

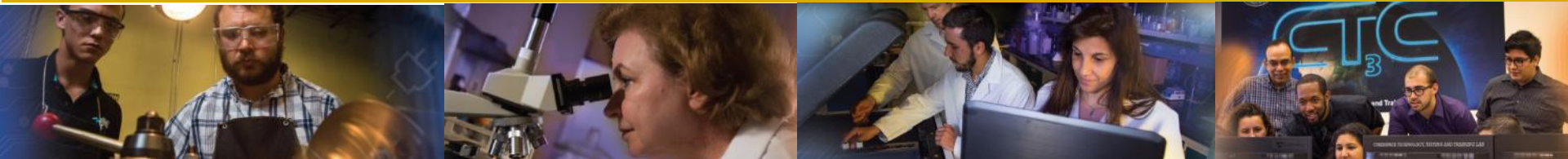


Welcome and Introduction to FIU's Applied Research Center

Interregional Workshop on Optimization of Technology Selection for Decommissioning of Large and Small Nuclear Installations

September 09-13, 2019

Leonel Lagos, PhD, PMP®
Director of Research
Applied Research Center
Florida International University





- Designated as **Minority Serving Institution (MSI)** – MSI/HBCU/HSI
- FIU is among the 10 largest public universities in the U.S. (57,000 students in 2018)
- Top tier research institution - R1 Carnegie Classification for Highest Research Activity
- **First in the nation in awarding bachelor's and master's degrees to Hispanic students.**
- FIU averages over \$140 million in research annually.



FIU ARC Team



FIU's Applied Research Center is a worlds ahead research organization specializing in solving real-world problems through multi-disciplinary research



Our entire team of staff and students invest in our future and success!



Research Focus Areas



Environment
&
Energy



Cybersecurity
&
Artificial
Intelligence



Aerospace,
Materials
Science
&
Robotics

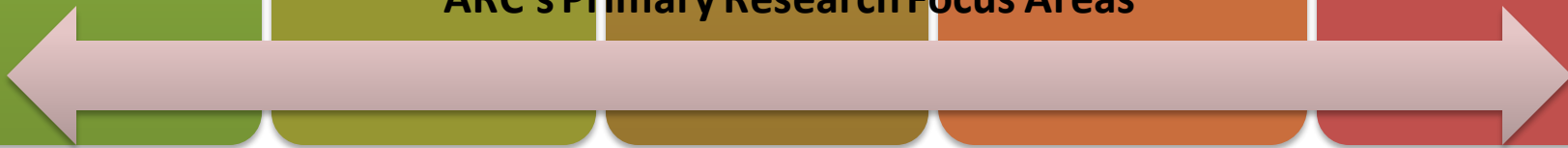


Radiochemistry
&
Nuclear
Research



STEM
Workforce
Development

ARC's Primary Research Focus Areas





Research Facilities



Environmental Lab – Composites Lab – Cybersecurity Research Lab – Materials Lab – Modeling, Simulation & GIS Research Lab – Artificial Intelligence & Big data Hub
Technology Testing & Demonstration Facility – Radiological Lab – Soil & Groundwater Lab – Multi-Functional Indoor Testing Facility – Engineering Design Center – Machine Shop



DoD Cyber Lab





STEM Workforce Development Model

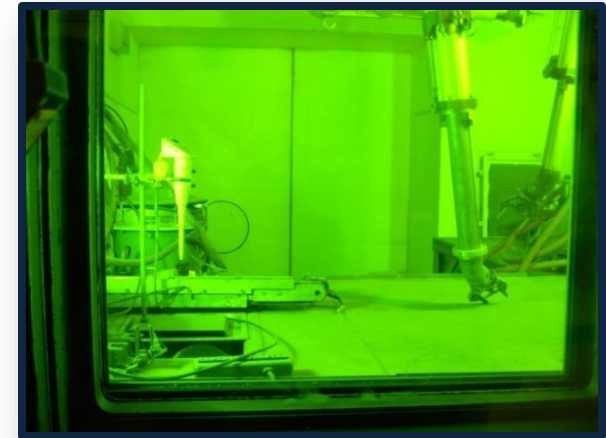


- Develop a *pipeline* of minority students trained and mentor in Department of Energy (DOE Fellows) & Department of Defense (Cyber Fellows), Army Corp of Eng. in technical areas of need
- Provide hands-on applied research opportunities that facilitates the training and mentorship of undergraduate, graduate students, and Post-Doctoral Fellows
- Provide summer internship opportunities to FIU students
- Provide professional development opportunities to minority STEM students (conferences presentations, workshops, etc.)
- Facilitate transition of minority students into the workforce by connecting the students to government and industry partners



DOE EM Environmental Challenges

60 Year Legacy of R&D and Production of Nuclear Weapons





University Based Research for DOE EM Florida International University's Applied Research Center



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

High level waste processing
Facility deactivation & decommissioning
Soil & groundwater remediation and modeling
Information technology
Knowledge management

Applied Research Center

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

Approaches

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



University Based Research for DOE EM

FIU

 Applied Research
Center

Evaluation of D&D fixative technologies for rad contaminated facilities

- Investigating industry foam technologies for fire resiliency in support of D&D activities
- Supporting SRNL research to develop radiation shielding foams
- Testing and evaluating intumescent and fixative technologies for use in nuclear facilities
- Developing uniformly accepted testing protocols and performance metrics for evaluating D&D technologies (ASTM International E10.03 Subcommittee)



Information Technology and Knowledge Management

- Developed the D&D Knowledge Management Information Tool (KM-IT) for DOE to prevent the loss of D&D knowledge and expertise that has been gained over the years by employees and contractors of DOE
- Developed the Waste Information Management System (WIMS) provides a central web-based technology to access waste forecast data for sites across the DOE complex
- Investigating the use of Predictive Analytics using real-time streaming data from facilities/structures/equipment
- Using LiDAR technology to map structures and generate highly detailed point clouds which are analyzed using machine learning



University Based Research for DOE EM



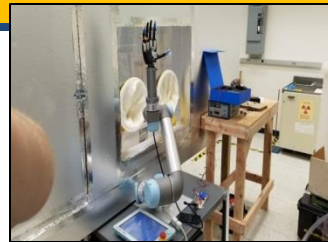
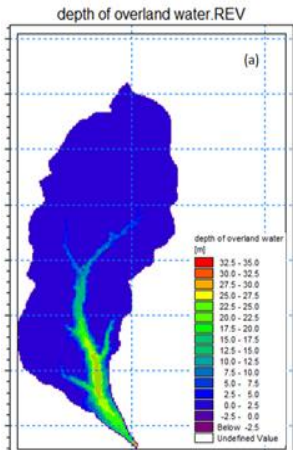
- Lab experiments to study contaminant fate and the impact of *in situ* remediation techniques for soil/ groundwater at Hanford, Savannah River, and WIPP
- Development of an integrated hydrology model to simulate flow and contaminant fate/ transport

Tc, I, U and other actinides

- Develop, prototyping an test/evaluation of cost effective robotic technologies for the evaluation of the structural integrity of the double-shell tanks (DSTs) storing high level radioactive waste at Hanford and

Developed mini robotic crawler for pipe and tank inspections

- Quantifying human muscle fatigue during prolonged glovebox operations by using EMG sensors
- Developing robotic arms and hands for use in glove boxes
- Investigating the feasibility of using a exoskeleton technologies for fatigue reduction in glovebox operators





Technology Development & T&E

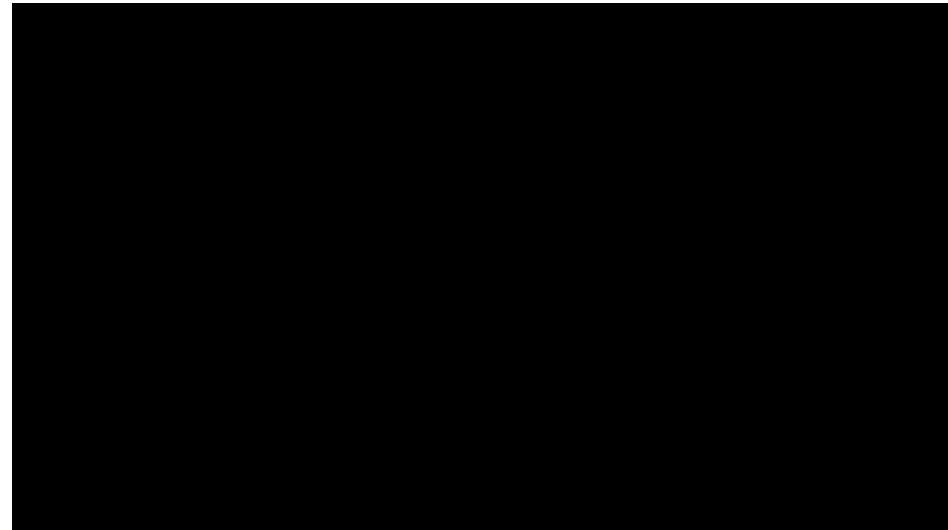




Working with Industry – International Climbing Machine



Remote Fixatives
Spraying



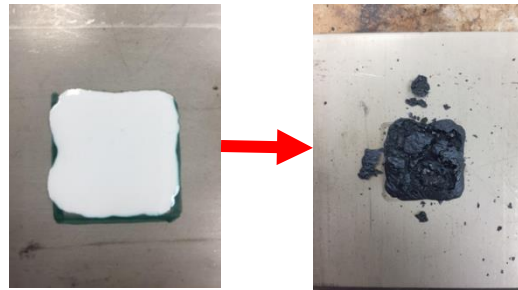
Remote Strippable
Coatings Removal



Innovation - Adaptation of Intumescent Coatings as a Fire Resilient Fixative



- Intumescent coatings are designed to swell 50 to 100 times original thickness into an insulating char upon exposure to heat / fire, providing a physical barrier to heat transfer
- Retention of mass in the char limits further involvement of the underlying materials in the fire
- Undergoes rigorous ASTM, NFPA, UL, and UBC fire testing
- Exceptionally cost effective (as low as \$0.75 cents per square foot)
- Easily applied via brush, roller, or sprayer to a wide variety of substrates (stainless steel, wood, sheetrock, sheet metal, etc.)
- Very resilient to environmental conditions (heat, humidity, etc.)



- Upon testing at FIU, all tested fixatives failed under exposure to high heat or direct flame.
- All tested fixatives, when layered with the intumescent coating, conclusively displayed enhanced fire resiliency.
 - Fixative and substrate remained relatively intact
 - Mitigated flame spread and propagation
 - Limited to no smoke

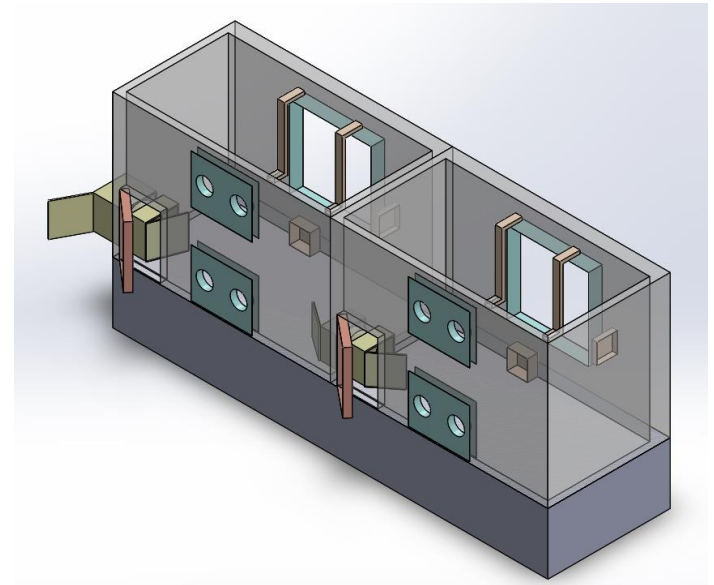


Construction of Hot Cell Test Bed



Hot Cell Test Bed constructed onsite at ARC to mirror the operating environment encountered in an adjoining corner and middle hot cell configuration at the SRS 235-F facility, including a raised floor.

- Initially used to evaluate the mechanics and processes associated with applying selected intumescent coatings in the hot cell.
- Future support to test and evaluate other technologies (e.g., robotics) to support D&D of SRS 235-F or other DOE EM complex hot cells.





D&D Projects



D&D KM-IT - WWW.DNDKM.ORG

The screenshot shows the D&D KM-IT website interface. At the top, it displays the title "D&D KM-IT Knowledge Management Information Tool" and a mobile link "Mobile: m.dndkm.org". A search bar with a "Search" button is present. Below the search bar are navigation tabs for "Home", "About", and "Contact Us", along with a "Welcome Guest" message and a "Login" button. A large banner image of the Earth is followed by the text "Powered by the Global D&D Community". A grid of yellow buttons provides access to various features: Hotline, Technology, Web Crawler, Mobile System, Lessons Learned, Best Practices, Picture Video Library, Document Library, Specialist Directory, Vendors, Collaboration Tools, and Training. Below this grid, a registration prompt asks users to register to access all features, with buttons for "U.S. Registration" and "International Registration". An "Additional Features" section highlights four key tools: ICM Crawler (Demo of Strippable Coatings), Prioritization Tool (Prioritize Maintenance Expenditures), ICM Demo at FIU (See the video), and ITS Module (Innovative Technology Summary Report). At the bottom, a "Quick Links" section provides shortcuts to "DOE EM D&D", "ALARA Center", and "EFCOG".

A web-based knowledge management information tool custom-built for the D&D user community by FIU-ARC in collaboration with DOE, EFCOG, and the former DOE ALARA Centers.



D&D KM-IT Modules



- D&D Hotline
- Technology Module
- Vendor Module
- Collaboration Tools
- Mobile Applications
- Lessons Learned
- Documents
- Pictures/Videos
- Search Tools
- Training
- Specialists
- Best Practices
- Fixative Module





MOBILE WEB APPLICATION

The D&D KM-IT mobile web application is now available on the iPhone, iPad, Blackberry, Android, or Windows smart devices to access the following modules:

- Vendor Module
- Technology Module
- Specialist Directory
- Picture Library
- Hotline
- Lessons Learned
- Best Practices
- Fixative Module



M.DNDKM.ORG



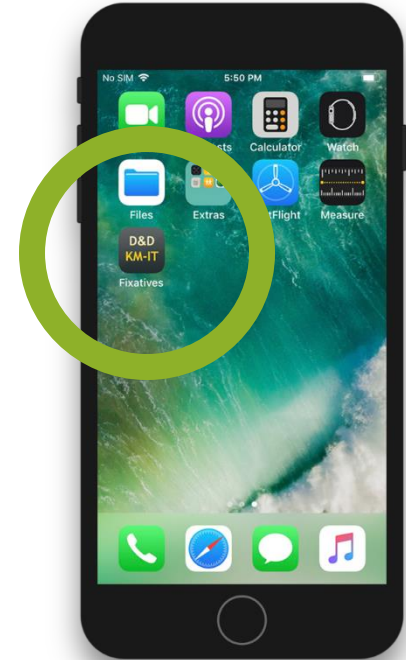
D&D KM-IT FIXATIVE MOBILE APP



The D&D Fixatives module can assist in the selection of fixatives, strippable coatings, and decontamination gels for application during D&D activities. The module includes a comprehensive database of commercially available fixatives and other contamination control products and is capable of filtering and sorting the available products according to the criteria entered by the user



Runs on Android 7.1 (Nougat)
(minimum target
Android 4.4)

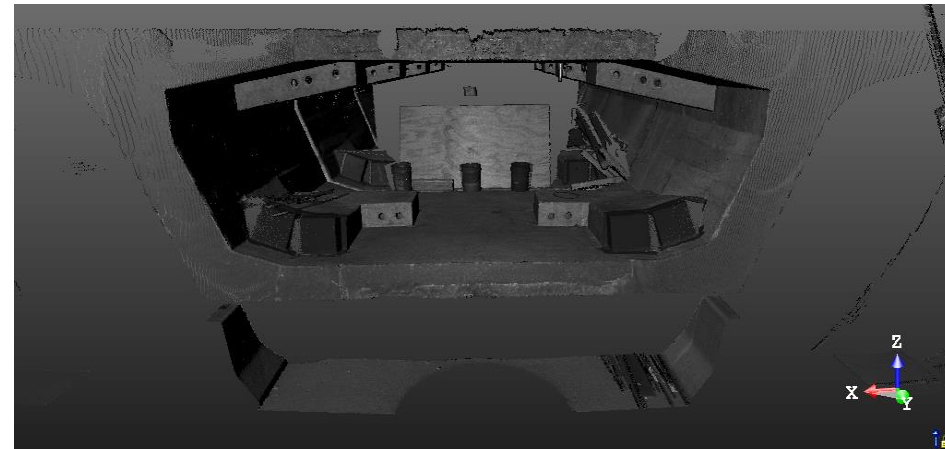
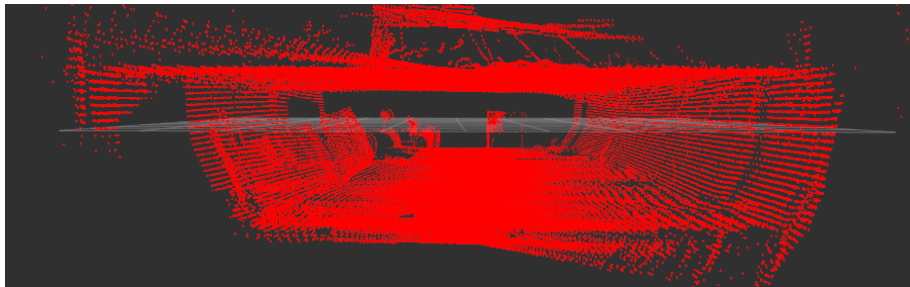
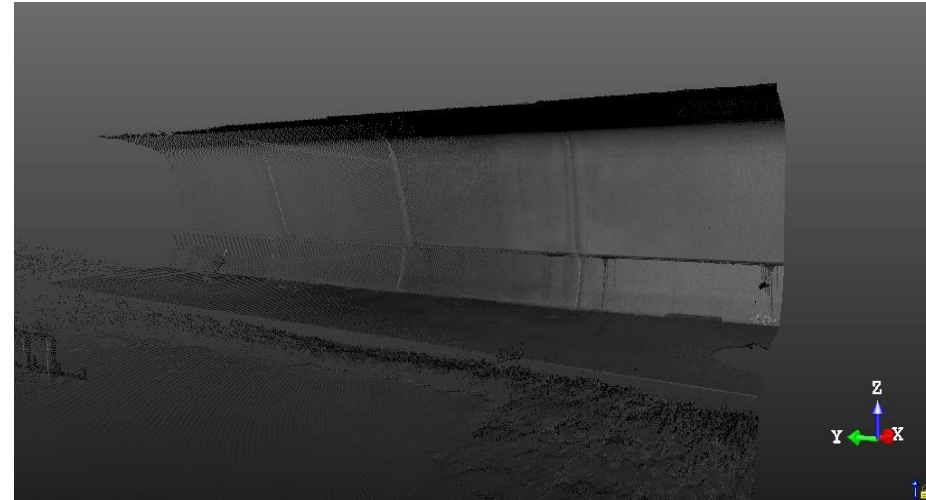
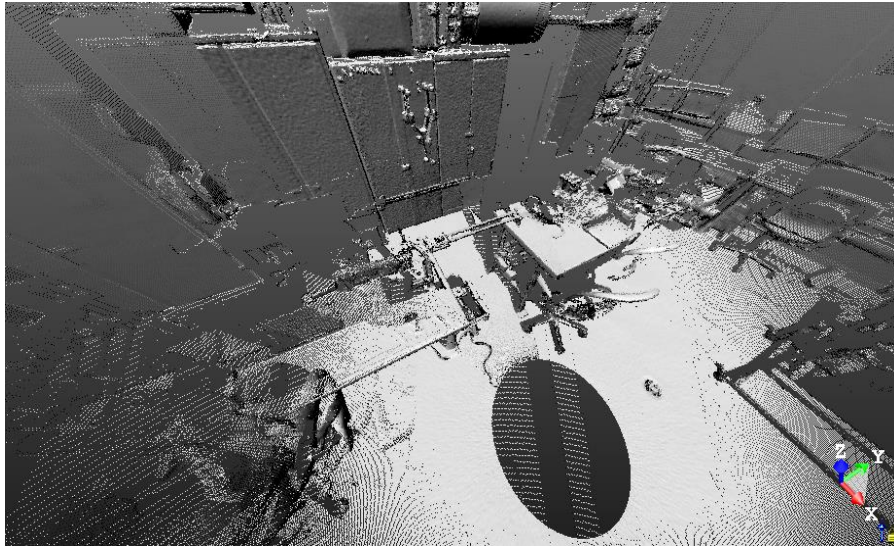


Runs on iOS7 and newer
(minimum target iPhone7)





Structural Health Monitoring – Lab & Bridge Section



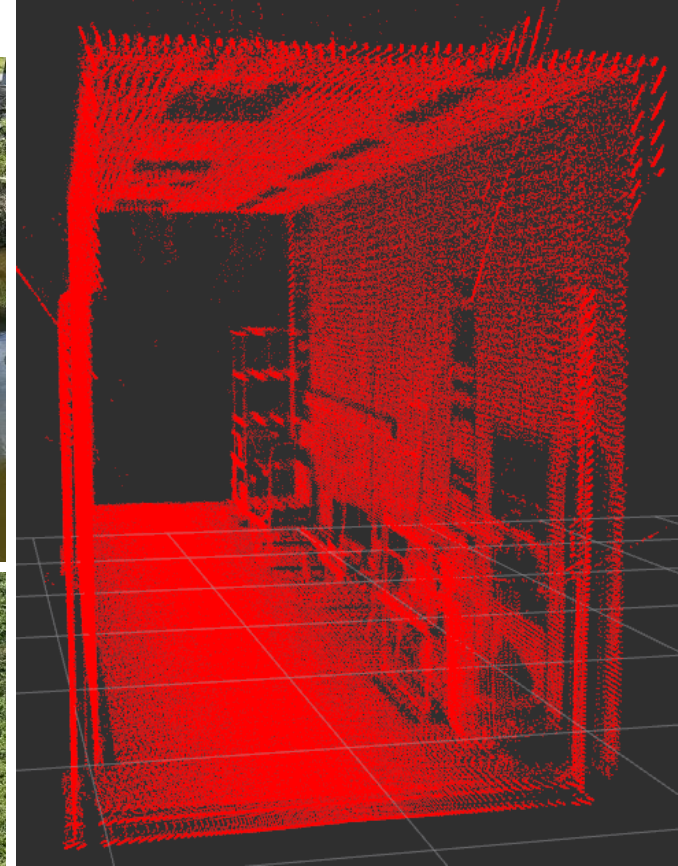


Structural Health Monitoring - Robotics/LiDAR: Culvert Inspection



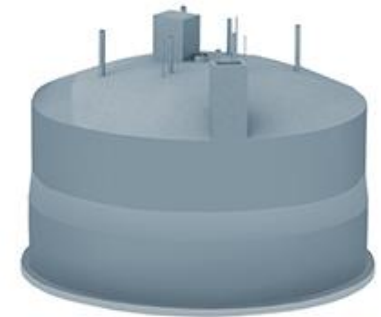


3D CAMERA, LIDAR & ROBOTICS PLATFORM





DOE's Hanford Site Tanks



177 TOTAL TANKS

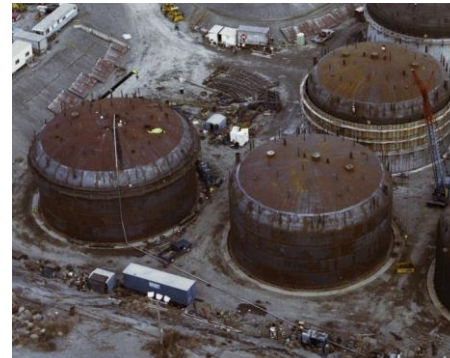
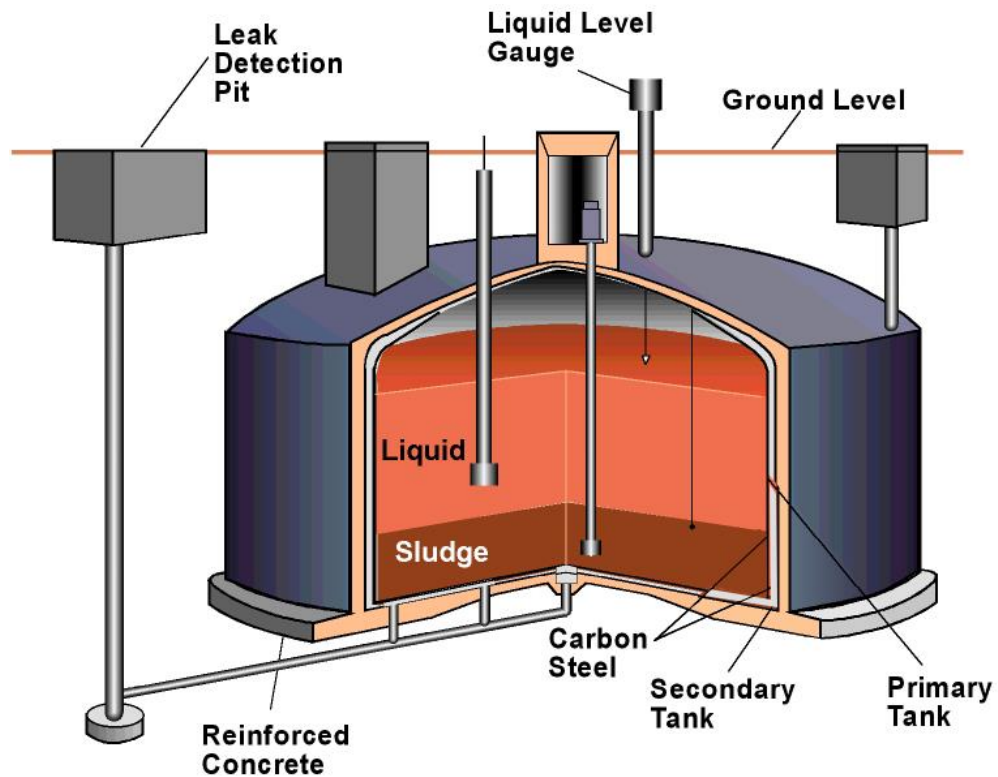
149 SINGLE-SHELL TANKS
Constructed 1943-1964

28 DOUBLE-SHELL TANKS
Constructed 1968-1986



DOUBLE-SHELL WASTE TANK

TANK FARM



MAGNETIC MINIATURE ROVER



Remotely controlled
Designed to travel upside
down along the tank floor by
using magnets and navigate
through the air refractory
channels
Provides live video

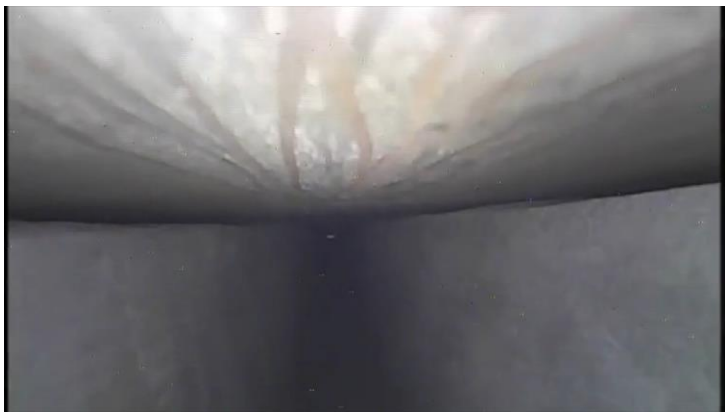
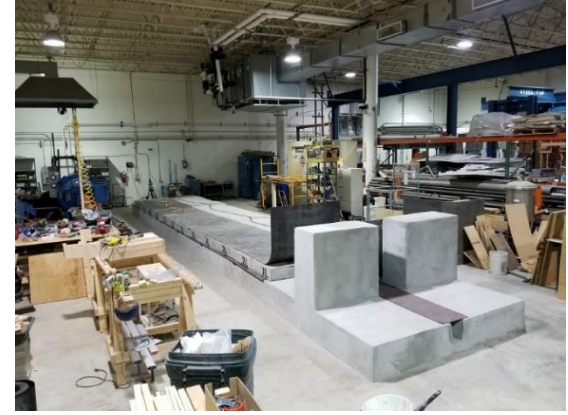


Tested on a full-scale DST
sectional test bed: 8' wide, 38'
long, including refractory slots
and drain lines as well as
primary and secondary liners





FULL-SCALE SECTIONAL MOCKUP FACILITY



Use of mockup and large scale testing representing the actual conditions/environment improves technology development & maturation process



Pneumatic Crawler



Remotely controlled to crawl through 3" & 4" air supply pipe

Navigates elbows, bends, transitions, & vertical runs

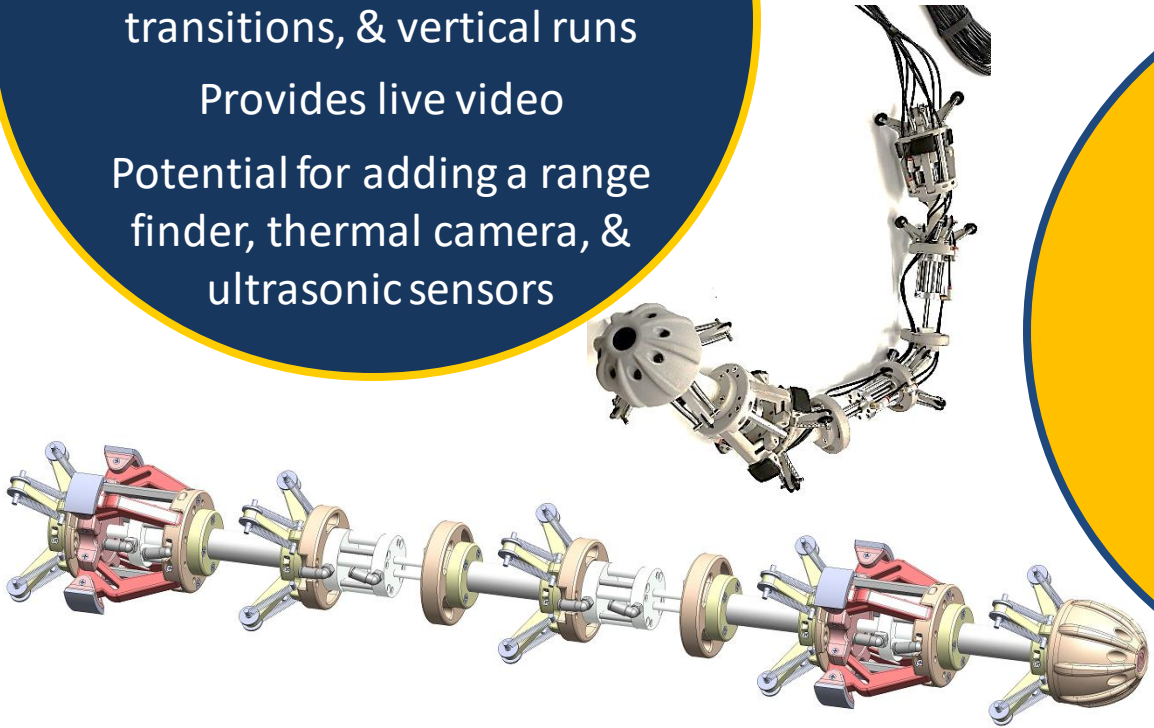
Provides live video

Potential for adding a range finder, thermal camera, & ultrasonic sensors

Pneumatic actuators emulate the contractions of the peristaltic movements

Movement does not require embedded electronics or electric actuators

Suitable for highly radioactive environments with potential exposure to flammable gases



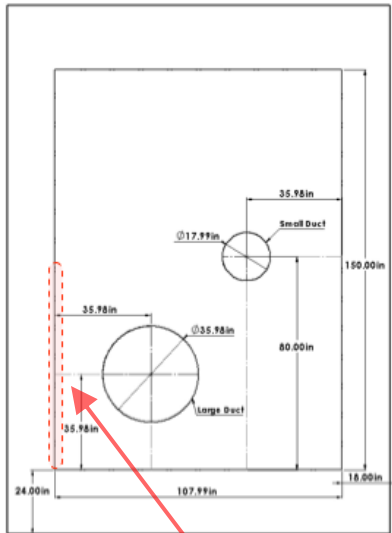


External Pipeline Crawler

Savannah River Site H-Canyon Separation Facility

Objective

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



Area of interest



Design Challenges

Build up of gravel, sand and dust atop the 36" diameter duct

Debris about 6-8 inches wide and 1 inch high, running the entire duct length

25-30 mph wind with sudden gusts

Duct is supported by a 1/4" thick hanger belt with rod attached to the ceiling

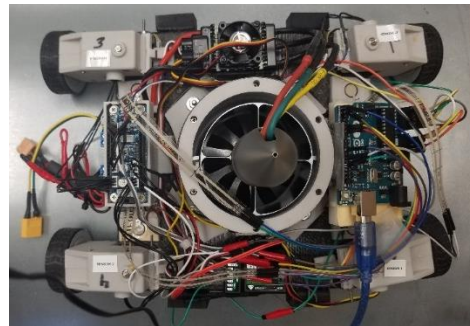


Applied
Research
Center



TEXAS
The University of Texas at Austin

FIU
Applied Research
Center



Two DOF rover drive
systems for lateral and
circumferential
maneuvering along and
around the duct

Curved chassis
composed of carbon
fiber material

Tethered but can be
modified for use with a
battery



GLOVE BOX OPERATION

ROBOTIC MANIPULATOR - MSIPP





DOE Fellows Induction Ceremony



A total of **156 FIU minority STEM students** have been inducted as DOE Fellows.

Conducted a total of
12 Induction
Ceremonies since
program inception in
2007





DOE Fellow Internships



136 internships completed at DOE sites, DOE national labs, DOE-HQ, and DOE contractors across the DOE Complex.



Christine Wipfli
March 2016 - March 2017
IAEA Internship
Vienna, Austria



DOE Fellows at Conferences



Won **one (1)** Best Professional Poster and **six (6)** Best Student Posters at Waste Management Symposia since 2008.

Presented over **210** papers and posters at Waste Management (2008-2019) and other national/international conferences, including two **(2)** presentations at ICEM13





DOE Fellows Poster Exhibitions



- 12 DOE Fellow Poster Exhibitions held at FIU since 2007
- DOE Fellows present their DOE EM research conducted at ARC or during summer internships



International Collaborations & Events



- International Atomic Energy Agency – D&D Workshop at FIU (09/09/18 – 09/13/19)
- Korean Atomic Energy Research Institute (KAERI) – Robotics Workshop – October 2019
- Nuclear Energy Agency (France) – Robotics Workshop at NEA HQ (Paris) – Summer 2020
- Six (6) weeks field assignment at IAEA (Summer 2020) – faculty/students (D&D and ER)
- Six (6) weeks field assignment at NEA (Summer 2020) – faculty students (D&D and Robotics)
- One (1) week workshop (July 2020) Universidad De Vigo (Spain) – faculty and students (D&D and Robotics)
- One (1) week workshop (October 2020) Karlsruhe Institute of Technology (Germany) – faculty and students (D&D and Robotics)



Questions



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