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)

PROJECT 1

Chemical Process Alternatives for Radioactive Waste

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FIU Personnel and Collaborators

Project Manager: Dwayne McDaniel

Faculty/Staff: Amer Awwad, Anthony Abrahao, Aparna Aravelli, Jose Rivera, Shervin Tashakori, Mayren Echeverria Boan, Mackenson Telusma

DOE Fellows/Students: Jeff Natividad, Sebastian Story, Joel Adams, Brendon Cintas, Josue Martinez, Raymond Piloto , Desmond Sinnott, Nicholas Espinal

DOE-EM: Genia McKinley, Robert Seifert, Latrincy Bates, Kurt Gerdes, Jean Papon

DOE-ORP: Erik Nelson

SRNL: Michael Poirier, Connie Herman, Bruce Wiersma, Jean Plummer, Christine Langdon, William Wells, Mark Kranjc, Eric Skidmore

PNNL: Kayte Denslow, Carl Enderlin, Matt Fountain, Matthew Asmussen

WRPS: Jason Gunter, Kayle Boomer, Glenn Soon, Joe Rice, Doug Reid, Jason Page, Ruben Mendoza

SRS: Jane Carter, Saiying Bowers

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Project Tasks and Scope

Task 17: ADVANCED TOPICS FOR HLW MIXING AND PROCESSES	
Subtask 17.2	Evaluation of Pipeline Flushing Requirements for HLW at Hanford and Savannah River Site
TASK 18: TECHNOLOGY DEVELOPMENT AND INSTRUMENTATION EVALUATION	
Subtask 18.2	Development of Inspection Tools for DST Primary Tanks
Subtask 18.3	Development of a Coating Deployment Platform for the H-Canyon Exhaust Tunnel
Subtask 18.4	Long-Term Surveillance of Nuclear Facilities and Repositories using Mobile Systems
TASK 19: PIPELINE INTEGRITY AND ANALYSIS	
Subtask 19.1	Pipeline Corrosion and Erosion Evaluation
Subtask 19.2	Evaluation of Nonmetallic Components in the Waste Transfer System
TASK 20: CORROSION PROTECTION AND CHARACTERIZATION OF EM INFRASTRUCTURE	
Subtask 20.1	Evaluation of Coatings for the H-Canyon Exhaust Tunnel
Subtask 20.2	Corrosion Evaluation of Steel Canisters for Hanford Integrated Disposal Facility **(NEW)**

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Task 17

Advanced Topics for HLW Mixing and Processes

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Subtask 17.1: Evaluation of pipeline flushing requirements for HLW at Hanford and Savannah River Site

Site Needs:

- The Defense Nuclear Facilities Safety Board (DNFSB) indicated a need for further investigation on the technical basis for the prescribed guidelines of flushing operations at Savannah River Site (SRS) and Hanford.
- Further tests investigate optimal conditions that will assist the US DOE in waste remediation, preservation of tank storage, prevention of additional waste creation, and processing.

Objectives:

- Simulate flushing operations of non-radioactive slurry simulants within an extendable, 3-inch diameter carbon steel experimental pipe loop.
- Investigate parameter effects on the efficiency of flushing operations at various concentrations and flush modes (fully-flooded, gravity-drained sediment conditions and continuous and pulsation flush velocity modes).

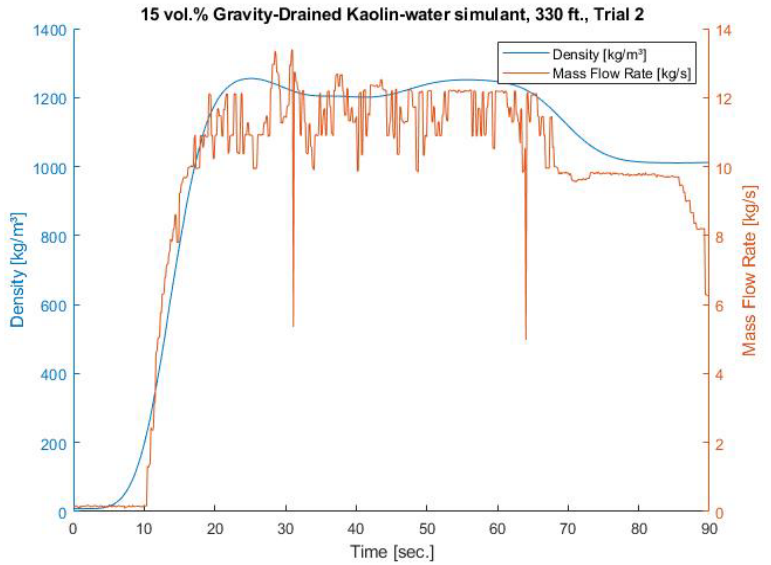
Subtask 17.1: Evaluation of pipeline flushing requirements for HLW at Hanford and Savannah River Site

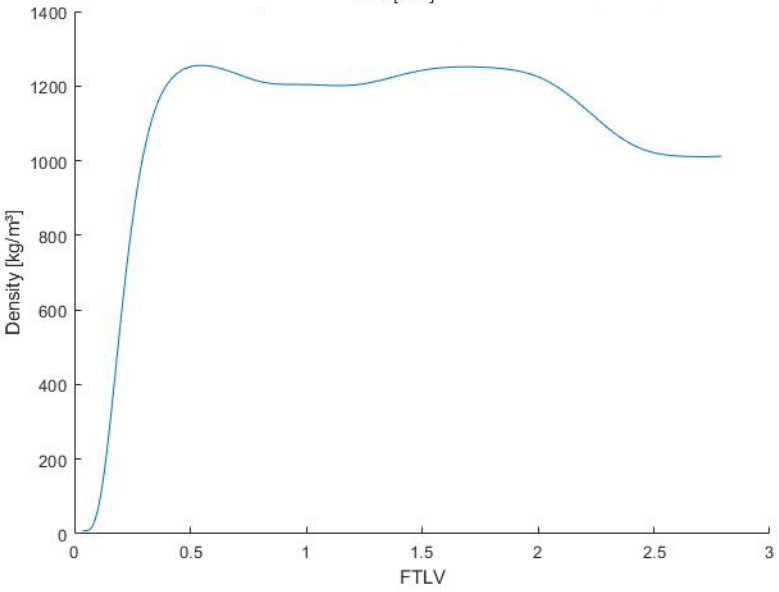
FIU Year 2 Research Highlights & Accomplishments:

- Completed construction of 330-ft loop
- Testing has been underway for fully-flooded and gravity-drained continuous pump operations
  - 10 vol.% and 15 vol.% fully-flooded
  - 10 vol.% and 15 vol.% gravity-drained
- Improvements to instrumentation and real-time analysis

One Day Sedimentation FTLV Results - FF		
	Trial 1	**Trial 2**
10%	2.45	2.51
15%	2.55	2.49
20%	TBD	TBD

One Day Sedimentation FTLV Results - GD		
	Trial 1	**Trial 2**
10%	2.49	TBD
15%	2.61	2.59
20%	TBD	TBD





Subtask 17.1: Evaluation of pipeline flushing requirements for HLW at Hanford and Savannah River Site

FIU Year 3 Projected Scope

- Completion of 330-ft tests
  - 20 vol.% Fully-Flooded / Gravity Drained
  - 10 vol.% Gravity Drained (Trial 2)
- Extension to 495-ft pipe length
  - Procurement of materials
    - 8x 20’ Sch40 steel pipes (total 168 ft)
    - 8x galvanized malleable unions
    - 18 UniStrut support structures
- Computational Flow Modeling
  - COMSOL
  - OpenFOAM
  - ANSYS Fluent
  - M-STAR

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Task 18

Technology Development and Instrumentation Evaluation

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Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

Site Needs

Understanding the structural integrity of single-shell and double-shell tanks at Hanford is of paramount importance.

Thus, there is a significant need for developing innovative tools and sensors that can provide information regarding the health of high-level waste tanks.

1944 aerial view of the single-shell tanks (SST) under construction at Hanford site C-Farm.

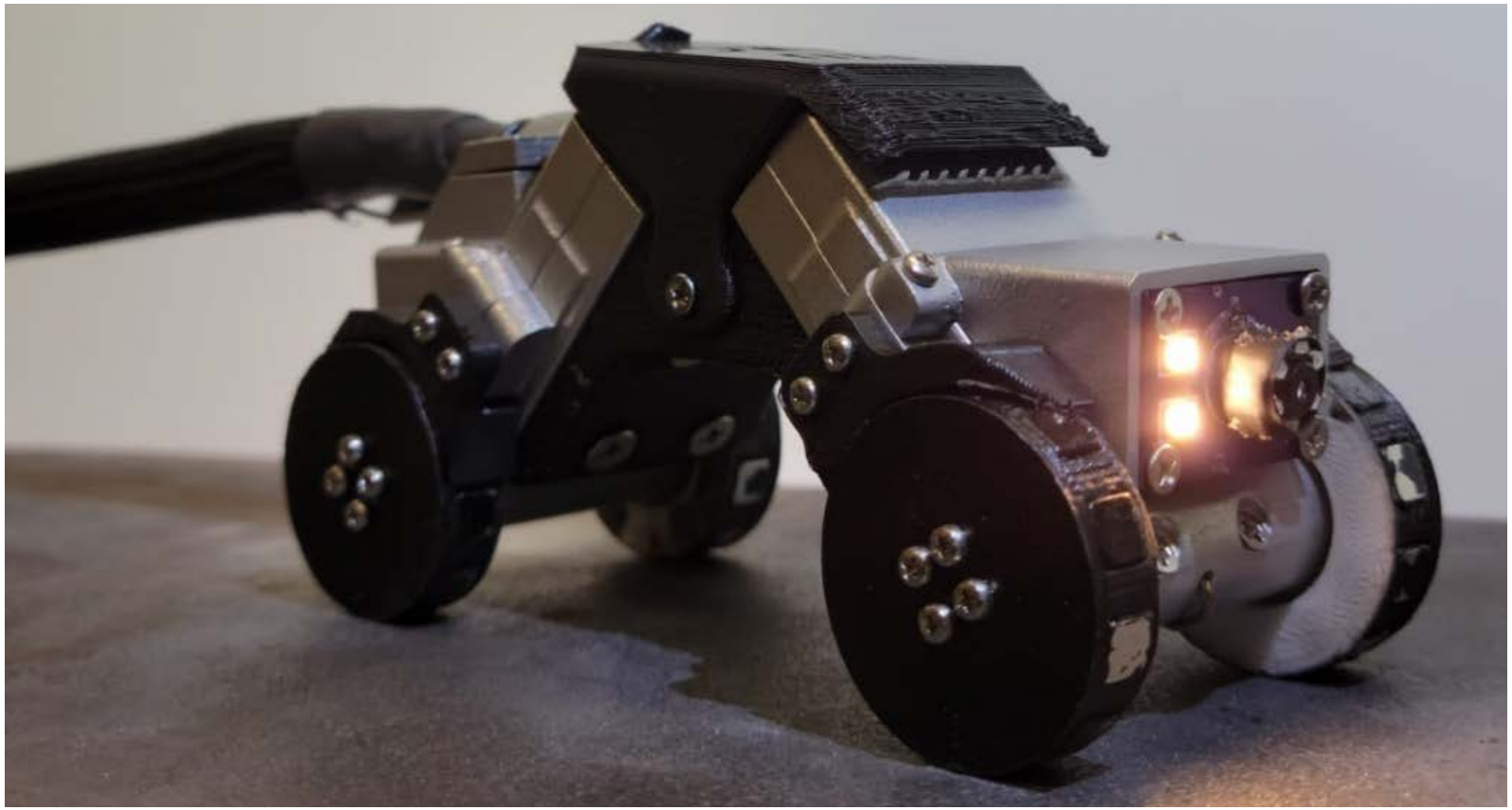
Objectives

- Help alleviate tank farm operation burdens
- Develop cost-effective inspection tools and sensors:
  - a miniature inspection rover for double-shell tanks,
  - a lateral gamma scanner for single-shell tanks, and
  - an off-riser sampler for single-shell tanks (concept demonstration)

Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

In March 2022, the FIU miniature inspection rover was **deployed at Hanford's AP-105 double-shell tank** by WRPS's site engineers, and the **technology was transferred to DOE**.



FIU's Minirover

Tool Control Box

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Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

Testing and training at ITVS facility

Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

AP-105 double-shell tank deployment

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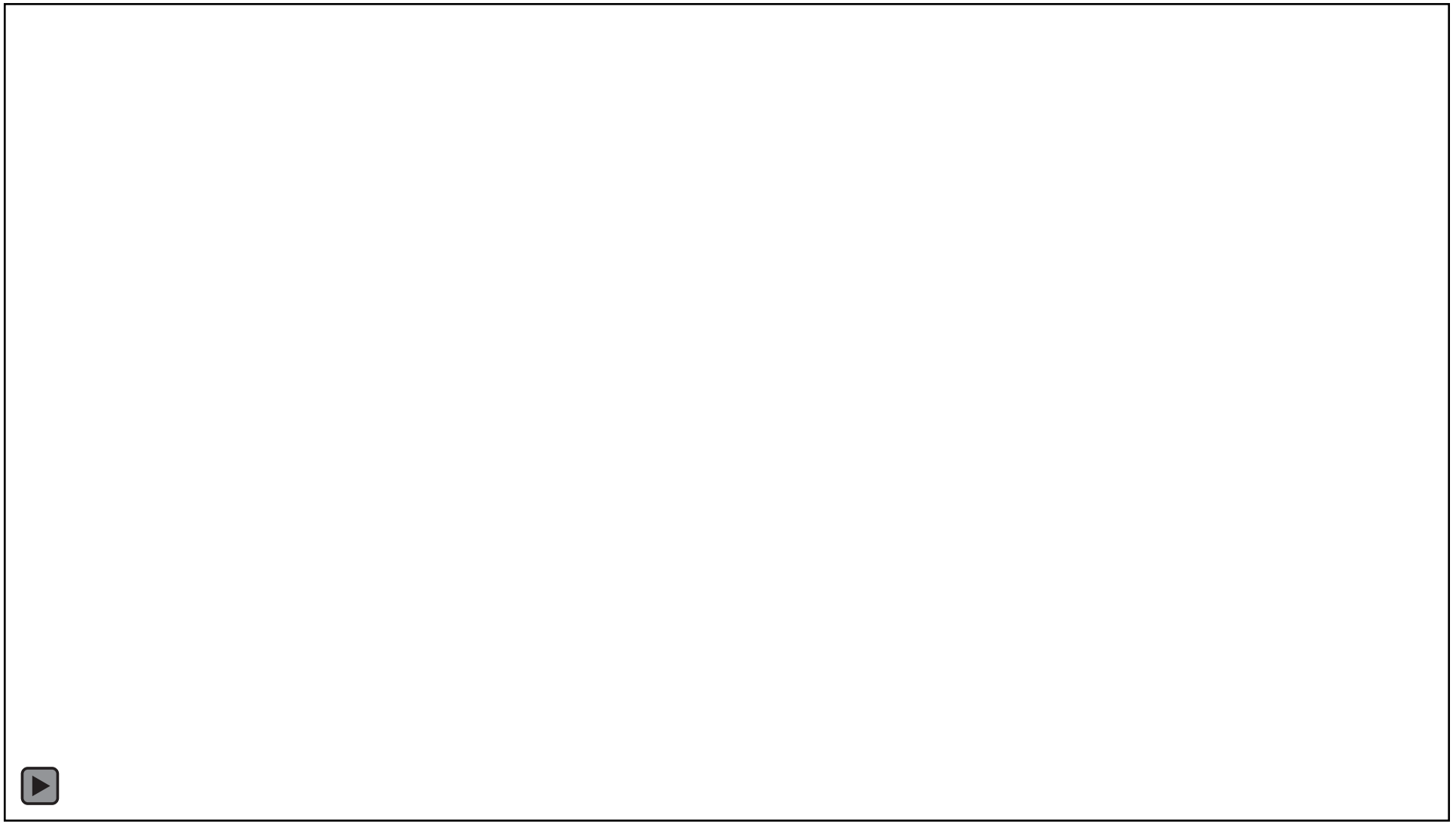
Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments



AP-105 double-shell tank deployment

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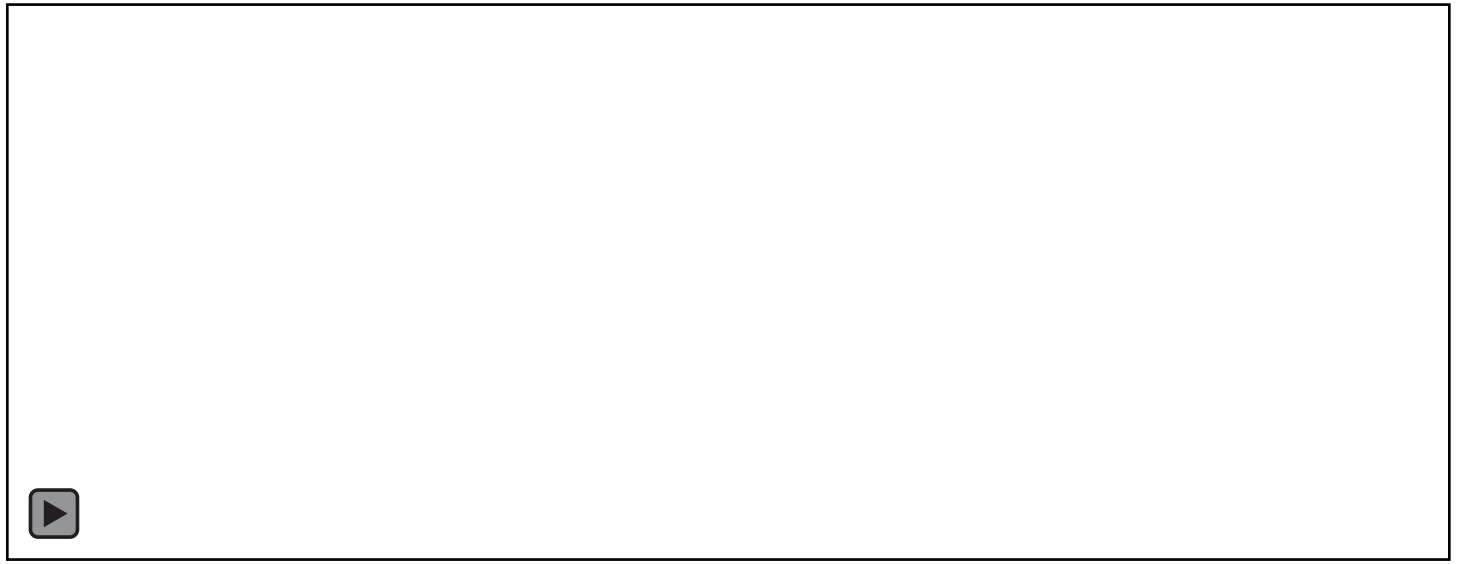
Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

AP-105 double-shell tank deployment



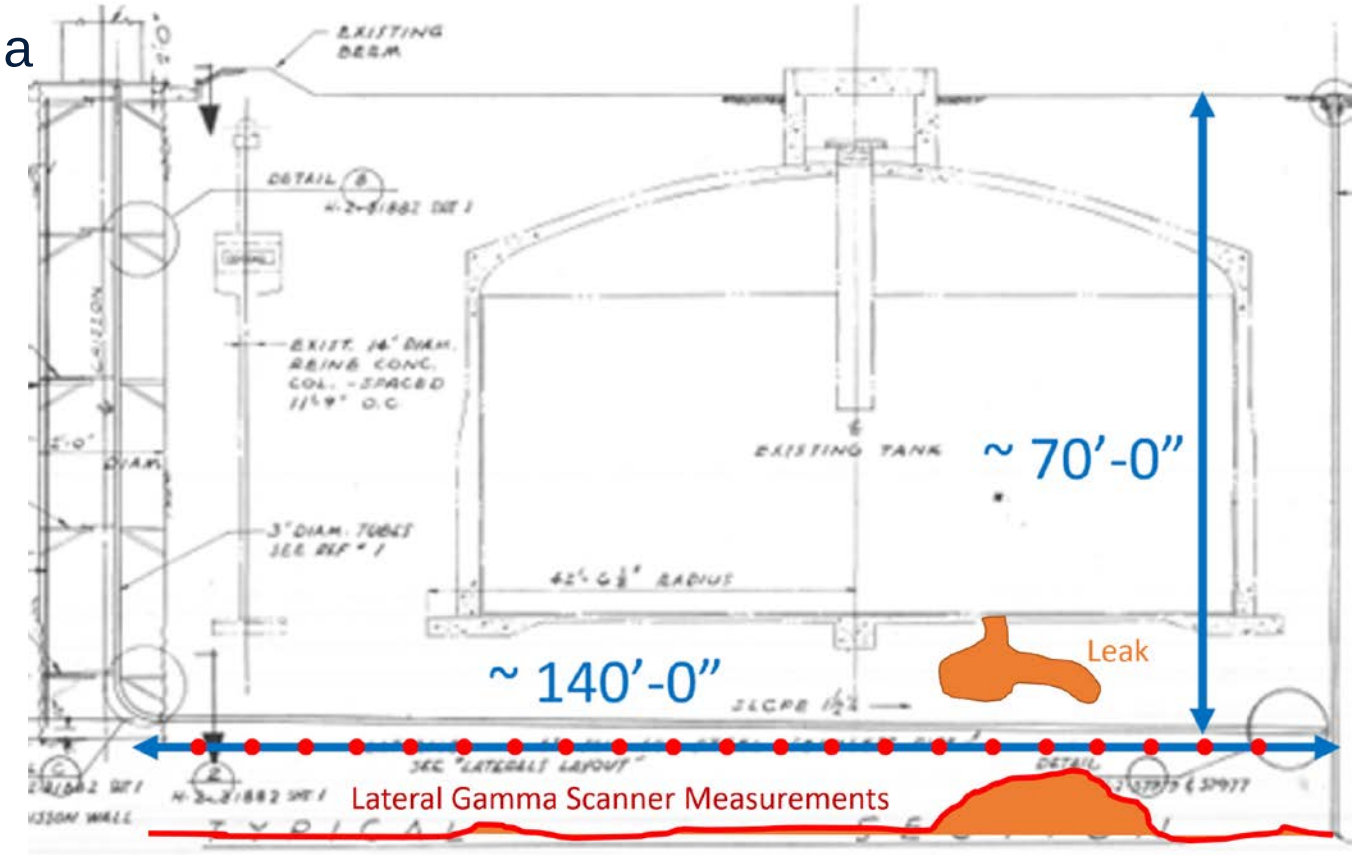
FIU mockup rust removal simulation

After deployment

Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

In July 2022, the FIU Lateral Gamma Scanner Crawler was **deployed at WRPS's Cold Test Facility**.



Proposed automated inspection

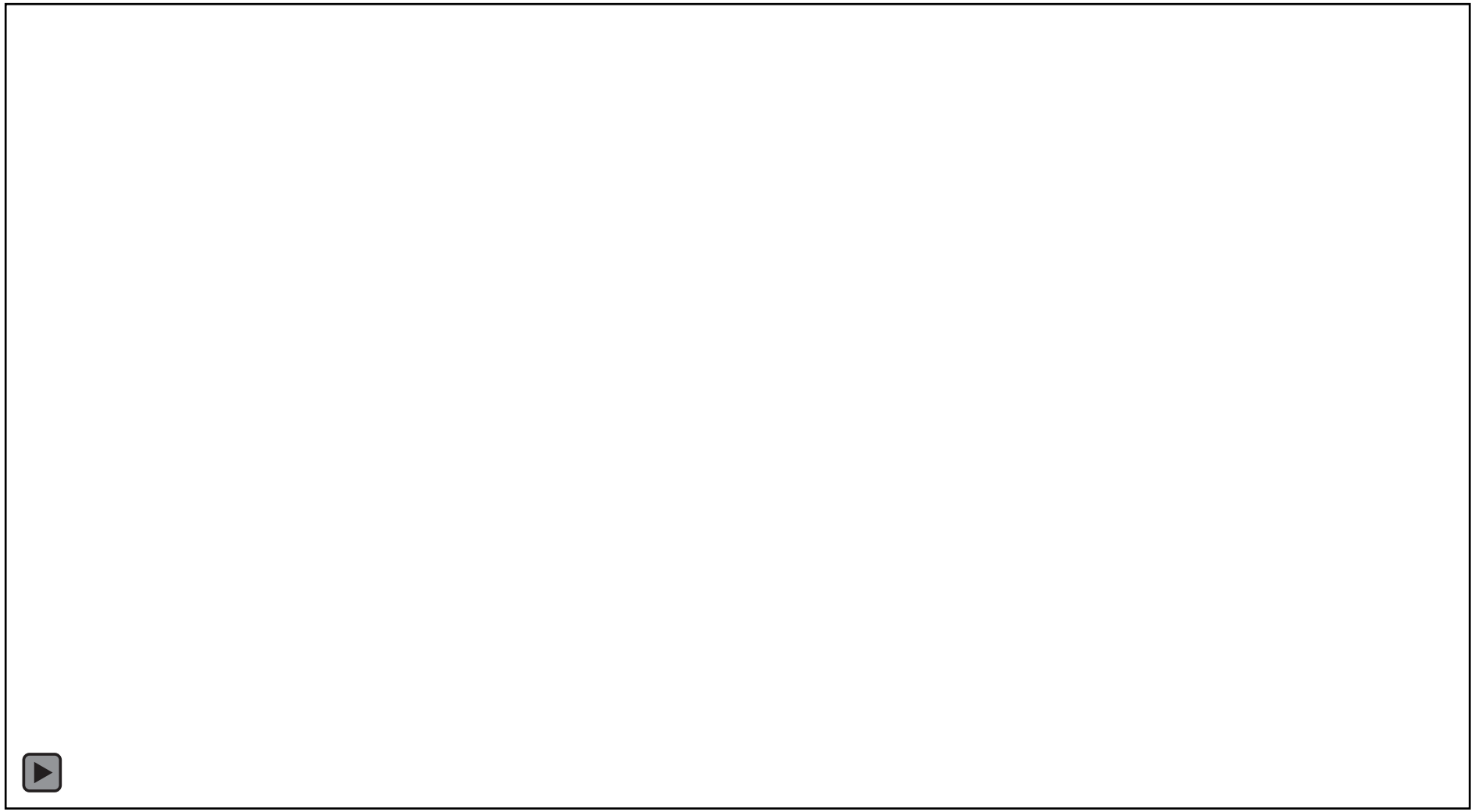
Cable Management

Lateral Gamma Scanner

Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

The overall design was also streamlined, and the inspection process was completely automated.



WPRS' Cold Test Facility Synchronization Test

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Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

WPRS' Cold Test Facility Deployment

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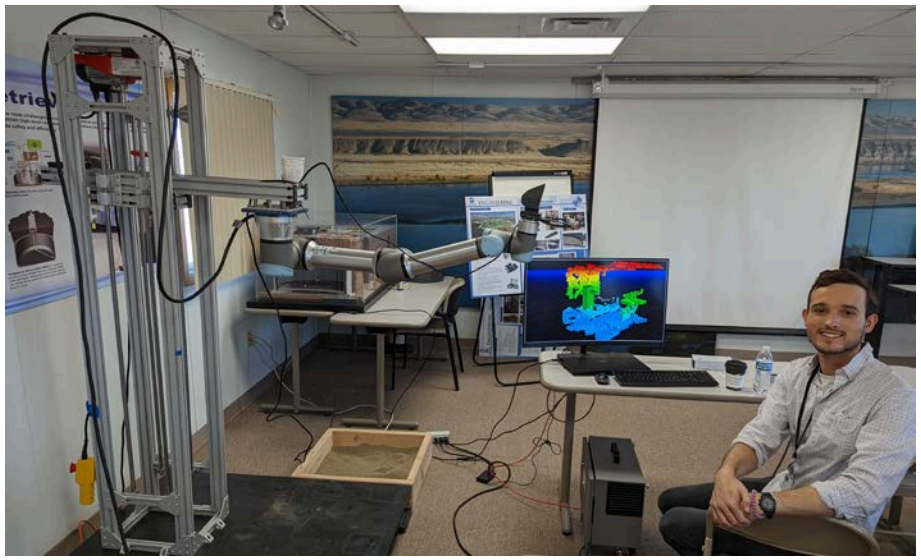
Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments

In Summer 2022, the FIU in collaboration with WRPS demonstrated at Hanford the potential of using robotic manipulators to perform off-riser sampling in high-level waste tanks.



Off-riser Sampler Demonstration

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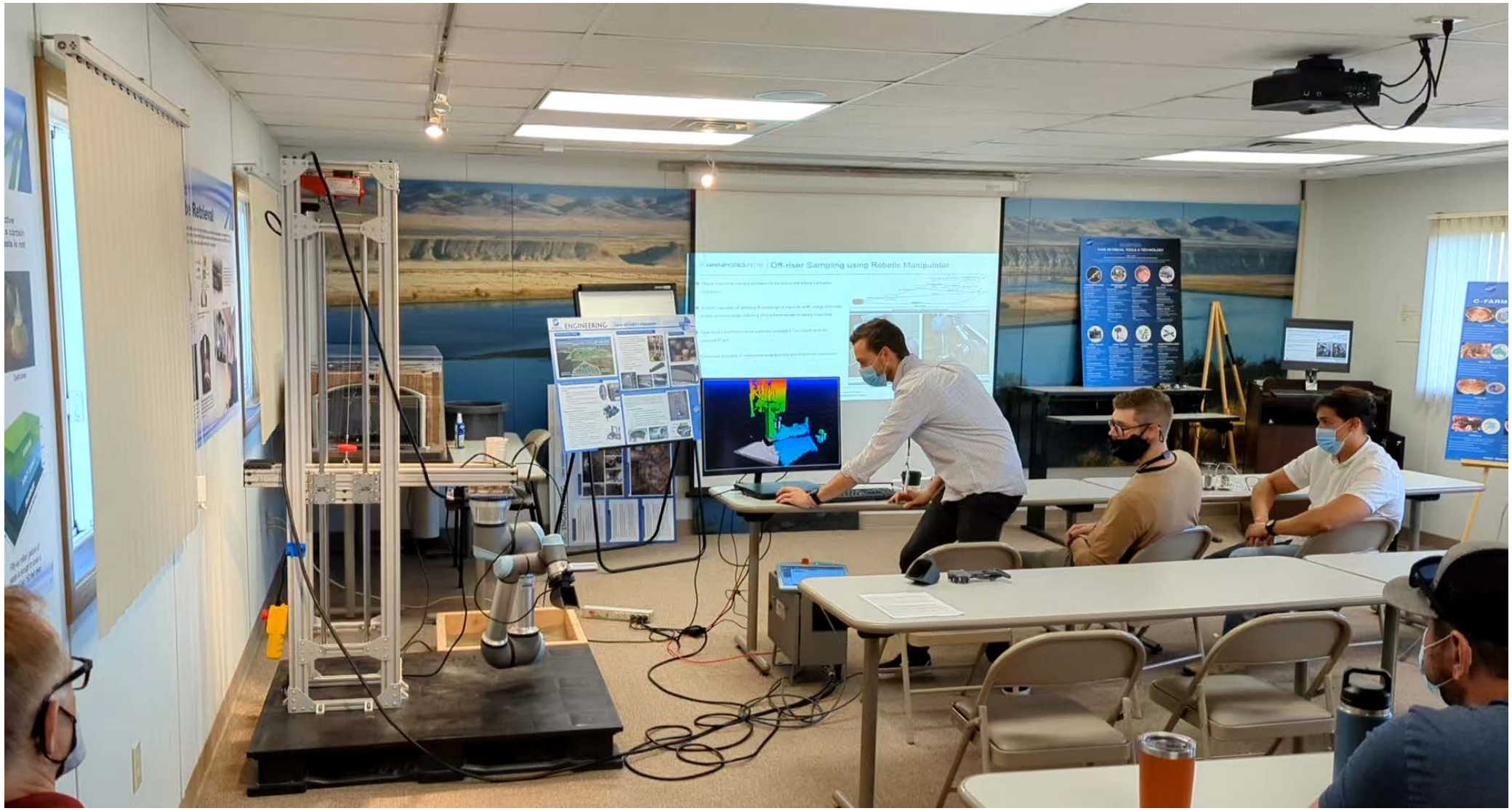
Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 2 Research Highlights and Accomplishments



Off-riser Sampler Demonstration

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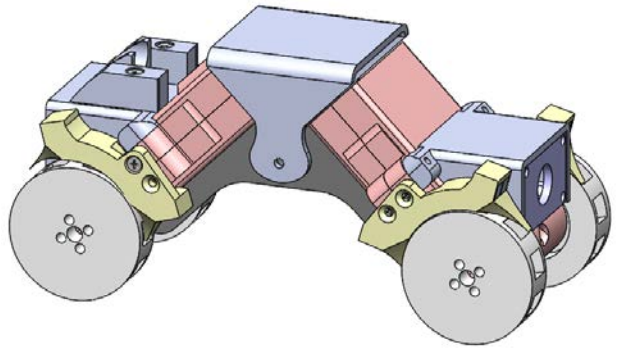
Subtask 18.2: Development of Inspection Tools for Hanford Tank Farm

FIU Year 3 Projected Scope

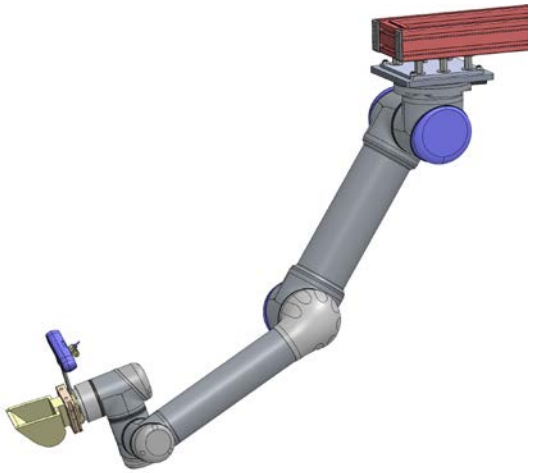
Minirover



- Enhance inspection capabilities by integrating a sampling arm and potentially an ultrasound sensor.
- Implement computer vision techniques to reconstruct refractory channel 3D models.

Lateral Gamma Scanner

- Integrate gamma radiation sensor.
- Enhance localization by adding visual and inertial odometry fused to tether length.
- Strengthen the gripper module.
- Streamline automated inspection routine.



Off-Riser Sampler

- Develop innovative end-effector tooling and samplers.
- Create a more natural interface with the operator.
- Deploy in summer at WRPS's Cold Test Facility.

Subtask 18.3: Development of a Coating Deployment Platform for the H-Canyon Exhaust Tunnel

Site Needs:

Visual inspections of the H-Canyon exhaust (HCAEX) tunnel showed degradation of the concrete walls. Also, a recent tunnel fragility analysis identified safety issues of the affected concrete regarding their strength.

The identification, evaluation and application of protective coatings to prevent further degradation of the concrete walls is needed to mitigate the damage.

Tunnel view

Degraded concrete exposing the steel rebar (red arrows).

Objectives:

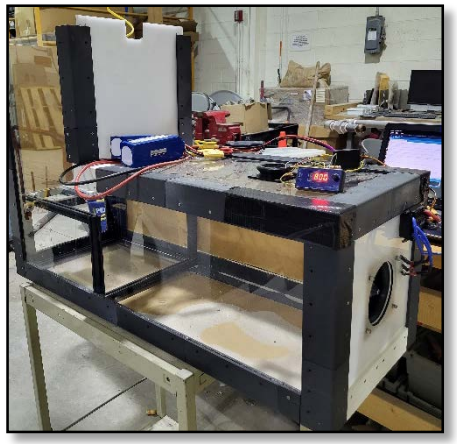
Develop a robotic platform that can navigate on the tunnel walls and apply protective coatings using an integrated coating application system.

Subtask 18.3: Development of a Coating Deployment Platform for the H-Canyon Exhaust Tunnel

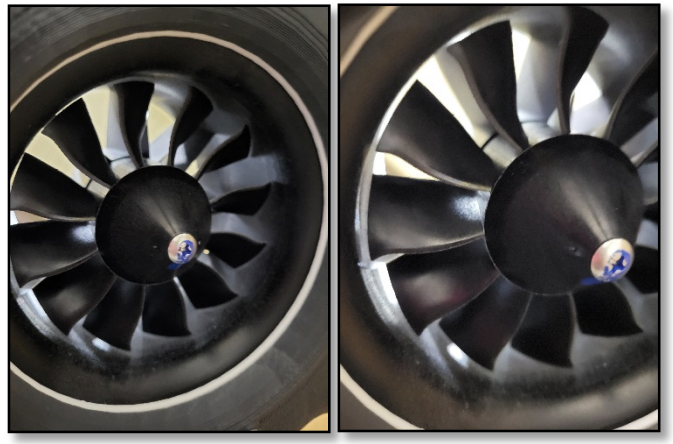
FIU Year 2 Research Highlights & Accomplishments:

Sand Ingestion Testing

- Smaller grain sand does not have a significant effect on thrust generation with the tested mass flow rate of sand into the ingestion chamber
- Degradation of blades are minimal and did not alter the basic performance of the EDF unit
- Extended ingestion testing allowed for the testing of the other electronic components such as the EDF unit itself, power supply and electronic speed controller (ESC)



Debris ingestion testing chamber



EDF unit with no significant blade damage

Support Arm

- 3 DOF arm design for providing support for extended testing of platform
- Used to compensate for reactionary forces from the coating process
- Can be used to harness the necessary transfer hoses needed for coating deployment

Supportive arm prototype being tested

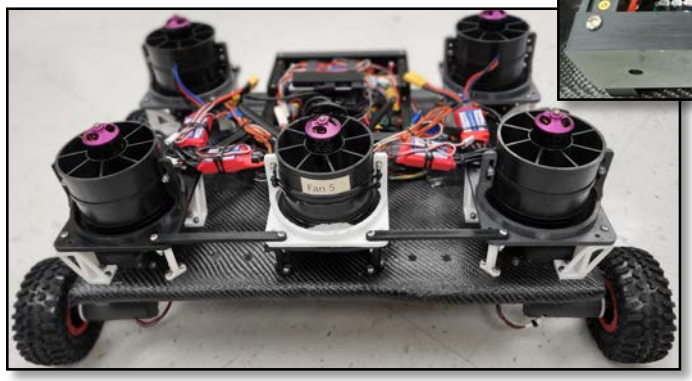
Subtask 18.3: Development of a Coating Deployment Platform for the H-Canyon Exhaust Tunnel

FIU Year 2 Research Highlights & Accomplishments:

Omnidirectional Platform

- Carbon fiber chassis has been fabricated and implemented on platform
- Control box has been redesigned to minimize weight from 3D printed enclosure
- Controls have been improved to include transitioning off from a vertical surface and reducing wear on geared motor mounts

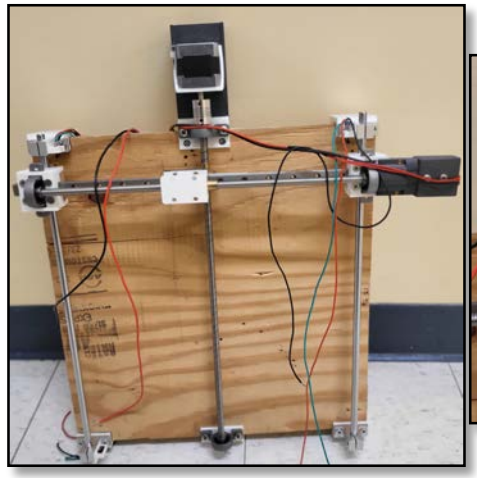
Redesigned control box module

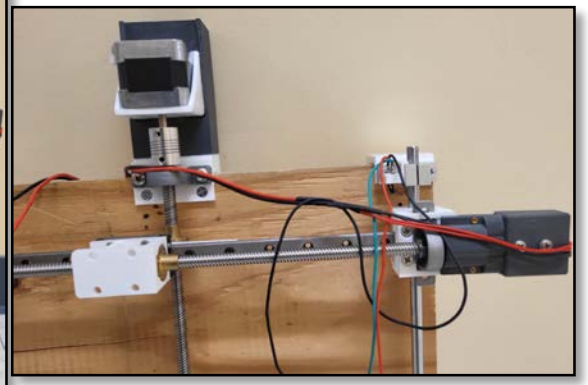


Current build with carbon fiber chassis

Coating Mechanism Design

- Coating mechanism is designed to operate over a 2D plane with the nozzle height fixed
- Initial testing use water leaving a nozzle at 2000 psi indicates that 3-5 lbs of reaction force can be generated
- Design of coating mechanism needs to robust to minimize failure from moisture and debris buildup





Lead screw-based prototype of coating mechanism

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Subtask 18.3: Development of a Coating Deployment Platform for the H-Canyon Exhaust Tunnel

FIU Year 3 Projected Scope

- Platform development
  - Finalize design of vector thrust unit and begin initial testing for failure analysis and design improvement
  - Develop electronic package to reduce electronic platform and minimize overall weight
  - Develop a reliable power distribution unit for extended time trials for testing
  - Implement semi-autonomous capabilities on platform to automate surface transition and reduce power consumption
  - Increase the DOFs of the current design of the support arm
- Coating system
  - Work with coating companies to develop model for a coating system for use on the mobile robotic platform
  - Integrate coating components with the wall crawler and conduct initial tests
- Testing
  - Develop initial design of tunnel mock-up which will be used for the testing of the wall crawling platform

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Subtask 18.4: Long-Term Surveillance of Nuclear Facilities and Repositories using Mobile Systems

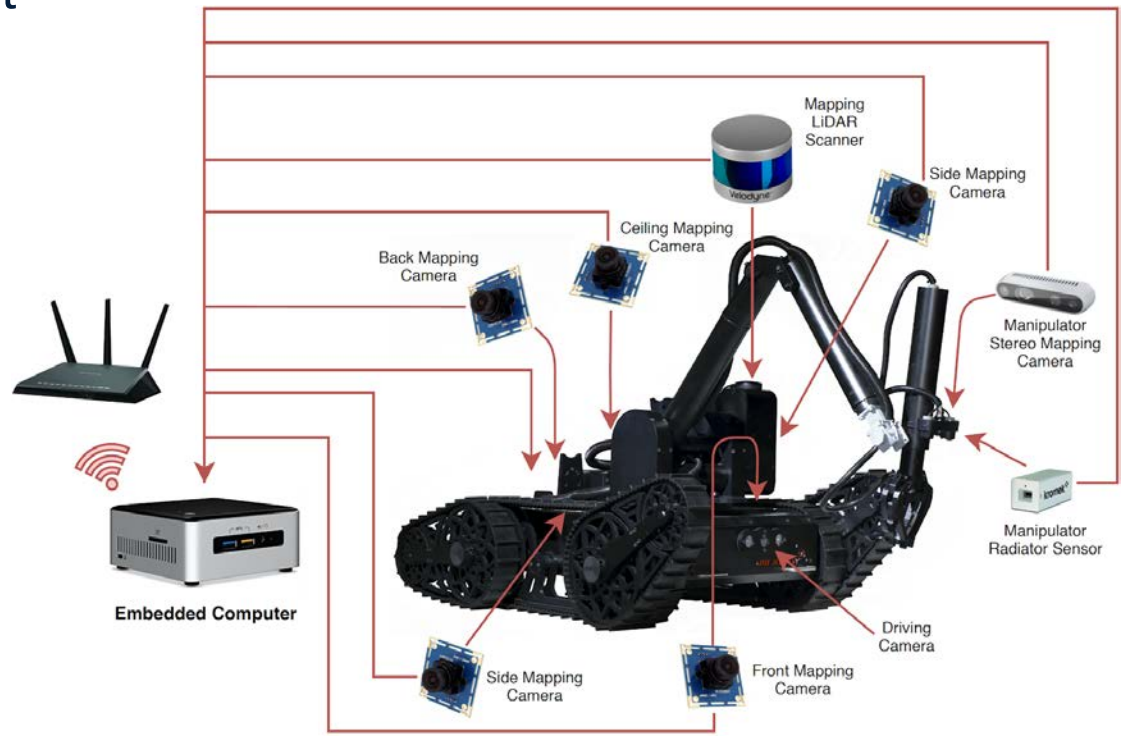
Site Needs

Continuous surveillance of nuclear facilities and repositories is a critical element in successfully controlling and understanding radiological environmental impact, among other hazards, planning cleanup efforts, and meeting quality assurance objectives established by the United States Department of Energy standards and guidelines

Conventional Site Inspections

Objectives

Automate aboveground routine inspections, surveillances, and emergency response at Hanford's thank farms.



FIU's Autonomous Surveillance Framework

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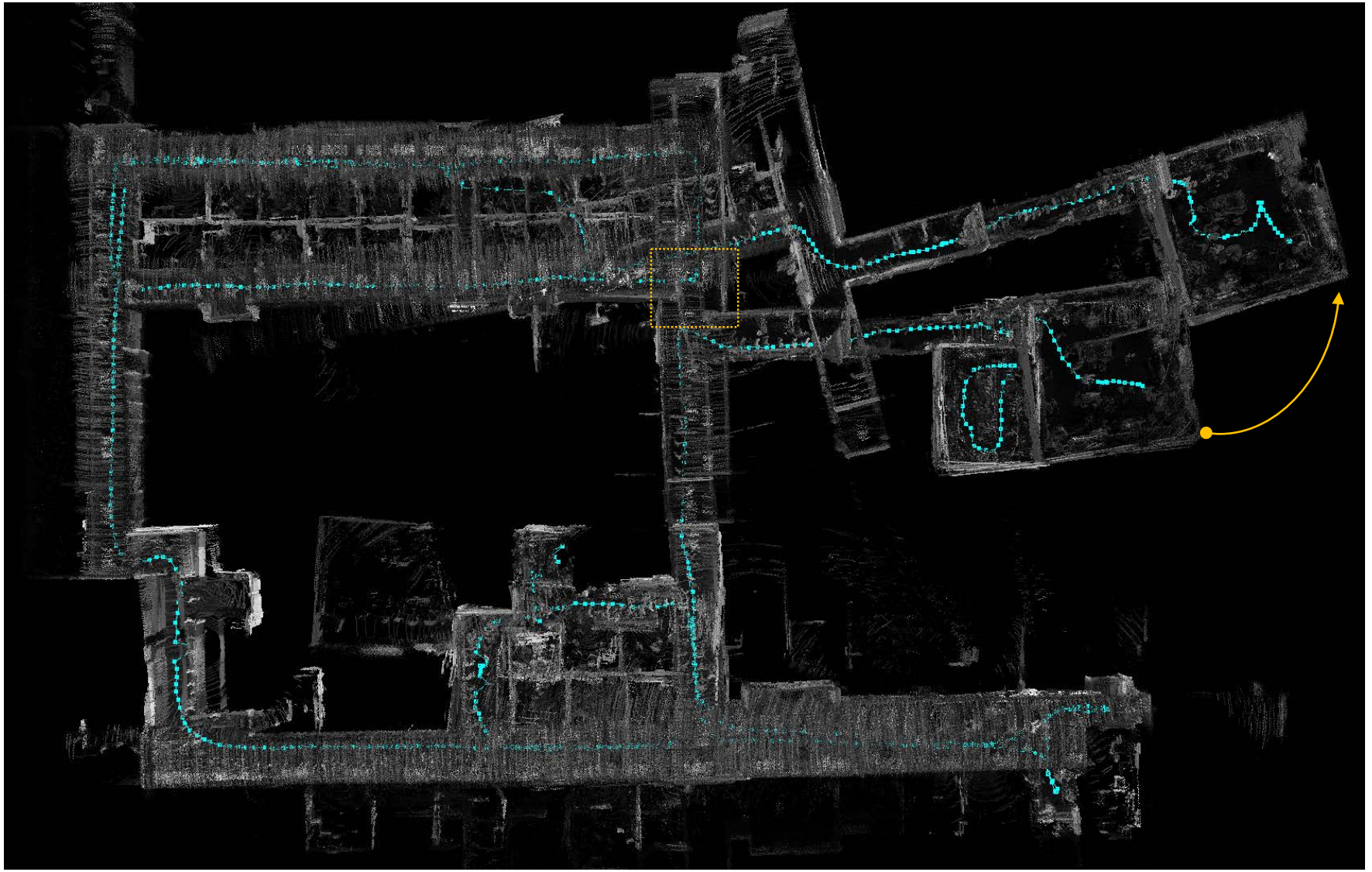
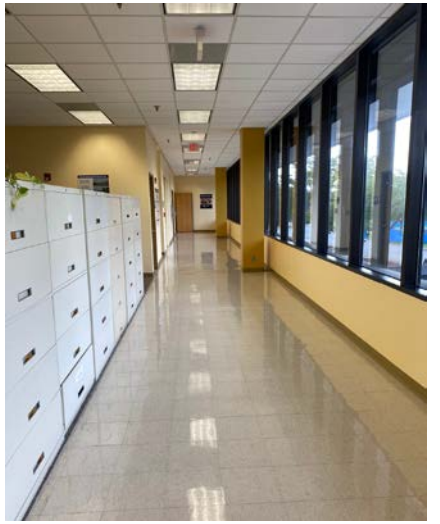
Subtask 18.4: Long-Term Surveillance of Nuclear Facilities and Repositories using Mobile Systems

FIU Year 2 Research Highlights and Accomplishments





Robust Indoor Navigation

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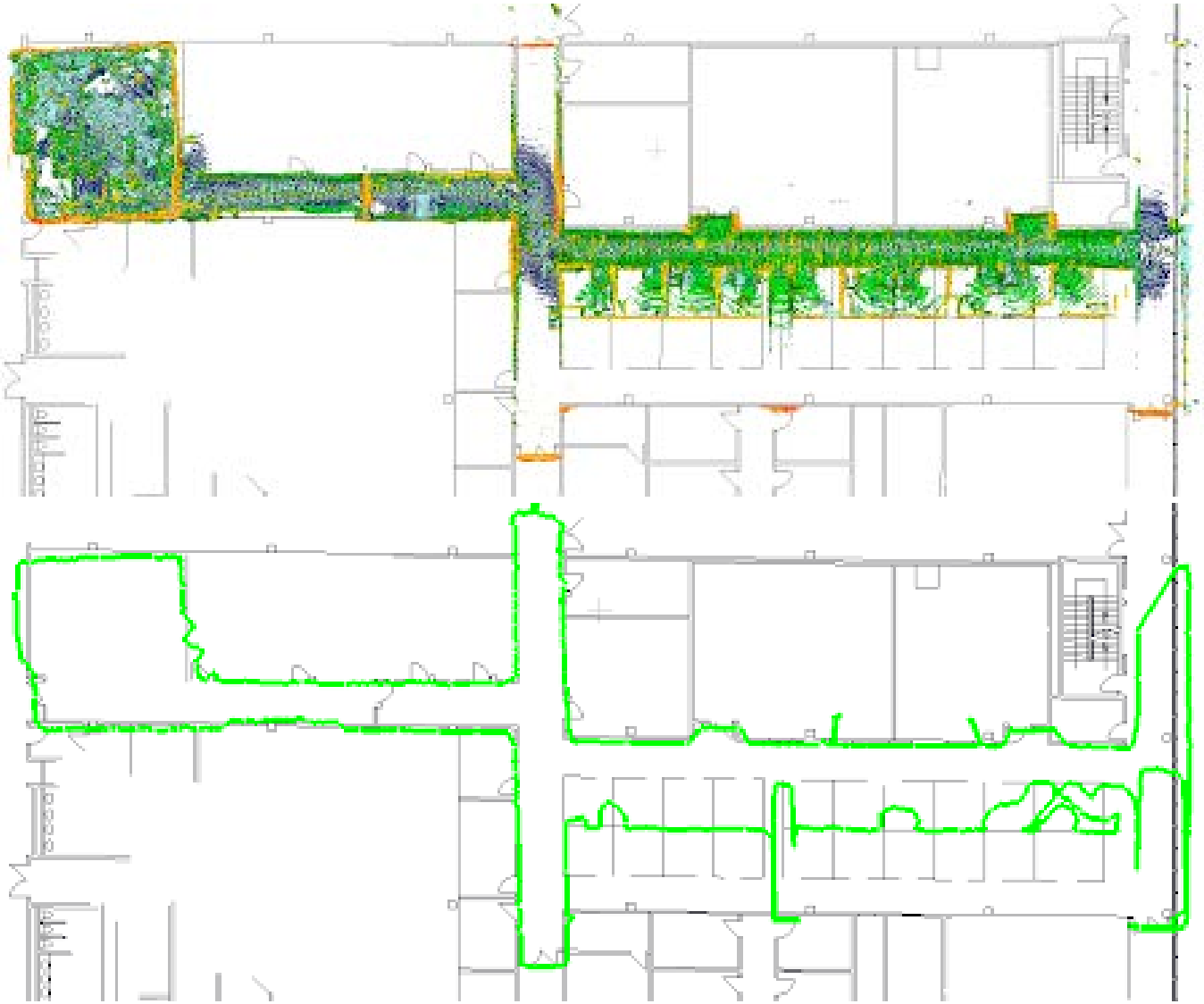
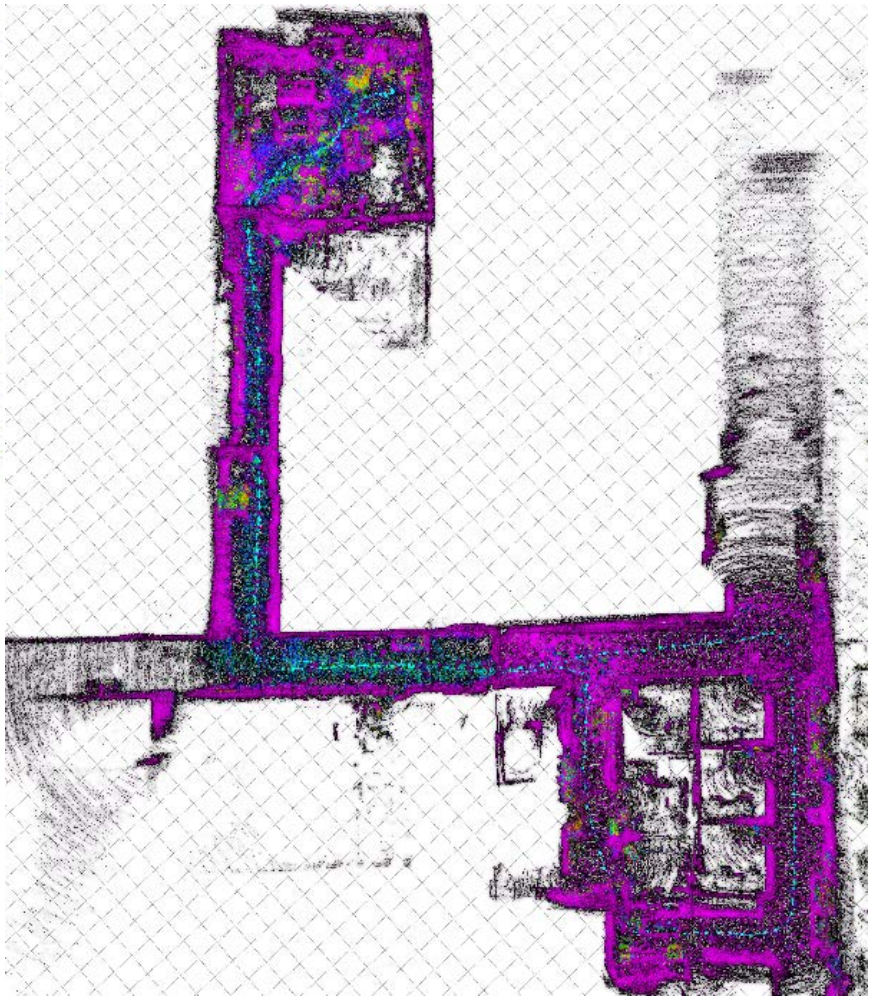
Subtask 18.4: Long-Term Surveillance of Nuclear Facilities and Repositories using Mobile Systems

FIU Year 2 Research Highlights and Accomplishments





Robust Navigation

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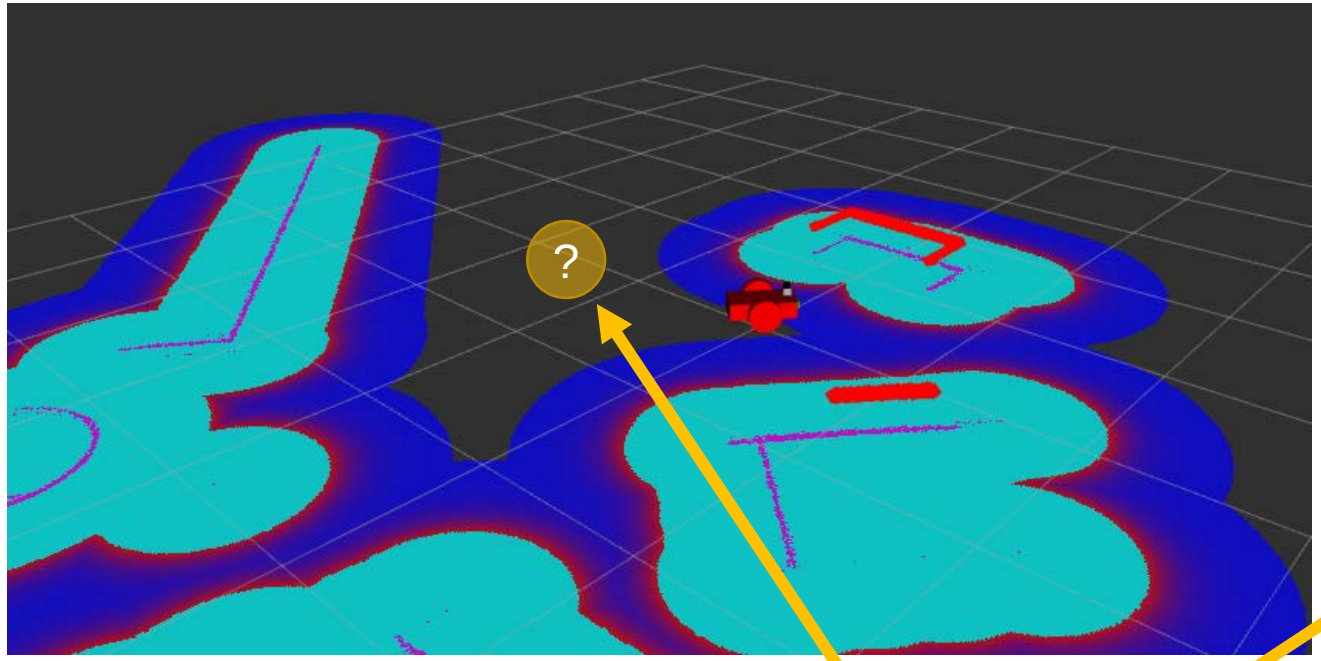
Subtask 18.4: Long-Term Surveillance of Nuclear Facilities and Repositories using Mobile Systems

FIU Year 2 Research Highlights and Accomplishments



?

No obstacle!

Is safe ?

Onboard Terrain Risk-awareness

Subtask 18.4: Long-Term Surveillance of Nuclear Facilities and Repositories using Mobile Systems

FIU Year 3 Projected Scope

- Streamline FIU's autonomous surveillance framework
- Establish routines for autonomous outdoor surveillance
- Enhance onboard terrain risk-awareness framework
- Implement information-driven planning and control algorithm
- Investigate integrating an ammonia sensor
- Retrofit a Robotic platform provided by WRPS
- Deploy in summer at WRPS's Cold Test Facility

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Task 19

Pipeline Integrity and Analysis

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Subtask 19.1: Pipeline Corrosion and Erosion Evaluation

Site Needs:

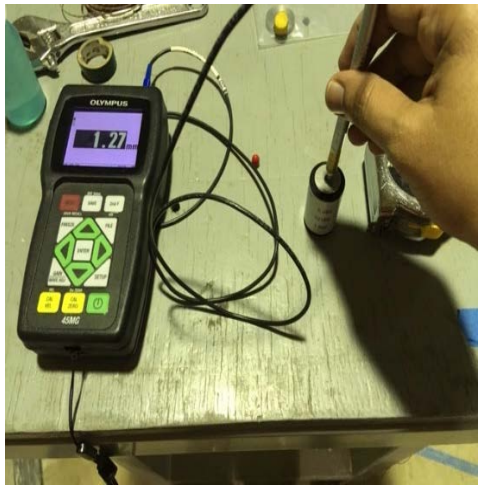
- Structural integrity and life assessment by corrosion and erosion detection in waste tanks and transfer lines.
- Due to uncertainties regarding the structural integrity of pipelines at Hanford, a Fitness-for-Service (FFS) program for the Waste Transfer System has been implemented.
- A direct inspection and assessment of the condition of buried pipelines is required to evaluate the corrosion and erosion wear rates and predict the existing system's remaining useful life.

Objectives:

- Evaluate technologies for real-time thickness changes in pipes and transfer lines.
- Validate flow erosion coupons developed by SRNL for erosion and corrosion detection.
- Model and predict erosion and corrosion using fluid flow dynamics and advanced data analytics.

Subtask 19.1: Pipeline Corrosion and Erosion Evaluation

Site	Technology		Benefit
SRNL	**SRNL erosion coupons**		structural integrity evaluation in pipes and transfer system components (in-situ erosion and corrosion detection)



Ultrasonic Sensor

Erosion Test Loop (Engineering Scale)

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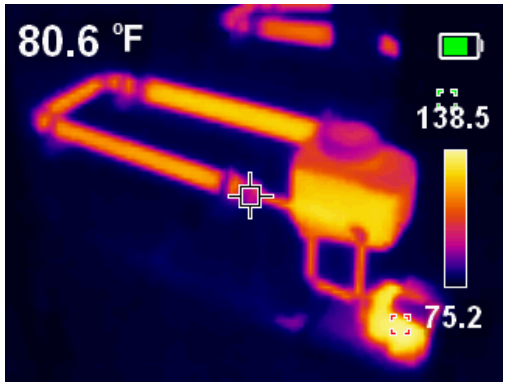
Subtask 19.1: Pipeline Corrosion and Erosion Evaluation

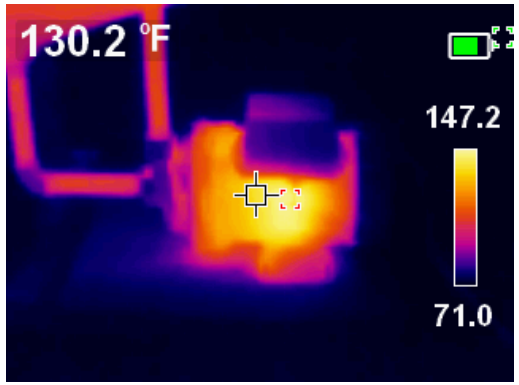
FIU Year 2 Research Highlights & Accomplishments:

Corrosion Test Loop (Bench Scale)

- 2- and 3-inch pipe sections (carbon steel straight sections and stainless-steel elbows)
- Modular, Loop footprint - @5 ft X 2 ft
- 1/3 HP centrifugal pump - up to 20 gpm stainless steel impeller and casing suitable for caustic solutions
- Chemical simulants for realistic corrosion tests

Chemical	Mass (g) (250ml) (baseline)
Sodium Hydroxide	10.1
Aluminum Nitrate	6.91
Sodium Sulfate	0.522
Sodium Carbonate monohydrate	2.6
Sodium Nitrate	11
Sodium Nitrite	3.86
Sodium Chloride	0.96



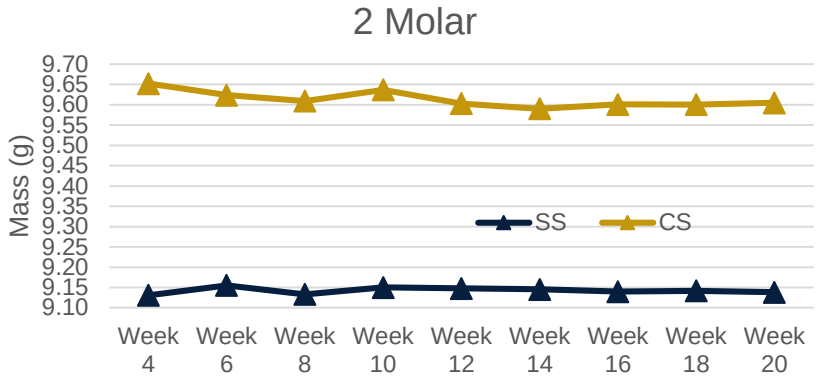


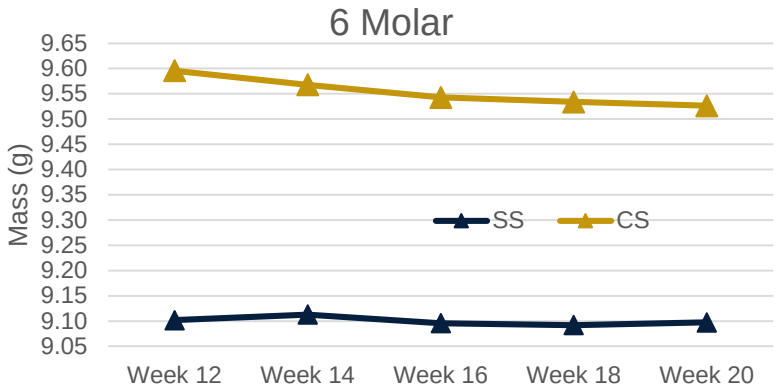
Subtask 19.1: Pipeline Corrosion and Erosion Evaluation

FIU Year 2 Research Highlights & Accomplishments:

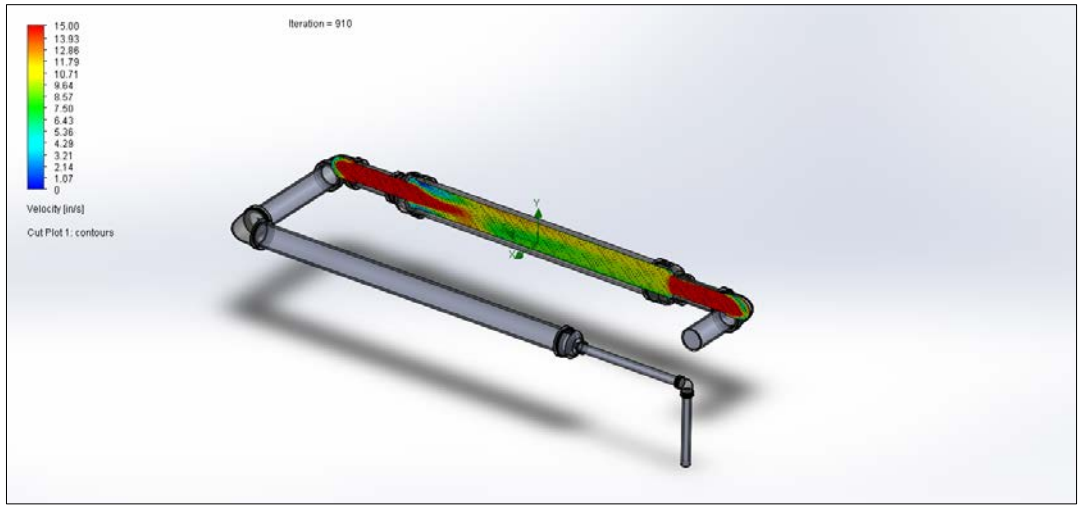
Corrosion Loop Results

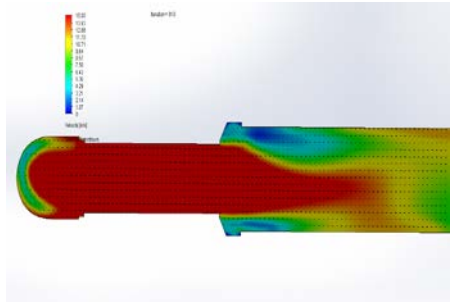
Experimental (caustic simulants)

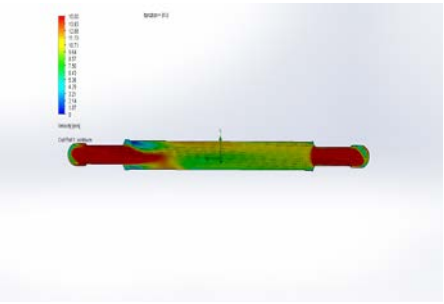




Computational Fluid Dynamics (CFD) Simulations







Subtask 19.1: Pipeline Corrosion and Erosion Evaluation

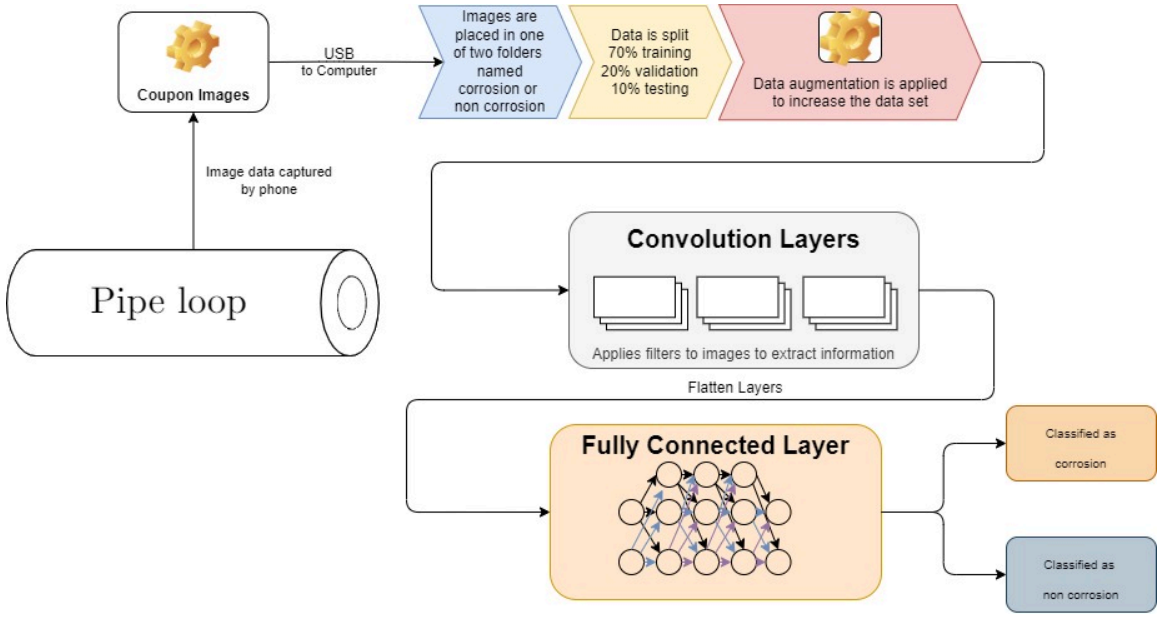
FIU Year 2 Research Highlights & Accomplishments:

Automated Corrosion Detection Using Machine Learning Models

SRNL coupon images (corrosion)

Molarity	Stainless Step	Stainless Inside	Carbon Step	Carbon Inside
2M				
4M				
6M				

Machine Learning Architecture



Subtask 19.1: Pipeline Corrosion and Erosion Evaluation

FIU Year 3 Projected Scope

- Continue erosion and corrosion testing in both flow loops using SRNL coupons.
- Model the effect of simulant flow dynamics on particle erosion and caustic corrosion for structural integrity assessment.
- Develop data analytics models using the experimental sensor data and simulation results to predict the remaining useful life of tanks and transfer system components.

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Subtask 19.2: Evaluation of Nonmetallic Components in the Waste Transfer System

Site Needs:

- Nonmetallic materials are used in the US DOE's Hanford Site Tank Farm waste transfer system. These include inner primary hoses in the HIHTLs, Garlock® gaskets, EPDM O-rings, and other nonmetallic materials.
- Nonmetallic materials are exposed to β and γ irradiation, caustic solutions as well as high temperatures and pressure stressors. How they react to each of these stressors individually has been well established, but simultaneous exposure of these stressors is of great concern.

Objectives:

- Provide the Hanford Site with data obtained from experimental testing of the hose-in-hose transfer lines, Garlock® gaskets, EPDM O-rings, and other nonmetallic components under simultaneous stressor exposures.
- Evaluation includes chemical aging and exposure of hose coupons to elevated temperature over time. Radiation is not included.

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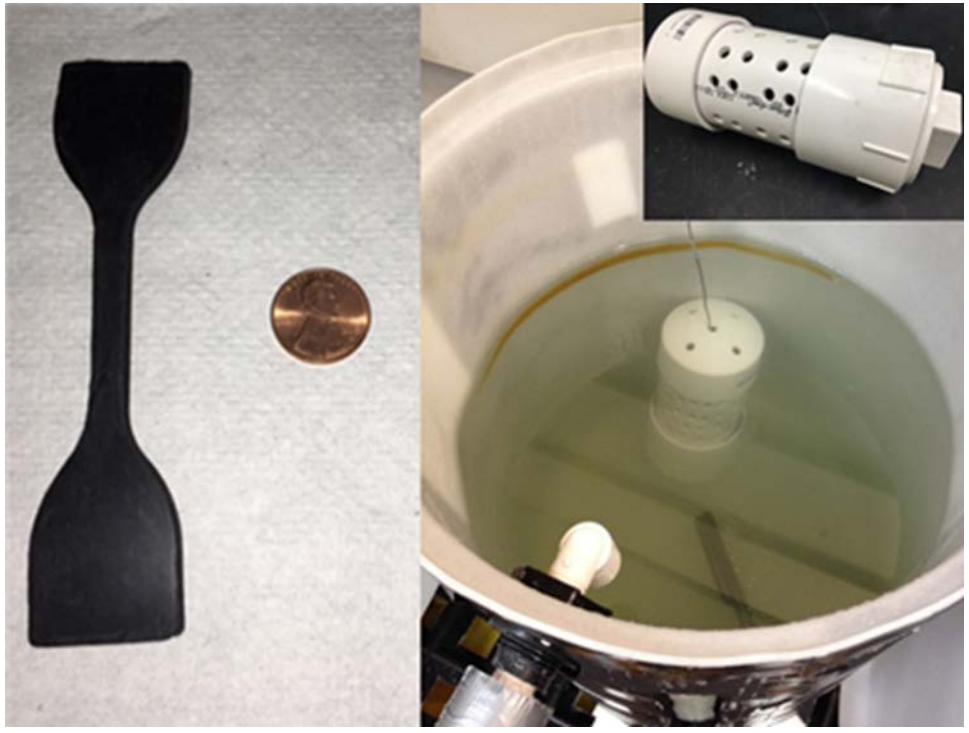
Subtask 19.2: Evaluation of Nonmetallic Components in the Waste Transfer System

FIU Year 2 Research Highlights & Accomplishments:

- An aging system that included four test loops was fabricated that circulated NaOH solutions of 25%, 12.5%, 6.25%, and 0% respectively at 170°F.
- Each test loop consisted of a pumping loop with three hose sections and six EPDM dog-bone specimens.
- Dog-bone coupon aging consisted of a coupon aging vessel submerged in each test loop's storage tank.



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Subtask 19.2: Evaluation of Nonmetallic Components in the Waste Transfer System

FIU Year 2 Research Highlights & Accomplishments:

After aging for 1-year, specimens had their material properties analyzed.

Material property analysis included:

- Hose burst pressure
- EPDM dog-bone tensile strength

Aging Type	Average Burst Pressure (MPa)	% Change
Baseline (Unaged)	20.71	0.00
Water Only	12.30	-40.61
6.25%	15.29	-26.17
12.50%	16.90	-18.41
25%	19.40	-6.32

Average Hose Burst Pressure

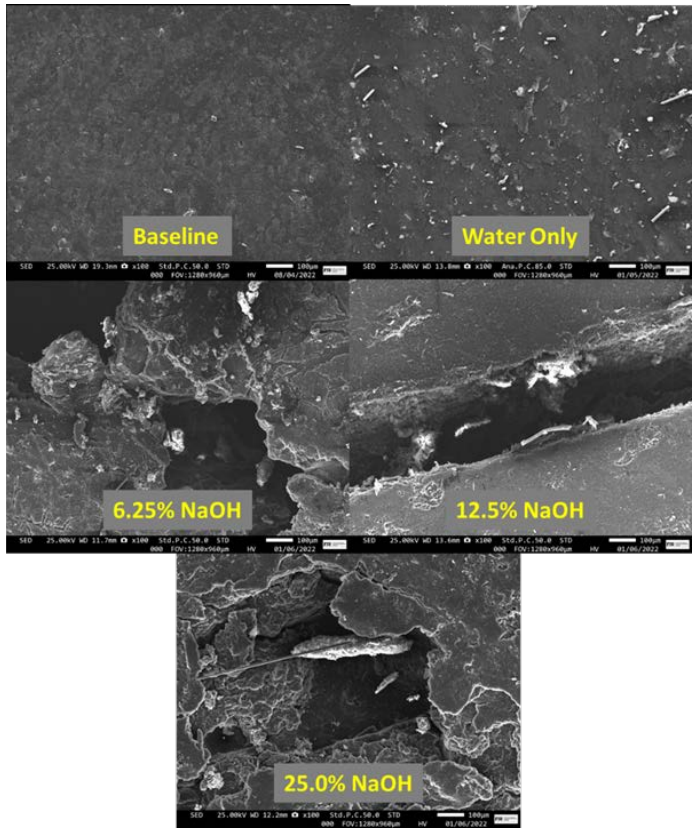
Aging Type	Average Tensile Strength (MPa)	% Change
Baseline (Unaged)	7.70	0.00
Water Only	6.43	-16.49
6.25%	0.95	-87.66
12.50%	1.73	-77.53
25%	1.79	-76.75

Average Dog-Bone Tensile Strength

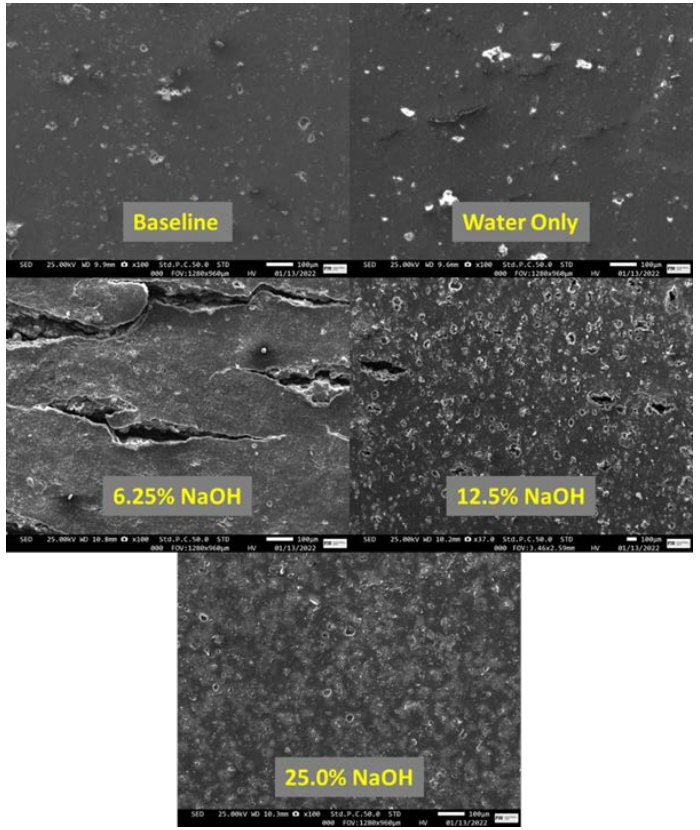
Subtask 19.2: Evaluation of Nonmetallic Components in the Waste Transfer System

FIU Year 2 Research Highlights & Accomplishments:

Scanning Electron Microscopy (SEM) analysis of aged specimens.



Hose specimens at 100X Magnification.



Dog-Bone specimens at 100X Magnification.

Subtask 19.2: Evaluation of Nonmetallic Components in the Waste Transfer System

FIU Year 3 Projected Scope

- Investigate fundamental aspects of aging and mechanisms of failure
  - This includes wettability and stress risers on the EPDM material
  - Provide an understanding of why the greatest material degradation occurs at the lowest (6.25%) NaOH concentrations.

- Investigate aging and testing of the Viper® hose used at SRNL. Provide a technical basis for the Viper hose use.

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Task 20

Corrosion Protection and Characterization of EM Infrastructure

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Subtask 20.1: Evaluation of Coatings for the H-Canyon Exhaust Tunnel

Site Needs:

Visual inspections of the H-Canyon exhaust (HCAEX) tunnel showed degradation of the concrete walls. Also, a recent tunnel fragility analysis identified safety issues of the affected concrete regarding their strength.

The identification and evaluation of protective coatings to prevent further degradation of the concrete walls is necessary.

Tunnel view

Degraded concrete exposing the steel rebar (red arrows).

Objectives:

- Develop and evaluate aged concrete surfaces trough accelerated aging tests.
- Identify and evaluate potential coatings for future application in the HCAEX tunnel.
- Develop a robotic deployment platform that can navigate on the tunnel walls and apply protective coatings.

Subtask 20.1: Evaluation of Coatings for the H-Canyon Exhaust Tunnel

FIU Year 2 Research Highlights & Accomplishments:

Materials and Methods

- Test plan developed
- Potential coatings identified
- Accelerated aging conditions:

0.5 M HNO_3 solution and erosion

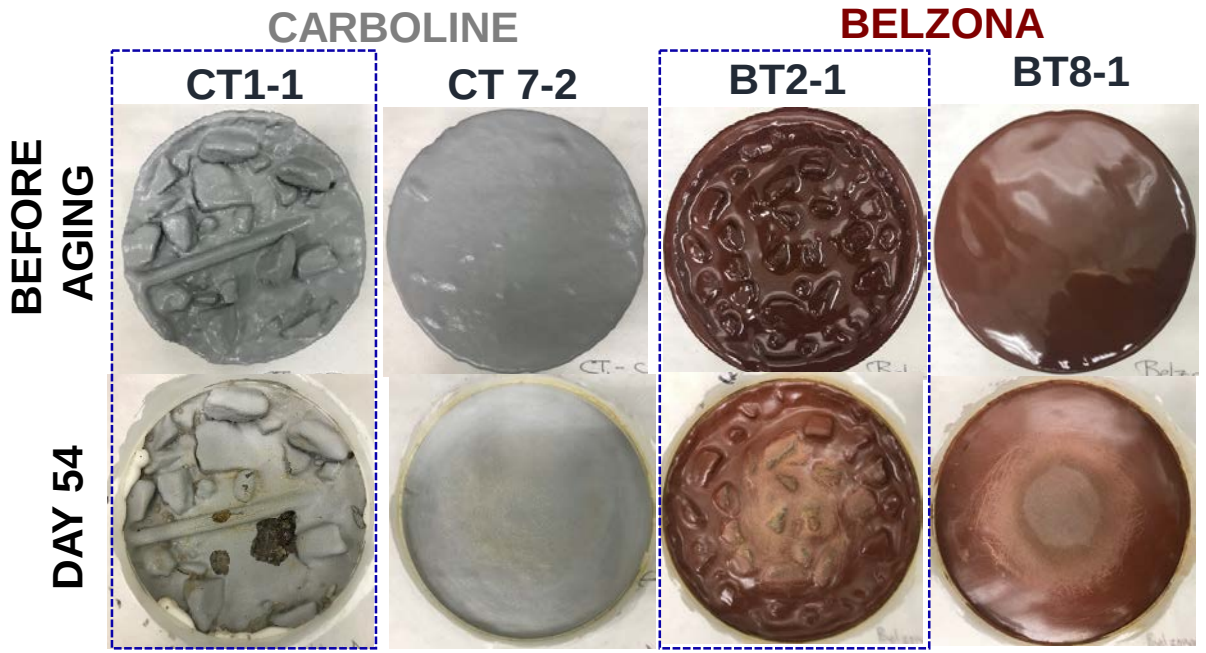
- Durability measurements (Visual inspection, thickness, impedance, pH)

Results of accelerated aging tests

1.Thickness:

Thickness loss (%), Day 35	Carboline samples	Belzona samples
With surface prep.	10-11	7.4 - 20
No surface prep.	10-14	15 - 23

2. Visual Inspection: Greatest degradation for aged concrete samples.



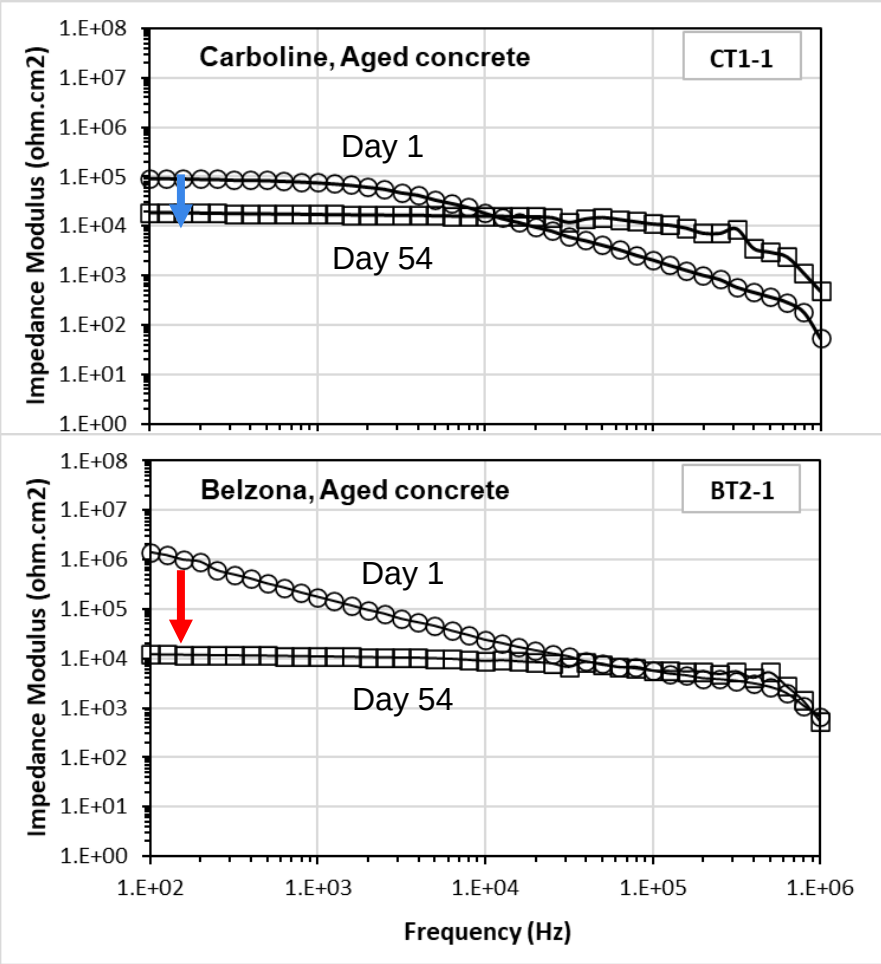
Highlighted in blue: samples with surface preparation

- In general, samples with surface preparation depicted less thickness loss
- Belzona coating, with and without surface prep, showed the greatest thickness loss.

Subtask 20.1: Evaluation of Coatings for the H-Canyon Exhaust Tunnel

FIU Year 2 Research Highlights & Accomplishments:

3. Impedance measurements: Greatest degradation observed on Belzona's samples. Lowest impedance values.



Accomplishments

- Potential coatings (coating systems and single coats) for the protection of the tunnel concrete walls were identified.
- Carboline and Belzona coated samples initiated the accelerated aging process.
- Preliminary evaluation of the Carboline and Belzona coatings was completed.
- Impedance measurements, with a new procured potentiostat, supported the evaluation of the coating's protective properties.

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Subtask 20.1: Evaluation of Coatings for the H-Canyon Exhaust Tunnel

FIU Year 3 Projected Scope

- Continue the evaluation of potential coatings trough accelerated aging tests.
- Initiate the evaluation of Sherwin-Williams coated samples.
- Study the effect of key variables on the coating’s performance.
- Coordinate the preparation of Framatome coated samples at their facilities.
- Perform surface characterization on selected coated samples.
- Establish a ranking based on the coating's behavior to the aging condition.

Subtask 20.2: Corrosion Evaluation of Steel Canisters for Hanford Integrated Disposal Facility (IDF) (NEW)

Site Needs:

- A technical gap for DOE is to understand the site-specific durability of steel canisters/containers containing waste forms at the Hanford IDF. The canisters are an additional barrier to environmental exposure that are not considered in long-term models.
- Currently, electrochemical corrosion data of steels in site specific conditions of the IDF is very limited.
- The main goal is to evaluate the corrosion behavior of canister/container materials in simulated Hanford IDF groundwaters using electrochemical techniques.

Containers for the storage of waste. Left: Carbon steel B-25 box for possible placement of cementitious waste forms, Right: Steel canister for LAW glass waste forms.

Objectives:

Evaluate material behavior of the canisters in environments similar to IDF conditions and obtain site-specific corrosion data through electrochemical measurements.

Subtask 20.2: Corrosion Evaluation of Steel Canisters for Hanford Integrated Disposal Facility (NEW)

FIU Year 2 Research Highlights & Accomplishments:

Materials and Methods

- 304 stainless steel samples
- Hanford simulated groundwater solution
- Corrosion potential (OCP), linear polarization resistance (LPR) and potentiodynamic (PDP) measurements

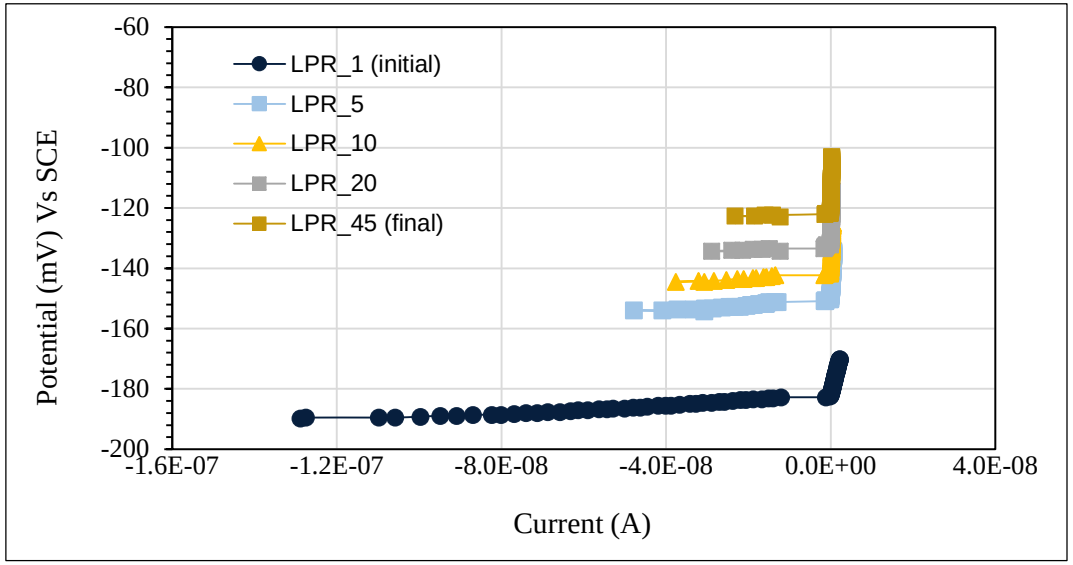
Potentiostat overload issues/Actions

- FIU followed recommendations of the AMETEK technical team and Hanford.
- Calibration and Dummy test performed
- Grounding connections modified
- Current and potential filters (1 Hz) used

Valuable data collected

View of the potentiostat, Faraday Cage and computer used for electrochemical measurements.

Polarization resistance (LPR) results



Polarization resistance for 304 SS canister material at different immersion times in simulated Hanford groundwater

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Subtask 20.2: Corrosion Evaluation of Steel Canisters for Hanford Integrated Disposal Facility (NEW)

Electrochemical test results

Corrosion parameters from LPR data for 304SS

LPR_#	Rp [Ω]	Icorr (A)	icorr (A/cm²)	R (g/m²y)	R (µm/y)
1	4.92E7	5.28E-7	3.27E-7	29.84	3.76
5	8.11E8	3.21E-8	1.99E-8	1.81	0.23
10	2.00E10	1.30E-9	8.06E-10	0.07	0.01
20	9.38E8	2.77E-8	1.72E-8	1.57	0.20
45	**1.15E10**	2.26E-9	**1.40E-9**	**0.13**	**0.02**

- Polarization resistance (Rp) values increase with immersion time and corrosion current (Icorr) and corrosion rate (R) values decrease.
- The decrease of the R and icorr after 48 hours of measurement to small values of 0.13 g/m²y and 1.40E-9 A/cm² may suggest that the steel is passivating.

Accomplishments

- Faraday cage for electrochemical measurements designed and built
- Initial samples of 304 SS prepared for the testing
- The potentiostat was setup.
- The overload issues of the potentiostat were solved.
- Preliminary corrosion data for 304 SS samples immersed in Hanford simulated groundwater were obtained through electrochemical tests (Ecorr, LPR and PDP).

Subtask 20.2: Corrosion Evaluation of Steel Canisters for Hanford Integrated Disposal Facility (NEW)

FIU Year 3 Projected Scope

- Continue the execution of the test plan.
- Continue the evaluation of 304 stainless steel.
- Study the effect of weld regions on the corrosion behavior.
- Study the effect of heat treatment zones on the corrosion behavior.
- Study the effect of certain ions on the corrosion process.
- Get and analyze the corrosion data obtained using specific software's

FIU Year 2 Overall Accomplishments

Conference Papers

- M. Echeverria-Boan, A. Litzinger (DOE Fellow), L. Lagos, D. McDaniel. **"Development and Evaluation of Aged Concrete Surfaces for the Study of Coatings for the HCAEX tunnel at Savannah River"** Paper 22053, Oral presentation. Waste Management 2022, Phoenix, AZ, March 2022.

Awards

- A. Litzinger (DOE-Fellow), M. Echeverria, L. Lagos and D. McDaniel. **"Standard Aging of Concrete for the Study of Protection Systems for H-Canyon Exhaust Tunnel at Savannah River Site"**. (Poster). Waste Management 2022 Conference, Phoenix, AZ, March 2022. (Best Poster of Undergrad Students Category)

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Technology Roadmap

		2020	2021	2022	2023	2024
Tank Farm Hanford	 Minirover	In-house Deployment	Site Deployment	Site Deployment	Technology Transferred	
	 UT Rover	Conceptual Design	Evaluation	In-house Deployment	Site Deployment	
	 Lateral Gamma		Integration	Cold Test Facility Deployment	Site Deployment	
	 Off-Riser Sampler			Integration	Cold Test Facility Deployment	Site Deployment
	 Long-Term Surveillance	Conceptual Design	Sensor Integration	Evaluation	In-house Deployment	Site Deployment
H Canyon SRNL	 Wall Crawler	Conceptual Design	Sensor Integration	Evaluation	In-house Deployment	Site Deployment
WIPP MSIPP	 Salt Closure Inspection	Evaluation	In-house Deployment	Site Deployment		
Rifle Cell LM	 Aerial Lidar	Evaluation	Site Deployment			
	 Ground Radar		Evaluation	Integration	Site Deployment	
Wearable SANDIA	 Exoskeleton		Conceptual Design	Integration	In-house Deployment	Site Deployment

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DOE-FIU Cooperative Agreement

Upcoming Events Announcement

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DOE Fellows Poster Exhibition

DOE Fellows Induction Ceremony

Thank You. Questions?