



DigiDecom 2021 – DIGITAL
 Online international workshop focusing on digital transformation, robotics and other game changing trends in nuclear decommissioning



Robotics Research and Applications

Leonel E. Lagos, PhD, PMP®
 Applied Research Center
 Florida International University
 March 2021





Florida International University

- FIU is a vibrant, 58,000 student-centered public research university located in Miami, Florida.
- *FIU is among the largest Hispanic-serving institutions in the U.S. and is designated a Minority-Serving Institution.*
- As a top-tier research institution, FIU emphasizes research as a major component in its mission.



University Based Research for the US Department of Energy's Office of Environmental Management DOE EM



Objective

To provide critical support in the areas of environmental remediation and workforce development to the U.S. Department of Energy's Office of Environmental Management (DOE EM) mission of accelerated risk reduction and cleanup of the environmental legacy of the nation's nuclear weapons program.

Major research areas

HLW and Robotics
 Facility deactivation & decommissioning
 Soil & groundwater remediation and modeling
 Information technology/AI
 Knowledge management

Applied Research Center

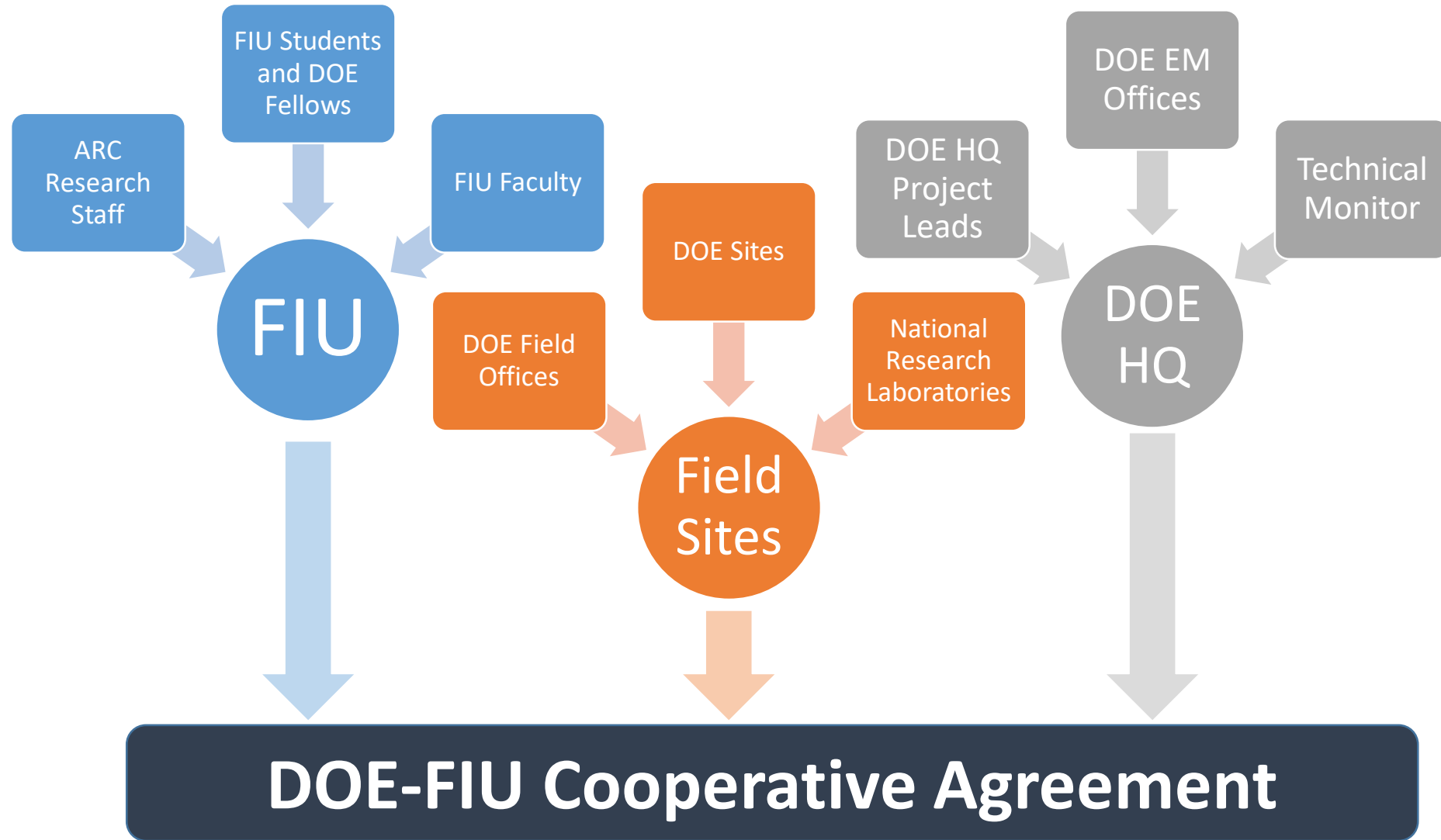
established in 1995
 31 undergrad students
 19 graduate students
 6 post-docs
 36 staff

Approaches

Basic research
 Applied research
 Technology development, testing, and evaluation
 Workforce development



Cooperative Agreement Team





Applied Robotics Laboratory



Principal Investigator: Leonel Lagos, Ph.D., PMP®
Project Manager: Dwayne McDaniel, Ph.D., P.E.
Research Scientists: Anthony Abrahao
 Aparna Aravelli, Ph.D.
 Mackenson Telusma
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DOE Fellows: Daniel Martin
 Sebastian Story
 Joel Adams
 Christopher Excellent
 Jeff Natividad
 Eduardo Rojas

Research Assistants: Julie Villamil
 Guilherme Daldegan
 Towhidur Rahman
 Caique Lara
 Md Sharif A. Sarker
 Md Munim Rayhan

Research supported by: U.S. DOE-EM, DOE-NETL, DOE-LM
 DOE-NEUP, DOE-MSIPP and NSF



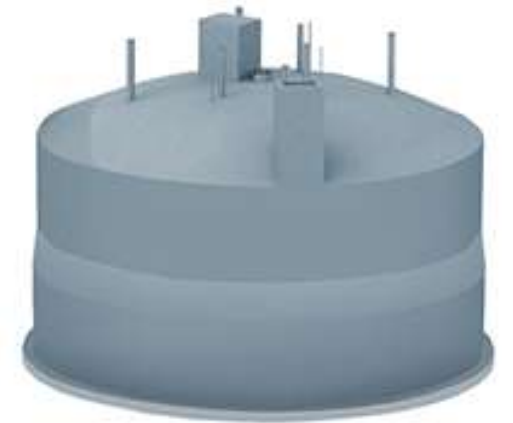
“Helping the efforts to overcome the challenges of an aging workforce actively and aggressively targeting STEM students across the US to enter DOE’s workforce.”

Personnel:

- 6 Fulltime Researchers
- 12 Research Assistants



Tank Farm Inspection



177 TOTAL TANKS

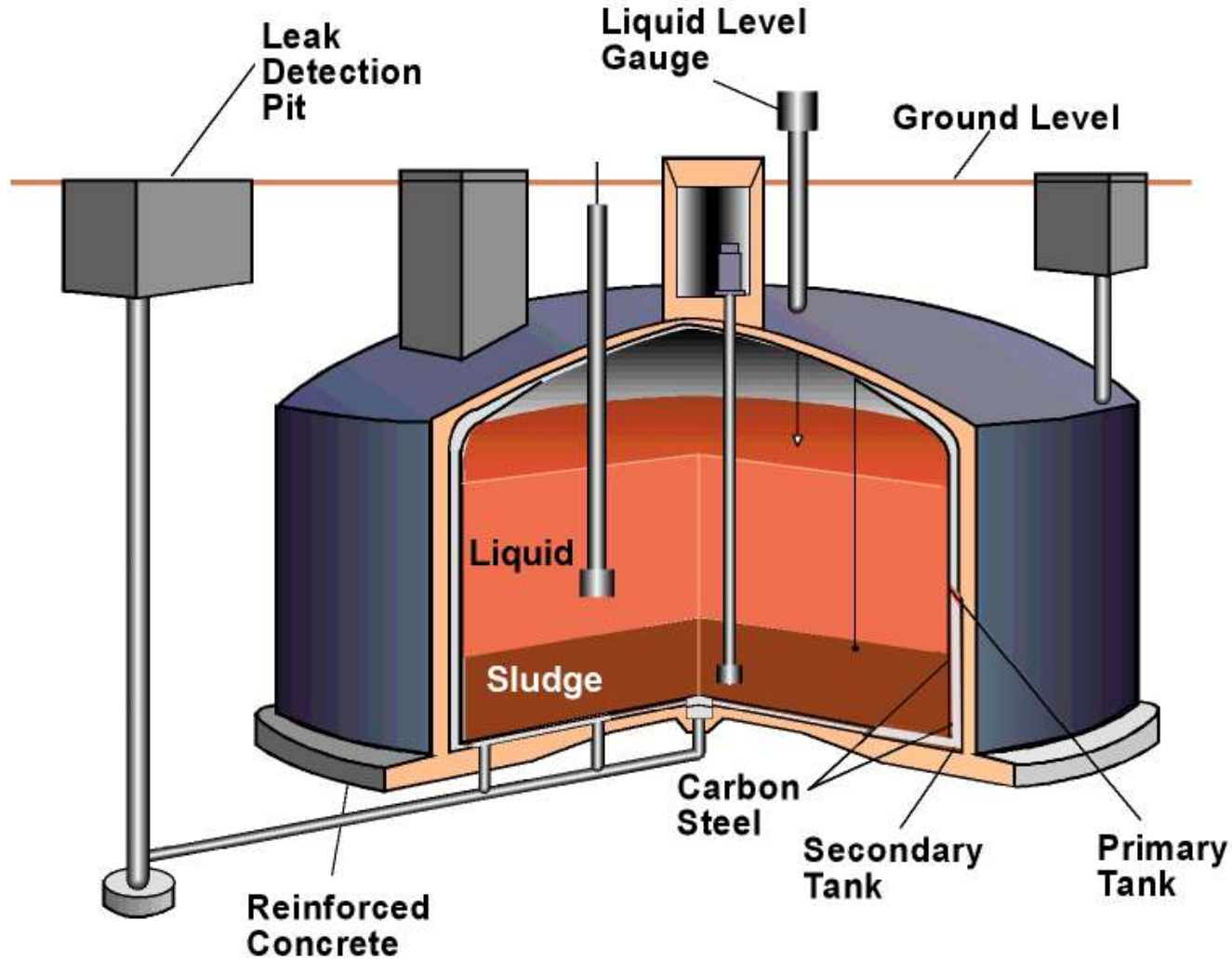
149 SINGLE-SHELL TANKS
Constructed 1943-1964

28 DOUBLE-SHELL TANKS
Constructed 1968-1986

Hanford site has 56 million gallons of high level radioactive waste stored in underground tanks

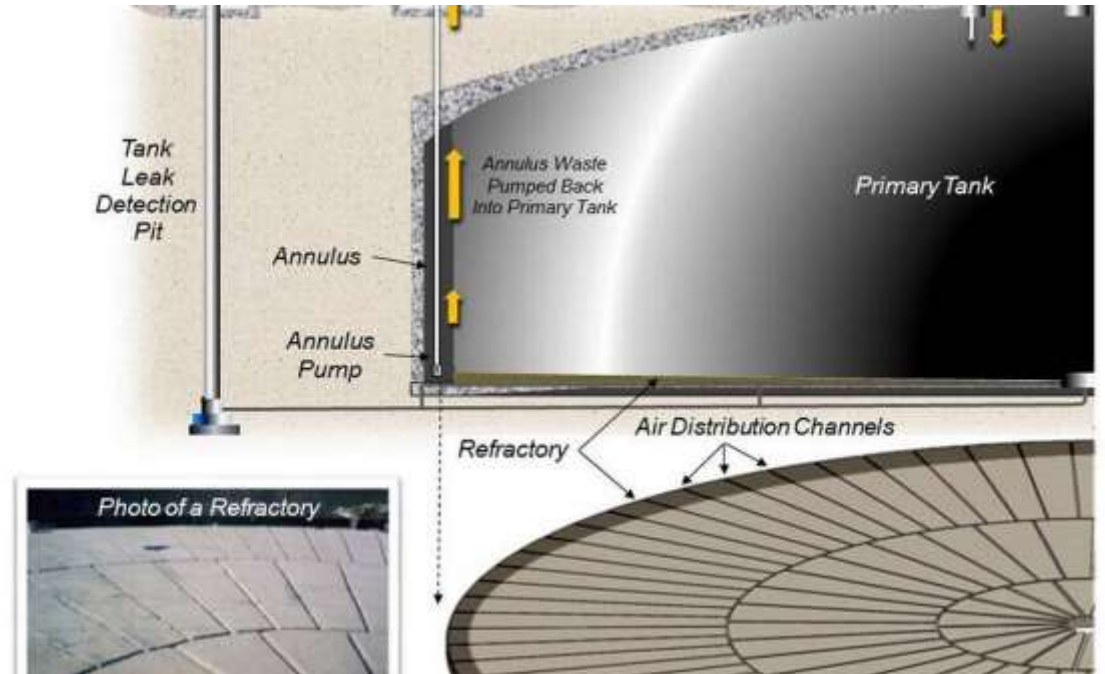
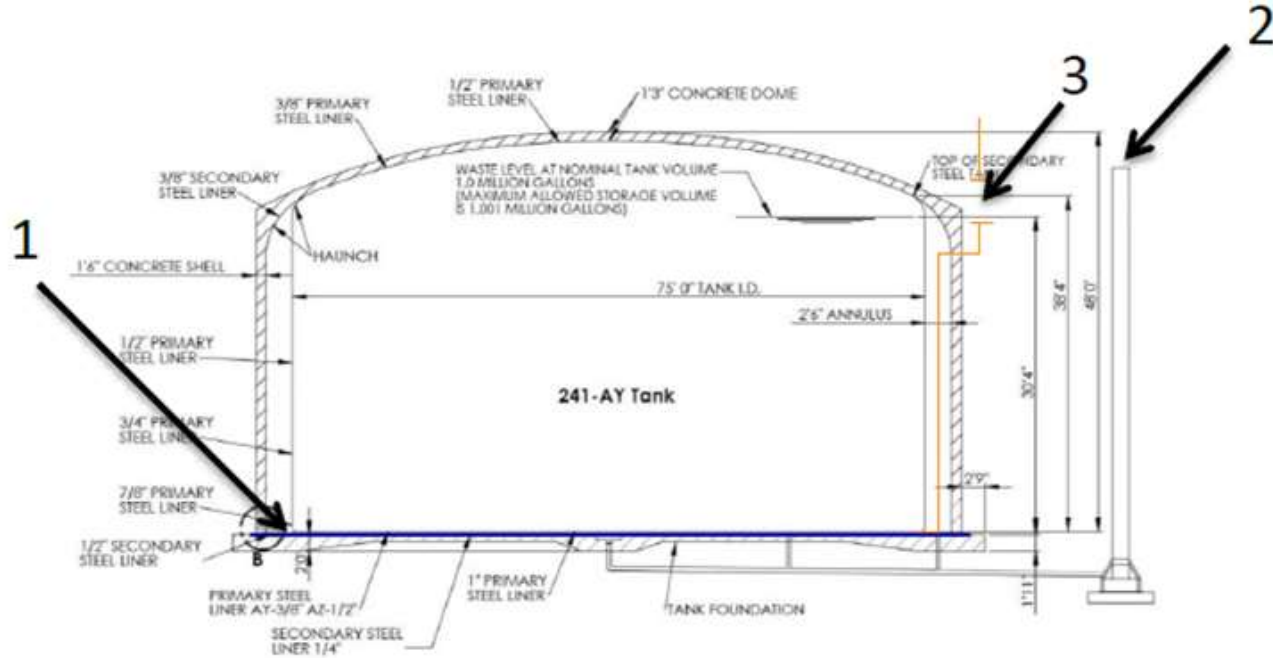


Double Shell Waste Tanks





Primary and Secondary Liner Inspection



- (1) Annulus Pit
- (2) Leak Detection Pit
- (3) Ventilation Pipe System



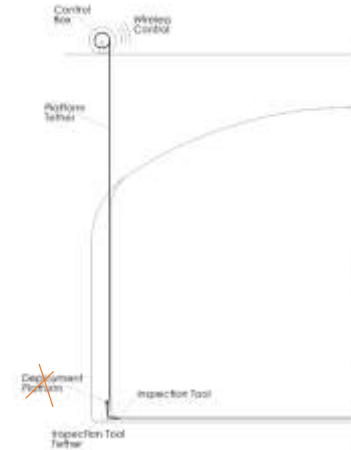
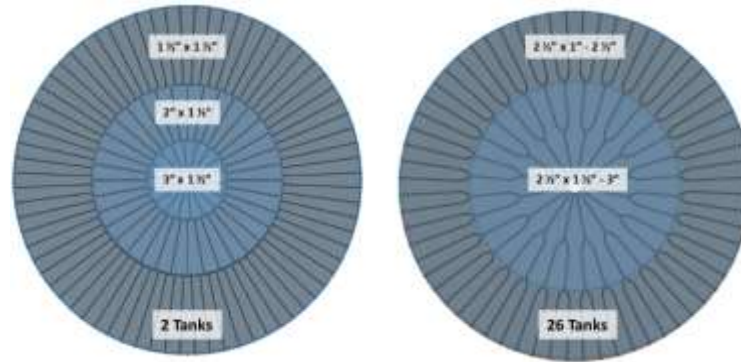
Primary Liner Inspection

Objectives:

Develop cost effective inspection tools that can travel through the refractory pad air channels underneath the primary liner and the drain line channels underneath the secondary liner while providing live video feedback.

Expected Conditions:

- Small cooling channels (~ 2 1/2")
- Radiation levels (~ 80 rad/hr)
- Elevated temperatures (~ 170 °F),
- Irregular weld seams
- Scaling, build-up and corrosion

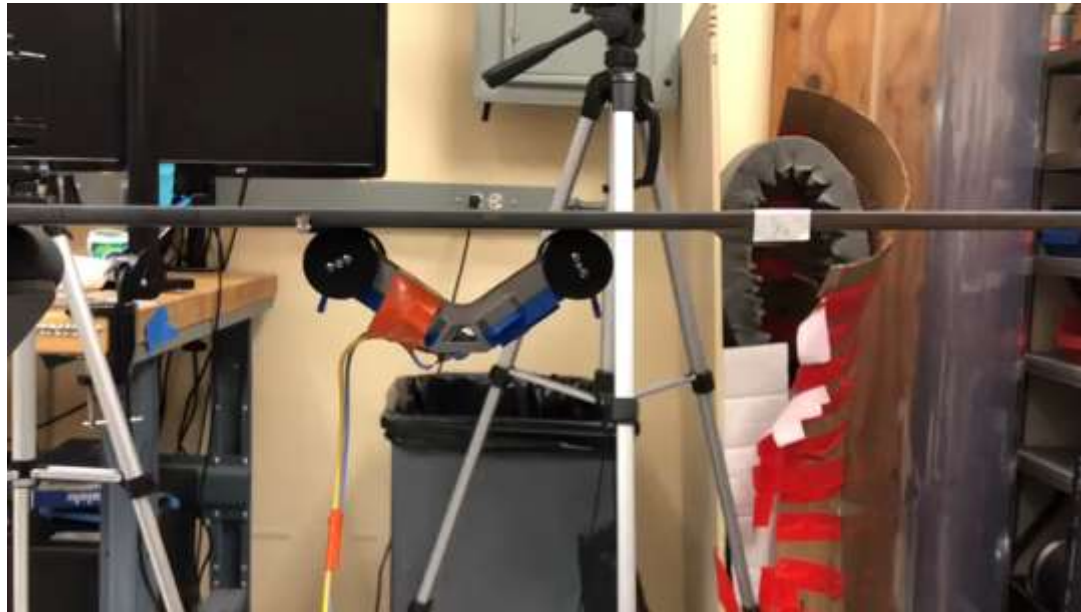




Deployment Test at FIU's Full Scale Mockup



Develop rigorous tests to simulate the inspection conditions



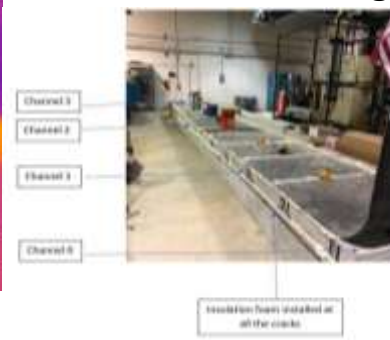
Traversing weld seams



Full scale mockup Inspections



Elevated Temperatures



Corroded Surfaces

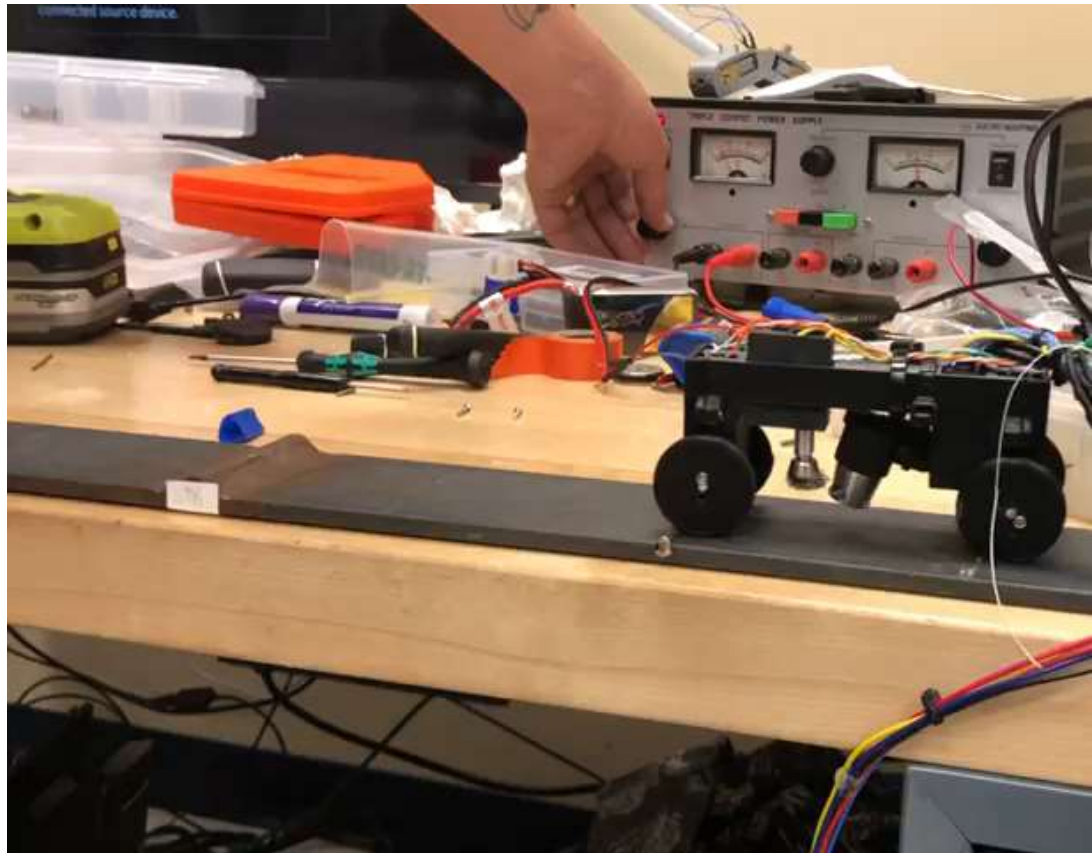




Ultrasound Sensor Integration



Integrate sensors providing measurements of the tank bottom conditions



Weld Seam Traversing



Ultrasound Measurement



Surface preparation



Secondary Liner Inspection

Objectives:

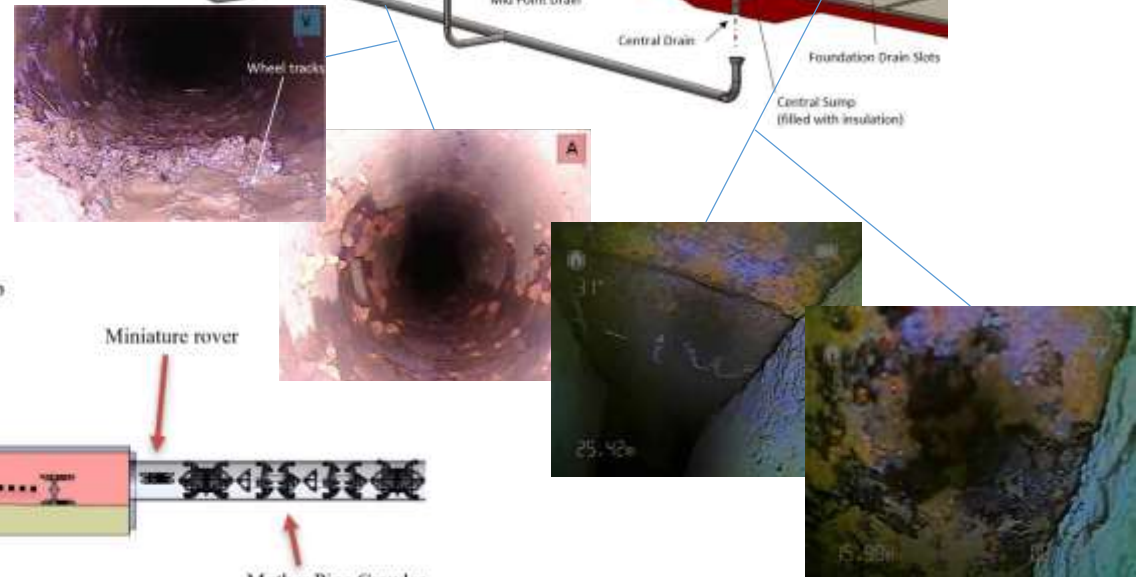
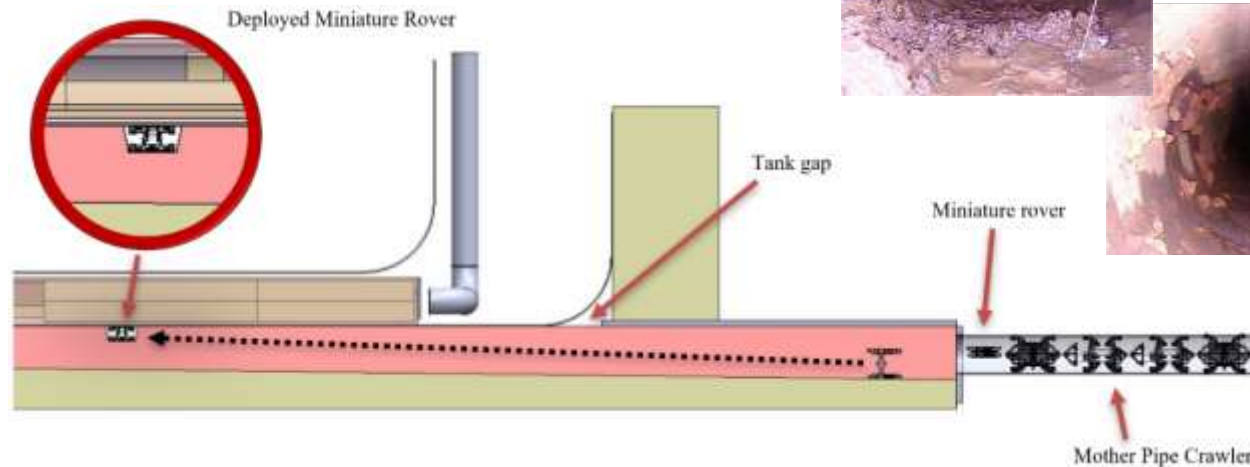
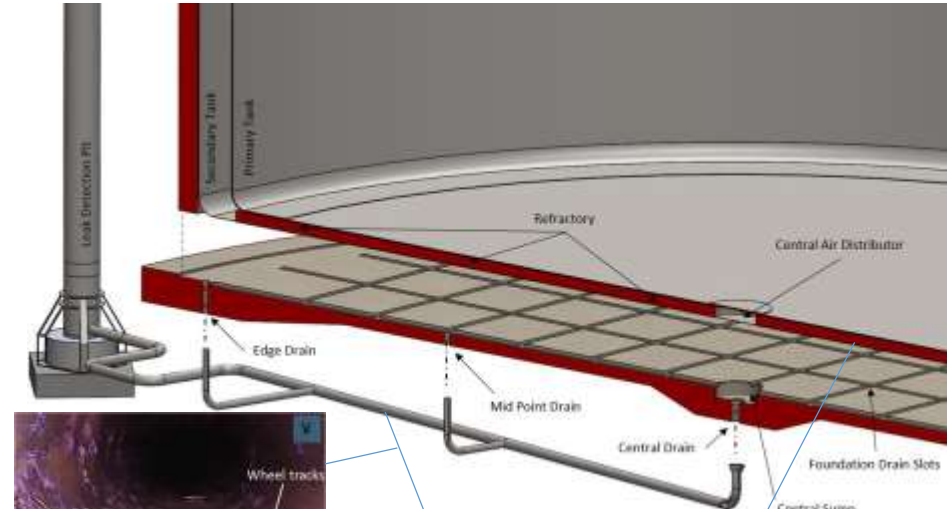
Develop an inspection tool that navigates through the foundation drain slots under the secondary liners of the DST while providing live video feedback.

Current Efforts:

Developing a marsupial type crawler that can traverse through the drain lines and deploy a rover into the drain slots.

Expected Conditions:

- No radiation
- Irregular weld seams
- Mud, scaling, build-up, and corrosion

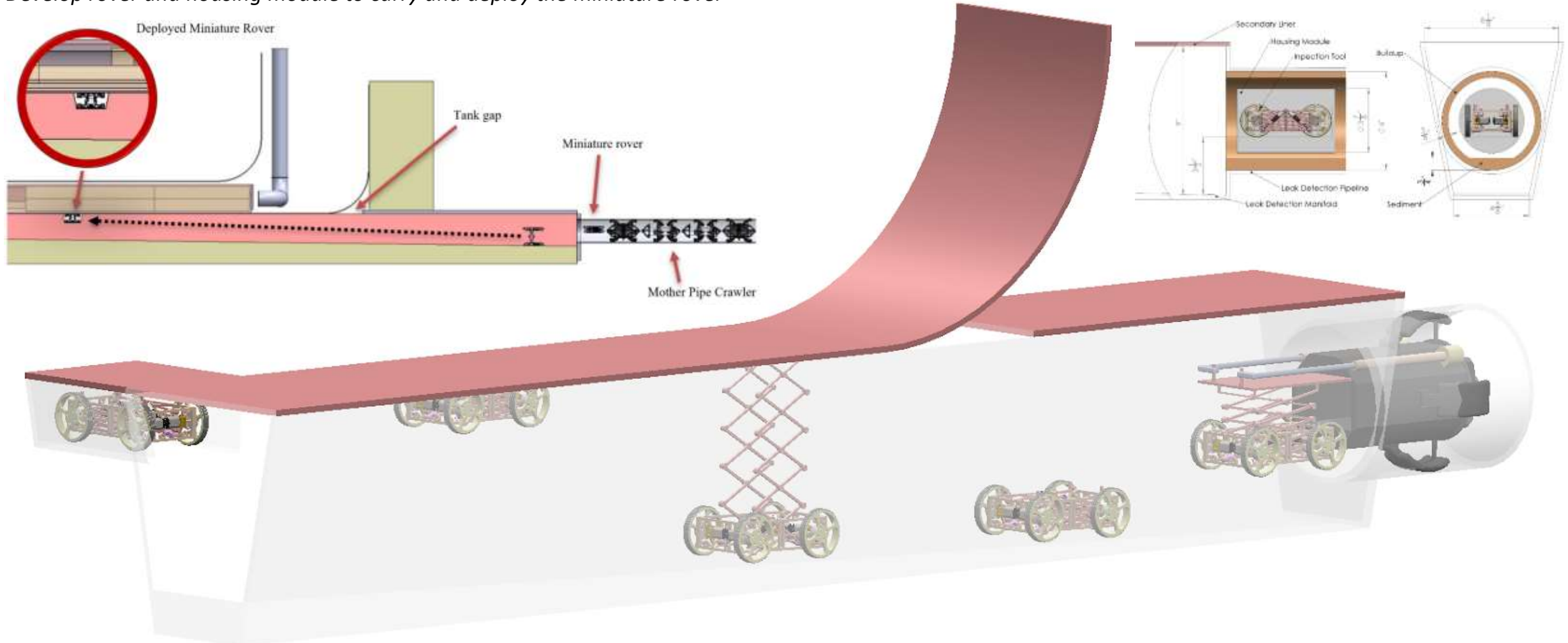




Secondary Liner Inspection

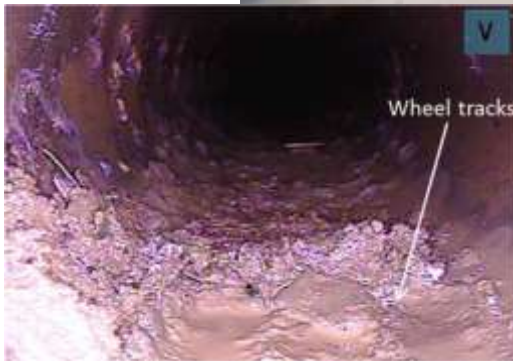


Develop rover and housing module to carry and deploy the miniature rover

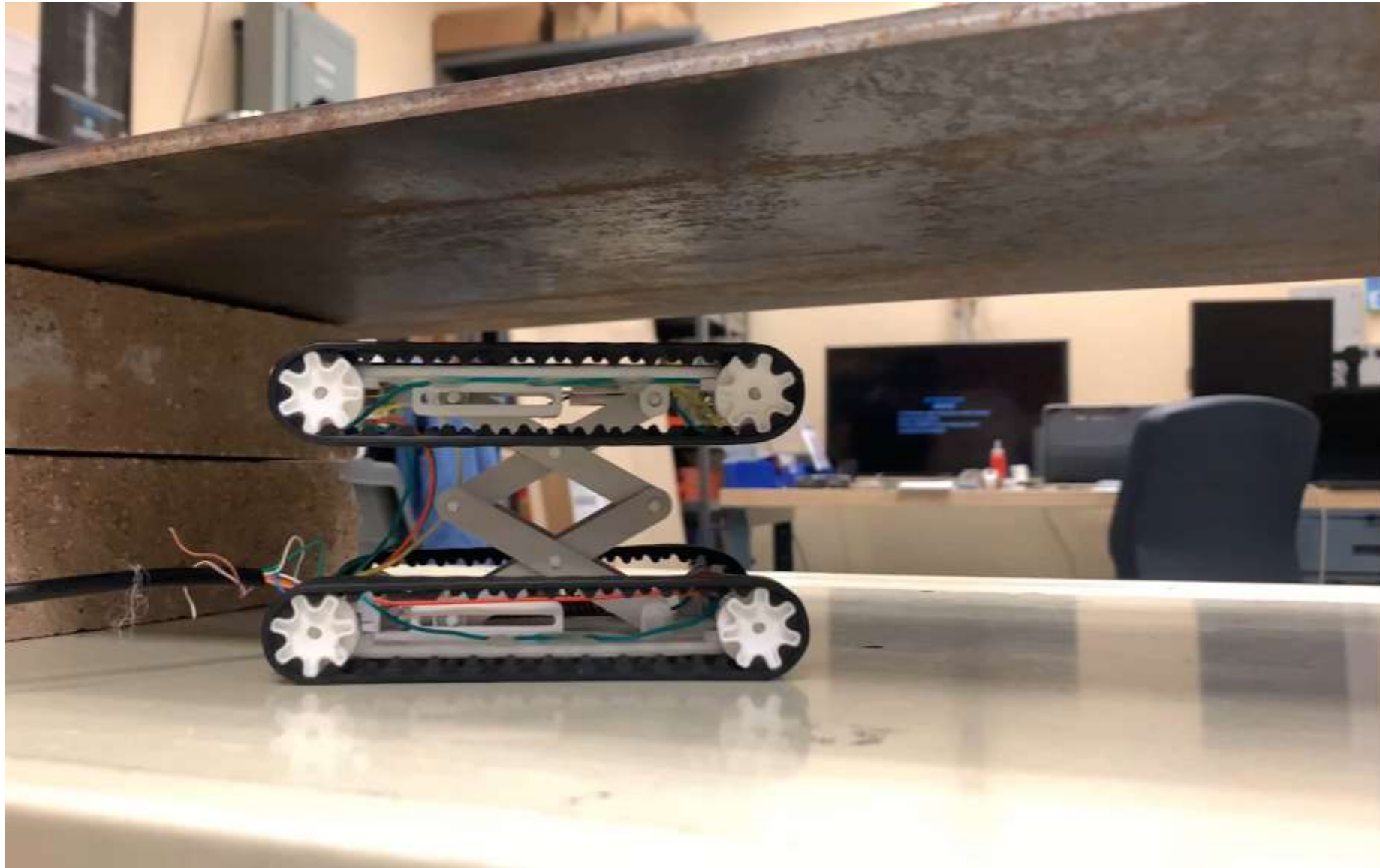




Marsupial Crawler for Drain Lines



Miniature (Child) Inspection Rover for Drain Slots





H-Canyon Concrete Wall Repair



H Canyon is the only operating, production-scale, radiologically-shielded chemical separations facility in the USA. It was constructed in early 1950's.



H-Canyon Concrete Wall Repair Platform



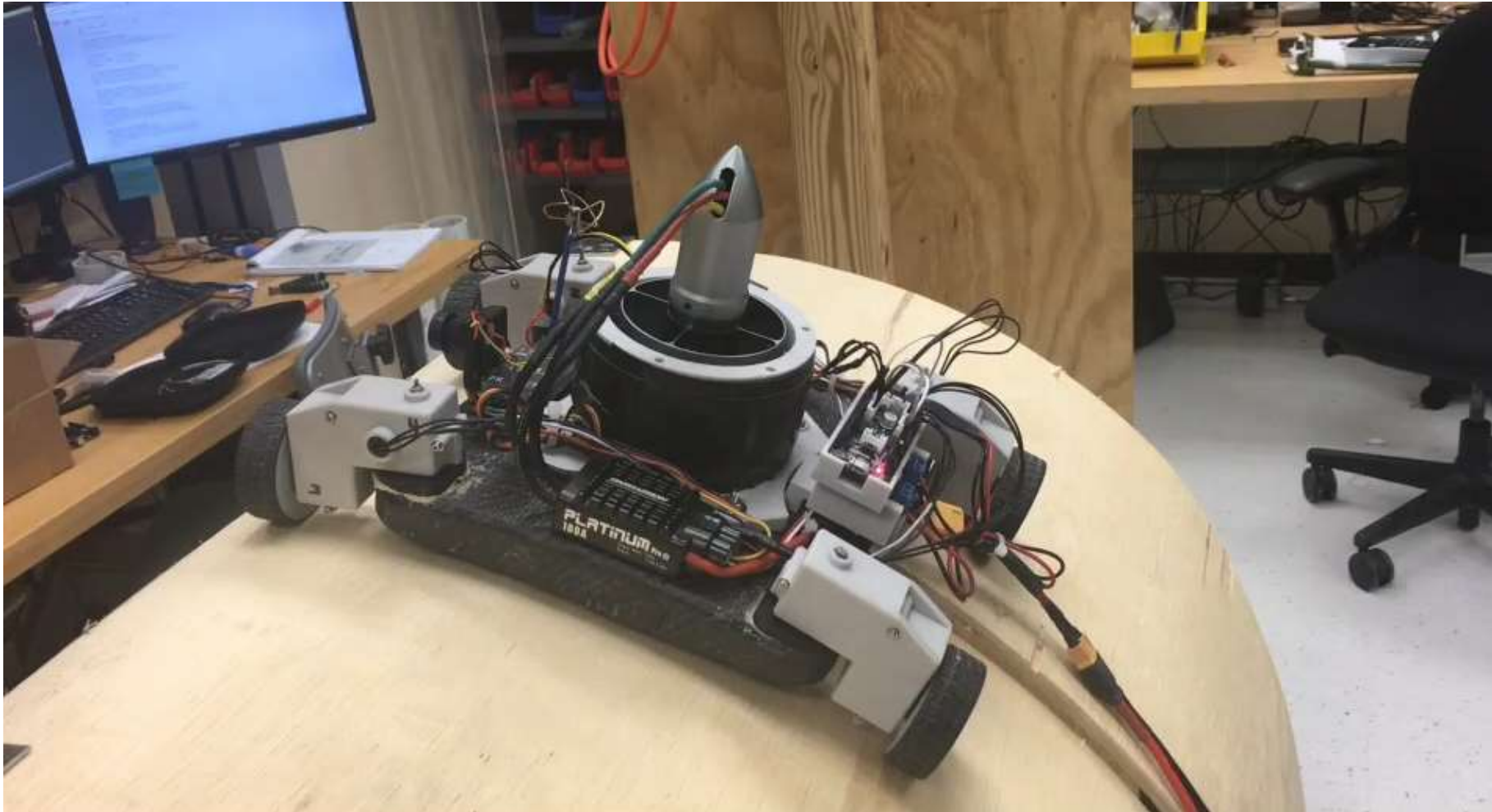
- The exhaust air from the processing cycle is routed through the Canyon Air Exhaust (CAEX) tunnel
- The inspection of the concrete walls of the CAEX for structural integrity



H-Canyon Concrete Wall Repair



Develop an inspection tool that can navigate around the exterior of a 3 ft diameter pipe and provide video feedback





Glovebox Automation



Quantify human fatigue during glove box operations and to evaluate the feasibility of a dexterous robotic manipulator for use in glove boxes and hot cells





Autonomous Surveillance of Nuclear Facilities and Repositories



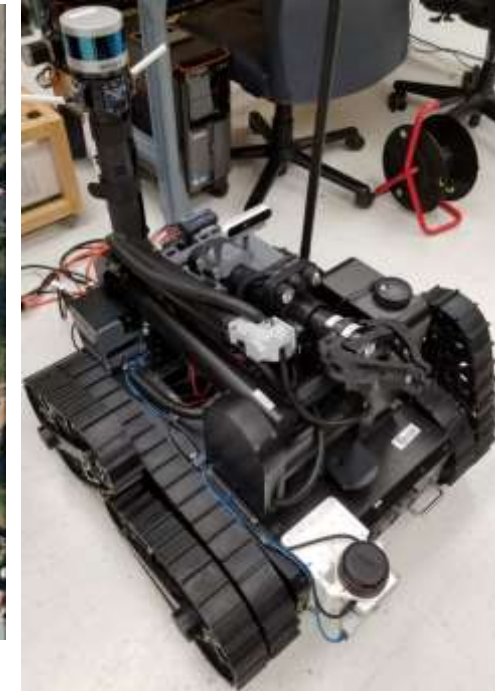
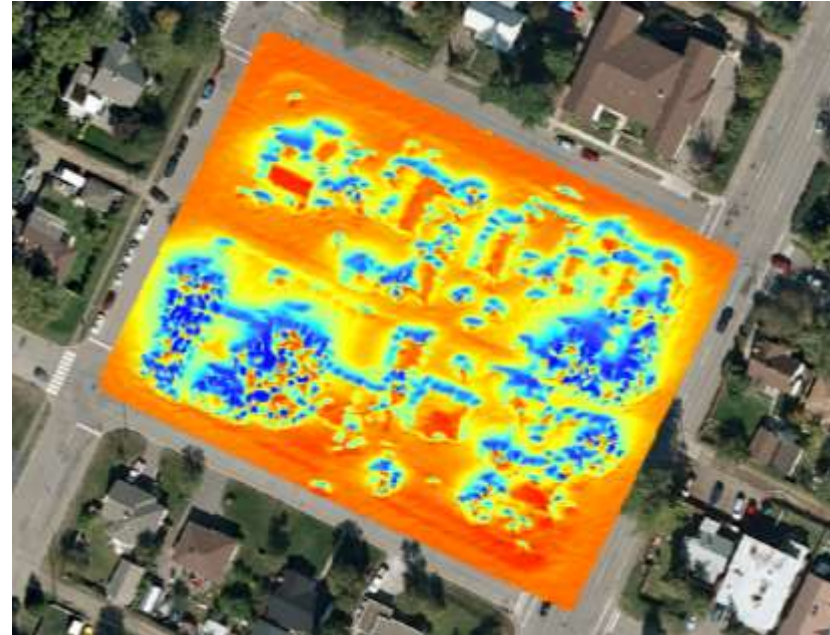
Objectives:

Combine robotic platforms and state of the art sensors for autonomous surveillance of nuclear facilities and sites.

Current Efforts:

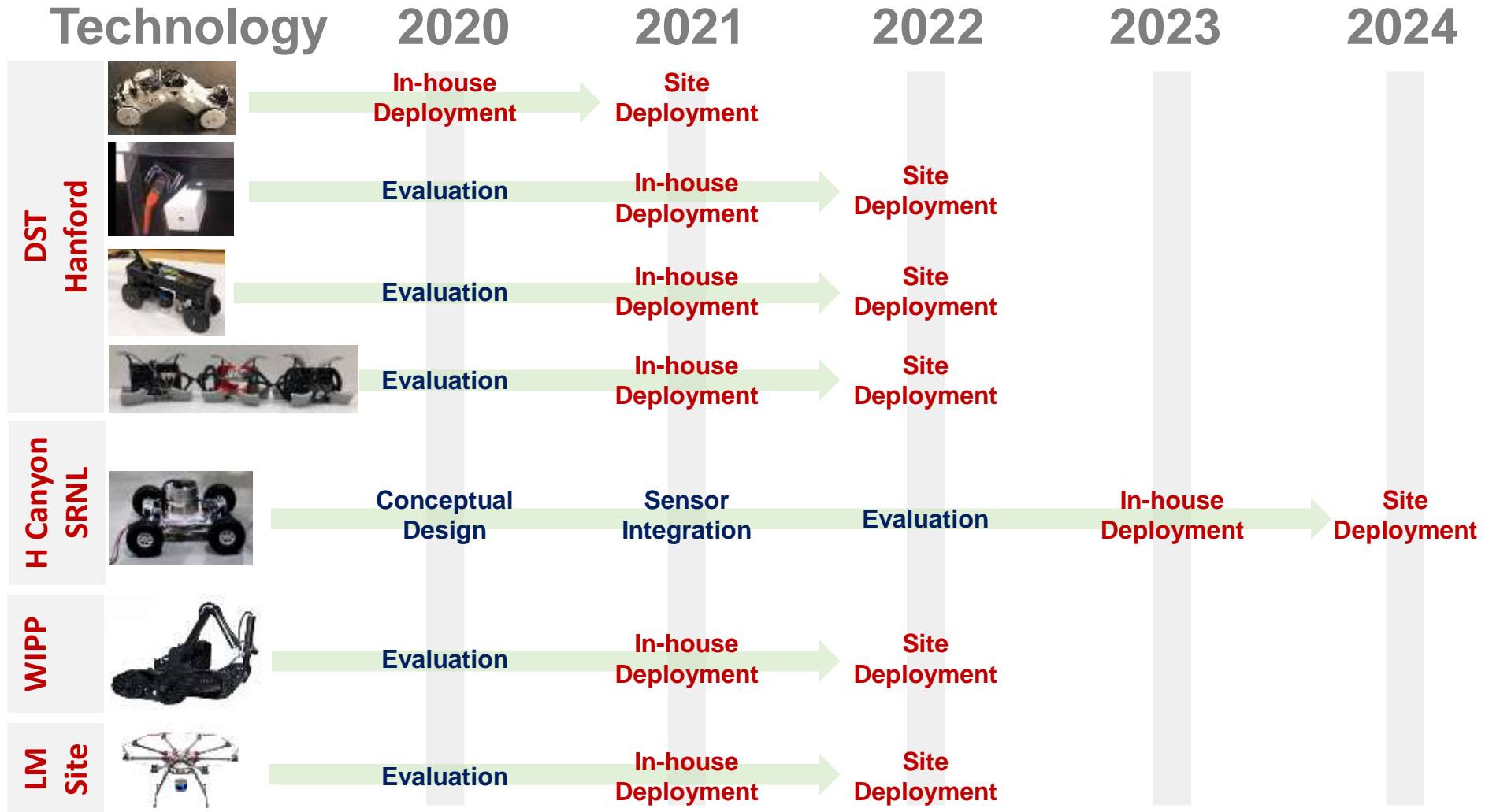
Developing mobile robotic systems that navigates through the Hanford site's tank farm automating surveillance activities by developing:

- continuous stochastic models to predict the overall radiation field by simultaneously fusing data from:
- non-destructive gamma measurements,
- surrounding images, and
- three-dimensional LiDAR mapping.





Deployment Roadmap





2021 Winter Meeting Embedded Topical

- American Nuclear Society
DESD/RRSD 2021
- ***“Tech + Green = Clean”***
- 2021 Winter Meeting Embedded
Topical, October 31 – November 4,
2021
- Washington, DC
- Call for papers: document will be
shared with DigiDecom
participants
- Email jbyrne4424@comcast.net
for more information





Questions

