



DOE-FIU Cooperative Agreement Annual Research Review – FIU Year 2

Tuesday, September 27, 2022

9:30 - 9:35 am EDT	Kick-Off /Welcoming Remarks (DOE-EM)	Kurt Gerdes (Director, Technology Development) – DOE EM-3.2
9:35 - 9:40 am EDT	Welcoming Remarks (DOE-LM)	Leonel Lagos on behalf of DOE Office of Legacy Management
9:40 - 10:00 am EDT	Projects 4 & 5: STEM Workforce Development and Training	FIU, DOE HQ (EM & LM), SRNL, PNNL, WIPP, SRS, ORP, LBNL, WRPS, INL, Grand Junction
BREAK		
11:00 - 12:00 pm EDT	Projects 4 & 5 (cont'd): STEM Workforce Development and Training	FIU, DOE HQ (EM & LM), SRNL, PNNL, WIPP, SRS, ORP, LBNL, WRPS, INL, Grand Junction
BREAK		
1:00 - 2:30 pm EDT	Project 1: Chemical Process Alternatives for Radioactive Waste	FIU, DOE HQ, PNNL, WRPS, SRNL, SRS
2:30 - 4:00 pm EDT	Project 3: Waste and D&D Engineering & Technology Development	FIU, DOE HQ, SRNL, PNNL, LBNL, INL, ANL

Wednesday, September 28, 2022

10:00 - 11:30 am EDT	Project 2: Environmental Remediation Science & Technology	FIU, DOE HQ, SRNL, PNNL, ORNL, LANL, CBFO
11:30 - 1:00 pm EDT	Wrap Up (FIU Projects 1, 2, 3, 4 & 5)	FIU, DOE HQ (EM & LM)

FIU

Applied Research
Center



DOE-FIU Cooperative Agreement Annual Research Review – FIU Year 2

PROJECT 3

Waste and D&D Engineering & Technology Development

Worlds
Ahead

Advancing the research and academic mission of Florida International University

FIU Personnel and Collaborators

Project Manager: Leonel Lagos

Faculty/Researcher: Himanshu Upadhyay, Joseph Sinicrope, Walter Quintero, Clint Miller, Santosh Joshi, Tushar Bhardwaj, Suresh Peddoju, John Dickson, Mellissa Komninakis, Kexin Jiao, *Yolanda Rodriguez

DOE Fellows/Students: Roger Boza, David Mareno, Aurelien Meray, Adrian Muino Ayala, Christian Lopez, Christian Dau, Philip Moore, *Oscar Roa

DOE-EM: Jennifer McCloskey, Dinesh Gupta, Genia McKinley, Jean Pabon, Jonathan Kang, Douglas Tonkay,

SRNL: Jennifer Wohlwend, Justin Kidd, Emily Fabricatore, *Connor Nicholson, *Tristan Simoes-Ponce, Carol Eddy-Dilek

ORNL: Alexander Johs

PNNL: Vicky Freedman, Rob Mackley

LBNL: Haruko Wainwright

*Former staff/student contributors



Project Tasks and Scope

TASK 1: WASTE INFORMATION MANAGEMENT SYSTEM (WIMS) (HQ)

Subtask 1.1 WIMS System Administration - Database Management, Application Maintenance & Performance Tuning

Subtask 1.2 Waste Stream Annual Data Integration

Subtask 1.5 Cyber Security of WIMS Infrastructure

TASK 2: D&D SUPPORT TO DOE EM FOR TECHNOLOGY INNOVATION, DEVELOPMENT, EVALUATION AND DEPLOYMENT

Subtask 2.1 Development of Uniform Testing Protocols and Standard Specifications for Dust Suppressant Technologies in Support of Open-Air Demolition during D&D

Subtask 2.2 Applications of Intumescent Foams and Other Fire-Retardant Materials to Mitigate Contaminate Release during Nuclear Pipe Dismantling and other D&D Activities

Subtask 2.3 Certifying Fixative Technology Performance when Exposed to Impact Stressors as Postulated in Contingency Scenarios Highlighted in Safety Basis Documents

Subtask 2.4 Multi-functional 3D Polymer Framework for Mercury Abatement

TASK 3: D&D KNOWLEDGE MANAGEMENT INFORMATION TOOL (KM-IT) (HQ, SRNL, INL, ANL)

Subtask 3.4 Content Management

Subtask 3.5 Marketing and Outreach

Subtask 3.6 D&D KM-IT System Administration

Subtask 3.7 Cyber Security of D&D KM-IT Infrastructure



Project Tasks and Scope

TASK 6: AI FOR EM PROBLEM SET (D&D): STRUCTURAL HEALTH MONITORING OF D&D FACILITY TO IDENTIFY CRACKS AND STRUCTURAL DEFECTS FOR SURVEILLANCE AND MAINTENANCE (SRNL)

Subtask 6.5	Design & Development of Machine Learning and Deep Learning Models to Identify and Locate Cracks in D&D Mockup Facility (NEW)
Subtask 6.6	Design & Development of a Mobile Application to Deploy Machine Learning and Deep Learning Models on the iOS Devices at SRS (NEW)
Subtask 6.7	Research and Prototype Deployment of a Web Service API framework for AI Deep Learning Model (NEW)

TASK 7: AI FOR EM PROBLEM SET (SOIL & GROUNDWATER) - EXPLORATORY DATA ANALYSIS & MACHINE LEARNING MODEL FOR HEXVALENT CHROMIUM [CR (VI)] CONC. IN 100-H AREA (PNNL)

Subtask 7.2	Data Pre-Processing & Exploratory Data Analysis to Evaluate the Chromium Conc. in the Samples (NEW)
Subtask 7.3	Groundwater and Surface Water Spatiotemporal Relationship Identification (NEW)

TASK 8: AI FOR EM PROBLEM SET (SOIL AND GROUNDWATER) - DATA ANALYSIS AND VISUALIZATION OF SENSOR DATA FROM WELLS AT THE SRS F-AREA USING MACHINE LEARNING (LBNL, SRNL)

Subtask 8.4	Data Ingestion/Communication Module Development for the AI/ML System (NEW)
Subtask 8.5	Development of the AI/ML-Based System to Perform Predictive Analytics using Datasets containing Time-Series and Imagery Data from Sensors (NEW)

Task 2

**D&D Support to DOE EM for
Technology Innovation, Development,
Evaluation and Deployment**



What is the current need?

- By FY '27, the F/H Laboratory Deactivation Project Team plans to remove all the buried LAD and HAD piping in the Courtyard between 772-F and 772-1F.
- The driver for removal is to prevent future release(s) to the environment from the buried, highly-contaminated piping.
- Our intent is to remove the piping to within 1' of the respective buildings and then to cap both the 2 & 3-inch "core" pipe and the 3 & 4-inch "jacket" pipe.
- The piping is generally buried to a depth of 3-5 feet.
- Total length of piping to be removed is approximately 250 feet. Piping will be cut to 5' lengths so that it may be disposed to a B-25.

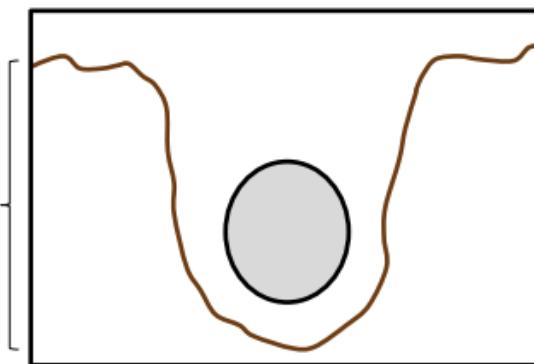
Buried LAD and HAD
Piping between 772-F
and 772-1F



Aerial view of Potential Hot Site at F-Area



3-5 ft trench to
expose pipes



Research Highlights & Accomplishments:

Evaluation of the adhesion and bonding properties of the Hilti CP-620 foam plug to Hastelloy C-22 piping

Evaluation of the adhesion and bonding properties of the Hilti CP-620 foam plug to Hastelloy C-22 piping under various moisture conditions

Determination of the heat profile of Hilti CP-620 foam during curing in Hastelloy C-22 piping

Establish the relationship between piping diameter and necessary quantity of Hilti CP-620 foam

Determine the internal pipe pressure after Hilti CP-620 foam deployment and curing time

Develop a leak test standard operating procedure to test for the effectiveness of the of Hilti CP-620 foam plug

Conduct a literature review to determine if using a hot tap is a viable method to deliver of Hilti CP-620 foam into piping

Gather information and reference material to initiate the construction of the mock-up test of the F/H labs courtyard.

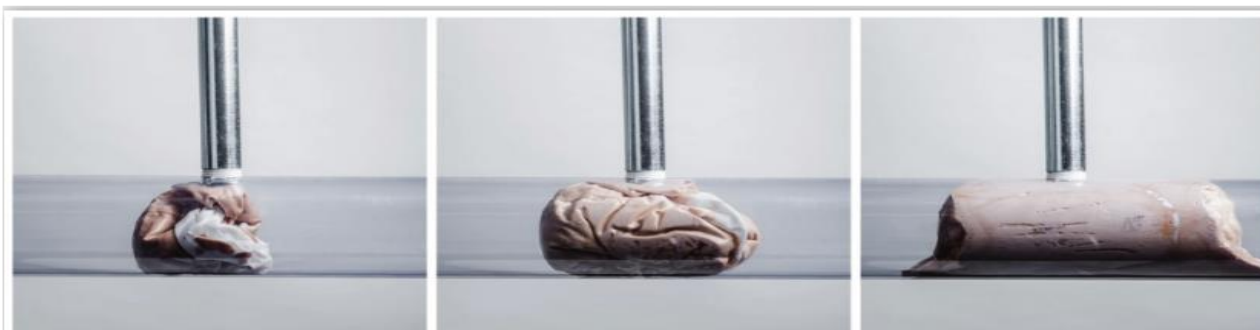
- Phase I Test Plan developed and approved in January 2022 and near completion.
- Provided 5 updates to stakeholders throughout Year 2 (January – July).
- Alternative technology identified that may be more compatible with hot tap procedures.



FIU Year 3 Way Ahead:

Alternative Fixative Foams (In the Event Hilti CP-620 is NOT Viable) - FOAMBAG™

- **FOAMBAG is very similar to the DRAINBLOCK technology.**
 - PU resin foam that expands to form a permanent seal.
- **The FOAMBAG technique has been in use in the UK in gloveboxes at Sellafield and meets the UK gas industry technical standard T/SP/E/59.**



The FOAMBAG™ holds the resin foam in place as it expands. At full expansion some of the foam seeps through the semi-porous panels of the bag to form an adhesive seal with the pipe



- Complete execution of Phase I Test Plan (Assessment of Hilti CP-620 Foam)
- Develop Phase II Test Plan (same series of tests on FOAMBAG technology)
- Initiate planning for construction of F/H Lab Courtyard mock-up in preparation for site demo in FY'24 / FY '25

Research Activity 2: Certifying Fixative Technology Performance when Exposed to Impact Stressors Postulated in Contingency Scenarios Highlighted in Safety Basis Document

Site Needs:

- Outdated regulations, such as the DOE-HDBK-3010, outline factors for dealing with residual contamination, but fail to account for the positive impacts provided by fixative technologies in reducing ARF coefficients.
 - Results in inconsistent certification methodology for fixative technologies.
 - Produces varying Source Term calculations.
 - Fails to provide sufficient credit for improvements in state-of-the-art fixative technologies.
- Key finding in the SRS 235F-PuFF research activity – after fixative deployment, site personnel could not take credit for fixatives in the safety basis calculations.
- Potential to reduce cost due to a more accurate/lower Source Term.

FIXATIVE STATE

- Reduces ARFs ↓
- Reduces RFs ↓

Contaminant Form	Impact ARF
Gas / Vapor	1.0
Powder	3e-4
Liquid	4e-5
Metal / Solid	No significant airborne release is postulated for this accident configuration.

High Risk

Low Risk

Objectives:

- Develop an experimental design for the quantification of contamination release during impact stress.
- Reevaluate ARF coefficients for powder contaminants under impact.
- Determine ARF coefficients for fixative materials under impact.
 - Fixative/Polymer State
- Integrate results to update DOE-HDBK-3010.



FIU Year 2 Research Highlights & Accomplishments:

- Baseline results (powder contamination only) support ARF coefficients outlined in DOE-3010-HDBK.
- Initial results when applying fixative technologies support the addition of a “fixative / polymer state” in DOE-3010-HDBK due to significant reductions in the ARFs.
 - Initial data shows that fixatives have a lower ARF than liquid form (about $5e-7$).

FIXATIVE STATE

- Reduces ARFs ↓
- Reduces RFs ↓

Initial empirical data supports

Contaminant Form	Impact ARF
Gas / Vapor	1.0
Powder	$3e-4$
Liquid	$4e-5$
Metal / Solid	No significant airborne release is postulated for this accident configuration.

High Risk

Low Risk

FIU Year 3 Way Ahead:**Experimental Design**

- Standardize process and equipment

Further Confirm ARFs under Impact

- Powder contamination
- Fixative / Polymer state

ASTM Testing Practice**Methods for Direct Comparison of Fixative Technologies**

Important for
consideration
as an ASTM
standard



Research Activity 3: Polydimethylsiloxane Micro-ribbons for Mercury Remediation

Site Needs:

- Developing novel technologies that support Hg remediation in water
- Address the adsorbing of various forms of Hg contaminants
- Enable an easy, cost-effective method to recycle the used sorbent

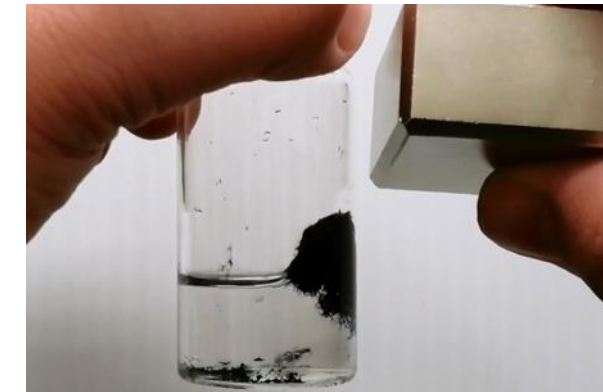
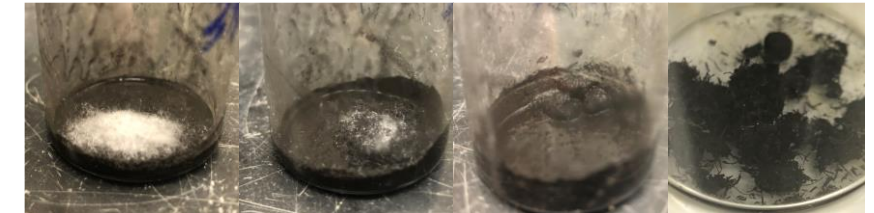
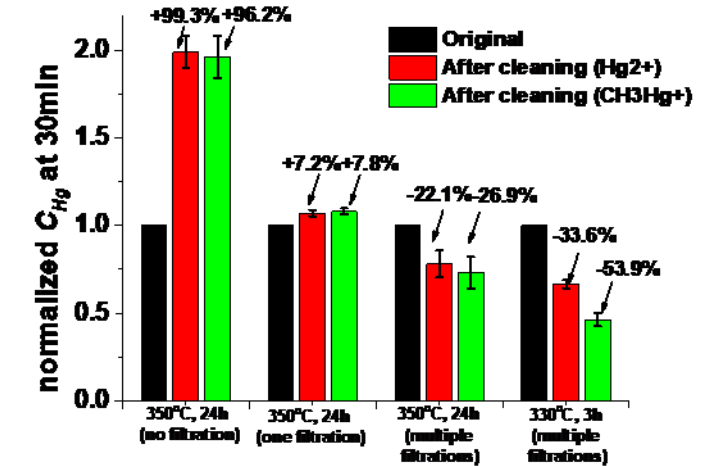
Objectives:

- Design recyclable polydimethylsiloxane micro-ribbons (PDMS-MRs) to achieve Hg^{2+} and CH_3Hg^+ abatement.
 - Confirm application of PDMS-MRs for Hg^{2+} remediation in water
 - Confirm application of of PDMS-MRs for CH_3Hg^+ remediation in water
 - Synthesis of magnetic PDMS-MRs (mPDMS-MRs)
 - Confirm the recycling of mPDMS-MRs in water



FIU Year 2 Research Highlights & Accomplishments:

- Confirmed application of PDMS-MRs for Hg^{2+} remediation in water
- Confirmed application of PDMS-MRs for CH_3Hg^+ remediation in water
- Synthesized of magnetic PDMS-MRs (mPDMS-MRs) to facilitate removal
- Confirmed the recycling of mPDMS-MRs in water



Research Activity 3: Polydimethylsiloxane Micro-ribbons for Mercury Remediation

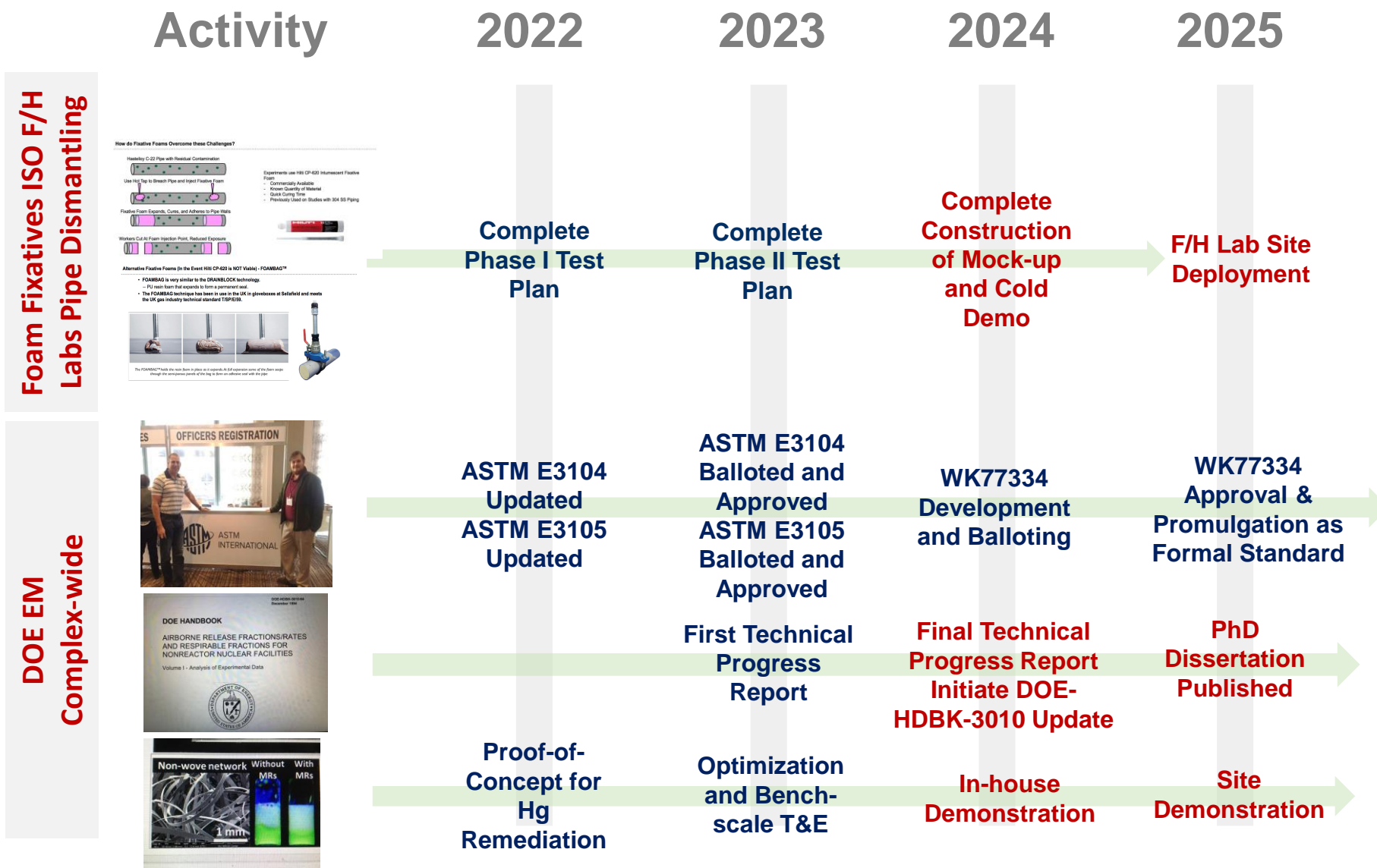
FIU Year 3 Way Ahead:

- Use PDMS-MRs for natural organic matters (NOMs) – Hg complexes remediation
- Use mPDMS-MRs for Hg^{2+} and CH_3Hg^+ remediation in water
- Develop the procedures for large-scale fabrication of PDMS-MRs and mPDMS-MRs



Technology Development and Deployment Road Map

D&D Roadmap





Thank You. Questions?