFs

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)

Research Activity #2: Certifying Fixative Technologies

FIU Applied Research Center

Define Operational Requirements

- Thermal
  - NRC 10 CFR 71.73 OR
    - 800°C (1475°F) for 30 mins
  - ASTM E814
    - 1093°C (2000°F) for 4 hrs.
- Environmental / Water
  - NRC 10 CFR 71.73
    - Immersion under 3 ft. water
- Seismic / Impact
  - 320 in-lb maximum
- Rad Hardening
- Airborne release fractions / Respirable fractions

Develop Uniform Testing Protocols

- Impact
  - ASTM D2794? - Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
- Preparation of fixed contamination on porous coupon surfaces
  - ASTM E3190

Codify / Update of Regulations

- Huge gaps exist in current regulations that fail to account for fixatives
- Results from testing can be used to update outdated guidelines
  - DOE-HDBK-3010
- Provides incentives to utilize fixatives
  - Allows for credit in reducing the MAR

ASTM Standard Specifications

E3104 – Strippable & Removable Coatings
E3105 – Permanent Coatings
E3191 – Permanent Foaming Fixatives

ASTM Standard Practices

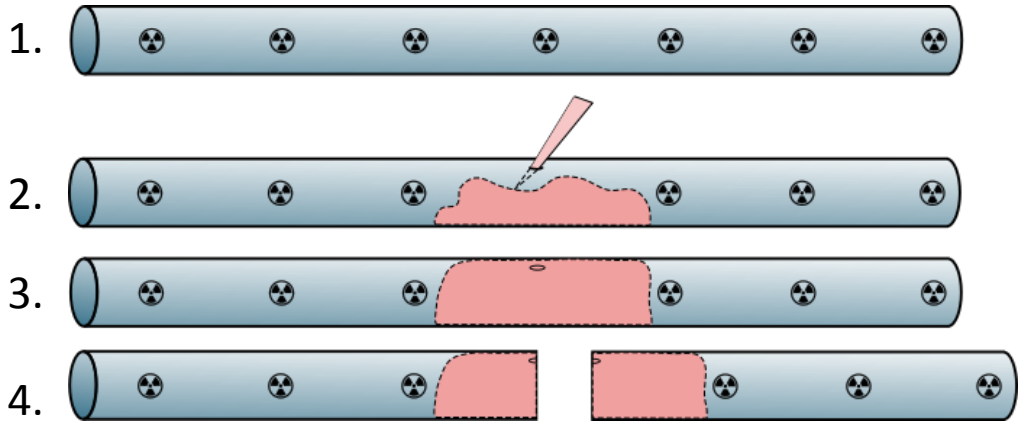
E2924 – Intumescent Coatings
E3190 – Preparation of Fixed Radiological/Surrogate Contamination on Porous Test Coupon Surfaces for Evaluation of Decontamination Techniques
E3XXX – Preparation of Loose Radiological/Surrogate Contamination on Non-porous Test Coupon Surfaces…

Ultimate End State

- A standards based fixative comparison matrix, using uniform stakeholder-approved testing protocols.

Fixative Coatings						
	PBS	FD	FD + PBS	ABC	ArmorSeal	FireGuard
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						

Research Activity #3: Fire Retardant Plug for D&D of Nuclear Pipework



Concept of Operations:

- Place fire resistant plugs at strategic cutting points along pipework
  - Intumescent Foam
  - Fire Barrier Mortar
- Serves as a barrier to segregate / trap / immobilize contamination to mitigate potential release while cutting, packaging, and storing
- Operational deployment in 2022

Fire Retardant Plug
Roadmap to Operational Test and Evaluation / Hot Demo

Year 1: Proof-of-Concept

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

Year 2: Operational Cold Testing

- **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*

Year 3: Operational Test in Radioactive Environment/Hot Demo

- **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 2022*

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

QUESTIONS

FLORIDA INTERNATIONAL UNIVERSITY