FINAL REPORT
September 29, 2020 to February 28, 2026

Project 4: DOE-FIU Science & Technology Workforce Development Initiative

http://fellows.FIU.edu/

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Addendum:

This document represents one (1) of five (5) reports that comprise the Final Technical Reports for the reporting period September 29, 2020 to September 28, 2025, prepared by Florida International University's Applied Research Center (FIU ARC) for the U.S. Department of Energy's Offices of Environmental Management (DOE-EM) and Legacy Management (DOE-LM) under Cooperative Agreement No. DE-EM0005213. It includes a summary of research accomplishments over the FIU Year 1 to FIU Year 4 (September 29, 2020 to September 28, 2024) reporting period and a detailed account of FIU's research activity in FIU Year 5 (September 29, 2024 to February 28, 2026). The period of performance for FIU Year 5 was extended to February 28, 2026 under no cost extensions.

The complete set of Final Technical Reports prepared by FIU ARC for the aforementioned contractual reporting period includes the following documents:

*Project 1: Chemical Process Alternatives for Radioactive Waste
Document number: FIU-ARC-2024-800012997-04b-005

*Project 2: Environmental Remediation Science & Technology
Document number: FIU-ARC-2024-800013918-04b-003

*Project 3: Waste and D&D Engineering & Technology Development
Document number: FIU-ARC-2024-800013919-04b-006

*Project 4: DOE-FIU Science & Technology Workforce Development Initiative
Document number: FIU-ARC-2024-800013920-04b-013

**Project 5: Long-Term Stewardship of Environmental Remedies: Contaminated Soils and Water and STEM Workforce Development
Document number: FIU-ARC-2024-800013922-04b-003

* Project Funded by DOE's Office of Environmental Management
**Project Funded by DOE's Office of Legacy Management

Each document will be submitted to OSTI separately under the respective project title and document number as shown above. In addition, the documents are available at the DOE Research website for the Cooperative Agreement between the U.S. Department of Energy Office of Environmental Management and the Applied Research Center at Florida International University:
https://doeresearch.fiu.edu

In addition, FIU maintains a dedicated website for the DOE Fellows program: htttps://fellows.fiu.edu

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EXECUTIVE SUMMARY

There has been a national need for more careers in science, technology, engineering, and mathematics (STEM) over the past two decades, particularly in federal agencies such as the U.S. Department of Energy's Office of Environmental Management (DOE-EM), where the shortage of entry-level STEM personnel has become a critical issue due to the average age of its workforce being over 55 years with a substantial percentage of personnel being eligible for retirement over the next 5 years. New ways to stimulate interest in STEM careers are therefore being initiated by the federal government to minimize the potential risk of knowledge gaps (discontinuity of lessons learned) within the department and the lack of skilled personnel to effectively carry out its cleanup mission.

In 1995, DOE-EM and FIU formed a unique partnership to support environmental cleanup technology development, testing, and demonstration at DOE sites. The DOE-FIU Science and Technology Workforce Development Initiative (also referred to as the DOE Fellows Program) was established in 2007 and builds upon this existing DOE-FIU relationship by creating a "pipeline" of young innovative scientists and engineers specifically equipped with the necessary tools and foundation to enter DOE-EM's workforce and immediately provide support to their environmental cleanup mission and address the multitude of problems across the DOE Complex. The program provides interested STEM students, selected as DOE-EM Fellows, with a unique opportunity to integrate course work, DOE fieldwork, and research work at FIU into a well-structured academic program that, upon graduation, could potentially lead to employment opportunities with DOE-EM, DOE contractors, DOE national laboratories, other federal agencies, and private industry, as well as the pursuit of post-masters or post-doctoral positions at DOE national labs. This innovative program was designed to help address DOE's future workforce needs by partnering academic, government and DOE contractor organizations to collaboratively mentor future scientists and engineers in research and development of new technologies to address DOE's environmental cleanup challenges.

The DOE-FIU Science and Technology Workforce Development Initiative has successfully been meeting its objectives by providing hands-on research, technical training and mentoring opportunities for FIU STEM students that equip them with a foundational background to support DOE-EM in addressing its environmental challenges. Since the program's inception in 2007, over 232 STEM students have been inducted into the program. Many of the DOE Fellows, after graduation, were hired by DOE, the national labs, DOE contractors, other federal, state, or local government agencies, or private STEM industry. Others chose to continue advancing their STEM education by pursuing advanced degrees at prestigious institutions such as Massachusetts Institute of Technology (MIT), Michigan State, Purdue, Stanford, Virginia Tech and Northwestern Universities and others. The DOE Fellows program has also established recruitment and retention mechanisms that allow eligible candidates to pursue advanced degrees in STEM programs at FIU while gaining invaluable work experience through participation in DOE-related research and through summer internships, increasing their opportunities for eventual career placement at DOE sites.

Additional information about the entire program and the DOE Fellows can be found on the website https://fellows.fiu.edu/.

PROGRAM HIGHLIGHTS

Since its inception in 2007, the DOE-FIU Science & Technology Workforce Development Initiative has achieved the following:

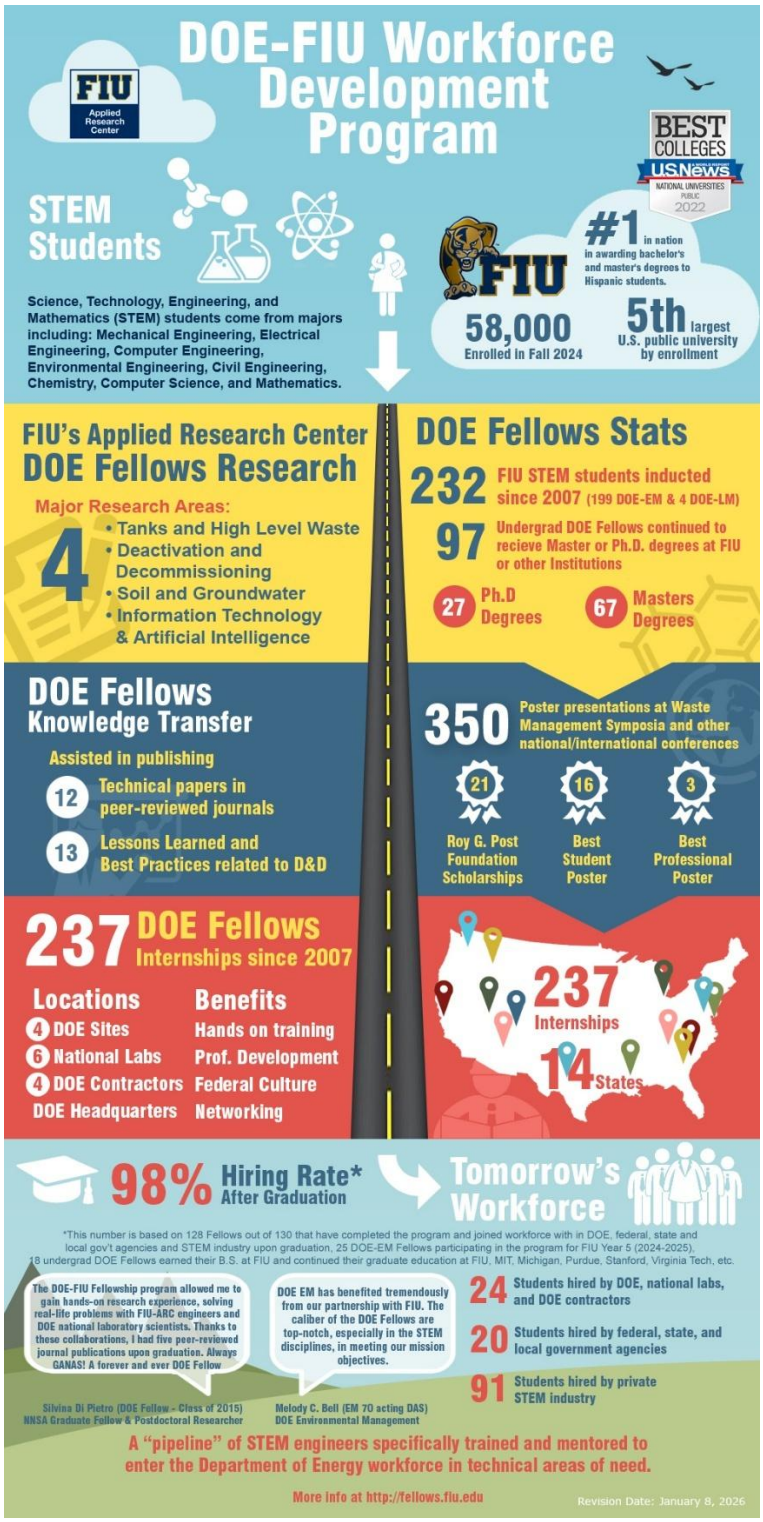

Figure 4-1. DOE Fellows Program infographic.

Figure 4-2. Recent Fellows hired between 2020 and 2025 (subset of total Fellows hired 2007–2025).

PROJECT 4 OVERVIEW

EM Mission Area: *Workforce Development & Training*
DOE Site(s) and End-users: *DOE Complex, DOE EM HQ: Rod Rimando, Danielle Chambers*

Introduction

The DOE-FIU Science and Technology Workforce Development Program is comprised of the following components:

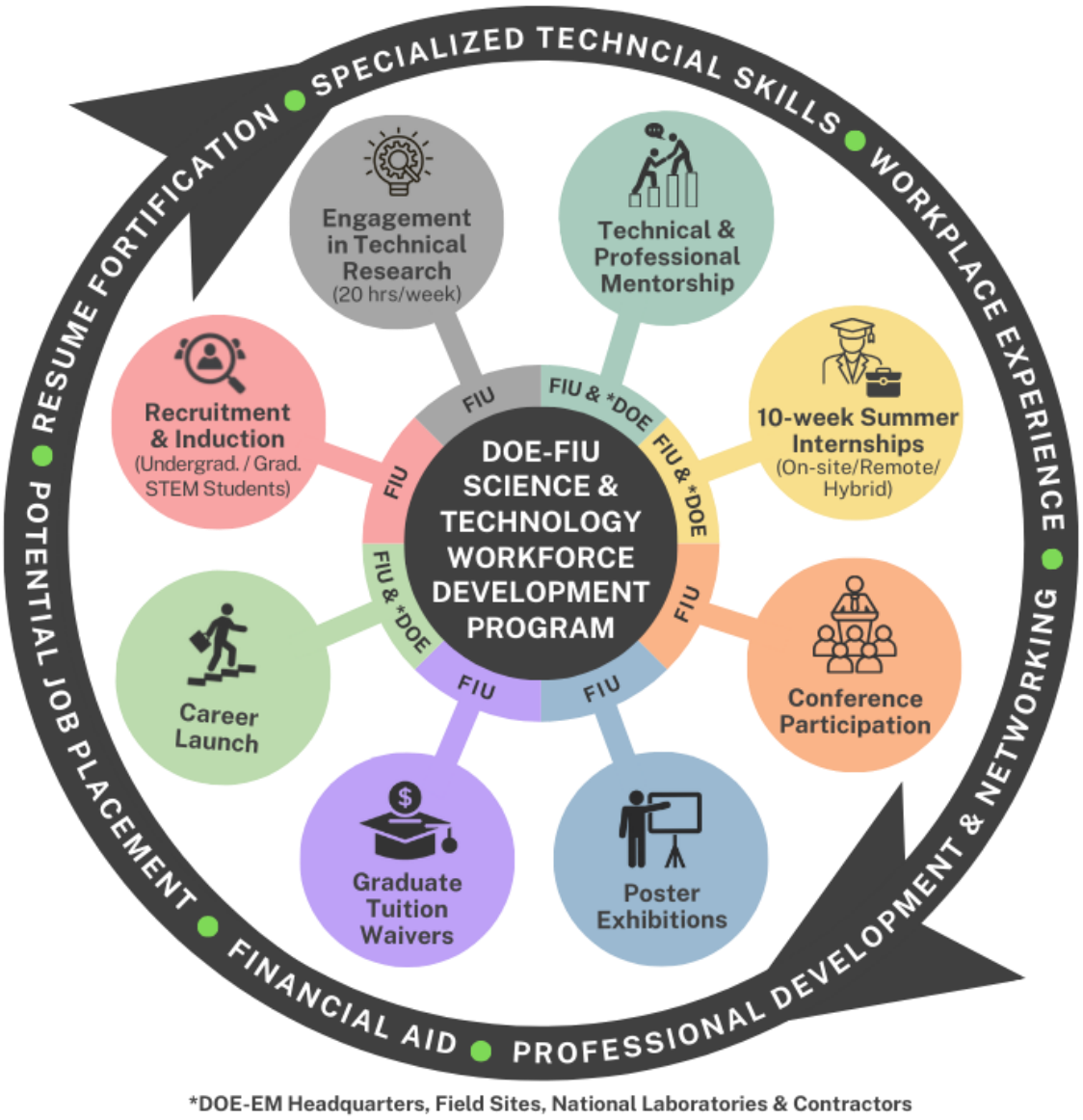

Figure 4-3. DOE-FIU Science & Technology Workforce Development Program (DOE Fellows Program) components.

Project 4 therefore incorporates several tasks that are aligned with these objectives. FIU STEM students selected for this program, coined "**DOE-EM Fellows**," are mentored and trained through a

combination of internships at DOE sites and/or national laboratories, DOE related hands-on research at FIU, workshops, seminars, and conferences. To achieve the objectives of this program, the following tasks were executed over the course of this five-year reporting period.

TASK NO	TASK TITLE
TASK 1:	Recruitment Efforts
TASK 2:	DOE-EM Research Identification and Assignments
TASK 3:	DOE-EM Fellows Poster Exhibition & Competition
TASK 4:	DOE-EM Fellows Induction Ceremony
TASK 5:	Summer Internship Program (SIP)
TASK 6:	Conference Participation and Presentations
TASK 7:	DOE-EM Fellows Lecture Series Forum
TASK 8:	DOE-EM Fellows and DOE-EM HBCU/MSIPP Collaboration/Integration

Objectives

The aim of the DOE-FIU Science and Technology Workforce Development Initiative is to recruit, train and mentor FIU STEM students in areas of need identified by DOE-EM and DOE-LM, addressing the shortage of STEM professionals to replace the aging workforce within the U.S. DOE. This initiative leverages the existing cooperative agreement between FIU and DOE-EM to build a skilled, mission-ready pipeline of future professionals.

Impacts/Benefits

The DOE Fellows program develops a new generation of innovative scientists and engineers equipped to immediately support DOE-EM's environmental cleanup mission and tackle complex challenges across the DOE Complex. Beyond meeting DOE needs, the program strengthens the broader STEM workforce by preparing highly skilled graduates ready to contribute across industry sectors.

Benefits to DOE-EM:

- Involves students in active DOE-EM research projects to develop a future pool of scientists and engineers specially trained and mentored in DOE-EM technical issues.
- Maintains and transfers DOE-EM knowledge to future generations of EM's workforce.
- Leverages cost savings to DOE-EM by utilizing student participation in projects.
- Creates potential for DOE, DOE national laboratories, and contractors to hire graduates from the program (bachelors, masters, and PhDs) to support the DOE-EM mission.

Benefits to FIU/ARC:

- Trains future workforce on DOE-EM technical issues/areas which will enhance their career opportunities and marketability.
- Promote and improve students' interest in science, technology, engineering, and mathematics (STEM).
- Increases the number of undergraduate students (U.S. citizen or permanent residents) going into graduate studies in STEM disciplines.
- Promotes, creates, and secures career opportunities for FIU students in critical government areas.
- Enhance faculty/staff engagement in applied technology applications.
- Enhances academic opportunities with the FIU College of Engineering & Computing and College of Arts & Sciences by developing programs under which students and faculty may receive academic credit for work on DOE research projects (thesis, dissertations, senior design projects, independent research credits, etc.).
- Advances undergraduate, graduate, post-doctoral fellows, and faculty efforts with mentors.

TASK 1: RECRUITMENT EFFORTS

Methodology

Recruitment sessions are conducted throughout the year, typically at the beginning of the Spring, Summer and Fall semesters, during which flyers are posted, and tables are setup at FIU's Engineering Center, as well as the Chemistry and Physics building at FIU's Modesto Maidique Campus (MMC) to promote the DOE Fellows Program, targeting eligible undergraduate and graduate STEM students who meet the following criteria:

- U.S. Citizen/Permanent Resident Alien (minimum of 4 years permanent residency required)
- Undergraduate students (sophomore/early junior, or senior accepted to FIU graduate school)
- Masters/PhD students (in first or second semester)
- Minimum 3.0 GPA

Classroom visits and presentations are also conducted, and a dedicated DOE Fellows website (*fellows.fiu.edu*) provides information about the program, instructions on how to apply, as well as the required application forms. Several social media platforms are also used to promote the program.

Applicants are asked to demonstrate their commitment to the program by completing an application package consisting of an application form, a statement of research interest, an updated resume, unofficial transcripts, two letters of recommendation from FIU faculty, and instructions for completing the application packet. Once the application window has passed, a review committee evaluates the pool of applicants and invites eligible candidates to be interviewed. Applicants are rated based on their qualifications, academics, aptitude, interpersonal skills, and any additional selection criteria specified by the committee. Successful applicants then go through the FIU hiring process to begin their research assignments as DOE-EM Fellows, supporting the DOE-related research under the guidance of an assigned mentor.

Major Accomplishments (FIU Years 1 – 4)

- From 2020 to 2024, FIU carried out multiple recruitment campaigns each fall, spring, and summer semester, resulting in the selection of 59 FIU students to join the DOE Fellows Program. These students were formally inducted into the program during annual ceremonies held each November. This sustained recruitment effort creates a "pipeline" of young innovative scientists and engineers specifically equipped with the necessary tools and foundation to enter DOE-EM's workforce and immediately provide support to their environmental cleanup mission and address the multitude of problems across the DOE Complex.
- **135** DOE-EM Fellows hired by DOE, federal/local/state government, and STEM industry.
    - **24** hired by DOE, national labs, and DOE contractors.
    - **20** hired by federal, state, and local government agencies.
    - **91** hired by private STEM industry
- **18** undergraduate DOE Fellows earned their B.S. at FIU and continued their graduate education at FIU, MIT, Michigan, Purdue, Stanford, Virginia Tech, and other institutions.

Table 4-1. DOE Fellow Inductees - Classes of 2020-2024

CLASS	NAME	DEGREE	MAJOR	MENTOR
2020	Joel Adams	Ph.D.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
	Stevens Charles	B.S.	Environmental Eng.	Angelique Lawrence
	Brendon Cintas	Ph.D.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
	Christian Dau	B.S.	Computer Science	Himanshu Upadhyay
	Mariah Doughman	Ph.D.	Chemistry	Yelena Katsenovich
	Josue Estrada	B.S.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
	Christian Gonzalez Lopez	B.S.	Computer Science	Himanshu Upadhyay
	Phuong Pham	Ph.D.	Chemistry	Ravi Gudavalli
	Raymond Piloto	M.S.	Computer Eng.	Himanshu Upadhyay
	Sebastian Story	B.S.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
	Thi Tran	B.S.	Mechanical Eng.	Anthony Abrahao
	Eduardo Rojas*	B.S.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
2021	Angel Almaguer	B.S.	Chemistry	Yelena Katsenovich
	Nicholas Espinal	B.S.	Mechanical Eng.	Mayren Echeverria Boan/ Mackenson Telusma
	Caridad Estrada	B.S.	Environmental Eng.	John Dickson / Ravi Gudavalli
	Karina Hernandez	B.S.	Environmental Eng.	John Dickson
	Aubrey Litzinger	B.S.	Environmental Eng.	Pieter Hazenberg/ Angelique Lawrence
	Juana Perucina	M.S.	Environmental Eng.	Joseph Sinicrope
	Oscar Roa	B.S.	Mechanical Eng.	Anthony Abrahao
	Rohan Shanbhag	B.S.	Computer Science	Himanshu Upadhyay
	Desmond Sinnott	B.S.	Mechanical Eng.	Aparna Aravelli/ Leonel Lagos
	Sebastian Trevino	B.S.	Cyber Security	Himanshu Upadhyay
	Shawn Cameron*	M.S.	Mechanical Eng.	Anthony Abrahao/ Pieter Hazenberg
2022	Alejandro De La Noval	M.S.	Computer Science	Himanshu Upadhyay
	Aris Duani	Ph.D.	Computer Science	Himanshu Upadhyay
	Bryan Torres	B.S.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
	Carolina Trummer	B.S.	Environmental Eng.	Ravi Gudavalli
	Douglas Baptiste	B.S.	Civil Eng.	Mayren Echeverria Boan
	Gabriel Cerioni	Ph.D.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
	Hannah Aziz	B.S.	Environmental Eng.	Pieter/Angelique
	Kirsten Olson	B.S.	Environmental Eng.	Ravi Gudavalli
	Melanie Sztyble	B.S.	Civil Eng.	Pieter Hazenberg
	Rafael Velasquez	B.S.	Electrical Eng.	Anthony Abrahao

CLASS	NAME	DEGREE	MAJOR	MENTOR
2023	Bryant Pineda	M.S.	Mechanical Eng.	Aparna Aravelli/ Leonel Lagos
	Carlos Rios	M.S.	Mechanical Eng.	Leonel Lagos
	Daniel Coelho*	Ph.D.	Computer Eng.	Pieter Hazenberg
	David Rojas	B.S.	Mechanical Eng.	Anthony Abrahao
	Fabiola Rivera	B.S.	Computer Science	Himanshu Updahay
	Grace Cooke	Ph.D.	Chemistry	Ravi Gudavalli
	Melissa Dieguez	B.S.	Biomedical Eng.	Yelena Katsenovich
	Pedro Chaviano	M.S.	Electrical Eng.	Amer Awwad/ Anthony Abrahao
	Reann Nicolas	B.S.	Civil Eng.	Ravi Gudavalli
	Theophile Pierre	B.S.	Mechanical Eng.	Anthony Abrahao/ Leonel Lagos
	Valeria Ocampo*	B.S.	Biochemistry	Ravi Gudavalli
	Victor Gonzalez	B.S.	Mechanical Eng.	Joseph Sinicrope/ Leonel Lagos
2024	Rayhan Alcena	B.S.	Computer Science	Himanshu Upadhyay
	Santiago Cuartas Palacio	M.S.	Computer Eng.	Anthony Abrahao
	Chloe McGuire	B.S.	Environmental Eng.	Ravi Gudavalli
	Mennah Orabi	B.S.	Mechanical Eng.	Mayren Echeverria Boan
	Carlos Perez de Alejo	B.S.	Mechanical Eng.	Joseph Sinicrope
	Ellie Risher	B.S.	Civil Eng.	Pieter Hazenberg/ Angelique Lawrence
	Sofia Salvador Turner	B.S.	Environmental Eng.	Yelena Katsenovich
	Jose Solares	B.S.	Computer Eng.	Anthony Abrahao/ Leonel Lagos
	Nicole Stofenmacher	B.S.	Environmental Eng.	Pieter Hazenberg / Angelique Lawrence
	Kevin Yulkowski	B.S.	Mechanical Eng.	Mackenson Telusma
	Tyler Coy*	B.S.	Computer Eng.	Pieter Hazenberg/ Anthony Abrahao
	Sahaira Paz*	B.S.	Mechanical Eng.	Pieter Hazenberg/ Angelique Lawrence

**DOE-LM Fellow*

DOE FELLOWS CLASSES OF 2020 & 2021

DOE FELLOWS CLASS OF 2022

Figure 4-4. DOE Classes of 2020-2024.

Progress Summary (FIU Year 5)

Multiple recruitment sessions were conducted in Year 5 as per the methodology described above, including Fall 2024, Spring 2025, and Fall 2025. During each recruitment period, tables were set up at the FIU Engineering campus, and the Physics & Chemistry building, and Computer Science building at the Modesto Maidique Campus to promote the program and distribute flyers. In addition, ARC staff and DOE Fellows visited classrooms to promote the program and encourage interested and eligible students to apply.

Figure 4-5. DOE Fellows Fall 2024 recruitment flyer.

An open house was hosted at FIU's Applied Research Center (FIU ARC) on September 20, 2024, and again on September 17, 2025, to showcase the research being conducted by the DOE Fellows in support of DOE's environmental cleanup mission. Both events featured short presentations and guided tours of the ARC facilities led by current DOE Fellows to encourage students to explore ongoing research activities.

Figure 4-6. DOE Fellows recruitment flyer (left) and Open House flyer (right).

A total of 106 applications were received from FIU STEM students over the Year 5 period of performance: Twenty-six (26) in Fall 2024, 25 in Spring 2025 and 55 in Fall 2025.

Of the Fall 2024 applications, eighteen (18) eligible students were chosen by the selection committee for face-to-face interviews, from which eight (8) were selected to join the DOE Fellows Class of 2024. Five (5) of the eleven (11) Spring 2025 applicants and six (6) out of the twelve (12) students from the Fall 2025 recruitment session were interviewed and selected to join the DOE Fellows Class of 2025. Thus, in Year 5 a total of **8 DOE Fellows for the Class of 2024 and 11 for the Class of 2025** were selected.

Table 4-2. DOE Fellows Class of 2024 and 2025 Selected During FIU Year 5 Recruitment

DOE Fellow Name	Degree	Major
Rayhan Alcena	B.S.	Computer Science
Santiago Cuartas Palacio	M.S.	Computer Engineering
Chloe McGuire	B.S.	Environmental Engineering
Mennah Orabi	B.S.	Mechanical Engineering
Carlos Perez de Alejo	B.S.	Mechanical Engineering
Sofia Salvador Turner	B.S.	Environmental Engineering

DOE Fellow Name	Degree	Major
Jose Solares	B.S.	Computer Engineering
Nicole Stofenmacher	B.S.	Environmental Engineering
Benjamin Vargas	M.S.	Mechanical Engineering
Luisa Rios Giraldo	B.S.	Environmental Engineering
Mathias Osiris	B.S.	Electrical Engineering
Ronald Verde	B.S.	Mechanical Engineering
Sebastian Elijah Vargas	M.S.	Mechanical Engineering

NOTE: Individuals selected during Fall 2025 recruitment are not included in the table above. It is anticipated that they will begin their roles following the initiation of a new 5-year contract between DOE-EM/LM and FIU.

TASK 2: DOE-EM RESEARCH IDENTIFICATION AND ASSIGNMENTS

Methodology

Successful applicants hired as DOE Fellows directly support FIU-ARC scientists and engineers in the development and execution of the technical work on the 4 major projects under the DOE-FIU Cooperative Agreement, gaining hands-on research in the areas of waste management, soil/groundwater modeling and research, deactivation & decommissioning, and computer science/IT development for environmental applications, while pursuing their STEM degrees (bachelors, master's and PhDs) at FIU.

The new DOE Fellows are assigned to a mentor and support the ongoing research by working on a part-time basis (approximately 20 hours/week). They are required to complete various health and safety training courses from the list below depending on the nature of their research prior to engaging in any laboratory work:

- Laboratory Hazard Awareness
- Hazard Communication (HAZCOM)
- Fire Safety (online or instructor-led)
- Environmental Awareness PT 1 & PT 2
- Small Spills and Leaks
- EPA: Hazardous Waste Awareness & Handling
- Personal Protective Equipment (Lab)
- Safe Use of Fume Hoods
- Safe Use of Emergency Eyewash & Shower
- Chemical Handling Safety - Basic Principles
- Compress Gas Safety Awareness
- Safe Use of Biosafety Cabinets
- Radiation Safety

The research being conducted may be used as the basis for the development of master's thesis and/or Ph.D. dissertation topics for DOE Fellows pursuing graduate degrees, and for Fellows pursuing technical undergraduate degrees, the research also provides senior research project and capstone project opportunities.

As part of the program, DOE Fellows also participate in weekly meetings conducted by the program director, during which they are each given an opportunity to present their DOE-related research performed at FIU or the work performed during their summer internships.

Major Accomplishments (FIU Years 1 – 4)

The following describes the programmatic and individual achievements of the DOE Fellows during FIU Years 1-4:

Nine (9) DOE Fellows (graduate STEM students) developed and successfully defended theses/dissertations based on their DOE-EM-related research conducted at FIU, subsequently graduating with M.S./Ph.D. degrees in their respective fields of study:

- Alejandro De La Noval (Computer Science, M.S., 2024)

  - Research topic: Deep Learning Based Spatial-Temporal Analysis on Groundwater Chromium Concentration
- Josue Estrada (Mechanical Engineering, M.S., 2023)
  - Research topic: Development of Inspection Tools for DST Tanks
- Sebastian Story (Mechanical Engineering, M.S., 2023)
  - Research topic: Development of a Material Sampling Miniature Rover for Hanford Double Shell Tank Inspections
- Shawn Cameron (Mechanical Engineering, M.S., 2025)
  - Research topic: n/a
- Silvina Di Pietro (Chemistry, Ph.D., 2021)
  - Research topic: Ammonia Gas Treatment for Uranium Immobilization at DOE Hanford's Site.
- Phuong Pham (Chemistry, Ph.D., 2022)
  - Research topic: Interaction of iodine species with Organoclays and Granulated Activated Carbon.
- Aurelien Meray (Computer Science, Ph.D., 2024)
  - Research topic: Analysis of Image Data using Machine Learning/Deep Learning and Big Data Technologies.
  - Successfully published a peer-reviewed paper titled "Machine Learning Approach for Spatiotemporal Multivariate Optimization of Environmental Monitoring Sensor Locations" in the journal *Artificial Intelligence for the Earth Systems*, Jul. 1, 2024.
- Juan Morales (Environmental Health Sciences, Ph.D., 2024)
  - Research topic: Accumulated Metalloestrogens Analysis for Health Risk Assessment and Watershed Toxicology Management in Tims Branch, SRS.
- Mariah Doughman (Chemistry, Ph.D., 2024)
  - Research topic: Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments.

DOE-EM national labs and contractors hired 12 DOE Fellows *(11 EM-Fellows and 1 LM-Fellow*)*:

- Silvina Di Pietro – Accepted post-doctoral position with National Nuclear Security Administration (NNSA) under the Defense Program (2021) and transitioned to a Research Scientist, Materials Science Division at Lawrence Livermore National Laboratory (2022).
- Phuong Pham – Joined Savannah River National Laboratory (SRNL) as a Postdoctoral Associate (2022).
- Juan Morales – Accepted position at Savannah River National Laboratory (SRNL) as an MSIPP Postdoctoral Fellow (2022).
- Tristan Simoes-Ponce – Accepted a position at Savannah River National Laboratory as a Mechanical Engineer Associate (2020).
- Jeff Natividad - Accepted Mechanical Engineer position with Washington River Protection Solutions (WRPS), the Tank Operations Contractor for the U.S. DOE Office of River Protection (ORP) subcontractor (2022).
- Giselle Gutierrez – Accepted a position at Surface Water Dept. at Kimley-Horn and Associates, Inc. (2022).
- Mariah Doughman – Accepted position as an MSIPP Graduate Research Fellow and later as an MSIPP Postdoctoral Fellow at Pacific Northwest National Laboratory (PNNL) (2024).

- Roger Boza – Accepted position at Idaho National Laboratory (INL) as a Machine Learning Intern.
- Alejandro De La Noval – Accepted a position as an MSIPP Graduate Research Fellow at Savannah River National Laboratory (SRNL).
- Josue Estrada – Accepted position as a Mechanical Engineer with H2C formerly known as Washington River Protection Solutions (WRPS).
- Sebastian Story – Accepted position as R&D Engineer at Los Alamos National Laboratory (LANL).
- Shawn Cameron *(LM-Fellow)** – Accepted position as Engineering Intern at UCOR followed by MSIPP Post Graduate Fellow at Savannah River National Laboratory (SRNL).

Progress Summary (FIU Year 5)

Twenty-five (25) DOE-EM Fellows participated in the program in FIU Year 5, each of them working on their respective research assignments. In addition, the students who attended summer internships presented their research accomplishments during the DOE Fellows weekly meetings and prepared internship reports which have been posted on the DOE Fellows website (*fellows.fiu.edu*) after receiving public release clearance from the sites.

There were also several academic milestones achieved in Year 5. Three (3) DOE Fellows (graduate STEM students) developed and successfully defended theses/dissertations based on their DOE-EM-related research conducted at FIU, subsequently graduating with M.S./Ph.D. degrees in their respective fields of study:

- Aubrey Litzinger (Environmental Engineering, M.S., Fall 2024)
  - Thesis title: *"Assessing the Impacts of Weather Patterns on Surface-Subsurface Hydrological Interactions in Southeastern New Mexico: A Case Study on the Nash Draw Near the WIPP Region Using the Simulator ATS."*
  - She received the *"Outstanding Graduate in Environmental Engineering"* award at the commencement ceremony.
- Joel Adams (Mechanical Engineering, Ph.D., Fall 2025)
  - Dissertation title: *"Modeling Heuristic and Adaptive Robot Behavior for Long-Term Surveillance of Nuclear Facilities." Major Professor, Dr. Leonel Lagos.*
- Theophile Pierre (Mechanical Engineering, M.S, Fall 2025)
  - Thesis defense titled *"Design and Control of a Pneumatically Actuated Robotic Manipulator for Off-Riser Sampling at the Hanford Site." Major Professor, Dr. Leonel Lagos.*

Figure 4-7. DOE Fellow Joel Adams and Major Professor Dr. Lagos at the Fall 2025 comencement ceremony.

Table 4-3. DOE Fellows Assigned Project Support During FIU Year 5

DOE Fellow	Project	Topic
Aris Duani Rojas	3	Nuclear Waste Identification and Classification using Deep Learning
Benjamin Vargas	1	LIDAR Backpack Development for Automated Salt Closure Monitoring at Waste Isolation Pilot Plant
Brendon Cintas	1	Long-Term Surveillance of Nuclear Facilities and Repositories using Mobile Systems
Bryant Pineda	1	Pipeline Corrosion and Erosion Evaluation
Carlos Perez de Alejo	3	Functionalization of Fixative Technologies to Stabilize Hazardous Contaminants in Harsh Environments Under Normal Operating Conditions and Postulated Contingency Scenarios
Carlos Rios	3	Digitalization in Decommissioning
Carolina Arenas Miranda	2	Investigating the Effect of KW-30 (Humate Material) on Co-contaminant Removal
Carolyn Cooke	2	Investigate Environmental Factors Controlling the Attenuation and Release of Contaminants in the Wetland Sediments at Savannah River Site
Chloe McGuire	2	Investigating the Effect of KW-30 (Humate Material) on Co-contaminant Removal
Ellie Risher	2	Hydrology Modeling of Basin 6 of the Nash Draw near the WIPP

DOE Fellow	Project	Topic
Fabiola Rivera-Noriega	3	Data Analytics, Visualization and Machine Learning Model Development for Hexavalent Chromium Cr(VI) Concentration in the 100 Area (PNNL)
Gabriel Cerioni	4	In-Situ 3D Printing Concrete Structures for Waste Containment
Joel Adams	1	Off-riser Sampler Development & Low-Level Waste Identification, Classification & Segregation Using Deep Learning (SRNL)
Jose Solares	1	Nuclear Waste Identification and Classification using Deep Learning
Kevin Yulkowski	1	Development of a Coating Deployment Platform for the H-Canyon Exhaust Tunnel
Luisa M Rios Giraldo	2	Remediation Research of Ammonia Gas Coupled with Strong Reductants for Vadose Zone Treatment
Mennah Orabi	1	Evaluation of Coatings for the H-Canyon Exhaust Tunnel
Nicole Stofenmacher	2	Model Development for Fourmile Branch with Specific Focus on the F-Area Wetlands
Rayhan Alcena	3	Chat Bot integration on the D&D KMIT Web Application/Documentation Summarizer Paper
Ronald Verde	1	Development of a Robotic Vacuum System
Victor Gonzalez	3	Emphasis on Functionalization of Foam Polymers for Gamma Radiation Shielding
Santiago Cuartas	1	Semi-autonomous repair and waste segregation system with plug-and-play tools for remote maintenance and cleaning
Sebastian Vargas	1	Integration of Autonomous Navigation in UGV for Inspections of Waste Isolation Pilot Plant
Sofia Salvador-Turner	2	Fate of Actinides in the Presence of Ligands in High Ionic Strength Systems
Theophile Pierre	1	Development of Robotic Systems for DOE Sites
Tyler Coy	5	Climate Resiliency Studies for Long-Term Surveillance of DOE-LM Sites
Valeria Ocampo	5	Use of Apatite for Uranium (U) Sequestration at Old Rifle Site
Sahaira Paz	5	Climate Resiliency Studies for Long-Term Surveillance of DOE-LM Sites

TASK 3: DOE-EM FELLOWS POSTER EXHIBITION & COMPETITION

Methodology

A poster exhibition/competition is held each year on the day before the annual induction ceremony. The DOE Fellows prepare and present posters in either the undergraduate or graduate session which showcase their research accomplishments in the areas of high-level waste, soil and groundwater, deactivation & decommissioning (D&D), and information technology (IT) in support of the Department of Energy's Office of Environmental Management. Posters may also be based on summer internship activities. The panel of judges is usually comprised of FIU faculty from the College of Engineering and Computing, the College of Arts, Sciences and Education, as well as DOE HQ, national laboratory, and contractor personnel.

Major Accomplishments (FIU Years 1 – 4)

A total of 60 posters were presented by the DOE Fellows during FIU Years 1 – 4 in 3 separate Poster Competition events as follows:

- In FIU Year 1, the DOE-EM Fellows Annual Poster Exhibition & Competition was postponed due to COVID-19 and the social distancing measures in place and was held November 10, 2021 during FIU Year 2.
- In FIU Year 2, 26 posters were presented in the DOE-EM Fellows annual Poster Exhibition & Competition. One undergraduate and one graduate poster session was conducted. The winning posters were:
    - ***Undergraduate poster session:***
        - **1st Place: Caridad Estrada** – *"Sustainable Sorbent Technology for Mercury Remediation in a Freshwater Aquatic System"*
        - **2nd place: Eduardo Rojas** – *"Remote Sensing Technologies for Long-Term Surveillance of DOE-LM Sites"*
        - **3rd place: Christian Dau** – *"Responsive Design Implementation of the D&D KM-IT Application Tool"*
    - ***Graduate poster session:***
        - **1st Place: Aurelien Meray** – "*pyLEnM: An Open-Source Machine Learning Framework for Long-term Water Quality Monitoring"*
        - **2nd place: Mariah Doughman** – *"Impact of Major Groundwater Components on the Adsorption of Uranium (VI) to Hanford Formation Sediment"*
        - **3rd place: Olivia Bustillo** – *"Interaction of Hydroxyapatite and Uranium in Groundwater at the Old Rifle Site to Facilitate Site Remediation."*
        - **3rd place: Phuong Pham** – "*Removal of Iodine-129 by Organoclays PM-199 and MRM at Savannah River Site wetlands"*
- In FIU Year 3, 18 posters were presented in the DOE-EM Fellows annual Poster Exhibition & Competition. The winning posters were:
    - **1st Place: Josue Estrada** – *"Automated Lateral Pipe Inspection System Integrating Pneumatic Crawler and Mechanized Reel"*

  - **2nd place: Roger Boza** – *"Crack Detection Using Convolutional Neural Network Deployed on Mobile Platform."*
  - **3rd place: Olivia Bustillo** – *"Incorporation and Co-Precipitation of Uranium onto Hydroxyapatite"*
- In FIU Year 4, 16 posters were presented in the DOE-EM Fellows annual Poster Exhibition & Competition. The winning posters were:
  - **1st Place: Nicholas Espinal** – **"***Design Improvements for H-Canyon Wall Crawling Platform: Semi-Autonomous Controls*".
  - **2nd Place: Brendon Cintas** – *"Development of a Long-Term Surveillance Unmanned Ground Vehicle (LTS-UGV) for Nuclear Facilities"*
  - **3rd Place: Shawn Cameron** – *"Climate Resiliency Studies for Long-Term Surveillance of DOE-LM Disposal Cell Sites"*

Progress Summary (FIU Year 5)

The DOE-EM Fellows 18th Annual Poster Exhibition & Competition was held on November 12, 2024 from 1:00 - 4:00 pm. A total of 17 posters (5 undergraduate and 12 graduate) were prepared and presented during this event. Mr. David Von Behren (DOE-LM), Mr. Theodis Chunn (SRNL), Dr. Sean Alford (SRNS), Dr. Chris Jarchow (RSI) and Mr. Charles J. Harley (UCOR) judged both graduate and undergraduate sessions.

Figure 4- 8. Participants of the 18th Annual Poster Exhibition & Competition, Including DOE Fellows, Dr. Leonel Lagos (Program Director), Dr. Ravi Gudavalli (Program Manager) and Judges.

Below is the list of graduate and undergraduate posters presented:

Graduate Session:

- **Aris Duani Rojas** - Optimizing Hexavalent Chromium Soil Flushing through Deep Learning of Function Norms

- **Brendon Cintas** - Development of a Long-term Surveillance Unmanned Ground Vehicle (LTS-UGV) for Facility Inspections at Hanford
- **Bryan Torres** - Pipeline Flushing Study of High-Level-Waste at Savannah River Site
- **Bryant Pineda** - Multi-Method Examination of Corrosion and Erosion Dynamics for Nuclear Waste Transfer Systems
- **Carlos Rios** - Digitalization of Decommissioning
- **Carolyn Cooke** - Attenuation of I-129 to Organoclay Amendments with Savannah River Site F-area Wetland sediment
- **Fabiola Rivera-Noriega** - Improving Radon Risk Mapping using Advanced Data Analytics and AI/ML
- **Gabriel Cerioni** - 3D Concrete Printer for Enhanced Engineered Barriers
- **Joel Adams** - Adaptive Radiation Mapping using Quadruped Robot with Manipulator
- **Rafael Velasquez** - Onboard Logic System for FIU's Miniature Rover
- **Santiago Cuartas** - Semi-Autonomous Repair Using Mobile Manipulator and Plug-and-Play Tooling for Nuclear Facilities and Tank Farms
- **Theophile Pierre** - Development of a Pneumatically Actuated Robotic Manipulator for Off-Riser Sampling at the Hanford Site

Undergraduate Session:

- **David Rojas** - Development of an Autonomous Inspection System for Single Shell Tank Laterals at the Hanford Site
- **Ellie Risher** - Hydrological Modeling and Climate Projections to Predict Contaminant Mobility in F-Area Wetlands at Savannah River Site, Aiken, SC
- **Jose Solares** - Nuclear Waste Identification and Classification using Deep Learning
- **Kevin Yulkowski** - Design Improvements for H-Canyon Wall Crawling Platform: Load Cell Integration
- **Victor Gonzalez** - Testing and Evaluation of Foam Fixatives to Mitigate Contaminant Release in 3D Void Spaces for D&D

Awards were presented to the winners of this year's DOE Fellows Poster Competition during the 18th Annual DOE-EM Fellows Induction Ceremony. The winners included:

- **Kevin Yulkowski** (1st place - Undergraduate Track), Poster title: *"Design Improvements of H-Canyon Wall Crawling Platform: Load Cell Integration"*
- **Theophile Pierre** (1st place - Graduate Track), Poster title: *"Development of a Pneumatically Actuated Robotic Manipulator for Off-Riser Sampling at the Hanford Site"*
- **Carolyn "Grace" Cooke** (2nd place - Graduate Track) Poster title: *"Attenuation of I-129 to Organoclay Amendments at Savannah River Site F-Area Wetlands"*
- **Brendon Cintas** (2nd place - Graduate Track) - Poster title: *"Development of a Long-Term Surveillance Unmanned Ground Vehicle (LTS-UGV) for Nuclear Facility Inspections at Hanford"*

Figure 4-9. Undergraduate Poster Session Winners: DOE Fellows Valeria Ocampo (DOE-LM Fellow) and Kevin Yulkowski.

Figure 4-10. Graduate Poster Session Winners: DOE Fellows Brandon Cintas & Carolyn Cooke (left); Theophile Pierre (right).

The planning and coordination of various activities in preparation for the 19th Annual DOE Fellows Poster Exhibition & Competition, to be hosted at FIU's Engineering Center, had been initiated. The DOE Fellows were to be presenting posters at this annual event to showcase either their research being conducted at ARC in support of DOE-EM's environmental clean-up mission, or the research they conducted as part of their summer internships at various DOE facilities, including DOE-EM headquarters, the DOE sites and national labs.

It was anticipated that a total of 22 posters were to be presented during this event. The event was scheduled for November 5, 2025, but has been postponed due to a temporary pause in federal operations. A new date has not yet been determined.

TASK 4: DOE-EM FELLOWS INDUCTION CEREMONY

Methodology

An annual induction ceremony is held every November to officially welcome the new class of DOE Fellows, preceded by lab tour presentations at the Applied Research Center. In attendance at the ceremony are the new Fellows and their families, ARC staff and students, FIU leadership, faculty and staff, DOE personnel from headquarters, the site offices and the national labs, DOE contractors, and others.

Major Accomplishments (FIU Years 1 – 4)

- DOE Fellows Induction Ceremonies were held annually during the reporting period. The events are typically held in November; however, due to the pandemic, the November 2020 ceremony was postponed and instead a Virtual Introduction Event was conducted via Zoom during which the new Fellows were introduced to collaborators at DOE Headquarters, the DOE sites, and the national labs. An in-person induction ceremony was held in November 2021, during which the DOE Fellows Class of 2020 and Class of 2021 were simultaneously inducted.
- Each year, the ceremonies were attended by DOE-EM and DOE-LM officials, including Mr. Tood Shrader, Principal Deputy Assistant Secretary for Environmental Management (2021); Ms. Jalena Dayvault, DOE-LM Site Manager (2021, 2022); Ms. Nicole Nelson-Jean, Assoc. Principal Deputy Assistant Secretary for Field Operations, DOE-EM (2022); Mr. Gregory Sosson, Associate Principal Deputy Assistant Secretary for Field Operations, DOE-EM (2023); Mr. Mark Kautsky, Federal Project Director and the Program Manager for the UMTRCA sites and AS&T Program, DOE-LM (2023); Mr. Rod Rimando, Director of Technology Operations, DOE-EM (2024); and Mr. David Von Behren, Director of the Education, Communication, History and Outreach (ECHO) Team, DOE-LM (2024).
- **DOE Fellow and Mentor of the Year Awards:** Each year, the program honors one outstanding DOE Fellow and one exceptional mentor for their contributions. Past recipients include:
    - **FIU Year 2 (2021):** Fellow of the Year *Olivia Bustillo* (DOE-LM Class of 2019); Mentor of the Year *Mayren Echeverria Boan, Ph.D.*
    - **FIU Year 3 (2022):** Fellow *Aubrey Litzinger* (DOE-EM Class of 2021); Mentor of the Year *Ravi Gudavalli, M.S., Ph.D.*
    - **FIU Year 4 (2023):** Fellow *Shawn Cameron* (DOE-LM Class of 2021); Mentor of the Year *Angelique Lawrence, M.S, GISP®*.

Progress Summary (FIU Year 5)

FIU hosted the 18th Annual DOE Fellows Induction Ceremony on November 13, 2024, and inducted 12 science, technology, engineering, and math (STEM) students into the program as DOE Fellows Class of 2024. Ten of the students will be supporting the DOE-EM research being conducted at FIU while two will be focused on DOE-LM research activities. Rod Rimando, DOE-EM's Director of Technology Operations, Genia McKinley, DOE-FIU Cooperative Agreement Technical Monitor and Danielle Chambers, Program Manager represented Department of Energy Office of Environmental

Management (DOE-EM). The Office of Legacy Management was represented by David Von Behren, Director of the Education, Communication, History and Outreach (ECHO) Team and delivered remarks on behalf of DOE-LM's Director Carmelo Melendez. FIU's administration was represented by Dr. Heather Russell (Vice Provost for Faculty Leadership and Success and Professor of Literature). Dr. Leonel Lagos (DOE Fellows Program Director and Principal Investigator for the DOE-FIU Cooperative Agreement) and Dr. Inés Triay (ARC Executive Director and Interim Dean of FIU's College of Engineering & Computing) also delivered messages to the new class. DOE-EM Fellow, Brendon Cintas, delivered a message to the new Fellows highlighting his personal experience, which he found fulfilling academically and professionally.

The Induction Ceremony events also counted with the participation of DOE-HQ Human Resources staff, Dr. Cheryl Lee. Industrial partners included Ray Johnson, Brian Peake and Chris Jarchow from RSI, DOE-LM contracting office, United Cleanup Oak Ridge (UCOR) represented by Darris Upton and Jeremy Harley, WRPS represented by Scott Lehrman as well as Sean Alford and Brian Ortner representing Savannah River Nuclear Solutions (SRNS).

Table 4-4. DOE Fellows Class of 2024 Inducted at the 18th Annual Induction Ceremony

DOE Fellow Name	Degree Level	Major
Rayhan Alcena	B.S.	Computer Science
Santiago Cuartas Palacio	M.S.	Computer Engineering
Chloe McGuire	B.S.	Environmental Engineering
Mennah Orabi	B.S.	Mechanical Engineering
Carlos Perez de Alejo	B.S.	Mechanical Engineering
Ellie Risher	B.S.	Civil Engineering
Sofia Salvador Turner	B.S.	Environmental Engineering
Jose Solares	B.S.	Computer Engineering
Nicole Stofenmacher	B.S.	Environmental Engineering
Kevin Yulkowski	B.S.	Mechanical Engineering
Tyler Coy*	B.S.	Computer Engineering
Sahaira Paz*	B.S.	Mechanical Engineering

**DOE-LM Fellows*

During the ceremony, awards were presented to the winners of the DOE Fellows Poster Competition held on November 12th, 2024. The winners are noted above in Task 3. Additionally, Mr. Theophile

Pierre received the DOE Fellow of the Year award, while Mr. Mackenson Telusma was honored with the DOE Mentor of the Year award.

Figure 4-11. Theophile Pierre (DOE Fellow of the Year) and Mackeson Telusma (Mentor of the Year).

Figure 4-12. DOE Fellows Class of 2024 with DOE and FIU Officials.

Planning and coordination of the 19th Annual DOE Fellows Induction Ceremony were initiated in anticipation of the event's originally scheduled date of November 6, 2025. Meetings were being held on a bi-weekly basis; however, the event was postponed due to a temporary pause in federal operations and has been rescheduled for the spring semester of 2026.

TASK 5: SUMMER INTERNSHIP PROGRAM (SIP)

Methodology

Every summer, 10-15 DOE Fellows engage in 10-week summer internships during which they are paired with scientists/engineers at DOE facilities across the complex to work on environmental research projects under their guidance and mentorship. The DOE Fellows are required to prepare and submit Summer Internship Technical Reports upon their return to FIU after completion of the internships, which are posted on the DOE Fellows website (http://fellows.FIU.edu) after being reviewed and cleared for public release by their DOE site mentors/scientists.

Major Accomplishments (FIU Years 1 – 4)

Between 2021 and 2024, 65 DOE Fellows completed summer internships at various national laboratories, producing technical reports that captured their research accomplishments. Approved reports have been published on the DOE Fellows website. The program provides students with hands-on experience while cultivating a strong pipeline for the future STEM workforce. This approach delivers long-term value to the Department of Energy through sustained talent development and mission-driven research. DOE Fellows Summer Internship Report for FIU Years 1- 4 are available on the DOE Fellows website under DOE Fellows Internships Reports - DOE Fellows

Progress Summary (FIU Year 5)

The DOE Fellows completed summer internships with various national laboratories during summer 2024 and drafted Summer Internship Technical Reports summarizing their research accomplishments. Reports approved for release have been uploaded to DOE Fellows website [DOE Fellows Internships Reports - 2024].

Table 4-5. DOE Fellows Participation in 2024 Summer Internships

NAME	SITE	MENTOR
Rafael Velasquez†	INL	Kevin Young
Gabriel Cerioni*	SRNL	Christine Langton
Aubrey Litzinger	Drummond Carpenter, PLLC	Joshua “Bud” Davis
Aris Duani Rojas	PNNL	Tim Johnson
Melissa Dieguez	PNNL	Alex Kugler
Bryan Torres	SRMC	Jeremiah Ledbetter
Bryant Pineda	SRNL	Bruce Wiersma/Pavan Shukla
Carlos Rios	SRNL	Michael Tomlin
Carolyn Cooke	SRNL	Hansell Gonzalez-Raymat
Victor Gonzalez	SRNL	Evan Koelker/Austin Coleman
Fabiola Rivera	SRNL	Tom Danielson
Brendon Cintas	WRPS	Douglas Reid

NAME	SITE	MENTOR
David Rojas	WRPS	Douglas Reid
Pedro Chaviano	WRPS	Douglas Reid
Theophile Pierre	WRPS	Douglas Reid

†Partially funded by INL
**Funded by MSIPP*

A total of twelve (12) DOE Fellows completed summer internships engaging in hands-on research and technical projects with various national laboratories during summer 2025 and drafted Summer Internship Technical Reports summarizing their research accomplishments. Highlights of these student internships are provided below. Reports that have been approved for public release are now available on the DOE Fellows website at https://fellows.fiu.edu/internships-reports/.

Table 4-6. DOE Fellows Participation in 2025 Summer Internships

NAME	SITE	MENTOR
Carlos Perez de Alejo	DOE-HQ	Quincy Mason
Nicole Stofenmacher	DOE-HQ	David Weyant & Christian D. Johnson
Sahaira Paz	DOE-HQ	Quincy Mason
Sofia Salvador-Turner	DOE-HQ	Julie Karceski & April Kluever
Chloe McGuire	Drummond Carpenter	Chad Drummond, Joshua Davis & Olivia Bustillo
Ellie Risher	Carlsbad	Anderson Ward
Santiago Cuartas Palacio	SRNL	Michael A. Brown
Sebastian Vargas	SRNL	Donald Benza
Benjamin Vargas	H2C	Douglas Reid & Josue Estrada
Carlos Rios	H2C	Douglas Reid
Ronald Verde	H2C	Douglas Reid
Tyler Coy	RSI	Christopher Jarchow
Kevin Yulkowski	SRNS*	Kameron Oliver

**Funded by Hosting Institution*

Ellie Risher participated in an internship at the DOE's Carlsbad Field Office in support of work at the Waste Isolation Pilot Plant (WIPP). The goal is to begin developing a machine learning model that classifies different lithofacies based on data she collects when analyzing bore samples via spectral gamma and ICP-MS analyses. This is beneficial to DOE-EM as this research can provide a more detailed understanding of the local geology, which is essential in predicting the long-term stability of the WIPP. Additionally, she will work remotely with Dr. David Moulton at Los Alamos National Laboratory (LANL) to further develop her understanding of the Advanced Terrestrial Simulator (ATS) model to support the hydrology modeling research being conducted on the DOE-FIU Cooperative Agreement Project 2 Subtask, "Hydrology Modeling of Basin 6 of the Nash Draw Near the WIPP".

DOE Fellow **Nicole Stofenmacher** interned with the U.S. Department of Energy's Headquarters in Washington, D.C., focusing on groundwater remediation research and modeling in collaboration with Pacific Northwest National Laboratory (PNNL). More specifically, her project centered on learning and applying MODFLOW 6 with FloPy to simulate and model amendment injections, used to improve contaminant cleanup efficiency in complex subsurface environments.

Nicole built and ran baseline groundwater flow and steady-state transport models, from which she then designed scenarios to test the effects of variable hydraulic conductivity values and injection rates in the distribution of amendments and plume behavior. She created maps that capture time and spatial representations of groundwater distribution, providing visuals that contribute to project management and decision-making efforts. Her modeling experience was enriched by visiting PNNL's laboratories where the real-world application of her work takes place. A highlight of this visit included touring the 200 West pump-and-treat facility at Hanford, in which practical design constraints and real applications of computational modeling take place in a field-scale cleanup mission.

"*This internship gave me essential tools to understand the foundations of groundwater modeling and even showed me how simple simulations can provide so much helpful information when it comes to key design tradeoffs, hence contributing to DOE-EM's mission*" Nicole said. "*It really deepened my interest in nuclear and environmental science, and I'm excited to continue honing the skills I learned this summer for future projects.*"

DOE Fellow **Santiago Cuartas Palacio** participated in an internship at Savannah River National Laboratory (SRNL) and is engaged in two exciting projects. One of his primary focuses has been the automation of the CCO (Criticality Control Overpack) horizontal storage system using an AGV (Automated ground vehicle), aimed at maximizing storage efficiency and minimizing human exposure to radioactive materials He added additional reflectors and conducted a full reflector survey to enhance AGV's LiDAR system for accuracy and recalibrated the system for precise localization. He also contributed to the layout design for AGV navigation through the storage racks and optimized the drum-picking routine by tweaking the angle logic in the code and setting operational limits to ensure smoother performance. He tested the AGV's ability to pick and place drums at various rack locations. Additionally, Santiago

worked on establishing network communication with a FANUC robot using SMB. Since the host PC disables SMB at login, he created a scheduled task that waits 20 seconds after startup and re-enables it—problem solved!

Santiago has been collaborating with another DOE Fellow Sebastian Vargas to build a navigation sensor package for autonomous movement. We installed ROS2 on a ClearPath platform and began integrating a 3D Ouster dome LiDAR, kicking off what promises to be another high-impact solution. “Overall, it’s been a hands-on, tech-packed internship - and I’m just getting started” – Santiago Cuartas Palacio.

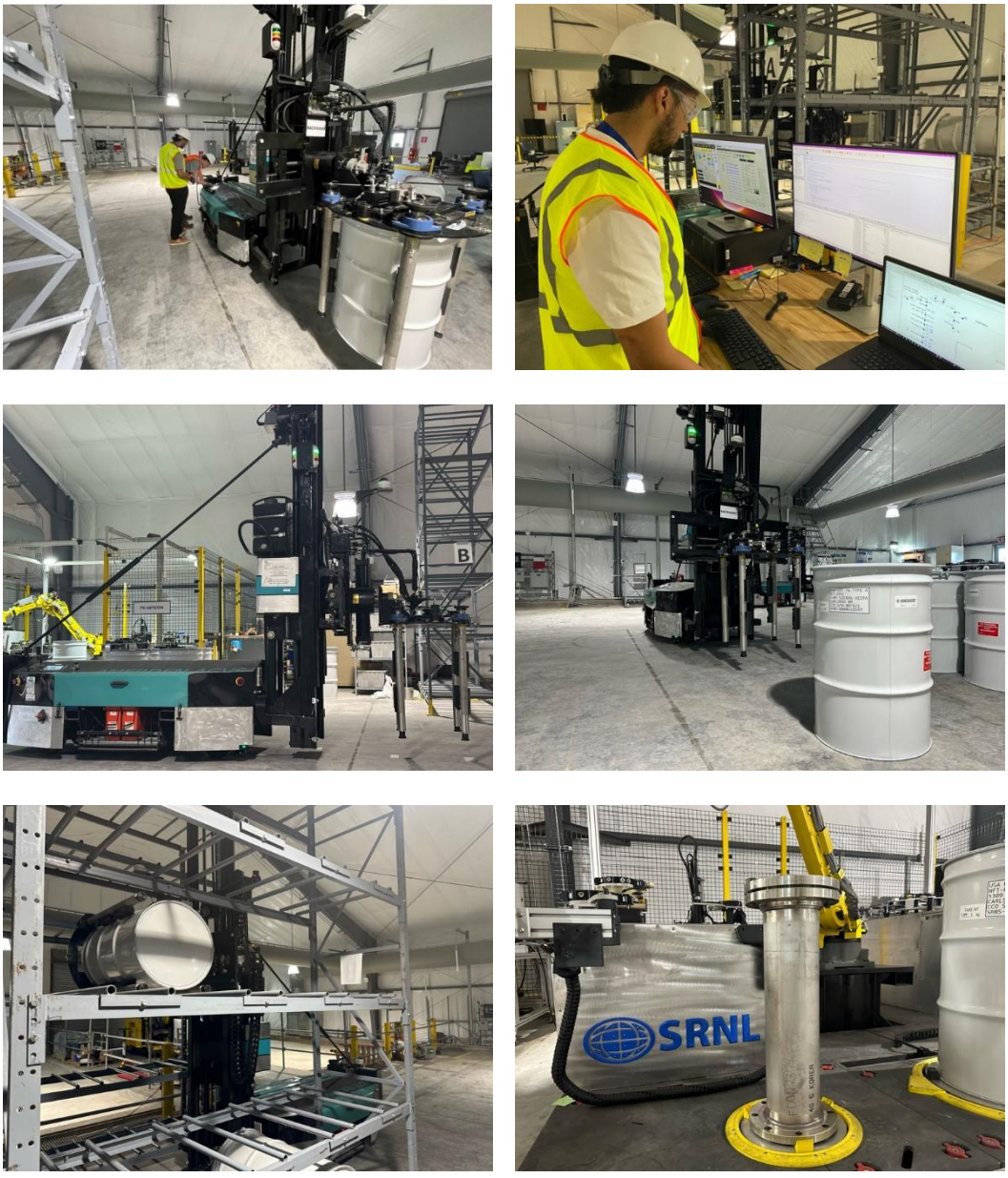

Figure 4-13. Development of AGV, Development and Testing of User interface, Criticality Control Overpack (CCO).

Benjamin Vargas spent 10 weeks doing an internship at the Hanford Tank Waste Operations and Closure, an organization under the supervision and guidance of Dr. Douglas Reid, Ph.D. Benjamin's internship project was initiated on June 9, 2025, and continued through August 14, 2025. The objective of Benjamin's internship was to support the development of a mobile-sensing platform capable of autonomously detecting and mapping subsurface waste-transfer infrastructure using a Ground Penetrating Radar (GPR).

Unlike traditional methods that rely on outdated schematics or intrusive excavation, Ground Penetrating Radar offers a modern, mobile solution that enhances both operator safety and data quality. The work builds upon prior Ground Penetrating Radar applications by introducing a structured, iterative calibration process for tuning scan parameters such as time window, stacking, and acquisition frequency-resulting in sharper, more interpretable scans. Furthermore, the integration of GNSS-based georeferencing and export workflows to Google Earth and CloudCompare bridges the gap between raw subsurface data and practical engineering insight.

These tools allow for immediate spatial visualization of detected features, streamlining interpretation and decision-making for field engineers. By establishing a repeatable scanning and post-processing pipeline, this project not only demonstrates the viability of autonomous Ground Penetrating Radar surveys at Hanford but also lays the foundation for future fusion with other sensor modalities and AI-based anomaly detection. The resulting platform is a flexible, scalable tool that transforms how subsurface infrastructure is understood, mapped, and maintained in high-risk environments.

Carlos Perez de Alejo is participating in a summer internship at the DOE's Head Quarters in Forrestal building. He finalized the Task Change Request (TCR) justification for multiple site wide Department of Energy projects, including a robotic repair platform at the Hanford site, as well as heavy-duty robotic manipulators for hot cells at the Transuranic Waste Processing Center (TWPC) and is preparing the corresponding PowerPoint presentations. The TCRs are essentially a document that assures the federal government is justified in developing their own engineering solution because the solutions that are available on the market are inadequate to need DOE specific needs.

Carlos is also working with the NuVision Engineering team (Paul Dixon, John Ritter, and Ashley Furman) and joined their discussions with Stephen from the UK's National Nuclear Laboratory. They are continuing to coordinate with Paul and Ashley in order to reach out to AI and robotics companies to gather information for NuVision's spreadsheet/database and prepare one-page summaries of each company's presentation at Waste Management 2025. Additionally, a big part of his internship has been to attend meetings with DOE staff, specifically the Technology Operations Office and EM 3 and the WISE interns, including sessions with folks across the DOE (Rod Rimando and Gregory Sosson), DOC, and the House Committee on Science, Space, and Technology.

Figure 4-14. DOE Fellows with other Interns in the Washington D.C. Area.

DOE Fellow **Sofia Salvador-Turner** participated in an internship at DOE Headquarters in Washington, D.C. with the Office of Environmental Management (DOE-EM), Office of Subsurface Closure on the Bioremediation Team. This role provided her with a unique opportunity to see how management and strategy decisions guide environmental cleanup efforts across DOE sites while contributing research on sustainability integration.

Her project focused on analyzing optimization metrics from DOE partners and external frameworks (including EPA, SURF, ASTM, GRI, and SASB). The internship provided an analysis of environmental, economic, and social indicators that can support site performance tracking, comparison of cleanup strategies, and long-term sustainability planning.

As part of her internship, Sofia was invited to a site visit at Savannah River National Laboratory (SRNL), where she studied the phytoremediation system used to treat tritium-contaminated groundwater. This case study demonstrated how deep-rooted pine trees provide a passive, sustainable remediation approach: treating nearly 190 million gallons of groundwater since 2001 at 80% efficiency, sequestering 192 tons of CO_2 annually, and reducing tritium levels in boundary wells to far below EPA standards. Compared to a projected $180M treatment facility, the phytoremediation system cost only $12M while also enhancing biodiversity, reducing risk, and strengthening community trust.

In addition to her technical work, Sofia was invited by mentors at DOE Headquarters to attend Congressional hearings on energy and environmental policy, giving her a firsthand look at how federal policymaking connects to DOE's mission and long-term sustainability strategies.

DOE Fellow, **Ronald Verde**, participated in a 10-week internship at Hanford Tank Waste Operations & Closure (H2C) Chief Technology Officer (CTO), with guidance from Dr. Douglas J. Reid and Rogeiro G. Renteria. The project focused on the development of a robotic vacuum crawler aimed at enhancing inspection and cleaning operations within the annulus space of double-shell tanks (DSTs). The work was aligned with the needs of H2C's Tank and Pipeline Integrity (TAPI) organization, as outlined in the Technology Element Description Summary (TEDS) MTW-89.

Ronald's research highlights the necessity of remote cleaning for concrete surfaces painted with a special protective coating (SPC), required for RCRA permit compliance, to enable proper inspection and repair in high-radiation environment. The project has demonstrated the viability of using remotely operated robotic systems for complex environmental management tasks, contributing to the broader mission of the U.S. Department of Energy's environmental remediation efforts. With continued development, the VCS has the capability to become a valuable tool in supporting the maintenance of nuclear storage facilities. The System's successful deployment underscores its readiness for further testing and integration into hazardous waste management operations.

Sebastian Vargas participated in an internship at Savannah River National Laboratory (SRNL) working on two projects. The first entailed assisting in the development of a measuring system that monitors sludge levels within a dissolver designed to process nuclear fuel. In particular, he was challenged to create a test bed for the measuring system since the dissolver resides in H-Canyon, where radiation levels prohibit any personnel from physically being at the dissolver. Sebastian worked on adding mounting points to the testing tank as well as engineering a solution to minimize the loss of simulant when resetting the system.

The second project focused on integrating a LiDAR system on an unmanned ground vehicle (UGV) and developing a package that will allow it to navigate autonomously. This was done in collaboration with DOE Fellow Santiago Cuartas. Ultimately, the project was done to research the feasibility of integrating similar packages onto UGVs across the Savannah River Site.

During the summer of 2025, **Kevin Yulkoswki** worked as an engineering intern at savannah river nuclear solutions (SRNS), where he gained industry experience supporting the maintenance of the united states' only chemical nuclear separations facility, H-canyon. His primary role was as a design authority engineer, focusing on maintaining and improving the H-canyon HVAC system. This work included monitoring ventilation fan operation, modifying design drawings to implement system improvements, and documenting maintenance procedures. Through this internship, he also gained valuable insight for research that aims to repair H-canyon's ventilation tunnels. Working closely with the lead HVAC and structural engineers of H-canyon, Kevin compiled a report detailing the facility's ventilation system, constraints on crawler operation within the facility, and highlighting areas of the ventilation system with the greatest degradation.

"My time at SRNS strengthened my engineering skill set and directly supported the development and application of the wall crawler" – Kevin Yulkowski

DOE Fellow **Chloe McGuire** interned with Drummond Carpenter, PLLC through the U.S. Department of Environmental Management (DOE-EM), where she supported long-term risk and performance assessment work for legacy nuclear sites. Her work focused on evaluating radionuclide transport and exposure pathways used to quantify dose and risk over extended time horizons.

Chloe worked primarily with RESRAD-OFFSITE, analyzing pathway-specific dose contributions and conducting sensitivity analyses on key radionuclides and model parameters to assess how assumptions influence long-term risk outcomes. She contributed to technical report development by organizing modeling results, reviewing assumptions for consistency, and helping translate quantitative findings into documentation used to support regulatory reviews.

"This experience reinforced how much responsibility comes with environmental modeling," Chloe said. "The results are used to guide decisions that affect people and the environment for generations, which made accuracy, transparency, and clear communication a priority in everything I worked on."

DOE Fellow **Sahaira Paz** interned at the U.S. Department of Energy Headquarters in Washington, D.C., where she applied her Mechanical Engineering background in a federal policy setting. Working under Quincy Mason, she reviewed federally funded robotics projects across multiple stages, aligning legislation with executive orders to support effective policy implementation. Her work focused on identifying opportunities to maximize the use of robotics, optimize budget allocation, and maintain worker safety. She collaborated across federal committees and attended congressional committee hearings to deepen her understanding of national energy policy and contribute to informed decision-making within the DOE.

A highlight of her internship was a week-long site visit to Pacific Northwest National Laboratory (PNNL) in Hanford, Washington, where she toured the robotics facilities overseen by her team's budget. This experience sparked a strong interest in PNNL's mission, and she expressed great enthusiasm for contributing her energy-focused research to federal laboratories.

TASK 6: CONFERENCE PARTICIPATION AND PRESENTATIONS

Methodology

DOE Fellows attend and participate in relevant national and international conferences, including the Waste Management Symposia, the American Chemical Society (ACS), American Nuclear Society (ANS), and American Geophysical Union (AGU), as well as local STEM conferences sponsored by FIU and/or other institutions in the South Florida area. The Fellows submit abstracts and develop student and professional posters as well as oral presentations based on their research conducted at FIU ARC or during their summer internships.

Major Accomplishments (FIU Years 1 – 4)

- Waste Management Symposium 2021:
    - Derek Gabaldon won Best Undergraduate Student Poster Award.
    - Aurelien Meray won Best Graduate Student Poster Award.
    - Juan Morales received the "best presentation" award for his outstanding presentation during the Emerging Contaminants session.
- Annual Research Symposium 2021 hosted by the MARC U*STAR Program:
    - Caridad Estrada was awarded first place for an oral presentation titled "Sustainable Sorbent Technology for Mercury Remediation in Freshwater Aquatic Systems."
- Waste Management Symposium 2022:
    - Four (4) DOE Fellows, Aurelien Meray, Caridad Estrada, Marian Doughman and Thi Tran, Roy G. Post Foundation scholarship recipients, displayed their posters on Sunday, March 6, 2022 during the *034a* Waste Management Symposium *2022 Roy G. Post Scholarship Winners Poster Display*.
    - Aubrey Litzinger received the best undergraduate poster award for her poster titled "*Standard Aging of Concrete for the Study of Protection Systems at Savannah River Site*."
- Waste Management Symposium 2023:
    - Three (3) DOE Fellows, Nicholas Espinal, Olivia Bustillo, and Phuong Pham were awarded the Waste Management Symposia's Roy G. Post Foundation scholarships for 2023.
- Waste Management Symposium 2024:
    - Two (2) DOE Fellows Alejandro De La Noval and Aubrey Litzinger, 2024 Roy G. Post Scholarship recipients, presented posters on Sunday, March 10, 2024, during Session 41 - Waste Management 2024 Roy G. Post Scholarship Winner Posters.
    - Bryant Pineda received the best graduate poster award for his poster titled "*Evaluating the Erosion and Corrosion Behavior in Nuclear Waste Transfer Systems" at* Waste Management Symposium 2024.

Progress Summary (FIU Year 5)

Fourteen (14) DOE Fellows attended and participated in posters and oral presentations at Waste Management Symposia 2025. DOE Fellows Aris Duani Rojas, Fabiola Rivera Noriega, and Theophile Pierre received Roy G. Post foundation scholarships and displayed their posters at the Roy G. Post foundation scholarship winner's session on Sunday, March 9th, 2025. Eleven (11) DOE Fellows prepared posters and presented them at the Student Poster Competition on Monday March 10th, 2025.

Table 4-7. List of Abstracts Submitted to Waste Management Symposia 2025

ABSTRACT ID	DOE FELLOW NAME	ABSTRACT TITLE
25098	Fabiola Rivera Noriega	Improving Radon Risk Mapping Using Advanced Data Analytics and AI/ML
25321	Aris Duani Rojas	Optimizing Hexavalent Chromium Soil Flushing through Deep Learning of Function Norms
25712	Carlos Rios	Digitalization of Decommissioning
25718	Theophile Pierre	Development of a Pneumatically Actuated Robotic Manipulator for Off-Riser Sampling at Hanford Site
25720	Ellie Risher	Hydrological Modeling & Climate Projections for Contaminant Mobility in F-Area Seepage Basins at Savannah River Site
25721	Jose Solares	Nuclear Waste Identification and Classification using Deep Learning
25724	Kevin Yulkowski	Wall Crawler Development for Concrete Structures Inspection and Repair
25735	Brendon Cintas	A Novel Approach to Routine Inspections at the Hanford Tank Farms
25737	Victor Gonzalez	Testing and Evaluation of Foam Technologies to Mitigate Contaminant Release in 3D Void Spaces for D&D
25740	Carolyn Cooke	Investigating Potential Amendments for the Sequestration of I-129 at the Savannah River Site F-Area Wetlands
25752	Gabriel Cerioni	Design of Concrete 3D Printer
25757	Joel Adams	A Behavioral Solution for Object Avoidance with Mobile Manipulators
25932	Santiago Cuartas	Remote System with Plug-and-Play Interchangeable Tools for Inspection and Repairs of DOE Nuclear Facilities
25936	Chloe McGuire	Investigating the Use of Humate Materials to Immobilize Uranium at the Savannah River Site
25939	Tyler Coy*	Developing an Autonomous Sensor Platform to Assist DOE-LM in the Long-term Surveillance of DOE-LM Sites

**DOE-LM Fellow*

Thirteen (13) student abstracts have been submitted and accepted by DOE Fellows for the WM2026 Student Poster Session. Additionally, eight (8) DOE Fellows applied for Roy G. Post Foundation Scholarships, and six (6) were selected as scholarship recipients.

Table 4-8. List of Abstracts Submitted to Waste Management Symposia 2026 by DOE Fellows

ABSTRACT ID	NAME	ABSTRACT TITLE
26677	Sahaira Paz*	Ground Penetrating Radar as a Sustainable Tool for Long-Term Health Monitoring in the Mexican Hat Cell, Utah
26687	Carolina Arenas Miranda	Evaluating Specific Conductance as an Indicator of Uranium Mobility at SRS F-Area
26490	Victor Gonzalez	Functionalizing Foam Polymer Fixatives to Enhance Gamma Radiation Shielding in Support of Nuclear D&D Activities
26659	Ellie Rischer	A Geological Perspective on Modeling the Waste Isolation Pilot Plant Region with the Advanced Terrestrial Simulator (ATS)
26626	Benjamin Vargas	LIDAR Backpack Development for Automated Salt Closure Monitoring at the Waste Isolation Pilot Plant.
26723	Kevin Yulkowski	Remote Repair and Inspection with a Semi-Autonomous Wall Crawling Platform
26630	Carolyn Cooke	Evaluating the Impacts of Environmental Parameters on the Utilization of Organoclays as an Amendment for I-129 Contamination
26671	Tyler Coy*	Potential of Hyperspectral Camera Observations for DOE LM
26621	Valeria Ocampo*	Usage of Hydroxyapatite for Uranium Remediation Under Varying Environmental Conditions
26673	Jose Solares	Vision-Guided Robotic Manipulation for Nuclear Waste Identification and Handling
26676	Nicole Stofenmacher	Evaluation of Environmental Parameter Variability in the F-Area Wetlands After Extreme Weather Events
26643	Sebastian Vargas	Autonomous Controls for Structural Mapping at the Waste Isolation Pilot Plant (WIPP)
26700	Ronald Verde	Development of Double Shell Tank Annulus Vacuum Crawler System

*DOE-LM Fellow

TASK 7: DOE-EM FELLOWS LECTURE SERIES FORUM

NOTE: This task was initiated in FIU Year 3.

Methodology

As part of the DOE Fellows programs, DOE-EM Fellows are required to participate in a DOE-EM Fellows Lecture Series Forum hosted by FIU, where speakers who are DOE-EM staff (sites and HQ) and national lab personnel discuss important DOE-EM topics with the Fellows and other FIU students. Through this forum, it is anticipated that the DOE-EM Fellows will learn about DOE-EM environmental issues directly from DOE scientists and engineers.

Major Accomplishments (FIU Years 1 – 4)

FIU hosted **19 Tech talks** on KM-IT which involved collaborations with Savannah River National Laboratory (SRNL), Washington River Protection Solutions (WRPS), Lawrence Berkeley National Laboratory (LBNL), Idaho National Laboratory (INL), Argonne National Laboratory (ANL), Institute for Energy Technology in Norway, Oak Ridge National Laboratory (ORNL), Pacific Northwest National Laboratory (PNNL), Los Alamos National Laboratory (LANL) and Florida International University's Applied Research Center (FIU-ARC) research team to present topics relevant to the DOE EM Complex. Topics included:

1. AI-Accelerated Strategies and Solutions in Environmental Technology (AI-ASSET)
2. Next-Generation Knowledge Management: Developing Agent-Driven Systems for Enhanced User Interaction
3. Graph Analytics on Exascale Systems
4. Significance of Resilient Analytics in Achieving the Energy Resilience of Microgrids
5. A Case Study: The Strategic Integration of Consensus Standards to Facilitate Fixative Technology Development, Deployment, and Acceptance
6. Development and Deployment of a ground robotic platform for radiation Radiological Contamination Detection
7. Uranium Characterization and Remediation at the Hanford Site
8. Natural Language Processing for Event Discovery, Extraction, and Inferential Forecasting
9. AI/ML Research support for Advance Long-Term Environmental Monitoring Systems (ALTEMIS)
10. DOE’s ALTEMIS Project: Advanced Long-Term Monitoring of Complex Groundwater Plumes
11. International Perspective on Decommissioning with focus on 3D hazard aware digital and robotics technology-based transformation
12. University R&D and Deployment of Robotics Systems at DOE Facilities
13. Understanding Decontamination
14. Decommissioning Knowledge Sharing in the 21st Century

15. Crack Detection and Localization Using Deep Learning Techniques
16. The Potential of Artificial Intelligence in the Nuclear Power Industry
17. Advanced Environmental Monitoring Systems (ALTEMIS): New Paradigm of Long-term Monitoring
18. Use of Robotics in Nuclear Applications
19. Successful Deployment of Fire-Retardant Fixative at SRS 235

Progress Summary (FIU Year 5)

The DOE Fellows attended a series of FIU-ARC's Tech Talks over the past year, including:

- On October 17, 2024, FIU collaborated with Oak Ridge National Laboratory (ORNL) to feature a Tech Talk from Aditya Sundararajan titled *"Significance of Resilient Analytics in Achieving the Energy Resilience of Microgrids".*
- *"Graph Analytics on Exascale Systems"* – presented by Dr. Mahantesh Halappanavar from Pacific Northwest National Laboratory (PNNL) on January 21, 2025.
- On April 22, 2025, FIU hosted a Tech Talk titled "AI/ML Research support for Advance Long-Term Environmental Monitoring Systems (ALTEMIS)", presented by Dr. Jayesh Soni, a Postdoctoral Associate at FIU.
- *"AI-Accelerated Strategies and Solutions in Environmental Technology (AI-ASSET)" (July 23, 2025).* – presented by former DOE Fellow Alejandro De La Noval, a MSIPP Fellow at Savannah River National Laboratory (SRNL).
- DOE Fellows attended a Tech Talk on October 29, 2025, hosted by FIU *titled "Quantum AI Innovations at Savannah River National Laboratory (SRNL)"* by Dr. Larry M. Deschaine from SRNL.
- DOE Fellows attended a Tech Talk on January 29, 2026, hosted by FIU titled "*Development of Robotic Tools for Nuclear Decommissioning*" by speaker Dr. Leonel Lagos from FIU.

TASK 8: DOE-EM FELLOWS AND DOE-EM HBCU COLLABORATION/INTEGRATION

Methodology

This task was created to encourage continuous communication and engagement with DOE-EM HBCUs and MSIPP STEM programs to promote collaborative synergistic research and STEM development efforts between FIU and HBCU universities related to EM technical issues and challenges and hopefully attract and encourage qualified STEM students to pursue graduate STEM degrees at FIU.

Connection with other HBCUs conducting research as part of the MSIPP technical and scholastic projects is fostered by FIU's principal investigator and project managers' participation in annual MSIPP meetings. During FIU Year 5, FIU's aim was to work closely with DOE-HQ and HBCU universities to conduct a Technical Summit at FIU.

Progress Summary (FIU Years 1- 5)

FIU maintained continuous communication with DOE MSIPP representatives on a quarterly basis to receive input on the MSIPP program and potential job placements for FIU students. This ongoing dialogue helps align FIU's efforts with DOE workforce development goals and ensures students are informed and prepared for career pathways within the DOE complex. The table below lists the DOE Fellows and FIU students who have been hired by DOE-EM, contractors and national laboratories.

Table 4-9. DOE Fellows and FIU Students Hired by DOE-EM, Contractors and National Laboratories

Former DOE Fellow	DOE Site
Shawn Cameron	SRNL
Josue Estrada	H2C Hanford
Jeff Natividad	H2C Hanford/Strata - Oak Ridge
Sebastian Story	LANL
Mariah Doughman	PNNL
Phuong Pham	SRNL
Alejandro De La Novela	SRNL
Melissa Dieguez	PNNL
Aubrey Litzinger	Drummond Carpenter
Olivia Bustillo	Drummond Carpenter
Tristan Simones-Ponce	SRNL
Roger Boza	INL
Sofia Salvador Turner	DOE-HQ
Juan Morales	SRNL-US Navy
Silvina DiPietro	NNSA/LLNL

FIU also focused on strengthening partnerships with HBCU institutions by supporting student participation in MSIPP-sponsored internship opportunities. These internships provided hands-on

research experience aligned with DOE-EM priorities and served as a pipeline for students to transition into graduate studies and DOE-related careers.

Table 4-10. MSIPP Student Summer Internships

Student	DOE Site	Year
Gabriel Cerioni	SRNL	2023 & 2024
Juan Hernandez Zapata	SRNL	2025
Oscar Gonzalez	SRNL	2025
Javier Figueroa	SRNL	2025
Maria Karla Sotolongo	SRNL	2025

PROJECT 4: OVERALL CONCLUSION & LESSONS LEARNED (FIU YEARS 1 – 5)

For this reporting period, a total of 14 DOE-EM Fellows and 2 LM Fellows were hired by DOE, DOE national labs, DOE contractors, and other federal agencies. The DOE Fellows also participated in a total of 77 internships. There was also a high level of participation by the DOE Fellows at major conferences such as the Waste Management Symposia, the American Nuclear Society, and others, with a total of 94 student presentations overall in the form of posters, oral presentations and panel discussions.

The vision of this program is to create a "pipeline" of young innovative scientists and engineers from a pool of FIU STEM students who are trained and mentored as DOE Fellows, equipped with skillsets necessary to enter DOE's workforce, and effectively carry out its cleanup mission while addressing the current shortage and critical need for skilled entry-level STEM personnel.

The DOE-FIU Science and Technology Workforce Development Initiative has been successfully meeting its objectives by providing hands-on research, technical training and mentoring opportunities for FIU STEM students that equip them with a foundational background to support DOE-EM in addressing its environmental challenges. Since the program's inception in 2007, FIU's recruitment efforts have resulted in over 232 STEM students being inducted into the program, with 60 recruited over this 5-year performance period.

The program has allowed the DOE Fellows to become intricately involved in the day-to-day project activities at FIU, playing an essential role in the research and technology development process. There were 65 student internship opportunities made possible through this program between 2020-2025, facilitating collaborative interaction with top scientists and engineers at the various DOE sites and national labs and giving the students invaluable experience, and in some cases, unique opportunities to observe real life demonstrations of the technologies that they have been working on at FIU.

Many of the DOE Fellows, after graduation, have been hired by DOE, national labs, DOE contractors, other federal, state, or local government agencies, or private STEM industry. Others chose to continue advancing their STEM education by pursuing advanced degrees at prestigious institutions such as Massachusetts Institute of Technology (MIT), Michigan State, Purdue, Stanford, Virginia Tech, Northwestern Universities and others. The DOE Fellows program has also established recruitment and retention mechanisms that allow eligible candidates to pursue advanced degrees in STEM programs at FIU while gaining invaluable work experience through participation in DOE-related research and

through summer internships, increasing their opportunities for eventual career placement at DOE sites. DOE Fellows who have been hired during this reporting period by DOE-EM, national labs, DOE contractors, and other federal agencies are shown in Table 4-11.

Table 4-11. DOE Fellows Hired During This Reporting Period by DOE-EM, National Labs, DOE Contractors and Other Federal Agencies

Former DOE Fellow	DOE Site
Silvina Di Pietro	National Nuclear Security Administration (NNSA)
Juan Morales	Savannah River National Laboratory (SRNL)
Tristan Simoes-Ponce	Savannah River National Laboratory (SRNL)
Roger Boza	Idaho National Laboratory (INL
Jeff Natividad	H2C (Formerly WRPS)
Olivia Bustillo	Drummond Carpenter, PLLC
Mariah Doughman	Pacific Northwest National Laboratory (PNNL)
Josue Estrada	H2C (Formerly WRPS)
Phuong Pham	Savannah River National Laboratory (SRNL)
Sebastian Story	Los Alamos National Laboratory (LANL)
Alejandro De La Novela	Savannah River National Laboratory (SRNL)
Melissa Dieguez	Pacific Northwest National Laboratory (PNNL)
Aubrey Litzinger	Drummond Carpenter, PLLC
Sofia Salvador Turner	DOE-HQ OSBP
Rafael Velesquez	U.S. Patent and Trademark Office
Shawn Cameron	Savannah River National Laboratory (SRNL)

While the DOE-FIU Workforce Development Initiative has successfully engaged and trained a diverse cohort of students, the program continues to face challenges in student retention. Maintaining consistent student participation throughout the multi-year program can be difficult due to academic workload, competing internship opportunities, and evolving career interests. Some students disengage before completing the full cycle of training and research. To address these challenges, several strategies are being explored, including:

- **Enhanced Mentorship and Engagement:** Strengthening mentorship, peer support, and early exposure to DOE mission areas can improve student commitment and retention. These efforts help foster a professional identity aligned with DOE priorities, encouraging students to remain engaged throughout the program.
- **Curriculum Alignment:** Ensuring that research assignments align closely with evolving DOE workforce needs, emerging technologies and student interests can enhance relevance and motivation.
- **Career Readiness Workshops:** Offering targeted workshops on federal hiring processes, resumé development, and technical writing can better equip students for DOE employment. These workshops also reinforce students' sense of purpose and long-term investment in the program.

Additional information about the entire program and the DOE Fellows can be found on the website https://fellows.fiu.edu/.

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APPENDIX A: FIU QUARTERLY AND YEAR END REPORTS AND ANNUAL RESEARCH REVIEW PRESENTATIONS

The following documents for the Cooperative Agreement (CA) between the U.S. Department of Energy's Offices of Environmental and Legacy Management and the Applied Research Center at Florida International University represent the research conducted by FIU during the current CA's period of performance, and are available at FIU ARC's DOE Research website https://doeresearch.fiu.edu/SitePages/Welcome.aspx

1. FIU Quarterly Reports
2. FIU Year End Reports
3. FIU Annual Research Review Presentations

APPENDIX B: DOE FELLOWS IN GRADUATE PROGRAMS

DOE Fellows in STEM Graduate Programs - Ph.D.

DOE Fellow	Discipline	Degree	Research Topic Based on DOE EM Projects	Graduation Year
Charles Castello	Electrical Engineering	Ph.D.	Soil/Groundwater - Sensor Development for Field Measurement of Mercury	2011
Claudia Cardona	Environmental Engineering	Ph.D.	Remediation of the uranium-contaminated subsurface in the deep vadose zone via NH_3 gas injection	2017
Hansell Gonzalez-Raymat	Chemistry	Ph.D.	Unrefined humic substances as a potential low-cost remediation method for groundwater contaminated with uranium in acidic conditions	2018
Sebastian Zanlongo	Computer Science	Ph.D.	Multipurpose All-Terrain Robotic Platform for D&D	2018
Roger Boza[2]	Computer Science	Ph.D.	Analysis of Image Data using Machine Learning/Deep Learning and Big Data Technologies	2021
Silvina Di Pietro	Chemistry	Ph.D.	Ammonia Gas Treatment for Uranium Immobilization at DOE Hanford's Site	2021
Cristian Acevedo[1]		Ph.D.	NA	NA
Emma Lopez[1]		Ph.D.	NA	NA
Reiner Hernandez[1]		Ph.D.	NA	NA
Eric Inclan[1]		Ph.D.	NA	NA
Bryant Thompson[1]		Ph.D.	NA	NA
Alejandro Garcia[1]		Ph.D.	NA	NA
Orlando Gomez[1]	Physics	Ph.D.	NA	NA
Alejandro Hersnandez[1]	Chemistry	Ph.D.	NA	NA
Phuong Pham	Chemistry	Ph.D.	Interaction of iodine species with OrganoClays and Granulated Activated Carbon	2022
Mariah Doughman	Chemistry	Ph.D.	Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments	2024
Aurelien Meray[2]	Computer Science	Ph.D.	Analysis of Image Data using Machine Learning/Deep Learning and Big Data Technologies	2024
Juan Morales	Public Health	Ph.D.	Accumulated Metalloestrogens Analysis for Health Risk Assessment and Watershed Toxicology Management in Tims Branch, SRS	2024

DOE Fellow	Discipline	Degree	Research Topic Based on DOE EM Projects	Graduation Year
Joel Adams	Mechanical Engineering	Ph.D.	Long Term Surveillance of Nuclear Facilities and Repositories	2025
Brendon Cintas	Mechanical Engineering	Ph.D.	Experimental analysis of flushing criteria for waste transport operations	2026 (anticipated)
Caridad Estrada[1]	Environmental Engineering	Ph.D.	NA	
Gabriel Cerioni	Mechanical Engineering	Ph.D.	In-Situ 3D Printing Concrete Structures for Waste Containment	2027 (anticipated)
Carolyn Grace Cooke	Chemistry	Ph.D.	Interaction of iodine species with Organoclays and Granulated Activated Carbon	2027 (anticipated)
Hannah Aziz[1]	Environmental Engineering	Ph.D.	NA	NA
Nicholas Espinal[1]	Mechanical Engineering	Ph.D.	NA	NA
Aris Duani Rojas[2]	Computer Science	Ph.D.	NA	2026 (anticipated)
Valeria Ocampo[3]	Chemistry	Ph.D.	NA	2031 (anticipated)

1. Student is pursuing graduate level degree at another academic institution/department.
2. Student left the DOE Fellows program before completion of his doctoral degree and continued his PhD degree with the respective FIU Academic Unit.
3. Student admitted to FIU PhD program in Chemistry starting Fall 2026.

DOE Fellows in STEM Graduate Programs – Master's

DOE Fellow	Discipline	Degree	Research Topic Based on DOE EM Projects	Graduation Year
Jose Vazquez	Environmental Engineering	Master's	Effects of temperature and pH on volatilization of mercury after chemical reduction	2009
Amy Pahmer	Engineering Management	Master's	Non-Thesis Option	2010
Duriem Calderin	Biomedical Engineering.	Master's	Modeling of Loose Contamination Scenarios to Predict the Amount of Contamination Removed	2010
Leydi Velez	Industrial Engineering	Master's	Decision Modeling Tools D&D Surveillance & Maintenance	2010
Serkan Akar	Biomedical Engineering	Master's	Design and Development of an Enzyme-Linked Biosensor for Detection and Quantification of Phosphate Species	2010
Amaury Betancourt	Environmental Engineering	Master's	Soil/Groundwater - Modeling of Mercury Contamination at ORNL	2011
Denny Carvajal	Biomedical Engineering	Master's	Soil/Groundwater – Bacteria Interaction due to Polyphosphate Injection at Hanford	2011
Edgard Espinosa	Mechanical Engineering	Master's	Waste Processing - CFD Modeling of NuVison's Power Fluidic Technology/Process Remote Stack Characterization System	2011

DOE Fellow	Discipline	Degree	Research Topic Based on DOE EM Projects	Graduation Year
Elsa Cabrejo	Environmental Engineering	Master's	Soil/Groundwater - Modeling of Mercury Contamination at ORNL	2011
Melina Idarraga	Environmental Engineering	Master's	Dissolution rate of natural meta-autunite: effects of aqueous bicarbonate, pH, and temperature	2011
Merlin Ngachin	Environmental Sciences	Master's	Waste Processing - Baltman-Lattice Method to Model HLW	2011
Stephen Wood	Mechanical Engineering	Master's	Modeling of Pipeline Transients: Modified Method of Characteristics	2011
William Mendez	Engineering Mngmt.	Master's	Development of Remote Stack Char. System	2011
Eric Inclan	Mechanical Engineering	Master's	Mesh adaptation for use in Lattice Boltzmann code	2012
Kanchana Iyer	Biomedical Engineering	Master's	Non-Thesis Option	2012
Lee Brady	Mechanical Engineering	Master's	Non-thesis option	2012
Lilian Marrero	Environmental Engineering	Master's	Soil/Groundwater - Modeling of Mercury Contamination at ORNL	2012
Mario Vargas	Mechanical Engineering	Master's	Kinematic Control of Remote Stack Characterization System	2012
Melissa Sanchez[2]	Environmental Engineering	Master's	Non-thesis option	2012
Yulyan Arias[2]	Environmental Engineering	Master's	Non-thesis option	2012
Elicek Delgado-Cepero	Electrical Engineering	Master's	Structural Health Monitoring Inside Concrete and Grout Using the Wireless Identification Sensing Platform	2013
Heidi Henderson	Environmental Engineering	Master's	Surface water and contaminant transport within the Oak Ridge National Laboratory	2013
Jaime Mudrich	Mechanical Engineering	Master's	Development of a Coupling Model for Fluid-Structure Interaction using the Mesh-free Finite Element Method and the Lattice Boltzmann Method	2013
Janty Ghazi	Electrical Engineering	Master's	Control, through Sensors and LabVIEW, of the Asynchronous Pulsing Unit	2013
Jose Matos	Mechanical Engineering	Master's	Development of improved Bodies for a Peristaltic Crawler for Radioactive Pipeline Unplugging	2013
Mariela Sliva	Engineering Management	Master's	Non-Thesis Option	2013
Joel McGill[1]	Environmental Engineering	Master's	Non-Thesis Option	2014

DOE Fellow	Discipline	Degree	Research Topic Based on DOE EM Projects	Graduation Year
Paola Sepulveda	Biomedical Engineering	Master's	Investigating the Role of a Less Uranium Tolerant Strain, Isolated from the Hanford Site Soil, on Uranium Interaction in Polyphosphate Remediation Technology	2014
Revathy Venkataraman	Computer Science	Master's	Performance Evaluation of Mobile Applications with KMIT Technology Web Services	2014
Valentina Padilla	Environmental Engineering	Master's	Non-Thesis Option	2014
Andrew De La Rosa[1]	Computer Science	Master's	Non-Thesis Option	2015
Dayron Chigin[1]	Electrical Engineering	Master's	Non-Thesis Option	2015
Maximiliamo Edrei	Mechanical Engineering	Master's	Investigation of Mixing Times of Sparged Bingham plastic type fluids as applied to the Pulse Jet Mixing Process	2017
Natalia Duque	Environmental Engineering	Master's	Non-Thesis Option	2017
Robert Lapierre[1]	Chemistry	Master's	Mineral characterization after uranium sequestration by pH manipulation using NH_3 gas	2017
Alejandro Garcia	GeoScience	Master's	The influence of biofilm formation on the SIP response of Hanford vadose zone sediment	2018
Mohammed Albassam	Water resource Engineering	Master's	Effect of Frequent Atmospheric Events on Flow Characterization in Tims Branch and its Major Outfalls	2018
Joseph Coverston	Mechanical Engineering	Master's	Evaluation of Pipeline Flushing Requirements for HLW at Hanford and Savannah River	2019
Joshua Nunez	Mechanical Engineering	Master's	The applications of intumescent technologies in support of D&D activities across the DOE complex	2019
Ryan Cruz	Cyber Security	Master's	Non-Thesis Option	2019
Amanda Yankcoskie[1]	Environmental Engineering	Master's	Non-Thesis Option	2020
Jason Soto	Mechanical Engineering	Master's	Design of Robotic Inspection Platform for Structural Health Monitoring	2020
Ron Hariprashad[1]	GeoScience (Hydrogeology)	Master's	Modeling of Surface Water Flow and Contaminant Transport in the Tims Branch Ecosystem	2020
Tristan Simoes-Ponce	Mechanical Engineering	Master's	D&D Technology Demonstration & Development and Technical Support to SRS's 235-F Facility Decommissioning	2020
Alexis Vento	Environmental Engineering	Master's	Fate of Actinides in the Presence of Ligands in High Ionic Strength Systems	2021

DOE Fellow	Discipline	Degree	Research Topic Based on DOE EM Projects	Graduation Year
Jeff Natividad	Mechanical Engineering	Master's	Evaluation of Coatings for the H-Canyon Exhaust Tunnel	2021
Edward Nina[1]	Mechanical Engineering	Master's	Non-Thesis Option	2020
Michael Thompson	Electrical Engineering	Master's	Structural health monitoring of pipelines in radioactive environments through acoustic sensing and machine learning	2020
Gisselle Guiterrez	Environmental Engineering	Master's	Digital Elevation Model and Hydrologic Network	2022
Lorryn Adnrade[1]	Environmental Engineering	Master's	Fate of Actinides in the Presence of Ligands in High Ionic Strength Systems	2022
Ryan Ocampo[1]	Civil Engineering	Master's	Evaluation of Coatings for the H-Canyon Exhaust Tunnel at the Savannah River	2022
Raymond Piloto[1]	Electrical Engineering	Master's	Pipeline corrosion and erosion evaluation	2022
Olivia Bustillo	Environmental Engineering	Master's	Use of Apatite for Uranium Sequestration at Old Rifle Site	2023
Josue Estrada	Mechanical Engineering	Master's	Development of Inspection Tools for DST Tanks	2023
Christian Dau[1]	Computer Science	Master's	Analysis of Image Data using Machine Learning/Deep Learning	NA
David Mareno[1]	Cyber Security	Master's	Analysis of Image Data using Machine Learning/Deep Learning and Big Data Technologies	NA
Aubrey Litzinger	Environmental Engineering	Master's	Model Development (for Basin 6 of the Nash Draw near the WIPP)	2024
Rohan Shanbhag[1]	Computer Science	Master's	AI for EM Problem Set (Soil and Groundwater)	NA
Sebastian Story	Mechanical Engineering	Master's	Development of Inspection Tools for Primary Tanks	2023
Stevens Charles[3]	Environmental Engineering	Master's	NA	NA
Alejandro De La Noval	Computer Science	Master's	Deep Learning Based Spatial-Temporal Analysis on Groundwater Chromium Concentration	2024
Philip Moore	Mechanical Engineering	Master's	Development of an Off-Riser Sampling System for Hanford Waste Tanks	2024
Bryant Pineda	Mechanical Engineering	Master's	Pipeline Corrosion and Erosion Evaluation	2025
Rafael Valesquez	Electrical Engineering	Master's	Improvement of Mobile Platform Efficiency	Anticipated 2026
Theophile Pierre	Mechanical Engineering	Master's	Development of Robotic Systems for DOE Sites	2025
Fabiola Rivera[1]	Computer Engineering	Master's	Exploratory Data Analysis & Machine Learning Model for Hexavalent	NA

DOE Fellow	Discipline	Degree	Research Topic Based on DOE EM Projects	Graduation Year
			Chromium [Cr(VI)] Concentration in the 100-H Area (PNNL)	
Bryan Torres[1]	Mechanical Engineering	Master's	Evaluation of Pipeline Flushing Requirements for HLW at Savannah River	NA
Benjamin Vargas	Mechanical Engineering	Master's	LIDAR Backpack Development for Automated Salt Closure Monitoring at Waste Isolation Pilot Plant	Anticipated 2026
Carlos Rios	Mechanical Engineering	Master's	Digitalization of Nuclear Decommissioning Using a Mobile Robotic Platform with Integrated LiDAR and Mesh Network	Anticipated 2026
Sebastian Vargas	Mechanical Engineering	Master's	Optimizing SLAM algorithm for navigation and mapping applications	Anticipated 2026
Victor Gonzalez	Mechanical Engineering	Master's	Functionalizing Foam Polymer Fixatives to Enhance Gamma Radiation Shielding in Support of Nuclear Deactivation and Decommissioning Activities	Anticipated 2026
Carolina Arenas Miranda[1]	Environmental Engineering	Master's	Investigating the Effect of KW-30 (Humate Material) on Co-contaminant Removal	NA
Ellie Rischer	Environmental Engineering	Master's	ATS modeling of Nash Draw	Anticipated 2027
Jose Solares	Computer Engineering	Master's	Autonomous Waste Segregation via Vision-Guided Robotic Manipulation in a Controlled Workcell for Nuclear-facility-relevant Sorting Tasks	Anticipated 2027

1. Student left the DOE Fellows program before completion of their master's degree.
2. Student left the DOE Fellows program but completed their master's degree at FIU.
3. Student is pursuing graduate level degree at another academic institution/department.

APPENDIX C: DOE FELLOWS EMPLOYMENT

DOE Fellows Hired by DOE-EM, Contractors and National Laboratories Since Program Inception

First Name	Last Name	Employer
Edgard	Espinosa	DOE EM Office of Nuclear Materials Disposition
Merlin	Ngachin	Waste Control Specialists (Texas) and currently hired by Argonne National Lab
Rubymir	Romero	Bechtel Power
Lee	Brady	DOE EM office of Deactivation and Decommissioning
Duriem	Calderin	Columbia-Energy Environmental Services (Richland, WA), AREVA NP (Richland, WA), Pacific Northwest National Lab (PNNL), and currently at IAEA
Charles	Castello	Oak Ridge National Laboratory (ORNL) - Energy & Transportation Science Division
Rosa	Ramirez	DOE EM International Programs
Stephen	Wood	Oak Ridge National Laboratory (ORNL)
Nicole	Anderson	National Energy Technology Laboratory (NETL)
Hansell	Gonzalez-Raymat	Savannah River National Laboratory (SRNL)
Adamandios	Manoussakis	Sandia National Laboratory
Silvina	Di Pietro	National Nuclear Security Administration (NNSA)
Juan	Morales	Savannah River National Laboratory (SRNL)
Tristan	Simoes-Ponce	Savannah River National Laboratory (SRNL)
Roger	Boza	INL
Jeff	Natividad	WRPS
*Olivia Hilda	Bustillo	Drummond Carpenter, PLLC
Mariah	Doughman	PNNL
Josue	Estrada	WRPS
Phuong	Pham	Savannah River National Laboratory (SRNL)
Sebastian	Story	LANL
Alejandro	De La Novela	SRNL
Melissa	Dieguez	PNNL
Aubrey	Litzinger	Drummond Carpenter, PLLC
Sofia	Salvador Turner	DOE-HQ
*Shawn	Cameron	Savannah River National Laboratory (SRNL)

**DOE-LM Fellow*

DOE Fellows Hired by Federal, State and Local Governament Agencies

First Name	Last Name	Employer
Serkan	Akar	Department of Commerce
Denisse	Aranda	NASA
Alex	Henao	Internal Revenue Services
Jose	Vazquez	Department of State
Amaury	Betancourt	Florida Department of Environmental Protection
Cindy	Cerna	Naval Sea Systems Command

Jennifer	Borges	Florida Department of Transportation
Elsa	Cabrejo	Dade County Environmental Department (Miami, Fla)
Alessandra	Monetti	Department of Defense – Office of the Secretary of Defense, Army Corp of Engineering
Kanchana	Iyer	Department of Health & Human Services
Alexander	Lopez	Florida Department of Transportation
Melissa	Sanchez	Florida Department of Environmental Protection
Frank	Silva	Department of State
Kiara	Pazan	U.S. Corps of Engineers
Jesse	Viera	U.S. Marine Corps
Christine	Wipfli	U.S. Dept of Defense
Sarah	Bird	U.S. Dept of Defense
Christopher	Strand	FAA
Mohammed	Albassam	City of Coconut Creek
Rafael	Velesquez	U.S. Patent and Trademark Office

DOE Fellows Hired by Private Industry

First Name	Last Name	Employer
Danny	Brenner	General Electric
Ramon	Colon	Bouygues Civil Works Florida
Henry	Diaz	Lockheed
Raul	Dominguez	Kimley-Horn and Associates, Inc.
Erica	McKinney	Boeing Company
William	Mendez	Boeing Company
Amy	Pahmer	Mount Sinai Medical Center
Giancarlos	Pena	Caribe Utilities of Florida, Inc
Jose	Rivera	FIU's Applied Research Center
Leydi	Velez	PriceSmart Inc
Sandra	Zapata	Johnson & Johnson
Melina	Idarraga	Nova Consulting Inc.
Dasney	Joseph	General Electric
Victor	Uriarte	Intel Corporation
Denny	Carvajal	Mount Sinai Medical Center
Rinaldo	Gonzalez Galdamez	Crane Aerospace and Electronics
Nadia	Lima	HJ Foundation
Jose	Matos	Beckman Coulter
Mario	Vargas	Boeing Company
Yulyan	Arias	CH2M Hill
Maite	Barroso	Sikorsky Aircraft
Givens	Cherilus	Florida Power & Light
Elicek	Delgado	Motorola
Janty	Ghazi	Kiewit Power
Heidi	Henderson	CPH Inc.

First Name	Last Name	Employer
Sheidyn	NG	Regeneron Pharmaceuticals
Shina	Rana	Florida Power & Light
Claudia	Cardona	STEM
Nel	Ciurdar	Burns & McDonnell
Lilian	Marrero	MWH Global
Joshua	Midence	Creativity, Value, Logic
Carol	Moreno-Pastor	Cummins
Jaime	Mudrich	Beckman Coulter
Ximena	Prugue	BRG Sports
Paola	Sepulveda	StryKer
Jennifer	Arniella	Permasteelisa North America
Francisco	Bolanos	Beckman Coulter
Dania	Castillo	HDR
Dayron	Chigin	Florida Power & Light
Joel	McGill	BND Engineers
Lucas	Nascimiento	Raytheon
Raul	Ordonez	Texas Instruments
Valentina	Padilla	Brown & Caldwell
Mariela	Silva	Conoco Phillips
Gabriela	Vazquez	Florida Power & Light
Revathy	Venkataraman	TradeStation
Michael	Abbott	Magic Leap Inc
Michelle	Embon	Kimley-Horn and Associates, Inc.
Mariana	Evora	King Engineering Associates, Inc
Eduardo	Garcia	UTC Aerospace Systems
Steve	Noel	Goldman Sachs
Sasha	Philius	HaikuTech Europe B.V.
Brian	Castillo	StryKer
John	Conley	Florida Power & Light
Andrew	De La Rosa	Lockheed
Jorge	Deshon	Lockheed
Maria	Diaz	Nova Consulting Inc.
Maximiliano	Edrei	Huntington Ingalls Newport News Shipbuilding Company
Janesler	Gonzalez	Velossa Tech
Meilyn	Planas	Florida Power & Light
Ryan	Sheffield	Applied Physics Laboratory
Aref	Shehadeh	Nova Consulting Inc.
Alexis	Smooth	Nexant
Sebastian	Zanlongo	Johns Hopkins University, Applied Physics Laboratory
Michael	DiBono	Microsoft
Ron	Hariprashad	RS&H
Ripley	Raubenolt	SCS Engineering

First Name	Last Name	Employer
Sarah	Solomon	County of Los Angeles Department of Public Works
Joseph	Coverston	Pennsylvania State University Applied Research Laboratory
Ryan	Cruz	Lockheed
Katherine	Delarosa	Advanced Environmental Laboratories
Christopher	Excellent	FPL
Ximena	Lugo	Kimley-Horn and Associates, Inc.
Joshua	Nuñez	Dayton-Granger, Inc.
Alex	Rivero	General Electric
Jason	Soto	SIA Solutions LLC
Patrick	Uriarte	iRobot
Alexis	Vento	SCS Engineering
Derek	Gabaldon	Rolls-Royace
Gisselle	Gutierrez	Kimley-Horn and Associates, Inc.
Daniel	Martin	FIU's Applied Research Center
Michael	Thompson	Raytheon
Rocio	Trimino Gort	A&P Consulting Transportation Engineers, Corp.
Adrian	Muino	Lockheed Martin
Eduardo	Rojas	Kinetic Engineering and Accident Reconstruction
Desmond	Sinnott	Florida Power and Light
Philip	Moore	Florida Power and Light
Theophile	Pierre	MOBY Robotics
Bryan	Torres	ESI Consulting Engineers
Rayhan	Alcena	Clone Ops

APPENDIX D: WASTE MANAGEMENT SYMPOSIA PAPERS/POSTERS PRESENTED BY DOE FELLOWS

Waste Management 2021

DOE Fellows Participation in Student Poster Competition

DOE Fellow	Abstract ID	Title
Adrian Muino	21434	Cyber Analysis of the Deactivation & Decommissioning Knowledge Management Information Tool
Alexis Vento	21431	The Impact of Ethylenediaminetetraacetic acid on Actinides Adsorption onto Dolomite Mineral in WIPP-relevant Environment
Aurelien Meray	21420	pyLEnM: Machine Learning and Analytics Toolkit for Long-term Water Quality Monitoring Using a Remote Sensing Network
David Mareno	21429	Knowledge Base for Environmental Management
Derek Gabaldon	21427	Assessing the effects of vibrational forces on the performance of fixative materials in mitigating risk during D&D activities
Gisselle Gutierrez	21416	Evaluation of Vegetation Removal Methods for UAV-Based Photogrammetry within the WIPP Land Withdrawal Act Boundary, NM
Jeff Natividad	21438	Collaboration for Improving Safety and Efficiency: Guidance for Autonomous Robotics Use at Hanford
Joel Adams	21435	Autonomous Surveillance of Nuclear Facility and Repositories
Juan Morales	21424	Investigation of Heavy Metal Biomarkers for the Assessment of Remediated Surface Waters
Katherine Delarosa	21433	Effect of modified-HA on the Sequestration of Uranium in acidic groundwater at the Savannah River Site
Mariah Doughman	21432	Evaluation of Competing Attenuation Processes for Mobile Contaminants in Hanford Sediments
Nathalie Tuya	21422	Influence of Environmental Factors on Iodine Attenuation and Release in Savannah River Site Wetlands Sediments
Philip Moore	21430	Evaluation of Fixatives for Three-Dimensional Voids
Phuong Pham	21447	Characterization of KW-15 modified humic acid - a potential in-situ technology for uranium remediation at the SRS
Raymond Piloto	21423	Flow-Induced Erosion Detection in Stainless-steel Coupons from SRNL
Roger Boza	21425	Robust Anomaly Detection of Nuclear Facility Structures with Convolutional Autoencoder
Sebastian Story	21436	Inspection rover for Leak Detection Channels within Double-Shell Tanks at the Hanford Site
Silvina Di Pietro	21419	Solid phase characterization of physicochemical mineral phase alterations upon NH_3 gas treatment
Stevens Charles	21421	Examining the Variation in the Sediment Transport process under different Erosion and Precipitation Criteria

Waste Management 2022

DOE Fellows Participation in Student Poster Competition

DOE Fellow	Abstract ID	Title
Aurelien Meray	22483	AI Approach to Predict Tritium Concentrations Using Specific Conductance as a Proxy Variable at the SRS F-Area
Caridad Estrada	22493	Sustainable Sorbent Technology for Mercury Remediation in a Freshwater Aquatic System
Mariah Doughman	22486	Impact of Major Groundwater Components on the Adsorption of Uranium (VI) to Hanford Formation Sediment
Thi Tran	22489	Intelligent Data Management to Produce Digital Twins from Autonomous Robotic Platforms
Angel Almaguer	22503	Re-oxidation of Technetium (99Tc) Comingled with Uranium (238U), and Nitrate (NO_3^-), Immobilized via Strong Reductants
Aubrey Litzinger	22485	Standard Aging of Concrete for the Study of Protection Systems at Savannah River Site
Brendon Cintas	22484	Evaluation of Pipe Length on Flushing Requirements for High-Level Waste at Hanford and Savannah River
Desmond Sinnott	22506	Design and Development of a Bench Scale Pipe Loop for Corrosion Monitoring Using Caustic Simulants
Gisselle Guiterrez	22488	Development of an Integrated Hydrology Model of a Sub-Basin within Basin-6 near the Waste Isolation Pilot Plant (WIPP), NM
Jeff Natividad	22482	Mechanical Updates on the Robotic System for Coating Application in Savannah River Site H-Canyon Exhaust Tunnel
Joel Adams	22499	Development of Intelligent Mobile Robot Platforms for Performing Nuclear Surveillance
Phuong Pham	22491	Removal of Iodine-129 by organoclays MRM and PM-199
Roger Boza	22481	Surface Crack Detection of Nuclear Facility Structures Using Deep Learning and Knowledge Transfer
Sebastian Story	22480	Retrofitted Pneumatic Pipe Crawler for Transfer Line Inspection of Double Shell Tanks at Hanford Site
Stevens Charles	22490	Surface Water Dynamics within the F-area of Savannah River Site and its Linkages with Groundwater and I-129 Geochemistry

DOE Fellows Participation in Professional Tracks

DOE Fellow	Abstract ID/ Presentation Type	Track	Title
Desmond Sinnott	22466 / Poster	033c Posters - HLW, SNF/UNF and Long-Lived Alpha/TRU Waste Retrieval and Processing (2.1c)	Effect of Caustic Simulant Flow on the Corrosion Characteristics of Waste Transfer Pipe Components
Brendon Cintas	22128 / Oral	024 Tank Farm Processing (2.4b)	Evaluation of Pipeline Flushing Requirements for High-Level Waste at Hanford and Savannah River
Silvina Di Pietro*	Panelist	053 Roundtable: Young Professionals in Nuclear Science and Engineering an International Perspective (R8.2)	N/A
Joel Adams	22317 / Oral	067 Nuclear and Industrial Robotics, Remote Systems and Emerging Technology (9.2)	Radiological Surveillance of Hanford Tank Farm Using an Autonomous Mobile Platform

DOE Fellow	Abstract ID/ Presentation Type	Track	Title
Phuong Pham	22609 / Poster	034c WM2022 Student Intern Poster Display - Featuring Savannah River National Laboratory	Sorption of Iodide and Iodate on Wetland Soils
Caridad Estrada	22172 / Oral	105 Groundwater Remediation Projects - Worldwide Experiences (7.7)	Sustainable Sorbent Technology for Mercury Remediation in a Freshwater Aquatic System
Roger Boza	22444 / Poster	119 Non-Paper Poster Topic for Emerging Issues and Late Abstracts (10.1)	Obstacle Detection for Drones Using Machine Learning
Sebastian Story	22104 / Oral	123 Tank Farm Inspections (2.4a)	Development and Deployment of the Miniature Rover for Inspection of Hanford's Double Shell Tank (DST)
Aurelien Meray	22320 / Oral	129 Artificial Intelligence (AI) and Machine Learning (ML) Applications in Radioactive WM (9.13)	pyLEnM: An Open Source Machine Learning Framework for Long-term Water Quality Monitoring

**Former DOE Fellow/NNSA Graduate Fellow and Postdoctoral Researcher*

Waste Management 2023

DOE Fellows Participation in Student Poster Competition

DOE Fellow	Abstract ID	Title
Nicholas Espinal	23645	Assessing Surface Preparation Effect on the Protective Properties of a Multilayer Coating System for Application in DOE Sites Infrastructures
Olivia Bustillo†	23611	Hydroxyapatite Formulation for Uranium Remediation at the Moab, UT Site
Phuong Pham	23627	Characterization of Savannah River Site's Wetland Soils at Different Depth Intervals
Aubrey Litzinger	23589	The Development of an Integrated Hydrological Model for Basin 6 of the Waste Isolation Pilot Plant (WIPP) using the Advanced Terrestrial Simulator (ATS)
Aurelien Meray	23607	Contaminant Forecasting Using Long Short-Term Memory - Deep Learning Approach Applied at the Savannah River Site F-Area
Brendon Cintas	23622	Validation of Slurry Rheology in DWPF Sludge Batch (SB) 10 Using Non-radioactive Chemical Simulants
Caridad Estrada	23590	Evaluation of the Effects of Dissolved Organic Matter on Engineered Sorbents for the Clean-Up of Mercury Aqueous Media
Gabriel Cerioni	23624	Nozzle Improvements for 3D printed Concrete Waste Containers
Joel Adams	23644	Reinforcement Learning Applied to Waste Segregation
Josue Estrada	23629	Development of an Autonomous Inspection System for Single Shell Tank Laterals at the Hanford Site
Mariah Doughman	23592	Impact of Chromium (VI) as a Co-mingled Contaminant on the Adsorption of Uranium (VI) to Hanford Formation Sediment
Philip Moore	23625	Development of an Off-Riser Sampling System for Single Shell Waste Tanks at Hanford Site
Sebastian Story	23633	Deployment of the Miniature Rover within AP-105 at the Hanford Site
Shawn Cameron†	23630	Climate Resiliency Studies for Long-Term Surveillance of DOE-LM Sites

DOE Fellows Participation in Professional Tracks

DOE Fellow	Abstract ID/ Presentation Type	Track	Title
Aurelien Meray	23123 / Oral	Session 023 Artificial Intelligence (AI) and Machine Learning (ML) Applications in Radioactive WM (9.13)	FDLPhysics-Informed Surrogate Modeling for Supporting Climate Resilience at Groundwater Contamination Sites
Aubrey Litzinger*	Panelist	044 Roundtable: Graduating Students and New Engineers - Wants and Needs - Are Companies Even Listening? (R8.1)	N/A
Caridad Estrada*	Panelist	044 Roundtable: Graduating Students and New Engineers - Wants and Needs - Are Companies Even Listening? (R8.1)	N/A
Gabriel Cerioni	23051 /Oral	051 Waste Disposal Facilities Evaluation, Design and Operations (3.7a)	3D Printed Containers for Long-Lived Isotopes and Remote Handled Radioactive Waste
Joel Adams	23444 / Oral	052 Application of Innovative D&D Technologies Including Application of Virtual Reality (6.7a)	Development of Semi-Autonomous Robotic Manipulator for Off-Riser Sampling of Tank Waste
Brendon Cintas	23167 / Oral	082 HLW and Highly Radioactive Waste Processing (2.4c)	Engineering-Scale Evaluation of Flushing Requirements for High-Level Liquid Waste at Savannah River and Hanford Sites
Olivia Bustillo†**	Panelist	130B Panel: US DOE National Labs and Academia Successful Partnerships in the Development and Training of STEM Workforce (R10.3)	N/A

†DOE-LM Fellow
**Former DOE Fellow*
***The panel was organized and chaired by Dr. Leonel Lagos and Jennifer Wohlwend (SRNL) and counted with participation from Hansell Gonzalez-Raymat (Former DOE Fellow and Senior Scientist at SNRL) as well as Simona Murph (SRNL) and Larry Boing (Argonne Nat. Lab)*

Waste Management 2024

DOE Fellows Participation in Student Poster Competition

DOE Fellow	Abstract ID	Title
Alejandro De La Noval	24590	Using Natural Language Processing for Semantic Search in the Nuclear Domain
Aubrey Litzinger	24668	Exploring the Surface and Subsurface Hydrology Near the Waste Isolation Pilot Plant Using Watershed Workflow and the Advanced Terrestrial Simulator
Aris Duani Rojas	24614	Deep Learning-Based Water Seepage Monitoring in F-Area 3 Basin Cap
Brendon Cintas	24694	Development of a Long-term Surveillance Unmanned Ground Vehicle (LTS-UGV) for Surveillance at the Hanford 200 Area

DOE Fellow	Abstract ID	Title
Bryan Torres	24695	Testing of Radiation Resistant High Density Polyurethane Foam
Bryant Pineda	24741	Evaluating the Erosion and Corrosion Behavior in Nuclear Waste Transfer Systems
David Rojas	24722	Lateral Gamma Scanner Deployment for Hanford's Single-Shell Tanks
Fabiola Rivera	24639	Monitoring Hexavalent Chromium and Remediation Technology with Deep Learning
Gabriel Cerioni	24691	3D printed Concrete Waste Container design
Hannah Aziz	24684	Evaluating the spatial distribution of contaminants over time in the Savannah River Site F-Area and their potential fate and transport
Joel Adams	24709	Continuous Surveillance of Nuclear Facilities Using Multiple Robot Platforms
Nicholas Espinal	24677	Design Improvements and Electronic Packaging for Current H-Canyon Wall Crawling Platform
Philip Moore	24704	Development of a Pneumatic Joint-Member for Use in an Off-Riser Sampling System for Hanford's Waste Tanks
Rafael Velasquez	24729	Camera Module Electronics Streamline for FIU's Lateral Gamma Scanner
Theophile Pierre	24679	Advancing Radioactive Waste Management: Developing an Innovative Sampling Mechanism for Enhanced Hanford Site Remediation

DOE Fellows Participation in Professional Tracks

DOE Fellow	Abstract ID/ Presentation Type	Track	Title
Olivia Bustillo*	Panelist	Session 6 Panel: Former Roy G. Post Scholarship Winners Now Leading Our Industry	N/A
Brendon Cintas	Oral	Session 39 Integrity and Inspections for HLW Retrieval (2.04a).	"Development of Long-term Surveillance Unmanned Ground Vehicles for Nuclear Facility Inspections"
Brendon Cintas	Panelist	62 Panel: Graduating Students and New Engineers - Wants and Needs - Are Companies Even Listening?	N/A
Olivia Bustillo*	Panelist	85 Panel: Young Professionals in Nuclear Science and Engineering an International Perspective	N/A
DOE Fellows and FIU Students	Roundtable Discussion	Round Table discussion with DOE- EM Leadership	N/A

* *Former DOE-LM Fellow*

APPENDIX E: STUDENT RESEARCH PROJECT

TECHNICAL REPORT

In-Situ 3D Printing of Concrete Structures for Waste Containment

FIU Collaborators:
Gabriel Cerioni (DOE Fellow)
Anthony Abrahao (Research Scientist)
Leonel Lagos, Ph.D., PMP® (Principal Investigator)

SRNL Collaborators:
Christine Langton, Ph.D. (Laboratory Fellow)

Submitted to:
U.S. Department of Energy
Office of Environmental Management
Under Cooperative Agreement No. DE-EM0005213

FIU | Applied Research Center
FLORIDA INTERNATIONAL UNIVERSITY

DISCLAIMER

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EXECUTIVE SUMMARY

This report summarizes the continued advancement of 3D concrete printing technologies for radiation containment applications at Florida International University's Applied Research Center (FIU). The objective of this effort was to develop and evaluate additive manufacturing approaches for producing scaled concrete waste containment structures, building on prior work conducted at SRNL to formulate printable UHPC mixtures. During this period, the printing platform underwent a major upgrade through the integration of a UR16e six-axis robotic arm, replacing the earlier gantry-style system and enabling more flexible toolpath execution. In parallel, the extrusion system evolved from an auger-based mechanism to a piston cylinder assembly following extensive simulant testing, resulting in a more reliable and consistent extrusion process suitable for scaled UHPC applications.

To support the upgraded hardware, FIU developed an in-house software suite that converts 3D models into robotic motion commands, including a custom G-code interpreter, graphical interface, and simulation environment for motion planning and collision avoidance. Preliminary evaluation of millimeter wave radar sensors was also conducted to assess their suitability for surface quality monitoring, though resolution limitations restricted their use for defect detection. With the completion of this work, the project concludes with a fully integrated robotic printing platform, a robust piston-style extrusion system, and a functional software stack, establishing a solid technical foundation for future research into automated concrete construction for radiation containment and related applications.

OBJECTIVES

The focus of this task is to develop novel radiation containment solutions implementing 3D printing technologies with unique materials such as concrete. Preliminary work has been completed at the SRNL research facilities to produce adequate concrete for 3D Printing.

FIU will design and assemble a simple small-scale gantry-style printer. This Printer will allow for the testing of scale model solutions for various adaptations to the printer. The first modification will be the development and testing of a nozzle that smooths and combines the layers of 3D prints. The uniform structure produces printed walls that can better resist shear forces. To maintain alignment with state-of-the-art technology, the 6-axis robotic arm will be retained and outfitted with a concrete nozzle to advance the development of scaled radiation containers.

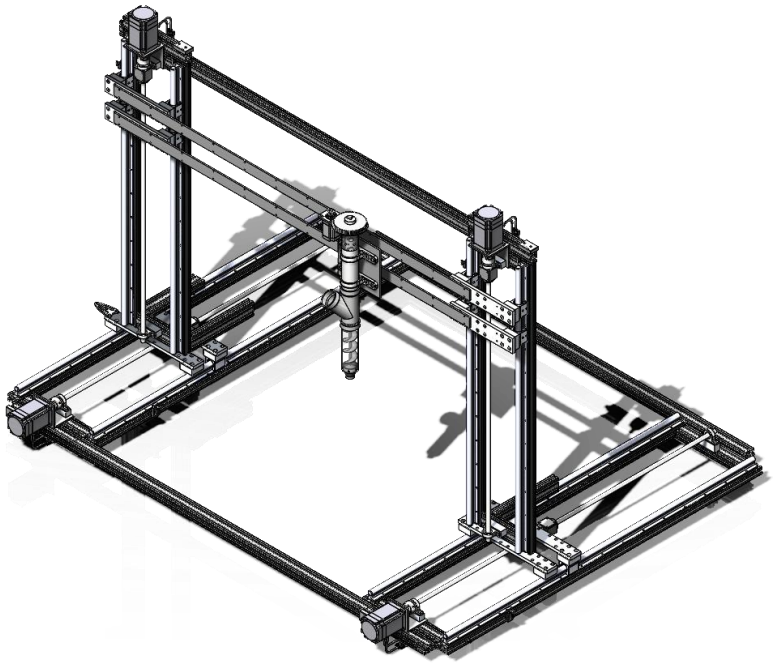

Figure 1. Completed CAD model of the gantry-styled printer.

INTRODUCTION

According to the United States Nuclear Regulatory Commission (U.S.NRC), Low Level Waste (LLW) includes items that have become contaminated with radioactive material or have become radioactive through exposure to neutron radiation. This waste typically consists of contaminated protective shoe covers and clothing, wiping rags, mops, filters, reactor water treatment residues, equipment and tools, luminous dials, medical tubes, swabs, injection needles, syringes, and laboratory animal carcasses and tissues. Traditionally, LLW waste is stored in steel containers and sent to Low-Level Waste Disposal Facilities. These Facilities can be commercially operated and are designed, constructed, and operated to meet safety standards. These standards involve analyzing site performance for thousands of years into the future. The steel containers currently being utilized for waste disposal will be subjected to harsh below ground environments of these facilities. This harsh below-ground environment leads to degradation and the release of contamination. These steel containers contain low level waste (LLW) and are placed in below-ground environments where they are exposed to water infiltration, causing the container to rust and degrade over time, leaching radioactive contaminants into the surrounding environment. The first line of defense for these facilities is the original container that the LLW is currently in. An alternative that is being researched and implemented in the construction sector is 3D Concrete Printing (3DCP), due to its potential to produce complex geometries at no additional costs, reduce construction waste, and improve worker safety. Ultra-High-Performance Concrete (UHPC) has been shown to be compatible with the 3DCP manufacturing method. UHPC has been increasingly adopted by the Construction sector due to its excellent hydraulic properties, low porosity, low permeability, and increased strength when compared to traditional concrete. UHPC offers excellent hydraulic properties, with low porosity and conductivity, resulting in minimal ion diffusion. These properties make UHPC desirable for containing radioactive waste and debris. Research into replacing steel with UHPC has already begun. Combining the geometric flexibility of 3DCP and durability of UHPC, allows for the engineering of custom enclosures utilized for irregular waste streams. This can address the challenge of containing low-volume LLW, such as legacy machinery and decommissioning debris that do not fit standard containers, while offering a cost-effective and flexible solution. Moreover, 3D printers can be deployed in remote locations or spaces with limited room for traditional containers. This project aims to explore 3DCP methods to assist SRNL, and other National labs, in evaluating the viability of using UHPC, in conjunction with 3DCP, as alternatives for LLW containers.

The collaboration between Florida International University (FIU) and Savannah River National Lab (SRNL) utilizes Additive Manufacturing (AM) to evaluate 3DCP waste containers. Initial work in 2024 involved designing and producing an aluminum-frame gantry system. While this setup successfully demonstrated basic extrusion, testing revealed that the frame lacked sufficient mechanical rigidity for consistent high-fidelity printing. Consequently, the research platform was upgraded in 2025 to a UR16e Robotic Arm. This transition addressed the rigidity limitations of the

previous system while simultaneously expanding operational capabilities. The 6-axis robotic arm offers kinematic precision and enables the generation of complex, non-planar tool paths for in-situ waste containment applications.

HARDWARE DEVELOPMENT

The hardware development phase of 2025 centered on two primary objectives: commissioning the UR16e Robotic Arm and iteratively engineering a robust concrete extrusion system. The aim was to transition from a static frame structure to a dynamic 6-axis platform capable of deploying material in complex geometries.

Robotic Arm Integration

During this period of performance, the UR16e robotic arm was physically commissioned along with its associated electrical infrastructure. The control unit from the 2024 gantry system was retrofitted to manage power distribution and communications for the robot, extruder, and future sensor arrays. Figure 2 shows the previously used components reconnected to the new system while Figure 3(a) shows all the components within the central control box connected to the UR16e system. To optimize operator ergonomics and safety, the computing workstation and control interface were mounted externally to the structural frame, ensuring unobstructed lines of sight and immediate access to emergency stops. In addition, the control box includes a manual switch that allows the operator to enable or disable the extrusion system independently of system power, as shown in Figure 3(b). This feature enables dry runs without code modification cuts power to the extruder motor in the event of failure or emergency.

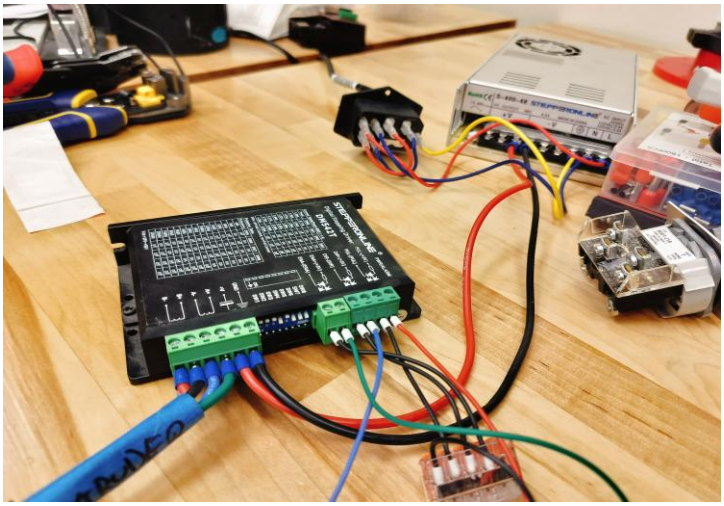

Figure 2. Power supply, motor controller, and electronics rewired for new system.

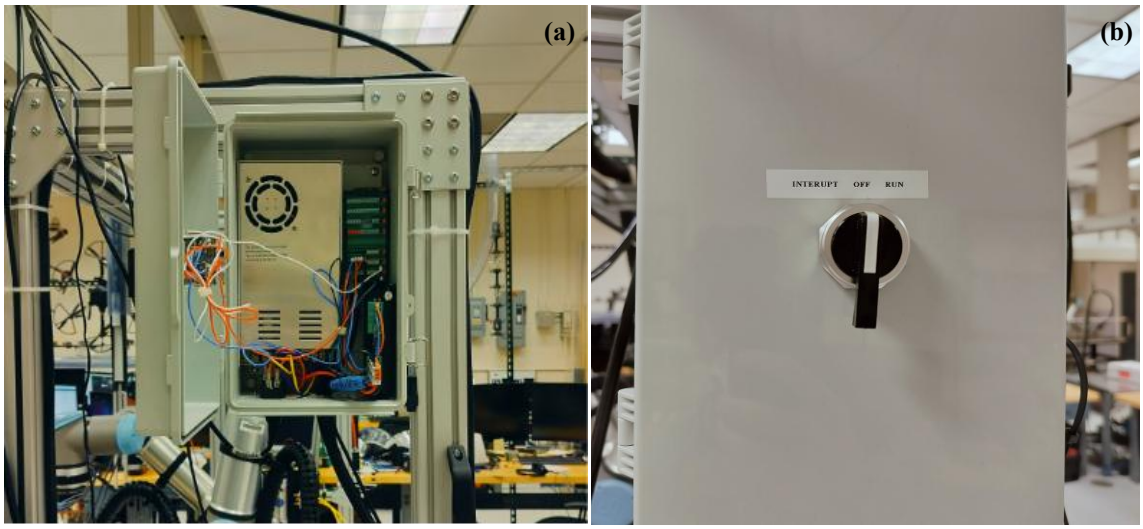

Figure 3. Control box for UR16e platform. (a) Components within central control box. (b) Manual control switch.

Development and Testing

Efforts early in the year were focused on the extruder mechanism, or "end effector", attached to the robotic arm. Internal schematics and a quick release mounting system were developed, allowing the extruder to be rapidly detached from the robotic arm for maintenance without tools, shown in **Figure 4**. Figure 5 show the quick release attached to the nozzle coupler during testing, while Figure 6 shows the full system mounted to the Ur16e via quick release. The alignment pins on the additively manufactured coupler sheared off and were replaced with a metal version, shown in black in Figure 6.

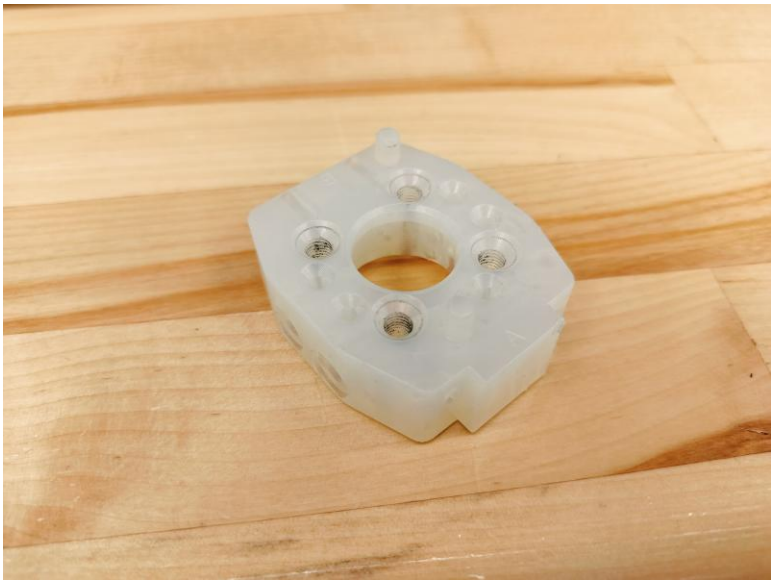

Figure 4. 3D-printed test model of the quick release system.

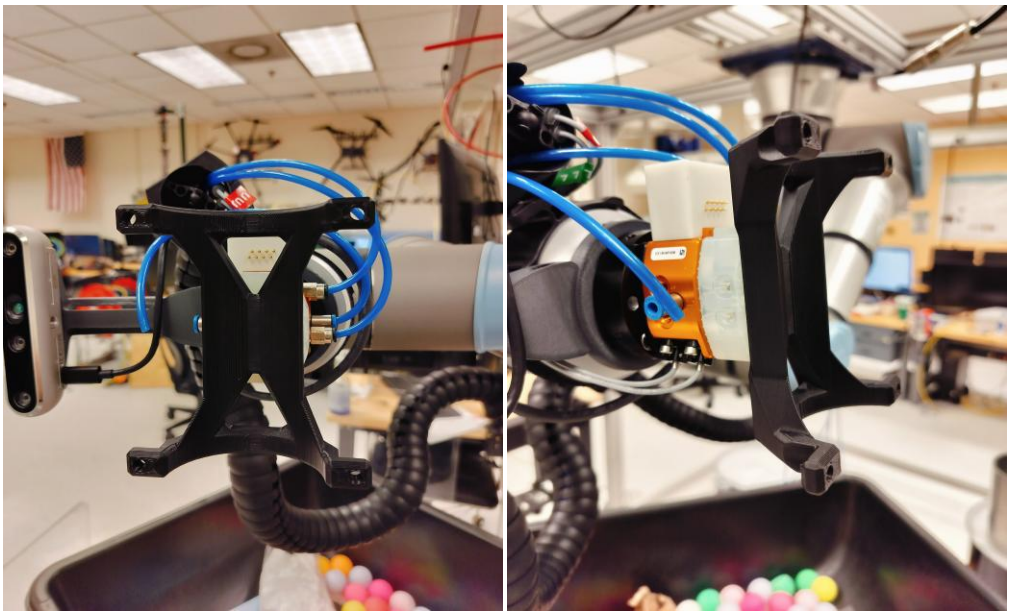

Figure 5. Extruder coupler/quick release attachment mounted to the UR16e.

Figure 6. Full extruder assembly mounted to UR16e via quick release system with metal coupler.

After establishing hardware connections and redesigning the software to communicate through the new controller, the extruder underwent a successful dry run. Shortly after, wet run was conducted using a concrete simulant. The simulant was selected for its green body stiffness and its non-curing/drying properties' allowing extended testing and debugging. Green body stiffness refers to the load a material can withstand before curing or drying without deformation. The simulants' green body strength closely matched that of UHPC, making it suitable for evaluation.

Initial failures included insufficient torque to extrude the simulant at full capacity. To address this, a 16:1 reduction gear box assembly was designed, manufactured, and incorporated into the extrusion system. Subsequent wet runs revealed that extrusion forces pushed the auger upward, separating the driving gears. A thrust bearing and hold-down were designed and incorporated to prevent the auger from pushing up and separating the gears from the drive. Figure 7 shows the modified motor mount with the thrust bearing assembly. Figure 8 shows some separation of the lower thrust bearing due to higher extrusion forces; although not a critical failure, this was remedied by replacing the 3D- printed hold-down with a metal version to prevent any future issues.

Figure 7. Reduction gear box on auger-styled extruder with thrust bearing.

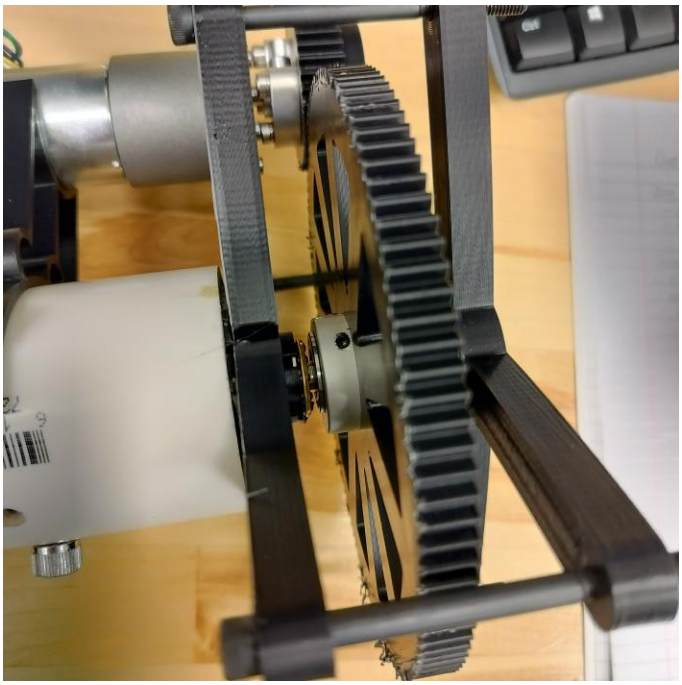

Figure 8. 3D-printed auger hold-down causing separation of thrust bearing.

With the upgraded hold-down installed, the extruder could extrude simulant at full capacity. However, the auger shaft attached to the coupler experienced failure under higher loads. Although the coupler could withstand the forces, the shaft material was too soft and susceptible to deformation under the set-screw style coupler, eventually causing slippage. A friction-style coupler was acquired to resolve this issue, along with gearbox modifications to accept the new coupler.

With higher torque capability, another wet run was attempted. The simulant's viscus properties differed significantly from UHPC, despite similar buildability, making loading into the auger system difficult and causing intermittent extrusion. This prompted a redesign to a piston-cylinder style extruder. This concept incorporated lessons learned from the auger system but replaced the auger with a lead screw and piston. The gearbox assembly remained largely unchanged except for a captive nut that was embedded into the final drive gear. Rotation of the gear advanced the lead screw, driving the piston to extrude material. A higher torque, lighter motor was installed to reduce inertia and improve accuracy The full culmination of these changes allowed for successful and consistent extrusions. Figure 9 shows the completed piston cylinder extruder mounted to the UR16e for dry run testing.

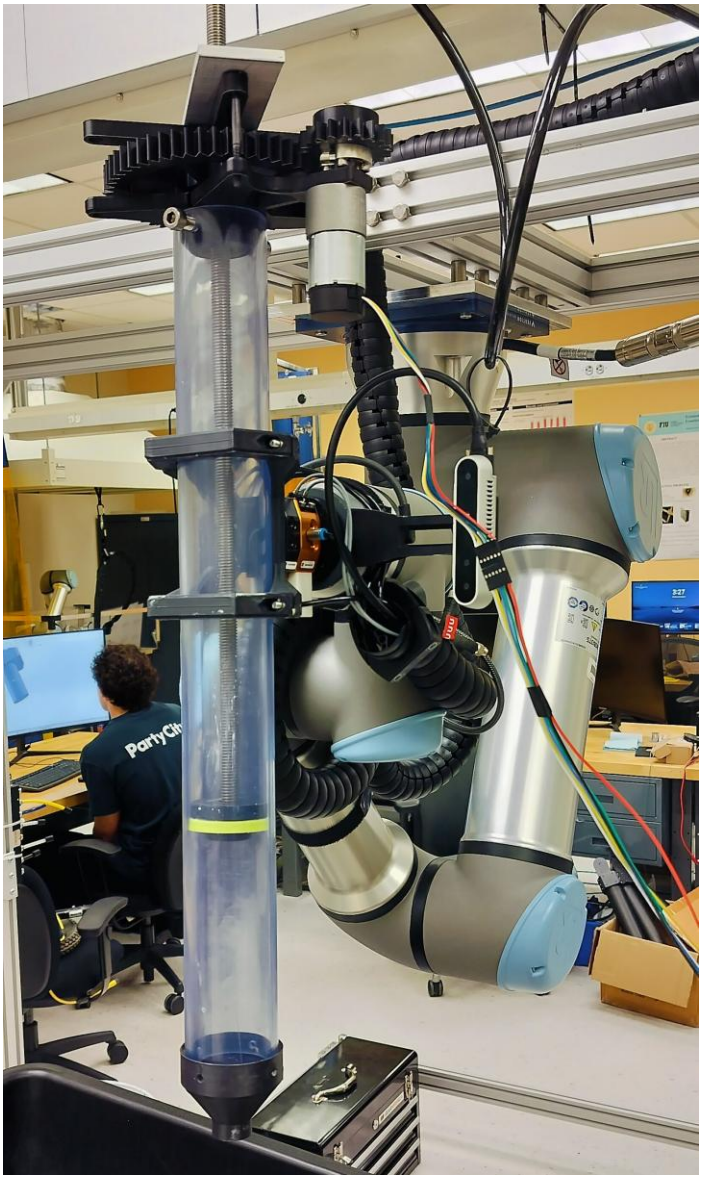

Figure 9. Fully assembled piston-style extruder mounted to UR16e robotic arm.

In parallel with the improvements to the extrusion system, bench tests of mmWave Radar sensor systems were performed.

Figure **10** shows the sensor wired to an I2C board for computer interfacing via USB. Millimeter-wave radar systems have shown promise in literature for surface structure analysis. The objective of these tests was to evaluate the potential of these sensors for quality control, specifically detecting geometric inconsistencies and surface deformations in 3DCP structures. Initial lab tests indicated limited resolution at laboratory scales, suggesting the need for alternative evaluation sensing methods. Figure 11 shows preliminary data points captured in 3D space, bounding boxes generated by the manufacture's grouping algorithm. Results demonstrated that the resolution would be

insufficient for defect detection, though potential applications may exist for object avoidance in closed loop systems.

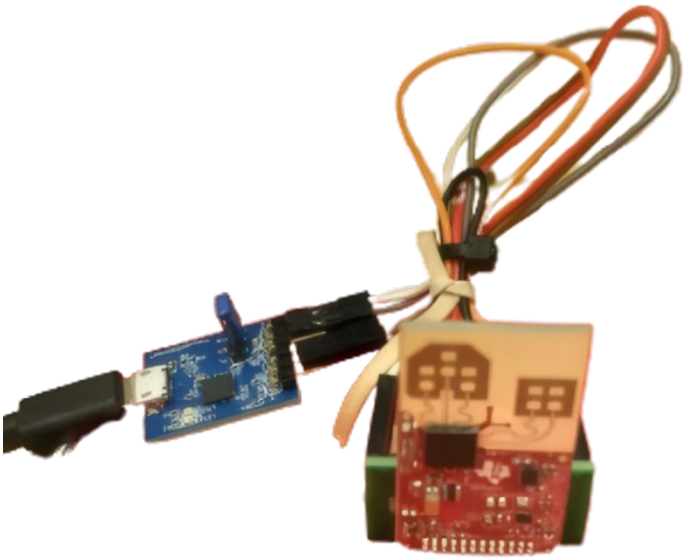

Figure 10. Preliminary bench test setup for mm wave radar sensor.

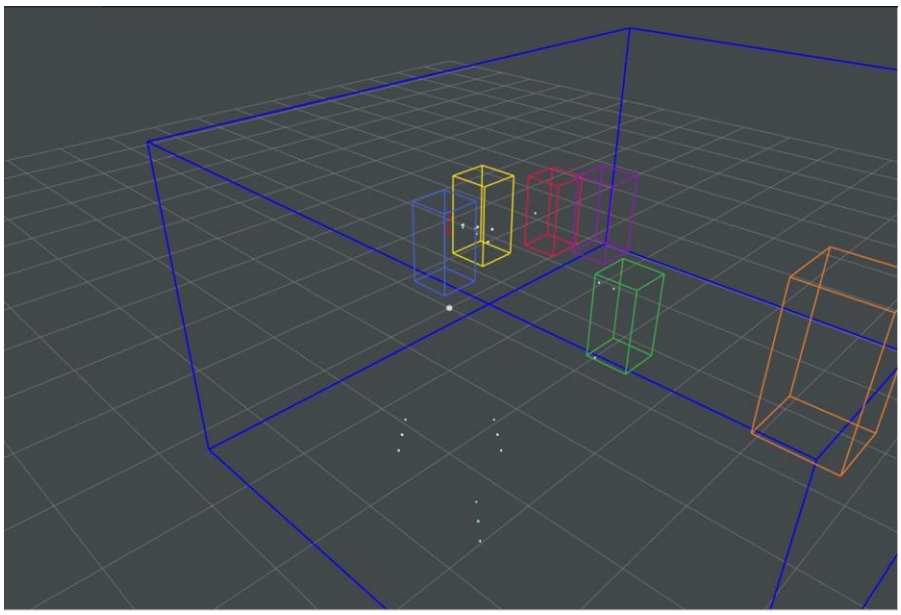

Figure 11. Preliminary Data Collected Showing Points at Various Distances from the Sensor.

SOFTWARE DEVELOPMENT

6-axis robotic systems are commonly used in industrial processes with an automated approach. This requires all tools, materials, and objects to be placed precisely so the robotic arm can perform a repeatable task with precision. Additive manufacturing is more dynamic and involves unique motion paths for different objects that can be modified during the process for optimization, which requires differing control strategies from the current automated assembly process. With the adoption of additive manufacturing, 6-axis robotic arms have been integrated with the 3D-printing manufacturing method. Commercial control software is available for controlling the robotic system to produce 3D-printed components. Existing commercial software is largely closed-source and requires vendor intervention for system-specific configuration, creating bottlenecks for research and development. Furthermore, the associated licensing fees exceeded the project's budgetary constraints. To overcome these operational and financial barriers, it was elected to develop a custom in-house control suite for the UR16e. This involved the creation of core software functionality, user interfaces, and integration with microcontrollers and the UR16e system. The software developed can translate 3D digital models into physical movement for the 6-axis arm. From the experience gained during development, the software evolved from script-based, manually coded motion commands to a graphical interface utilizing industry-standard machine code.

Motion Path Generation

Initially, Python scripts were used to send direct, linear motion commands to the robotic arm. This allowed for rough positioning and creation of simple objects with only a few layers and geometric features, such as a cube. To interpret 3D objects, the initial software parsed Standard Triangle Language (STL) files to extract vertices. STL converts the geometric surfaces into discrete triangles; three points in 3D space together make one triangle. This provides the ability to interpret model geometry into motion paths. Parsing the list of points and sending them as waypoints to the motion system allows for movement and simple object generation. However, due to the nature of STL, any curved surfaces would be reduced to a list of flat triangles. STL files also lack any object information, such as which side is the internal volume and which is the external. Additionally, utilizing STL vertices for motion planning proved problematic due to the shared topology of tessellated meshes. Because adjacent triangles share vertices, treating these points as sequential waypoints resulted in redundant toolpath traversals and material deposition discontinuities.

Another early issue experienced was the robot's lack of consistent starting locations. Algorithms were written to determine starting vertices based on the lowest and closest points to the origin, which maintained a consistent initial point and path for similar objects. While functional for simple shapes with a low number of triangles and vertices, the user still must decode the parsed waypoints mentally to estimate the motion path. Additionally, this method lacked the ability to control complex printing factors like speed or material flow, which would allow for live control by the operator.

To assist the user, a visualization method was developed, using the Matplot python library. This was chosen due to its simplicity of implementation, which allowed the user to visualize the waypoints converted by the software. Figure 12 shows the results of inputting a cube STL into the software. T-the vertices of the cube have been marked by red points; these are the same points that will be passed to the UR16e to be used as waypoints.

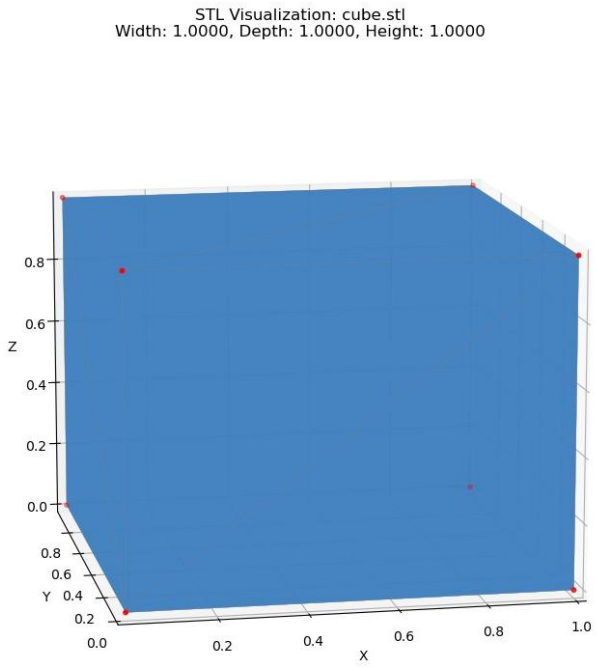

Figure 12. Initial STL viewer developed to assist the operator in determining motion paths.

Generating complex toolpaths solely from STL files was sufficient for objects with a low number of vertices. Any additional complexities, such as arches or objects with holes, would increase the error to unacceptable levels. The limitation of STL files to simple vertex data hinders reproducibility, requiring additional mathematical functions to calculate missing toolpath parameters. To address these obstacles, the project leveraged available open-source software known as "slicers," which natively implement the required processing functions. Consequently, the system was rebuilt to utilize G-code, the standard programming language for computer numerical control (CNC) and 3D printing machinery. G-code is the standard output file type of slicers, with the added benefit that it also contains necessary context, such as tool paths, travel speeds, and extrusion commands. The extruder parameters were incorporated into the slicer to generate G-code that accounts for the extruded material width and height.

To interface this new architecture, the team developed a custom Graphical User Interface (GUI). As shown in Figure 13, this application parses the G-code file for relevant information, such as motion and extrusion commands, and generates a visual map of the waypoint path that will be sent to the UR16e for user review prior to physical motion. On the left side of the software window in Figure 13, the program shows the raw G-code file that can be used for reference or modified by

the user from the GUI. The right-side pane of the software shown in Figure 13 is a visual representation of the waypoints that have been parsed by the program from the G-Code. The points are connected to show the path that the UR16e will follow.

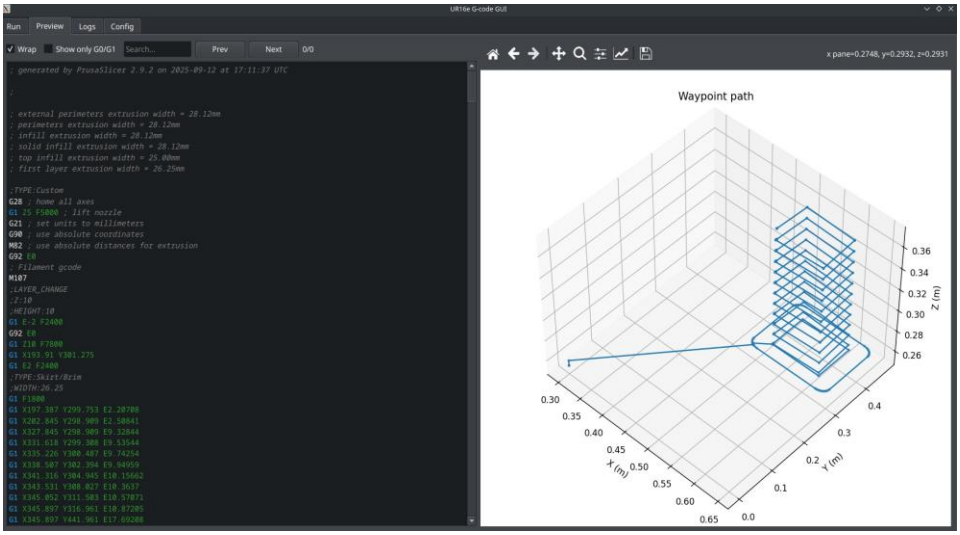

Figure 13. Improved software GUI that allows view of raw G-Code and motion path.

In addition, due to the nature of additive manufacturing, printing process parameters have a significant impact on final object quality. Therefore, the GUI was enhanced to incorporate a dedicated tab that allows for adjustment of system parameters, such as speed and layer clearance, for manual fine tuning. Figure 14 shows the software window that allows the user to interact with the system via manual control overrides.

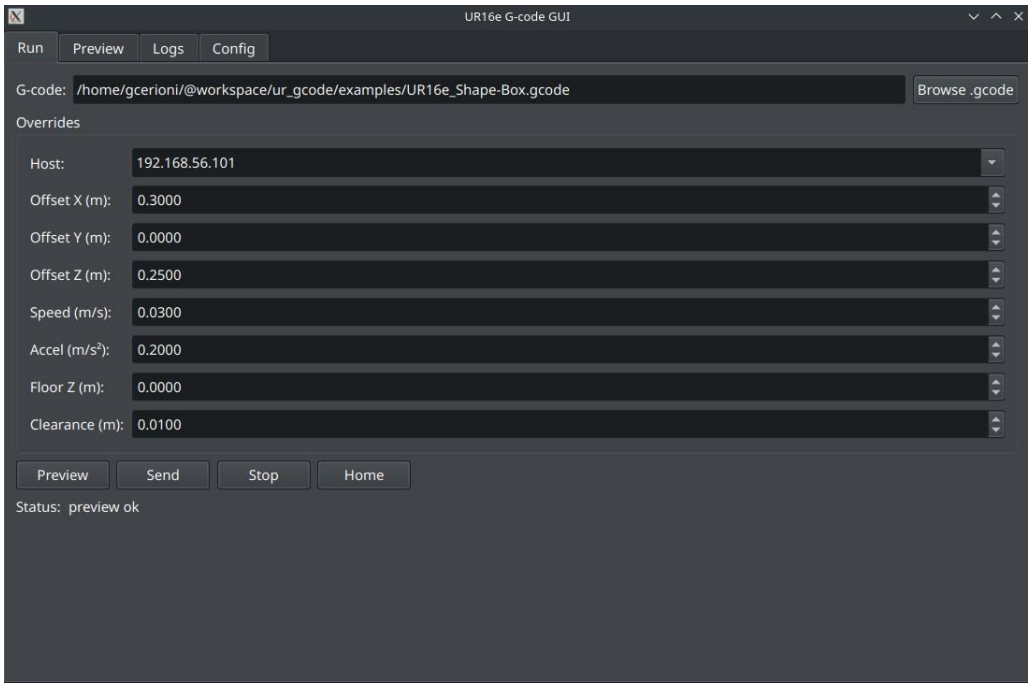

Figure 14. Enhancement to the software that allows manual control by the user.

Simulation and URDF-Based System Modeling

The control software was combined with the simulated UR16e robotic arm to test print paths without damage to the real machine. This was achieved by creating a Unified Robot Description Format (URDF) file. URDF is a standard that is interpretable by many simulation software packages, such as RVIZ and Gazebo. These files standardize the physical property information of robotic models, including any custom extruders and mounting hardware, allowing for more accurate simulation. *Figure 15* is the initial URDF of the UR16e robotic arm. This URDF did not yet incorporate the extruder. The blue line is a trace of the path followed by the tip of the arm, where the end effector would mount, of the cube STL motion path generated by the initial STL parser software.

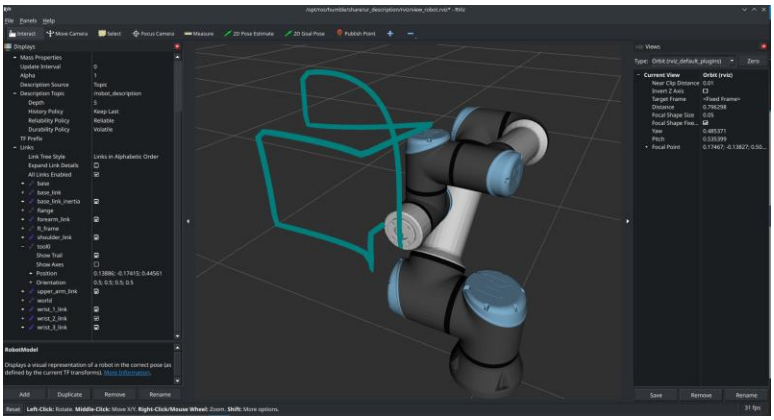

Figure 15. Simulation of the UR16e robotic arm following the motion path generated by the software of a cube STL.

Throughout the year, this digital model was refined to match the physical changes made to the system. The URDF was updated to include the unified model of the extruder, the quick-release mount, and accessories attached to the UR16e as shown in Figure 16. The origin point of the extruder was also corrected to resolve an error that was causing poor path planning, leading to inaccurate waypoints and the real arm entering singularities. Singularities are positions where the robot locks up, such as fully extended, and cannot calculate a trajectory past that.

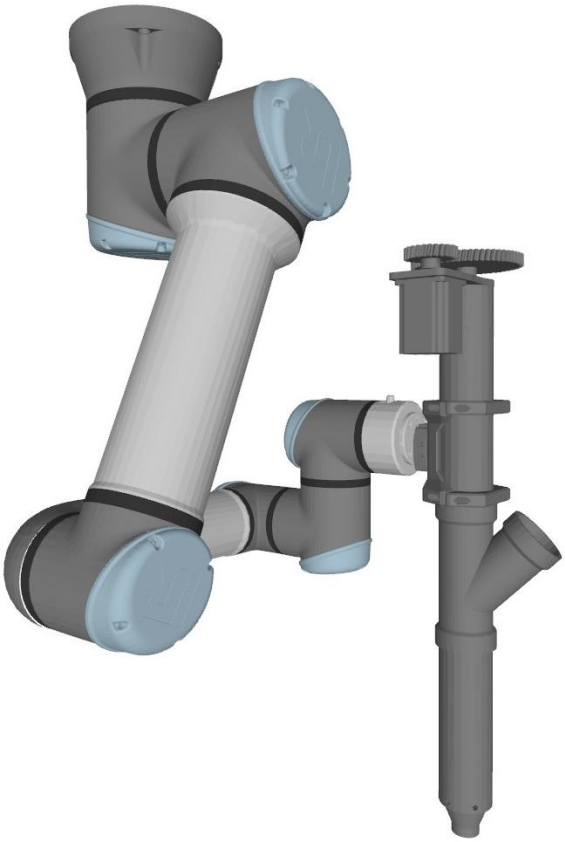

Figure 16. Completed URDF of the UR16e with the auger-style extruder attached.

CONCLUSION

The work completed in 2025 advanced the technology infrastructure at the Applied Research Center (ARC) at Florida International University (FIU), modernizing the 3D Concrete Printing (3DCP) platform and aligning it with contemporary automated construction capabilities for Low Level Waste storage. The transition from a static gantry framework to the UR16e 6-axis Robotic Arm significantly expanded the system's operational flexibility and precision, establishing a more capable foundation for additive manufacturing research.

In Parallel with the platform upgrade, the extrusion system underwent significant refinement based on material simulant testing. Mechanical limitations encountered during auger-based extrusion, including inadequate torque for the non-curing simulant, prompted a redesign. The evolution from an auger-based mechanism to a piston-cylinder assembly, reinforced by metal gearbox housing, resulted in a system capable of consistent extrusion under load. To support this new hardware, the team developed an in-house software capable of converting 3D objects into executable motion commands. This was developed in response to the lack of affordable and flexible commercial solutions. The resulting software suite includes a custom G-code interpreter, GUI, and URDF simulation, which enables precise motion planning and collision avoidance.

Bench tests of mmWave Radar sensors indicated that their resolution was insufficient for surface defect detection in 3DCP structures at laboratory scales. With the completion of this work, the project concludes with a fully integrated Ur16e robotic arm, a robust piston-style extrusion system, and a functional in-house software stack. Together, these develo9pments establish a strong technical foundation that can support future research efforts in automated concrete printing and the exploration of advanced containment solutions for LLW and related applications.

ACKNOWLEDGMENTS

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APPENDIX

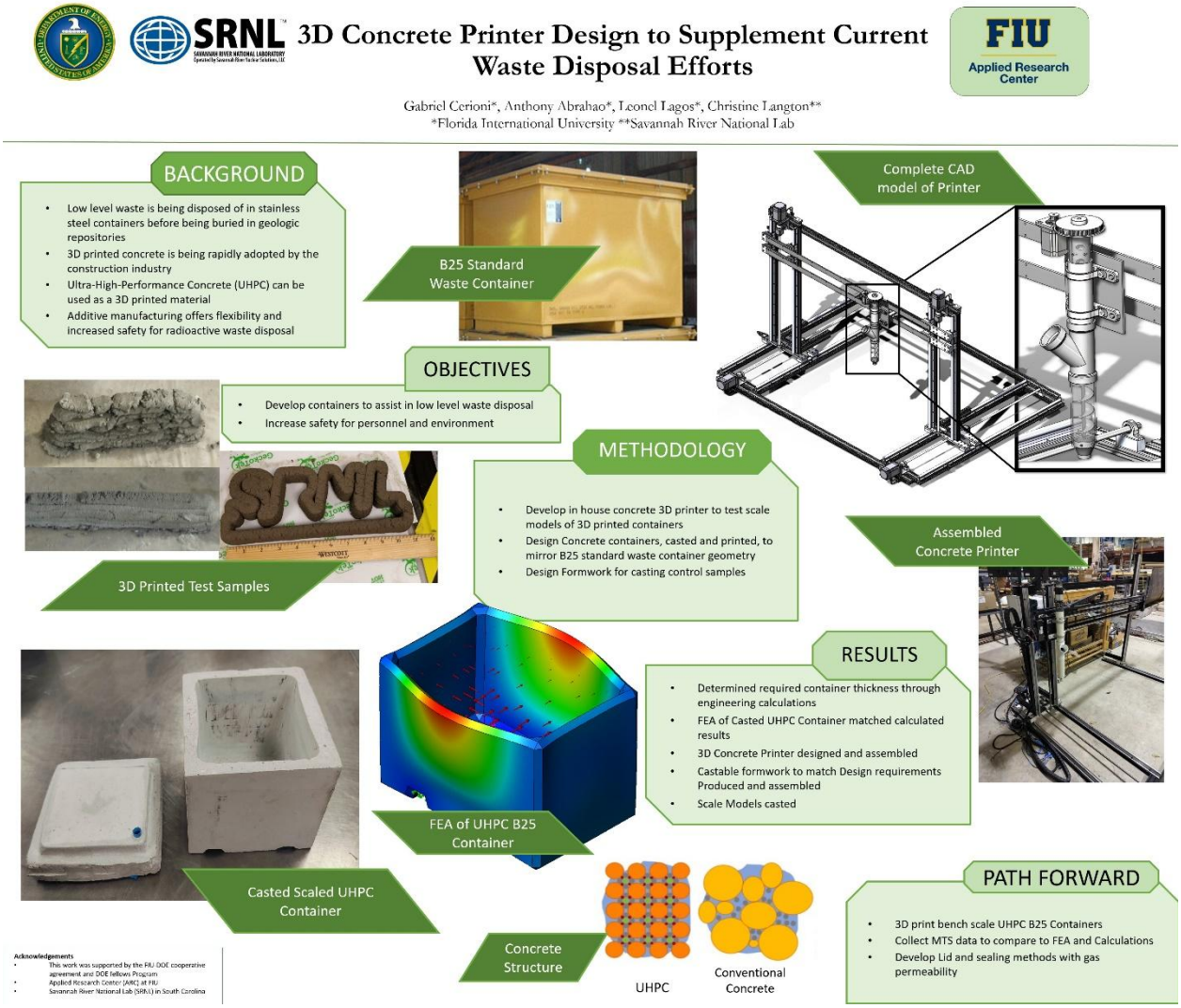

Figure 17. Poster showing progress on the 3D concrete printer at FIU presented at WM2025.

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