



# DOE-EM Cooperative Agreement
# FIU Year 5 Research Review

Presented: April 3, 2015
to the U.S. Department of Energy
by Dr. Leonel Lagos, PhD, PMP®
Dr. Dwayne McDaniel, PhD, PE
Dr. Yelena Katsenovich
Dr. Himanshu Upadhyay

Florida International University

# FIU-DOE Research Review

FIU Applied Research Center

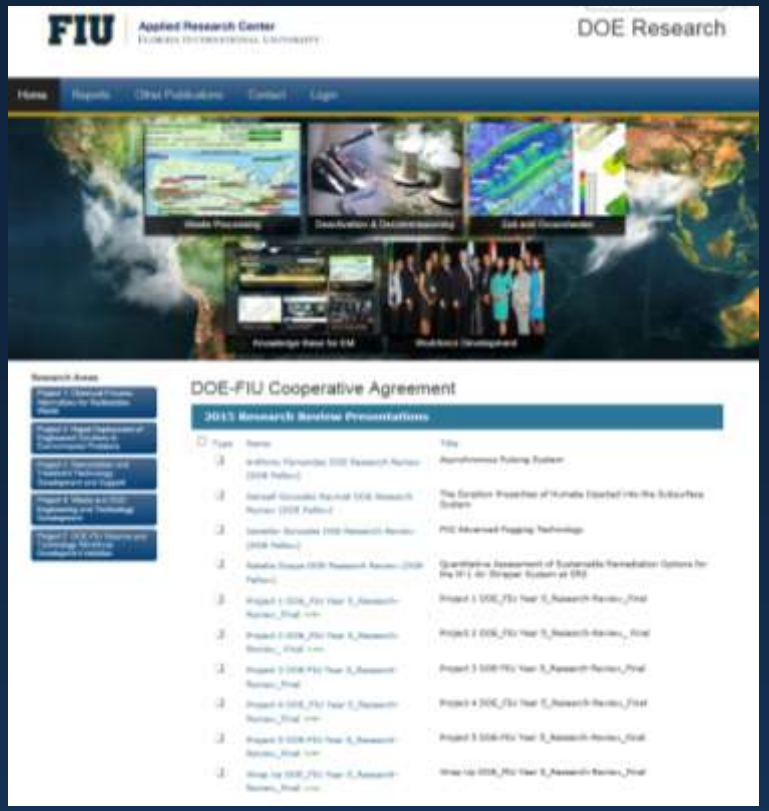
| Tues, March 31 | Wed, April 1 | Thurs, April 2 | Fri, April 3 |
|---|---|---|---|
| **10:00 AM - 12:00 PM**<br>*Presentation- Env. Remediation Technologies (FIU Project 3)*<br>Discussion of research area in support of EM<br><br>**1:00 - 3:00 PM**<br>*Presentation- Env. Remediation Technologies (FIU Project 2)*<br>Discussion of research area in support of EM | **10:00 AM - 12:00PM**<br>*Presentation- Workforce Development and Training (FIU Project 5)*<br>Discussion of research area in support of EM<br><br>**1:00 - 3:00 PM**<br>*Presentation- D&D and Env. Mngt IT Research (FIU Project 4)*<br>Discussion of research area in support of EM | **1:00 - 3:00 PM**<br>*Presentation- High Level Waste/Waste Processing Research (FIU Project 1)*<br>Discussion of research area in support of EM | **10:00 AM - 12:00 PM**<br>*Wrap-up - Discussion of DOE-FIU Cooperative Agreement* |

# DOE Research Webpage

FIU Applied Research Center

## DOE-FIU Cooperative Agreement - Research Website

FIU Year 5 Research Review Presentations are available here.




http://doeresearch.fiu.edu


FIU
Applied Research Center

# Florida International University

FIU, is a vibrant, 54,000 student-centered public research university located in Miami, Florida. FIU is worlds ahead in its commitment to learning, research, entrepreneurship, innovation, and creativity so that graduates are prepared to succeed in a global market.

*FIU is among the largest Hispanic-serving institutions in the U.S. and is designated a Minority-Serving Institution.*

As a top-tier research institution, FIU emphasizes research as a major component in its mission.

*FIU averages over $100 million in research annually.*

# FIU's Applied Research Center Serves as a Portal to FIU

FIU Applied Research Center

- Founded in 1995, ARC has executed over $94 million in research with DOE, DoD, other Federal and State Agencies as well as private industry.
- ARC's Portal Concept provides ease of access to FIU's Colleges and Centers to facilitate collaborative research.
- ARC's mission is to provide world-class R&D and technology solutions to clients.
- ARC's multicultural, multilingual staff are client service-oriented professionals and include Project Management Professionals (PMP®) and Professional Engineers (PE).
- Successful Workforce Development Programs.

FIU
Applied Research Center

# FIU | Applied Research Center
## FLORIDA INTERNATIONAL UNIVERSITY

**The Applied Research Center at Florida International University would like to thank its domestic sponsors!**

# ARC's Technical & Workforce Development Support to DOE-EM

FIU Applied Research Center

- DOE-FIU Cooperative Agreement program established in 1995 as a partnership between Florida International University and DOE's Office of Science & Technology (EM-50)
- Since 1995 the Center has executed over 300 applied research projects for DOE in the areas of:
  - Deactivation & Decommissioning (D&D)
  - Soil & Groundwater Research & Modeling
  - Waste Processing/High Level Waste
  - Information Technology Development for Environmental Management
  - Workforce Development & Training
- The Center includes five research facilities, a radiological lab, a high bay facility, and a Large Scale Technology Test Site
- The Center collaborates with other FIU Centers & Laboratories (Chemistry, SERC, AMERI) to accomplish DOE-EM applied research
- The Center supports 18 full-time researchers (scientists and engineers), 2 FIU faculty collaborators, and about 30 students per year being trained in DOE-EM research (DOE Fellows Workforce Program)

# Applied Research Center Facilities

FIU Applied Research Center

**Technology Testing & Demonstration Facility:** This outdoor facility is available to conduct large scale testing and demonstrations of technologies (pipe unplugging technologies, In-Situ Decommissioning and Hot Cell mockup – fogging, fixatives, strippable coatings demos).

# Applied Research Center Facilities


**Radiological Laboratory:** This laboratory is equipped with state-of-the-art glove boxes, a three-stage HEPA-activated charcoal filtration system, fume hood, and a shielded enclosure for conducting studies on any material emitting alpha, beta, or gamma radiation.

# Applied Research Center Facilities

FIU Applied Research Center

**Analytical Chemical Laboratory:** Analytical chemistry (wet chemistry) laboratory to supports applied environmental research.

# Applied Research Center Facilities

FIU Applied Research Center

**Soil & Groundwater Laboratory:** Research on fate, and transport of contaminants in soil, sediments, water, and biota; water and wastewater treatment; and soil sorption analysis.

# Applied Research Center Facilities

FIU Applied Research Center

**Robotic & Sensors Laboratory:** Development of innovative cleanup, monitoring, maintenance, and surveillance technologies for contaminated facilities

# Applied Research Center Facilities

FIU Applied Research Center

**Multifunction Technology Testing and Deployment Facility:** This 3,125-square-foot high-bay building is the primary laboratory resource for large-scale applied research activities and technology prototyping and testing.

# Applied Research Center Facilities


**Information Technology Facilities:** 1) DOE secured server room; 2) DOE EM Modeling, Simulation and GIS Research Laboratory; and 3) Cybersecurity Research Lab/classroom.

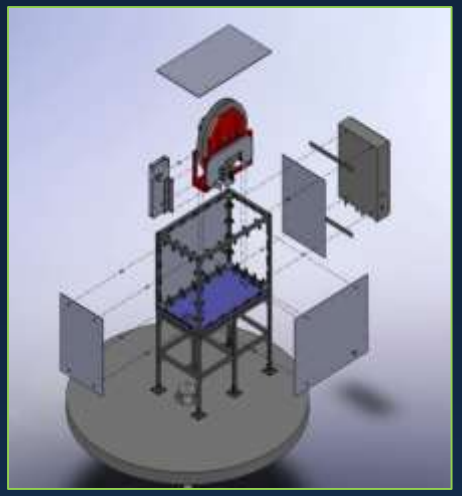
# Applied Research Center Facilities

FIU Applied Research Center

**Machine Shop:** Full-service machining and fabrication services for prototype manufacture, modification, and small-scale production: lathe operations, 3-D computer controlled milling, precision drilling, cutting, welding, fabrication, and assembly.

# Applied Research Center Facilities

FIU Applied Research Center



**Engineering Design Center:** Provides engineering design, analysis and prototyping services: drafting, design review, reverse engineering, manufacturing consulting, dynamic simulation, finite element analysis and 3-D printing

# Technology Development & Evaluations

FIU Applied Research Center










# FIU-DOE Cooperative Agreement

FIU Applied Research Center

Project 1: Chemical Process Alternatives for Radioactive Waste (Dr. Dwayne McDaniel)

Project 2: Rapid Deployment of Engineered Solutions to Environmental Problems (Dr. Yelena Katsenovich)

Project 3: Environmental Remediation Technologies (Dr. Leonel Lagos)

Project 4: Waste and D&D Engineering and Technology Development (Dr. Leonel Lagos, Dr. Himanshu Upadhyay)

Project 5: DOE-FIU Science and Technology Workforce Development Initiative (Dr. Leonel Lagos)

# Major Accomplishments – Graduate Degrees Based on DOE EM Applied Research

DOE-EM based applied research on the Cooperative Agreement projects are the basis of master's degree theses and PhD dissertations completed or currently in progress (DOE Fellows & graduate students):

# Major Accomplishments – Graduate Theses / Dissertations

- Paola Sepulveda-Medina, Master's thesis, *Investigating the Role of a Less Uranium Tolerant Strain, Isolated from the Hanford Site Soil, on Uranium Interaction in Polyphosphate Remediation Technology* (Spring 2014)
- Valentina Padilla, Environmental Engineering- Masters (Spring 2014)
- Joel McGill, Environmental Engineering- Masters (Spring 2014)
- Janti Ghazi, Engineering Management - Masters (Spring 2013)
- Jose Matos, Masters Thesis *Development of Improved Bodies for a Peristaltic Crawler for Unplugging of Hanford Waste Transfer Pipelines,* Mechanical Engineering (Summer 2013)
- Eric Inclan, Masters Thesis *The Development of a Hybrid Optimization Algorithm for the Evaluation and Optimization of the Asynchronous Pulsing Unit*, Mechanical Engineering (Summer 2013)
- Jamie Muldrich, Masters Thesis *Development of a Model for Fluid-Structure Interaction using the Meshfree FEM and the Lattice Boltzmann Method,* Mechanical Engineering (Fall 2013)

# Major Accomplishments – Graduate Theses / Dissertations



- Elicek Delgado Cepero, Master's Thesis, *Structural Health Monitoring Inside Concrete and Grout Using the Wireless Identification Sensing Platform (WISP),* Electrical Engineering (Spring 2013)
- Sainath Munavalli, Master's Thesis, *Structural Data Acquisition Using Sensor Network,* Electrical Engineering (Spring 2013)
- Mariela Silva, Master's Thesis, *SharePoint Based Secured Collaboration System,* Engineering Management (Fall 2013)
- Revathy Venkataraman, Master's Thesis, *Performance Evaluation of Mobile Applications with KMIT Technology Web Services using Windows Communication Foundation,* Information Technology (Spring 2014)
- Sandhya Appunni, Master's Thesis, *Design and Implementation of Disaster Event Information System,* Computer Science (Spring 2014)

# Major Accomplishments – Peer Reviewed Journal Publications 2014-2015

FIU Applied Research Center

- Sepulveda-Medina, P., Y. Katsenovich, V. Musaramthota, M. Lee, B. Lee, R. Dua, L. Lagos. 2015. The Effect of Uranium on the Bacterial Viability and Cell Surface Morphology Using Atomic Force Microscopy in the Presence of Bicarbonate Ions. *Research in Microbiology*.

- Sepulveda-Medina, P., Y. Katsenovich, D. Wellman, L. Lagos. 2015. The Effect of Bicarbonate on the Microbial Dissolution of Autunite Mineral in the Presence of Gram-Positive Bacteria. *Environmental Radioactivity*.

- Gokaltun, S., D. McDaniel, A. Awwad and J. Varona. 2014. Pipeline unplugging experiments with the fluidic Wave-Action Technology. *Engineering Science and Technology,* an International Journal, 17 (2014) 73-84.

# Major Accomplishments – Peer Reviewed Journal Publications - 2013

- Gudavalli, R., Y. Katsenovich, D. Wellman, L. Lagos, B. Tansel. 2013. Quantification of kinetic rate law parameters for the dissolution of sodium meta-autunite as a function of aqueous bicarbonate concentration. *Environmental Chemistry,* 10(6),p. 475-485.
- Gudavalli, R., Y. Katsenovich, D. Wellman, M. Idarraga, L. Lagos, B. Tansel. 2013. Comparison of the Kinetic Rate Law Parameters for the Dissolution of Natural and Synthetic Autunite in the Presence of Aqueous Bicarbonate Ions. *Chemical Geology*, p 299-309.
- Malek-Mohammadi, S., G. Tachiev, K. Bostick, A. Daniel. 2013. Migration of VOC Plume in the Subsurface Domain at the Y-12 National Security Site. *Journal of Remediation*.
- Katsenovich, Y., D. Carvajal, R. Guduru, L. Lagos, C. Li. 2013. Assessment of the Resistance to Uranium (VI) Exposure by Arthrobacter sp. Isolated from Hanford Site Soil, *Geomicrobiology Journal*, 30(2), 120-130.

# Major Accomplishments – Peer Reviewed Journal Publications - 2012


- Carvajal, D., Y. Katsenovich, L. Lagos. 2012. The Effects of Aqueous Bicarbonate and Calcium Ions on Uranium Biosorption by Arthrobacter G975 Strain. *Chemical Geology*, 330-331, 51–59.
- Malek-Mohammadi, S., G. Tachiev, E. Cabrejo, A. Lawrence. 2012. Simulation of flow and mercury transport in Upper East Fork Poplar Creek, Oak Ridge, Tennessee. *Remediation Journal*, 22(2), 119–131.
- Li, Y., Y. Yin, G. Liu, G. Tachiev, D. Roelant, G. Jiang, Y. Cai. 2012. Estimation of the Major Source and Sink of Methylmercury in the Florida Everglades. *Environ. Sci. Technol.*, 46(11), 5885–5893.
- Dickson, D., G. Liu, C. Lib, G. Tachiev, Y. Cai. 2012. Dispersion and Stability of Bare Hematite Nanoparticles: Effect of Dispersion Tools, Nanoparticle Concentration, Humic Acid and Ionic Strength. *Science of the Total Environment*. 419(1). 170–177.
- Katsenovich, Y., Carvajal, D., Wellman, D., Lagos, L. 2012. Enhanced U(VI) release from autunite mineral by aerobic Arthrobacter sp. in the presence of aqueous bicarbonate. *Chemical Geology* 308–309, 1–9.
- Öztürk, Z., B. Tansel, Y. Katsenovich, M. Sukop, S. Laha. 2012. Highly organic natural media as permeable reactive barriers: TCE partitioning and anaerobic degradation profile in eucalyptus mulch and compost. *Chemosphere*, 89(6), 665-671.

# Information Sharing

**OSTI** – FIU submits technical reports to OSTI as required by the Cooperative Agreement. Over 220 documents from the current 5-year CA cycle have been submitted or are in queue for submission.

**DOE Research Website (http://doeresearch.fiu.edu)** – FIU has created a website for sharing all DOE EM related research with all stakeholders and the public. This is in addition to submissions to OSTI and includes a wide variety of documents: technical reports, research presentations, conference posters and presentations, etc.

**Direct** – FIU regularly shares research results with DOE EM and the sites/national labs through bi-weekly teleconferences, monthly and quarterly progress reports, and technical reports.

# Information Sharing

**Conferences** – Research results are also shared with the general environmental management community of practice through papers and presentations at national and international conferences (Waste Management Symposium, American Nuclear Society, Decontamination and Remote Systems, etc.) 20 student posters and 9 professional presentations/posters presented at WM15 in March 2015.

**Peer Reviewed Journal Publications** – Research results are published in peer reviewed journal publications. Total of 13 during 2012-2015 period.

**D&D KM-IT** – Information and tools related to D&D are shared through this system, including D&D decision tools, databases, technology demonstrations (including photos and videos), documents/reports, etc. Currently has 898 D&D vendors, 1186 D&D technologies, 725 registered users, and 83 subject matter specialists.

# Information Sharing

**DOE Fellows Website (http://fellows.fiu.edu)** – Information related to DOE Fellows events and news, biographies, and summer internship technical reports are made available on the DOE Fellows website.

**DOE Fellows Lecture Series** – Information sharing in both directions via hosting speakers to present technical topics to the DOE Fellows.

- Mr. Jim Voss, January 27, 2015, “Magnetic Separation of Uranium and Plutonium.”
- Dr. Miles Denham, April 8, 2015, “Helping Nature Heal – Enhanced Attenuation.”

**Masters & PhD Theses/Dissertations** – DOE EM research also published in Master theses and PhDs dissertation manuscripts


# FIU PROJECT 1:
# DR. DWAYNE MCDANIEL

# CHEMICAL PROCESS ALTERNATIVES FOR RADIOACTIVE WASTE

FLORIDA INTERNATIONAL UNIVERSITY

# Project Tasks and Scope

FIU Applied Research Center

**Task 2 Pipeline Unplugging and Plug Prevention**

- develop novel technologies that can be utilized to remove plugs formed in HLW pipelines
- computational simulation and evolution of HLW pipeline plugs

**Task 17 Advanced Topics for Mixing Processes**

- computational fluid dynamics modeling of HLW processes in waste tanks

**Task 18 Technology Development and Instrumentation Evaluation**

- evaluation of FIU's SLIM for rapid measurement of HLW solids on tank bottoms
- development of inspection tools for DST primary tanks

**Task 19 Pipeline Integrity and Analysis**

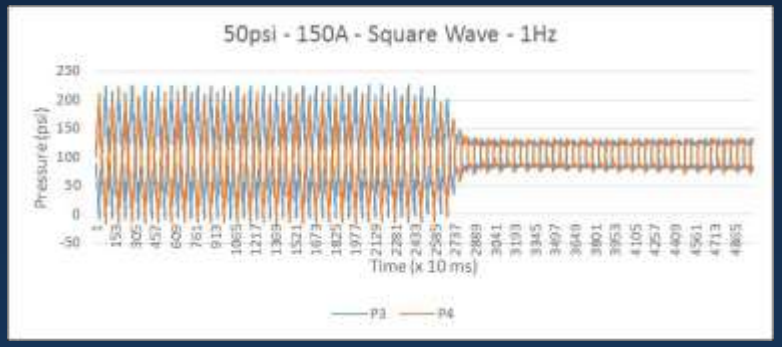
- pipeline corrosion and erosion evaluation
- Nonmetallic materials evaluation

# Major Accomplishments

FIU Applied Research Center

## Task 2 Pipeline Unplugging and Plug Prevention

- Conducted additional parametric tests on an engineering scale test bed with the asynchronous pulsing system (APS) to determine optimal parameters for unplugging.
- Resolved issues with plug strength variability.
  - Developed a more robust procedure for manufacturing plug simulants
- Conducted multiple tests of air entrainment effects on APS using the engineering scale testbed.

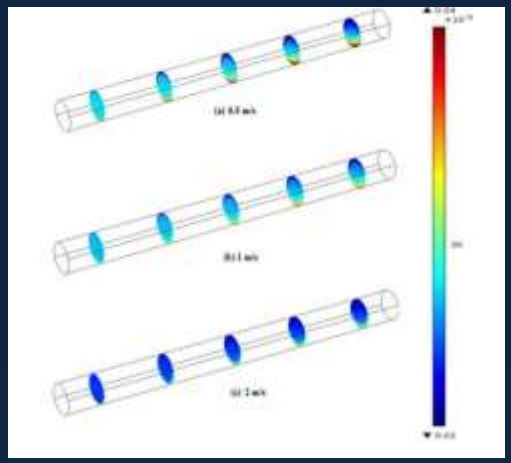


# Major Accomplishments

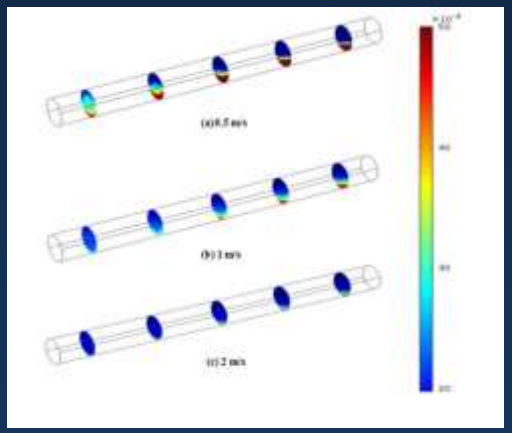
FIU Applied Research Center

## Task 2 Pipeline Unplugging and Plug Prevention

- Evaluated the use of COMSOL's multiphysics software to couple the chemistry module with the flow module.
- Developed a 3D CFD multiphase models (solid/liquid) to establish a baseline for simulating settled solids as a function of solid density, solid volume fraction and particle size. Results from the 3D model were similar to the 2D results, PNNL experiments and empirical correlations.
- Initialed the modeling of PNNL's test loop to evaluate effects of pipeline configuration of plug development.



45 µm



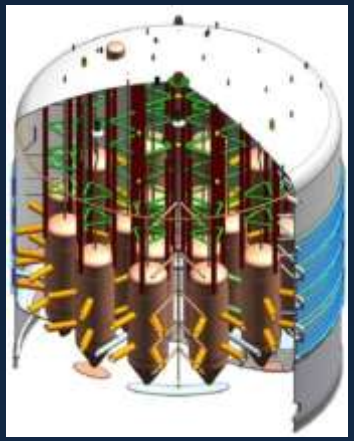
200 µm

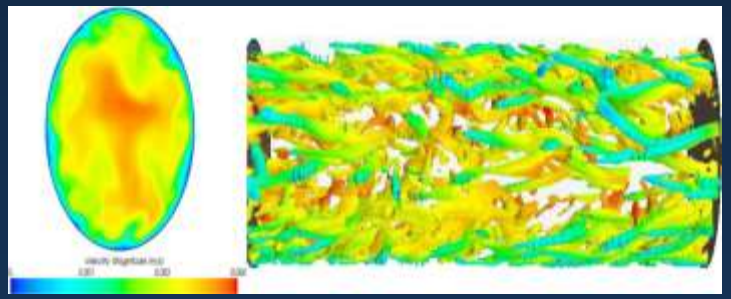
# Major Accomplishments



## Task 17.2 CFD Modeling of HLW Processes in Waste Tanks

- Evaluated Star-CCM+ as a Direct Numerical Simulation (DNS) tool.
- Completed literature review on DNS single-phase and multi-phase turbulent flows.
- Initiated bench marking for single-phase Newtonian DNS simulations.



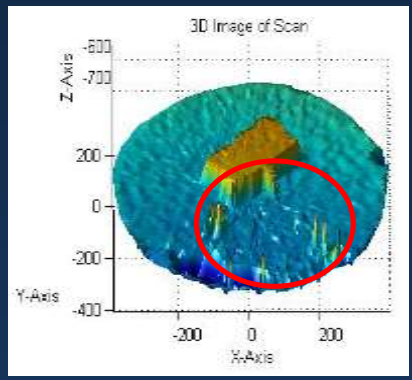


# Major Accomplishments

FIU Applied Research Center

## Task 18.1 Evaluation of FIU's SLIM for Rapid Measurement of HLW Solids on Tank Bottoms

- Developed computer code to post process and image scans from a commercial 3D sonar.
- Developed a lab scale testbed and conducted initial tests in water to validate sonar use with reduced scan time.
- Initiated tests to evaluate the 3D sonar's ability to image in vessels with suspended solids.

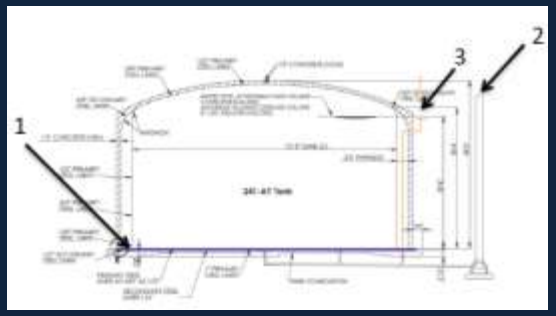


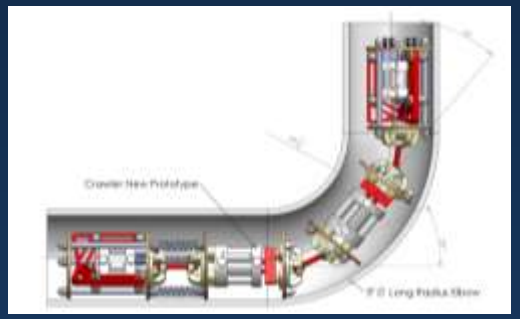
# Major Accomplishments



## Task 18.2 Development of Inspection Tools for DST Primary Tanks

- Improved on first prototype design of inspection tool to travel through the refractory pad vents
  - Addition of 4 wheels, housed camera, reduced height, better controls
- Tested device and can travel 17 ft without stalling
- Developed a conceptual design for inspection crawler to navigate through the 4 inch air supply line – modular system with 3 or 4 inch diameter capability



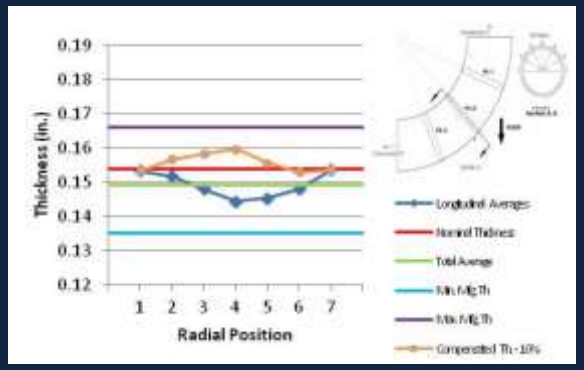



# Major Accomplishments

FIU Applied Research Center

Task 19.1 Pipeline Corrosion and Erosion Evaluation

- Collected and evaluated thickness data for a number of primary and secondary encasements including SN-285, SN-286, SN-278, SL-509, SL-510, SL-609, SL-610 and PW-4531.
- Analyzed 5 jumpers form the 242-A Evaporator and 2 jumpers from the 214-AW-02E Evaporator Feed Pump Pit.
- Analyzed 4 nozzles from the POR104 Valve Box
- Data from the systems evaluated have shown little to no erosion/corrosion based on minimum and maximum manufacturing tolerances.
- Initiated investigation of alternative installation methods for real time thickness transducers.




| Jumper | Section | Erosion Rate (in/Mgal) |
|---|---|---|
| | Elbow-3 | -1.150E-4 |
| 19-5 | Straight-3 | -1.675E-4 |
| | Straight-4 | -9.619E-5 |
| C-4 & 5 | Straight-5 | -9.009E-5 |
| J-13A | Elbow-8 | -2.404E-4 |

# Major Accomplishments



Task 19.2 Evaluation of Nonmetallic Components in the Waste Transfer System

- Developed a test plan to evaluate the effects of stressors for nonmetallic materials in the HLW transfer system. (Temperature, and caustic exposure).
  - EPDM material will be tested initially (HIHTL, gaskets and O-rings)
  - Three separate temperatures with three exposure lengths using 25% sodium hydroxide.
  - Configuration specific aging and material coupon aging.

- Initiated the design of a test loop that will allow for the multiple stressors and extended aging. Aged materials strengths will be compared with baseline materials.

# Conferences/Publications

FIU Applied Research Center

## Waste Management 2015

Professional Papers/Posters

- *Analysis of Erosion/Corrosion Data for High-Level Waste Pipelines at Hanford, Dwayne McDaniel, Jennifer Arniella, Brian Castillo, Dennis Washenfelder (WRPS) and Jason Engeman (WRPS)*
- *Computational Modeling of Plug Formation in Pipelines, Romani Patel, Deanna Moya, Dwayne McDaniel, Seckin Gokaltun*
- *Testing of a 3-D Sonar for Future Deployment to Image Solids on the Floor of Hanford HLW Conditioning Tanks, David Roelant, Dayron Chigin*

Student Posters

- *Enraf(R) Reference Level Updates for High-Level Nuclear Waste Tanks at Hanford Site - Anthony Fernandez (DOE Fellow)*
- *Erosion & Corrosion Analysis from POR104 Valve Box at Hanford - Brian Castillo(DOE Fellow)*
- *Residual Waste Imaging in High Level Waste Mixing Tanks - Dayron Chigin (DOE Fellow)*
- *Non-Invasive Pipeline Unplugging Technology for Hanford High-Level Waste Asynchronous Pulsing System - John Conley (DOE Fellow)*
- *Miniature Motorized Inspection Tool for Department of Energy Hanford Site Tank Bottoms - Ryan Sheffield (DOE Fellow)*

# Conferences/Publications

FIU Applied Research Center

## American Nuclear Society (ANS) 2015

Student Posters

- *Miniature Motorized Inspection Tool for DOE Hanford Site Tank Bottoms, Ryan Sheffield*
- *Direct Numerical Simulation of Turbulent Multiphase Bingham Plastic Undergoing Pulse Jet Mixing, Maximiliano Edriei*

## Journal Publications

S. Gokaltun, D. McDaniel, A. Awwad and J. Varona, "Pipeline unplugging experiments with the fluidic Wave-Action Technology", *Engineering Science and Technology, an International Journal*, 17 (2014) 73-84.

# Project 1 Future Work (FY15)

FIU Applied Research Center

## Task 2 - Pipeline Unplugging and Plug Prevention

- Development of Alternative Unplugging Technologies
  - Support as requested for deployment at Sites.

## Task 17 - Advanced Topics for Mixing Processes

- Collaborate with Joel Peltier of Bechtel and Rod Rimando to support CFD efforts for EM
  - Continue to conduct small scale DNS simulations to better understand the shear rate behavior.
  - Analyze the relaxation time for Bingham fluids which is considered to be instantaneous for ideal conditions but finite in real gelling scenarios.

# Project 1 Future Work (FY15)

FIU Applied Research Center

## Task 18 - Technology Development and Instrumentation Evaluation

- Evaluation of FIU's SLIM for Rapid Measurement of HLW Solids on Tank Bottoms
  - Continue evaluating SLIM with simple simulants up to 20% solids. If successful evaluate SLIM with more complex mixtures, varying in particle density and diameter.
- Development of Inspection Tools for DST Primary Tanks
  - Continue to make design modifications for the refractory pad inspection tool to enable turning in the channels.
  - Incorporate rad hardened components and materials into the system.
  - Develop first prototype and conduct tests for the crawler inspection tool that will be able to navigate through the 4 inch air supply line.

# Project 1 Future Work (FY15)

FIU Applied Research Center

## Task 19 - Pipeline Integrity and Analysis

- Pipeline Corrosion and Erosion Evaluation
  - Design and develop prototypes of a mechanical system that will allow for the use of real time ultrasonic transducers on straight sections and elbows.
- Evaluation of non-Metallic Components in the HLW Transfer System
  - Complete experimental test loop and begin the aging process of hose-in-hose lines, seals and gaskets when exposed to elevated temperature and caustic materials.
  - Conduct initial tests on the effects of the aging on EPDM materials.

## Task 20 - Innovative Nuclear Separations of High Level Radioactive Waste (New)

  - investigate the performance of ion exchange resins for HLW separations, including Crystalline SilicoTitanate (CSTs) and spherical resorcinol-formaldehyde resin (SRF).


# FIU PROJECT 2:
# DR. YELENA KATSENOVICH

# RAPID DEPLOYMENT OF ENGINEERED SOLUTIONS FOR ENVIRONMENTAL PROBLEMS

FLORIDA INTERNATIONAL UNIVERSITY

# Project Description



– Task 1.1 *Sequestering Uranium at the Hanford 200 Area Vadose Zone by In Situ Subsurface pH Manipulation Using NH3 Gas*

- **Carryover scope**: Testing different standards such as calcium chloride and lithium chloride to get better deliquescence predictions on U-free samples at low water activities values.
- Evaluate the stability of the U-bearing precipitates created in the soil as a result of ammonia gas additions. This information would help to more accurately predict the deliquescence behavior of U(VI)- bearing precipitates in the post-treated vadose zone soil.
- Characterize the uranium-bearing solid phases created after ammonia injections
- Evaluate of the roles of major system components in the uranium speciation

# Project Description

FIU Applied Research Center

– Task 1.2 *Investigation on Microbial-Meta-Autunite Interactions - Effect of Bicarbonate Ions*

- Bacteria is an important environmental factor affecting the stability of soil minerals.
- Investigate bacteria-U(VI) interactions under anaerobic conditions and study the potential role of bicarbonate to influence U(VI) biorelease from autunite minerals by *Shewanella oneidensis* MR-1.

# Project Description

– Task 2 *Remediation Research and Technical Support for Savannah River Site*

- Carryover scope: explore the effect of the higher HA concentrations up to 50 ppm and study if there are any synergistic interactions between U(VI) ions, humic acid and silica on the U(VI) removal.
  - HA is a major component of soil organic matter and an important ligand affecting the mobility behavior of radionuclides in the environment.
- Investigate whether a base solution of dissolved sodium silicate can replace the carbonate base to restore the pH of the treatment zone.
- Identify the optimal concentration of sodium silicate required to achieve uranium precipitation.

# Project Description

- Subtask 2.2: *Monitoring of U(VI) bioreduction after ARCADIS demonstration at F-Area*
  - A microcosm study is investigating molasses and sulfate additions for U(VI) remediation via the Enhanced Anaerobic Reductive Precipitation (EARP) process at the SRS F-Area.
    - Determine whether forms of reduced iron such as siderite and pyrite would arise in the reducing zone after molasses and sulfate addition and if any mineralogical changes occurred in sediments.
- Subtask 2.3: *The sorption properties of the humate injected into the subsurface system*
  - Conduct batch sorption experiments to understand the HA sorption versus pH to correlate results with HA injection tests

# Project Description

– Task 3 *Evaluation of ammonia fate and biological contributions during and after ammonia injection for uranium treatment*

- Study the potential biological and physical mechanisms associated with the fate of ammonia after injection into unsaturated subsurface
  - Understand the partitioning of $NH_3$ in bicarbonate-bearing solutions at different pH, and temperature
  - Predict potential results during and after $NH_3$ gas injection into Hanford's vadose zone

# Major Accomplishments



Task 1.1

- Finalized carryover experiments on solid-liquid transitions of the synthetic multicomponent precipitate samples prepared from synthetic porewater solutions mimicking conditions at the Hanford Site.
- Summarized observations on all experimental water activities as a function of molality for each multicomponent sample.

# Major Accomplishments



- Data suggested that the deliquescence behavior of the multicomponent precipitates is governed by the solubility of polymerized silica created in alkaline conditions after ammonia injection.
- Fabricated a new isopiestic chamber with lower head space.
- Set up environmental chamber in the radiation lab to conduct experiments with uranium-bearing solids.

# Major Accomplishments

- Conducted TEM analysis to get diffraction information for selected points rather than bulk sample (as XRD).
  - Preliminary findings show a clearly polycrystalline pattern
  - Average d-spacings are being compared to those of proposed minerals a diffraction database
- Employed geochemical modeling software to support experimental investigations into the role of various pore water components.

# Major Accomplishments



Task 1.2

- Obtained preliminary data on the effect of facultative *Shewanella* MR1on U(VI) release from autunite mineral
  - bicarbonate concentrations 0, 3, 5, and 10mM.
- Data showed that higher bicarbonate concentrations might interfere with uranium (VI) reduction by anaerobic bacteria.

# Major Accomplishments

FIU Applied Research Center

Task 2.1 Carryover scope: Obtained results for the 50ppm of HA concentration on the U(VI) removal

- SI-bearing samples showed slightly higher removal compared to Si-free samples
  - At pH 3, maximum U(VI) removal was around 50%
  - Colloidal silica does not seem to have a significant effect on U(VI) removal
- Humic acid is very insoluble at low pH values unlike uranium, which is very soluble at this pH
  - Possible coagulation may caused the highest removal at low pH
- Soil-bearing batches showed about 80% for U(VI) removal

# Major Accomplishments



## Task 2.1

- Conducted a series of experiments to identify the optimal concentration of sodium silicate required to achieve uranium precipitation.
  - Tested 10, 20, 40, 50, 60, 70, and 80 ppm
- Found some difference in U(VI) removal in filtered and non-filtered samples
- The amount of uranium precipitation was directly influenced by the concentration of sodium silicate present in each sample.
- Overall, 70 ppm appeared to have the highest percent of uranium removal via precipitation.

# Major Accomplishments



Task 2.2

- Conducting microcosm experiment on monitoring of U(VI) bioreduction after ARCADIS demonstration at F-Area
- Completed XRD analysis for two batches of samples augmented with molasses and sulfate
- Monitored the evolution of pH conditions
- Found high ferrous iron concentrations in most of the samples
  - It suggests that anaerobic conditions were established
- Samples inoculated with anaerobic bacteria (Sets 1 and 4) had the highest average iron concentrations

# Major Accomplishments



Task 2.3

- Studied sorption of Huma-K on SRS sediments at different HA concentrations and pH values.
- Observed that as pH increase, the Huma-K sorption and precipitation is decreased.
- Preparing for kinetic studies evaluating sorption and desorption of Huma-K.

# Major Accomplishments



Task 3.1

- Conducted literature review on gas solubility studies
- Obtained equipment and completed experimental set up
- Initiated ammonia injection experiments to test methods of ammonia injections and investigate its effect on pH and conductivity change

# Major Accomplishments



- 2 manuscripts were accepted for the publication in peer-reviewed journals:
  - Sepulveda-Medina P, Katsenovich Y, Wellman D, Lagos L, The effect of bicarbonate on the microbial dissolution of autunite mineral in the presence of gram-positive bacteria, 2015(a). J Environ Radioactiv, 144, 77-85.
  - Sepulveda-Medina P, Katsenovich Y, Musaramthota V, Lee H, Lee B, Dua R, Lagos L. 2015 (b). The Effect of Uranium on the Bacterial Viability and Cell Surface Morphology Using Atomic Force Microscopy in the Presence of Bicarbonate Ions. Res Microbiol J (*in press*).
- Submitted a proceeding papers for WM15. This paper was accepted for the oral presentation (presented by Hansell Gonzalez).
- 6 student posters were prepared for the WM14 conference.
- Christine Wipfli (DOE Fellow) won first prize for student poster.

# Conferences/Publications

FIU Applied Research Center

**Oral presentation on WM-2015 (Session107):**

- **Hansell Gonzalez**, Yelena Katsenovich, Miles Denham, Ravi Gudavalli, Leonel Lagos, "**The Influence of Humic Acid and Colloidal Silica on the Sorption of U(VI) onto SRS Sediments Collected from the F/H Area**".

**Students posters displayed on WM-2015:**

- **Aref Shehadeh** (DOE Fellow), "**Monitoring of U(VI) Bioreduction After ARCADIS Demonstration at Savannah River Site F-Area**"
- **Christine Wipfli** (DOE Fellow), "**Sodium Silicate Treatment for Uranium (VI) Bearing Groundwater Systems at F/H Area at Savannah River Site**"
- **Christian Pino** (DOE Fellow), "**Use of XRF to Characterize Pre-Hanford Orchards in the 100-OL-1 Operable Unit**"
- **Hansell Gonzalez Raymat** (DOE Fellow), "**Study of an Unrefined Humate Solution as a Possible Remediation Method for Groundwater Contamination**".
- **Robert Lapierre** (DOE Fellow), "**Characterization of the Uranium-Bearing Products of the Ammonia Injection Remediation Method**".
- **Sandra Herrera Landaez** (Graduate assistant), "**A Study of Autunite Dissolution in the Presence of Shewanella Oneidensis MR1 and Different Bicarbonate Concentrations**".

# Future Work for Current Year - Task 1

FIU Applied Research Center

- Continue with isopiestic measurements of U-bearing samples containing Na-Si-Al-Ca-U-$NO_3$-$CO_3$ ions.
- Continue with analysis to characterize the U-bearing phases:
  - Complete an ongoing optimization study for new sample preparation methods
  - Proposal for analysis at PNNL's EMSL facility
    - To expand instruments available for analysis chemicals containing radiological components
      - FIB, TEM w/ EDS, Scanning TEM, EMPA

# Future Work for Current Year - Task 1

FIU Applied Research Center

- Finalize analysis of calcium and phosphorous via ICP instrument.
- Initiated a new experiment in strictly anaerobic conditions in the glove box and evaluate if further reduction of uranium (VI) is obtained in the presence of bicarbonate ($HCO_3^-$).

# Future Work for Current Year - Task 2

- Task 2.1 (Carryover)-Initiate experiments with 30 ppm HA to see if any trend in U removal using intermediate HA concentration
- Task 2.1-Examine the conditions under which uranium precipitate experiences re-solubilization.
- Task 2.1-Examine mineralogy and surface morphology of dried uranium precipitate using XRD and SEM/EDS.
- Task 2.2 - Repeat ICP for Fe on Batch 2 Samples 2 through 4 with a lower calibration curve.
  - Repeat XRD analysis on Batch 2 Samples 2 through 4 under different parameters to observe any small peaks that may have been missed.
  - Conduct a mass balance analysis on Batch 2 Samples 2 through 4 for iron analysis.
  - Determine the reactions that will occur once the samples are returned to aerobic conditions.

# Future Work for Current Year - Task 2&3

- Task 2.3- Initiate kinetic experiments for sorption and desorption of Huma-K.
- Task 3-Initiate experiments on ammonia gas partitioning using bicarbonate solutions at different temperature.

# Future Work

**As part of the renewal work scope for the new Cooperative Agreement (2015-2020) FIU will:**

- Task 1. Remediation Research and Technical Support for the Hanford Site
  - Investigate the deliquescence behavior of uranium-bearing multicomponent precipitates at different temperatures and compositions.
    - Finalize characterization of U-bearing precipitates
  - Investigate the dissolution of autunite and apatite in the presence of facultative (e.g., Shewanella) and anaerobic microorganisms in bicarbonate-amended media.
  - Investigate potential biological and physical mechanisms associated with ammonia (NH3) gas injections; (New) investigate via column experiments for the bacterial community response associated with the degree of saturation.

# Future Work - Task 1

- **(New)** Evaluate ammonia adsorption onto the Hanford soil in the presence of bicarbonate.
- **(New)** Study transformations of the bacteria community before and after NH3 injections.
- **(New)** Investigate the influence and corresponding electrical geophysical response of microbial activity on vadose zone uranium sequestration using gas phase ammonia injections.

# Future Work

- Task 2. Remediation Research and Technical Support for Savannah River Site
  - Investigate synergetic interactions between humate and silica.
  - Conduct humate batch sorption/desorption studies in the presence of U(VI) to control uranium behavior.
  - Conduct column studies to investigate the effect of HA on uranium mobility through porous media.


# FIU PROJECT 3:
# DR. LEONEL LAGOS

# ENVIRONMENTAL REMEDIATION TECHNOLOGIES

FLORIDA INTERNATIONAL UNIVERSITY

# Project Description

## Background/History

- Integrated surface/subsurface flow & contaminant transport models of ORR watersheds (East Fork Poplar Creek, Upper EFPC (Y-12 NSC Area) and White Oak Creek).
- Expt'l studies to obtain kinetic/equilibrium data parameters related to Hg transport, speciation and methylation/demethylation kinetics within EFPC watershed.
- GIS technology for storage and geoprocessing of spatial/temporal model data.

## New scope (FY13 – Year 4):

- Level 2 (semi-quantitative) Green & Sustainable Remediation (GSR) analysis at DOE sites.
- Analysis of the baseline, optimization studies and development of system improvement plan for A/M Area groundwater remediation system at SRS.

## Transition from ORR to SRS (FY14 – Year 5):

- Experimental studies, modeling efforts and sustainability studies now focused at SRS.

# Project Tasks (Yr 5)

FIU Applied Research Center

- **Task 1: Modeling of the Migration and Distribution of Natural Organic Matter Injected into Subsurface Systems**
  - Work plan for experimental column studies.
  - Column testing of migration/distribution of HA injected into subsurface systems.
  - Development of subsurface flow, fate and transport model of HA.
- **Task 2: Surface Water Modeling of Tims Branch**
  - Development of a detailed GIS-based representation of the Tims Branch ecosystem.
  - Modeling of surface water and sediment transport in the Tims Branch system.
- **Task 3: Sustainability Plan for A/M Area Groundwater Remediation System**
  - Analyze Baseline.
  - Energy Efficiency.
  - Mechanical Design and Operations Modifications for Sustainable Remediation (while controlling contaminant migration)

# Major Accomplishments

## Completion of FIU Year 4 Carryover Work Scope

- Task 1 Final Technical Report: “EFPC Model Update, Calibration, and Uncertainty Analysis”
  - Submitted July 31, 2014.
- Task 2 Final Technical Report: “Simulation of NPDES- and TMDL-Regulated Discharges from Non-Point Sources for the EFPC and Y-12 NSC”
  - Submitted July 31, 2014.
- Task 3 Final Technical Report: “Green and Sustainable Remediation Practices, Tools and their Application at DOE Office of Environmental Management Sites”
  - Submitted September 26, 2014.
- Task 4 Final Technical Report: “Geodatabase Development for Hydrological Modeling Support”
  - Submitted June 30, 2014.

# Major Accomplishments

FIU Applied Research Center

**Task 1: Modeling of the Migration and Distribution of Natural Organic Matter Injected into Subsurface Systems**

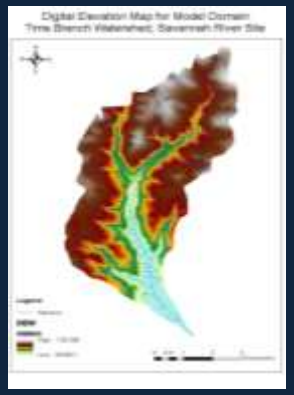
- Completed work plan for experimental column studies.
- Estimated parameters for column experiments (column size, flow rates, concentration of humic acid).
  - 25 mm id 300 mm glass column from Ace Glass
- Characterized FAW-1: 60'-70' SRS soil to obtain bulk density, particle density, porosity and pH.
- Calibrated bromide electrode and tested for reliability.
- Developed column set-up drawings and configuration.
  - Identified tubing and adapters for pump to achieve required flow for experiment.

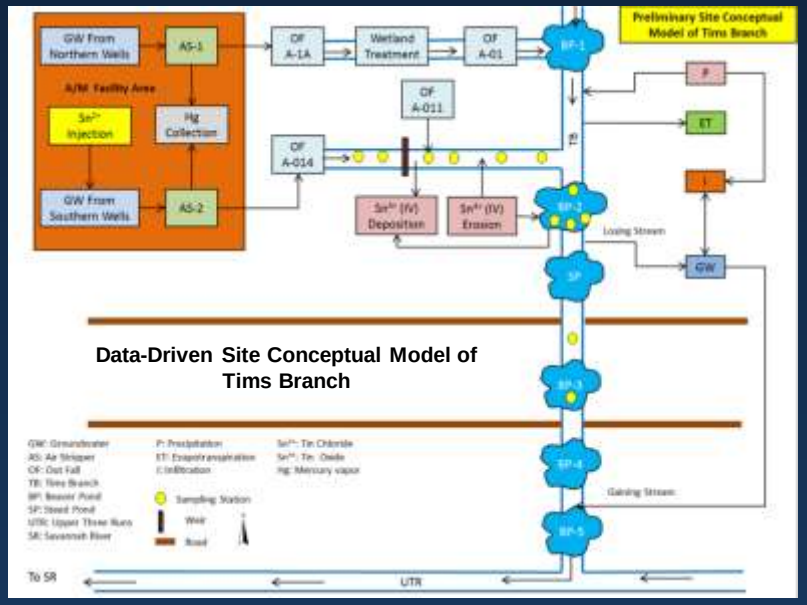
# Major Accomplishments

FIU Applied Research Center

## Task 2: Surface Water Modeling of Tims Branch

- Developed process flow models for preprocessing model data.
- Developed 2D/3D GIS-based representations of SRS A/M Area and Tims Branch.
- Developed grid files for MIKE SHE model input from existing GIS data and literature review data.
- Completed Literature Review and submitted Summary Report.
- Developed data-driven and process-driven conceptual models of Tims Branch.





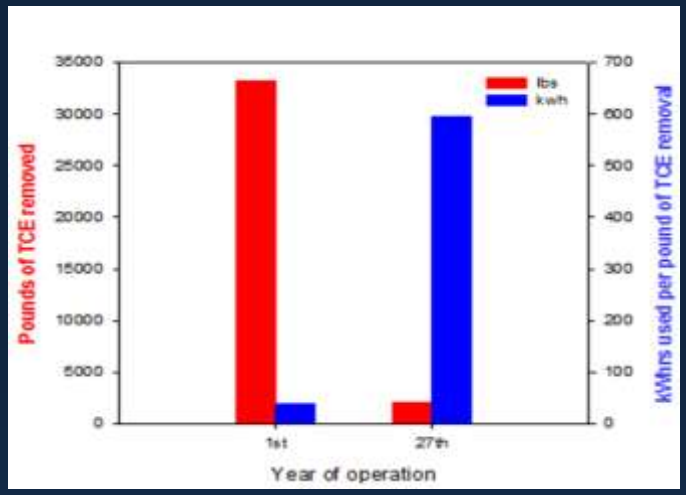

Data-Driven Site Conceptual Model of Tims Branch

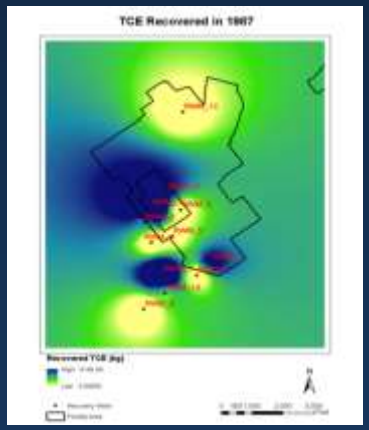
# Major Accomplishments

FIU Applied Research Center

## Task 3: Sustainability Plan for the A/M Area Groundwater Remediation System

- Collected per Well Data - Major effort in FIU Year 5 was identification of missing data per well on TCE & PCE recovery to allow for per well analyses.
- 2 Technical Reports in FIU Year 5
  - "Green and Sustainable Remediation Practices, Tools and their Application at DOE Office of Environmental Management Sites"
  - "Baseline Summary Report for Sustainable Remediation Options for the M1 Air Stripper at DOE SRS"




# Conferences/Publications

FIU Applied Research Center

## 2015 Waste Management Symposium

- Professional Paper/Poster
  - "Utilization of GIS Technology to Support Development of Flow and Contaminant Fate and Transport Models at US DOE Sites" – Angelique Lawrence, Georgio Tachiev.
- Professional Paper/Presentation
  - "Modeling and Quantitative Assessment of Green and Sustainable Remediation Options for the M1 Air Stripper System at DOE SRS" – David Roelant, Ralph Nichols, Natalia Duque.
- Student Paper/Poster
  - "Column Testing of the Migration and Distribution of Humate Injected into Subsurface Systems at Savannah River Site's F/H Area" – Kiara Pazan (DOE Fellow), Ravi Gudavalli.
  - "Quantitative Assessment of Sustainable Remediation Options for the M-1 Air Stripper System at SRS" – Natalia Duque (DOE Fellow), David Roelant.

# Project 3 Future Work (FY15)

FIU Applied Research Center

## Task 1: Modeling of the Migration and Distribution of Natural Organic Matter Injected into Subsurface Systems

- Finish column experiments to determine sorption and desorption properties
- Determine HA concentration using UV-Vis (spectrophotometer), iron and silica concentration using ICP-OES
- Determine transport parameters for modeling migration and distribution of HA injected into subsurface
- Complete development of subsurface flow, fate and transport model of HA.
- Technical Report for Task 1: Modeling of the migration and distribution of natural organic matter injected into subsurface systems

# Project 3 Future Work (FY15)

FIU Applied Research Center

## Task 2: Surface Water Modeling of Tims Branch

- Complete Subtask 2.1: Development of detailed GIS-based representation of Tims Branch ecosystem.
- Complete Subtask 2.2: Modeling of surface water and sediment transport in the Tims Branch system.
- Technical Report for Task 2: Surface Water Modeling of Tims Branch

## Task 3: Sustainability Plan for the A/M Area Groundwater Remediation System

- Identify opportunities to improve efficiencies related to electrical energy, water usage, and the use of other resources, beginning with mechanical design modifications.
- Investigate operational strategies to increase system performance by optimizing the hydraulic loads, pumping rates, contaminant mass flow rates and well drawdown levels.
- Determine a set of metrics which will correlate the pumping rates, the cone of depression, and the interaction between the wells with the contaminant mass flow rates.
- Technical Report for Task 3: Sustainability Plan for the A/M Area Groundwater Remediation System

# Project 3 Future Work (FY15)

- Presentation overview to DOE HQ/SRNL of the project progress and accomplishments (Year End Review)
- Draft Year End Report

# Future Work (2015-2020)

Experimental studies and development/testing of sampling/monitoring technologies for better understanding of long-term behavior of subsurface contaminants and potential effects of remediation technologies.

Proposed research includes:

- Laboratory experiments on soil and contaminants in SRS F/H Area including:
  - Batch and column experiments to estimate adsorption/desorption and transport parameters to better predict and apply remediation technologies.
  - Laboratory analyses of aqueous chemistry of metals (uranium and other radioactive contaminants) in soils and surface water.

# Future Work (2015-2020)



Targeted study of contaminants and recovery of Tims Branch may include:

- Biota/biofilm sampling in Tims Branch for contaminants and effects of remediation strategies.
- Laboratory analyses of aqueous chemistry of metals in biota, biofilms, sediments and surface water in Tims Branch.
- Development/refinement of surface water models of Tims Branch ecosystem to simulate surface movement, sorption/desorption & transport of contaminants.

# Future Work (2015-2020)

- Green Sustainable Remediation assessment of the Groundwater Remediation System (GWRS) at A/M Area & other remediation systems/strategies at SRS including:
  - Develop baseline for SRS sustainability performance (water resources, electricity, emissions, etc.) for A/M Area GWRS and propose alternative processes or new technologies to improve sustainability.
  - Work with SRS on follow up studies to facilitate implementation of improved processes/technologies on A/M GWRS.
  - Review additional site remediation systems at SRS, develop baseline, identify improvements with modeling to show impacts and support implementation (one remediation system at a time).
  - Support EM-13 in communications and encouraging more Sustain Remediation analyses at DOE EM sties.

# Future Work (2015-2020)

- FIU staff and students will support DOE Office of Soil and Groundwater in the testing and evaluation of ASCEM community released code.

- Based on the DOE Fellow summer internship experience during summer 2014, FIU proposes to involve other DOE Fellows and students in the testing and evaluation of ASCEM code.

Note: Future discussion will be conducted with EM-12 regarding this task


# FIU PROJECT 4:
# DR. LEONEL E. LAGOS
# DR. HIMANSHU UPADHYAY

# WASTE AND D&D ENGINEERING AND TECHNOLOGY DEVELOPMENT

FLORIDA INTERNATIONAL UNIVERSITY

# Project Task Descriptions

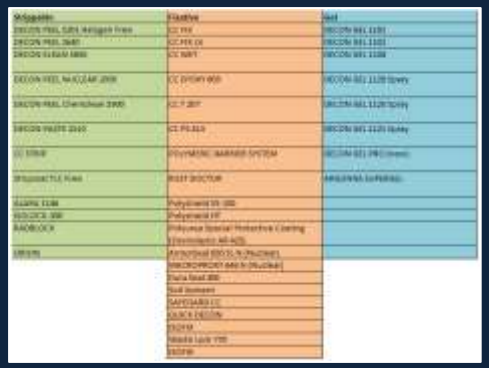
- D&D Support to DOE EM for Technology Innovation, Development, Evaluation and Deployment
  - Provides direct support to assist DOE EM in meeting the D&D needs and technical challenges around the DOE complex. Identifying and evaluating innovative technologies in support of SRS 235-F project.
- Waste Information Management System (WIMS)
  - Receives, integrates and organizes the DOE waste forecast data from across the DOE complex on an annual basis and to automatically generate waste forecast data tables, disposition maps, GIS maps, and transportation details.
- D&D Knowledge Management Information Tool (KM-IT)
  - A web-based community-driven system developed to maintain and preserve the D&D knowledge base and tailored to serve the technical issues faced by the D&D workforce across the DOE Complex.
- Global Knowledge Sharing & Collaboration for EM
  - A study of international knowledge sharing protocols and development of a pilot system for knowledge sharing and collaboration with the international community.

# Project 4 - Decision Model - Accomplishments

A decision model for the selection of fixatives, strippable coatings, and decontamination gels is being created to better guide the product end users in the selection of the appropriate products depending on site conditions and requirements (e.g., SRS 235-F facility).

# Project 4 - Decision Model - Accomplishments

FIU Applied Research Center



Commercially available fixatives, strippable coatings, and decontamination gels (> 40 products), continuously updated


Decision model created in MatLab to filter by selected criteria

Display of products best matched to criteria

## Initial Decision Model

# Project 4 - Decision Model - Accomplishments

FIU Applied Research Center

**Decision Model** will be deployed on the D&D KM-IT platform as **web** and **mobile application** for selection of fixatives, strippable coatings, and decontamination gel products.

# Project 4 - Advanced Fogging Technology - Accomplishments

FIU Applied Research Center

**Need:** Advanced technology system to better address the challenges associated with potential airborne contaminants in a radioactive environment.

## Potential Solution: FX2 Fogging Agent

INL proprietary mixture of water, latex paint, glycerin, and sodium lauryl sulfate.

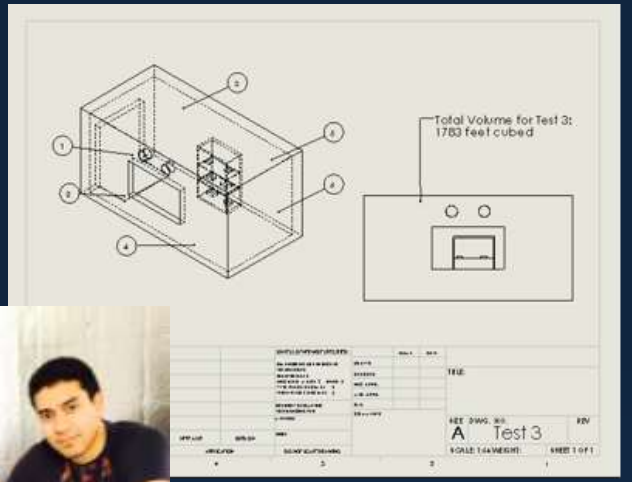
Initial test results by INL demonstrate superior results at reducing airborne contamination via enhanced penetration, fixing, and adhesion of particulates.

# Project 4 - Advanced Fogging Technology - Accomplishments

FIU Applied Research Center

## FIU Testing & Evaluation of FX2 Fixative

FX2 Test Plan execution: March 30 to April 3 at FIU ARC Hot Cell Mockup Facility in Miami




- Expanded test objectives include:
  - Shielding properties against Alpha emitters
  - Resiliency and characterization testing in accordance with various ASTM / NFPA standards
    - ASTM E84 (Burn Rate)
    - ASTM D3065 (Flammability)
    - ASTM D1331 (Surface Tension)
  - Adhesiveness and coverage on various surfaces in line-of-sight / non line-of-sight configurations at varying dimensions

# Project 4 – Incombustible Fixatives - Accomplishments

FIU Applied Research Center

- Concept: Fixative resiliency and performance can be enhanced via combining / layering
- Decon solutions and fixative coating materials to be tested:
  - DECONGEL 1101 -DECONGEL 1120
  - DECONGEL 1121 -DECONGEL 1108
  - DECONGEL 1128 -Dicalcium Silicate
- Test Plan development underway
  - Phase I: Baselining above materials
  - Development of testing protocols and performance metrics

# Project 4 - WIMS - Accomplishments

FIU Applied Research Center

- Completed integration of 2014 waste forecast and transportation data into WIMS.
- New 2015 dataset expected in April 2015, will be integrated and deployed on WIMS.
- Presented WIMS at WM15 Symposia.

# Project 4 – D&D KM-IT

FIU Applied Research Center

**Deactivation and Decommissioning Knowledge Management Information Tool**

- D&D KM-IT is successfully deployed and can be accessed from the web address http://www.dndkm.org.

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

FIU Applied Research Center

# D&D KM-IT MODULES

# Project 4 – D&D KM-IT – Mobile Applications

FIU Applied Research Center

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

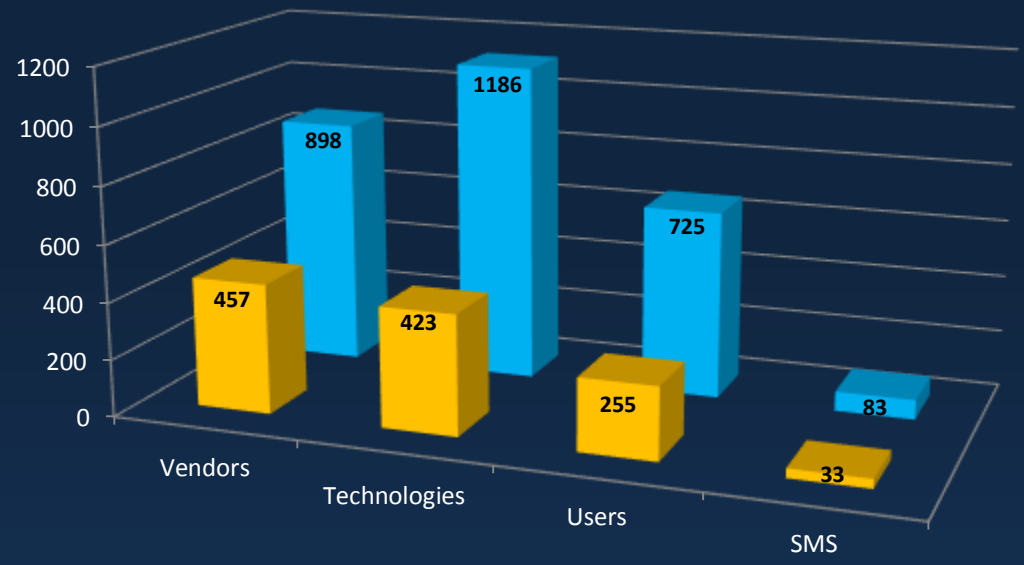
- Vendor Module
- Technology Module
- Specialist Directory
- Picture Library
- Hotline
- Lessons Learned


M.DNDKM.ORG

# Project 4 – D&D KM-IT – Accomplishments – Content Management

FIU Applied Research Center

- 725 registered users
- 83 subject matter specialists
- 898 D&D vendors
- 1186 D&D technologies
- 195 questions and solutions in Hotline module
- 169 ALARA Center reports archived
- 231 Innovative Technology Summary Reports archived

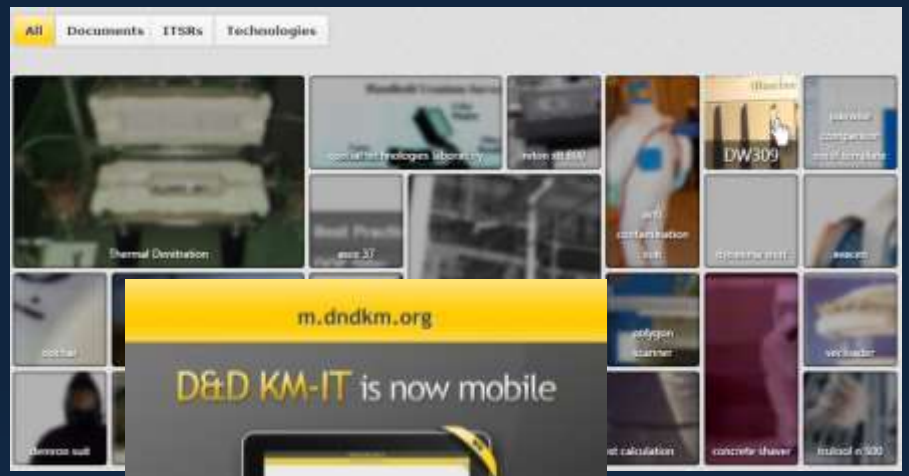



**Growth from March 2012 to March 2015**

# Project 4 – D&D KM-IT – Accomplishments

FIU Applied Research Center

- Deployment of popular display on homepage
- Deployment of Lessons Learned and Best Practices lite mobile applications
- Presented at Decommissioning and Remote Systems (ANS Conference) 2014 and Waste Management 2015




# Project 4 – D&D KM-IT – Accomplishments

FIU Applied Research Center

Developed and distributed newsletters:

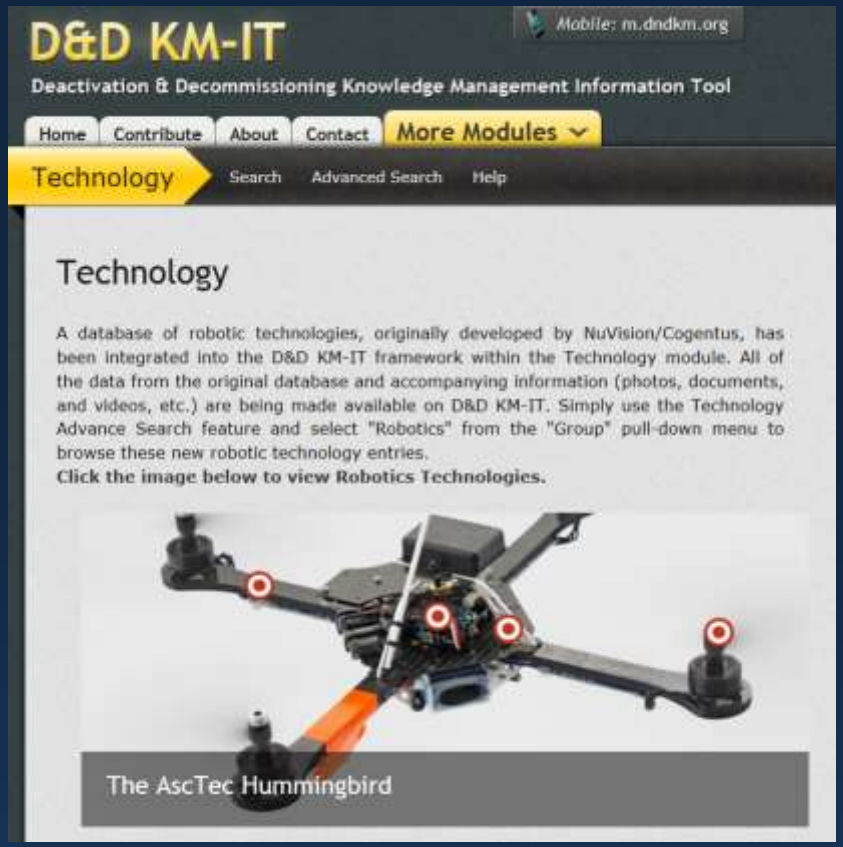
- Availability of ITSRs on D&D KM-IT
- Fixatives and other contamination control products
- Innovative PPE at Hanford



# Project 4 - D&D KM-IT – Accomplishments - Robotics

FIU Applied Research Center

- Database of robotic technologies, originally developed by NuVision/Cogentus.
- Integrated into the D&D KM-IT framework for ongoing hosting/ dissemination/ maintenance of the information.
- New “Robotics” group created within the Technology module.
- Over 440 robotic technologies are currently live on D&D KM-IT.



# Project 4 - D&D KM-IT – Accomplishments - Robotics

FIU Applied Research Center

Robot Characterization System (Oak Ridge National Lab)

Gamma Rover (PNNL)

Phantom (DJI)

Mighty Mouse (Sandia National Lab)

# Project 4 – Global Knowledge Sharing & Collaboration for EM

FIU Applied Research Center

- **Study of Protocols and Standards for Collaboration and Knowledge Sharing with the International Community**

  Pilot U.S.-U.K study to identify and analyze international nuclear and cyber standards, regulations, and protocols sharing non-classified nuclear decommissioning related information. The study will thoroughly assess the potentials and limitations for the development and maintenance of a web-based collaboration environment.

- **Develop Pilot System for Collaboration with the UK**

  Develop, test and deploy a secured collaborative knowledge/information sharing pilot platform for unclassified information to the stakeholders for D&D collaboration within the participating agency (UK).

# Project 4 – Global Collaboration – Accomplishments

FIU Applied Research Center

## Section A: Source Documents

- Source documents compiled and retained for reference
- Types of documents include: federal regulations, agency protocols, conference proceedings, international treaties, bilateral arrangements

## Section B: Document Reviews

- An executive summary & the direct implications of each source document

## Section C: Framework

- Provides recommendations organized by topic
- Highlights potential conflicts in regulations
- Framework developed using the Source Documents Reviews - Section B

# Project 4 – Global Collaboration – Accomplishments

FIU Applied Research Center

**Reviewed Documents:**

- Memorandum for Chief Information Officers of Executive Departments and Agencies: Requirements for Accepting Externally-Issued Identity Credentials (US Office of Budget and Management, 2011)
- Arrangement between the Office for Nuclear Regulation of Great Britain and the United States Department of Energy for the Exchange of Information and Cooperation in the Area of Nuclear Safety (DOE & the Office for Nuclear Regulation of Great Britain, 2014)
- A discussion on "Interagency Collaboration: Implications of a Common Alignment of World Regions among Select Federal Agencies" ( United States Government Accountability Office, 2011)
- Collaboration – How HHS Agencies Work with Outside Entities (U.S Department of Health and Human Services, 2014)

**Documents in process of being reviewed:**

- A Resource on Strategic Trade Controls (U.S. Department of State, 2011)
- The International Traffic in Arms Regulations (ITAR) (U.S. Department of State, 2015)
- Export Administration regulations (EAR) (U.S. Department of Commerce, 2015)
- The Arms Export Control Act (AECA) (U.S. Department of State, 1976)
- NNSA Export Control Regulations (National Nuclear Security Administration, 2015)
- Treaty on the Non-Proliferation of Nuclear Weapons (NPT) (1970)

# Project 4 – Global Collaboration – Accomplishments

FIU Applied Research Center

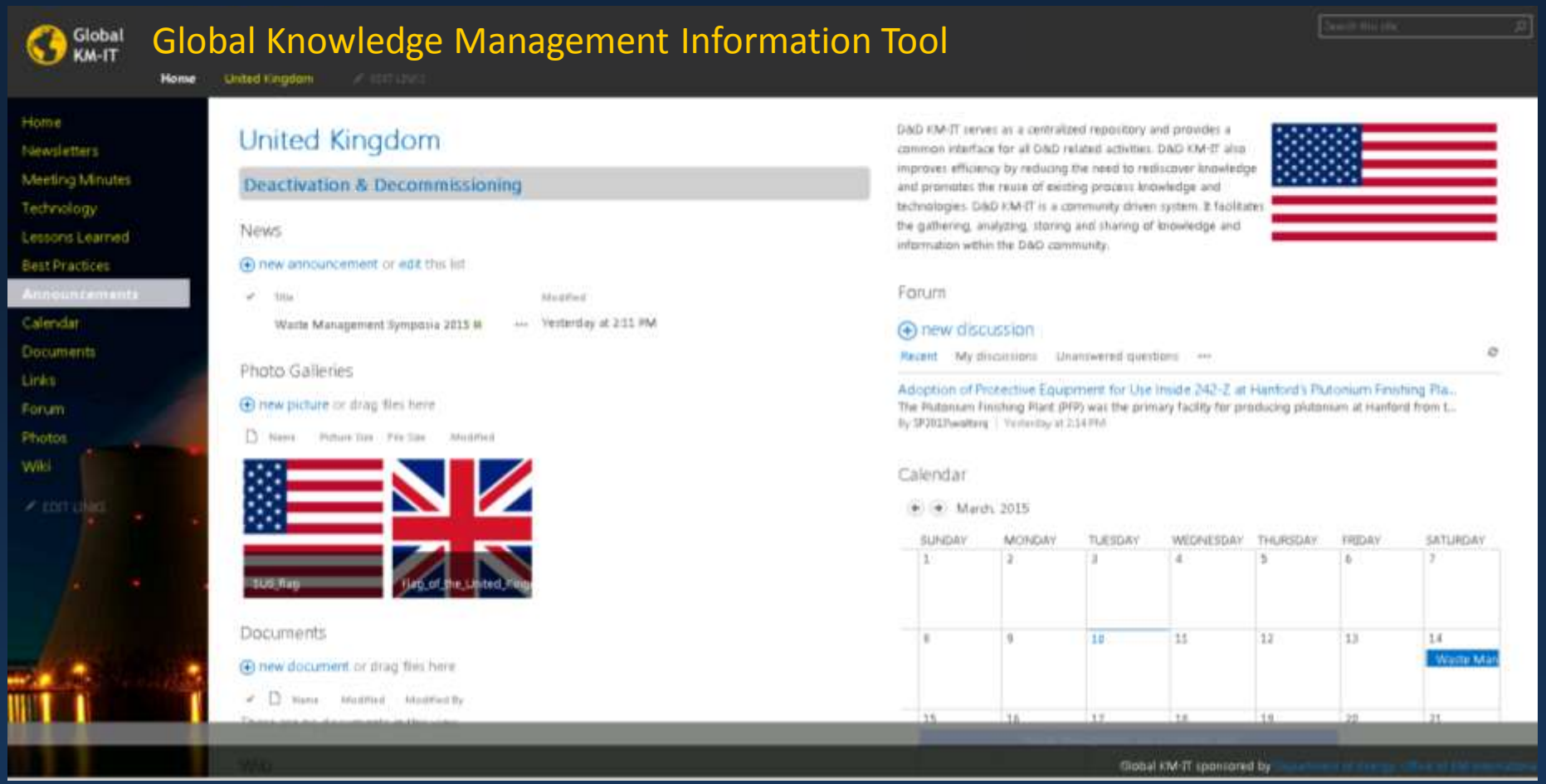
## International Knowledge Sharing & Collaboration Platform for unclassified information

- Platform will be developed based on the Protocols and Standards for knowledge sharing established in Task 1 with focus on U.K.
- Platform may contain features like Newsletters, Meeting Minutes, Technology, Lessons Learned, Best Practices, Documents, Announcements, Calendars, Link, FAQ, Wikis, etc.
- Information that can be shared with multiple countries vs. Shared within participants of specific country
- Presentation to waste management team for International collaboration for requirement gathering

# Project 4 – Global Collaboration – Accomplishments

FIU Applied Research Center

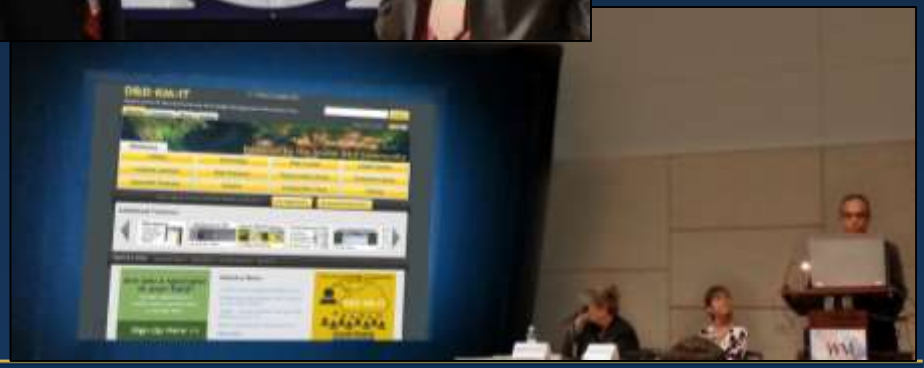
## Global Knowledge Management Information Tool



# Project 4 – Conferences & Presentations

FIU Applied Research Center

- D&D Remote Platform and D&D KM-IT presented at ANS Decommissioning and Remote Systems (June 2014)
- WIMS poster presented at WM15 (March 2015)
- D&D KM-IT presented at WM15 (March 2015)

# Project 4 – Future Work

FIU Applied Research Center

As part of the renewal work scope for the new Cooperative Agreement (2015-2020) FIU will:

## D&D Fixative Decision Model

- Refine the decision support model for the selection of fixatives, strippable coatings, and decontamination gel products specific to the site applications.
- Design and develop the mobile application for the selection of fixatives in an online and offline environment.

# Project 4 - Future Work

## Advanced Fogging Technology

- Research feasibility for development of a robotic fogger with path planning, obstacle detection / avoidance to enhance delivery and application
- Continue collaboration with INL to complete identification, selection, testing, and evaluation of fogging products

## Incombustible Fixatives

- Execute Phase I Test Plan to determine baseline incombustible characteristics of selected products
  - DECONGEL 1101
  - DECONGEL 1121
  - DECONGEL 1120
  - DECONGEL 1108
  - DECONGEL 1128
  - Dicalcium Silicate
- Develop and execute Phase II Test Plan for combinations of products (e.g., layering or mixing) to improve incombustible characteristics

# Project 4 – Future Work

## Organic Semiconductor Thin Films

- Complete the applied research on dual purpose organic semiconductor thin films for polymer interface and electrostatic applications, which has application to SRS 235-F and the DOE complex for radioactive waste handling and packaging.

## Remote Technology for Highly Contaminated Areas

- Perform applied research for the identification or development of a remote technology for implementation at SRS 235-F Facility to meet the site's need for a remote system that can enter highly contaminated areas.

# Project 4 – Future Work

## WIMS

– Maintain WIMS via database management, application maintenance, and performance tuning. Integrate an annual data update.

## D&D KM-IT

- Design and develop the mobile application for the selection of fixatives in an online and offline environment.
- Research creating native mobile applications for each of the three major mobile device platforms with the ability to work offline and sync with the main system when the connection is available. Work with DOE sites to identify additional high priority needs for mobile applications and perform feasibility analysis for design, development and deployment.
- Expand the D&D knowledge base to other EM areas (e.g., high-level waste, etc.) based on results of a feasibility analysis.


# FIU PROJECT 5:
# DR. LEONEL E. LAGOS

# DOE-FIU SCIENCE AND TECHNOLOGY WORKFORCE DEVELOPMENT PROGRAM

Florida International University

# DOE Fellows Program Description

FIU Applied Research Center

*FIU's Applied Research Center (ARC) is supporting the U.S. Department of Energy's Office of Environmental Management in the training of STEM, minority FIU students in an effort to create of **pipeline** of scientists and engineers that will enter DOE's workforce upon completing their degrees and research at FIU.*

# Eligibility Requirements

FIU Applied Research Center

- United States Citizens/Permanent Resident Aliens
- Minimum 3.0 grade point average
- Two letters of recommendation from faculty members
- Fill out Program's application (fellows.fiu.edu)
- Open to undergraduate (juniors and seniors) and graduate students
- Under-represented minority students

# Student Recruitment

- DOE Fellows recruiting other FIU students
- Information Sessions (Spring and Fall semesters)
- In-class presentations for selected STEM discipline courses
- FIU Career and Engagement Office
- Presentations at student societies (ASME, SHEP, SBEP, SWE, etc.)
- DOE Fellows Selection Committee integrated by DOE-EM (HR and Technical), FIU College of Engr., FIU College of Arts & Sciences, and ARC staff

# Program's Components

- Paid 10-week summer internships at DOE national laboratories, DOE sites, DOE-HQ or DOE contractors, working under the supervision of DOE scientists (mentors).
- Paid 20 hours/week Student Research Assistantship at ARC during school year.
- Research experience with ARC scientists at FIU during school year: one-on-one mentoring performing **"hands on"** DOE-related applied research.
- Tuition waiver for graduate studies (Master, PhDs).
- 2 to 4 years Developmental Training Program (depends on masters or PhD track).
- DOE Lecture Series and technical seminars.
- Participation in conferences/workshops.


# DOE-FIU Science & Technology Workforce Development Program

# Accomplishments

FLORIDA INTERNATIONAL UNIVERSITY

# DOE Fellows Hands on Research at FIU

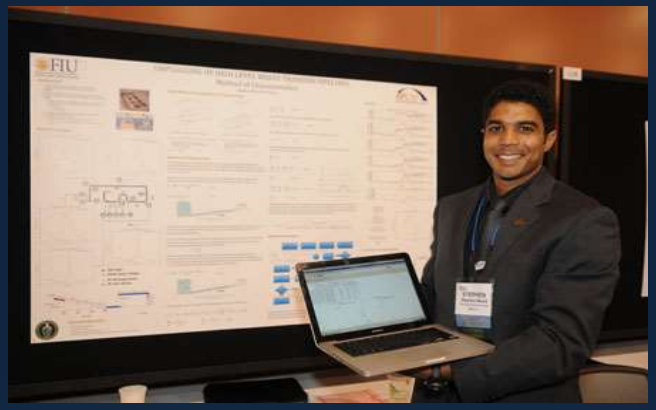
FIU Applied Research Center


# DOE Fellows Induction Ceremony

Conducted a total of 8 Induction Ceremonies since program inception in 2007. A total of **108 FIU minority STEM students** have been inducted as DOE Fellows.

# DOE Fellows at Waste Management Symposia

FIU Applied Research Center




A total of **140 DOE Fellows have presented at Waste Management Symposia** since 2008. Obtained Best Student Poster at 5 WM and Best Professional Poster in 2009 (DOE Fellow, Leydi Velez).

# DOE Fellows at WM Conference

FIU Applied Research Center

WM Student Posters Sessions


Panel Member – Young Professionals

# 81 DOE Fellows Internships Completed

FIU Applied Research Center




Pacific Northwest
NATIONAL LABORATORY

Lawrence Livermore
National Laboratory

Battelle

Y-12
National Security Complex

DEPARTMENT OF ENERGY
UNITED STATES OF AMERICA

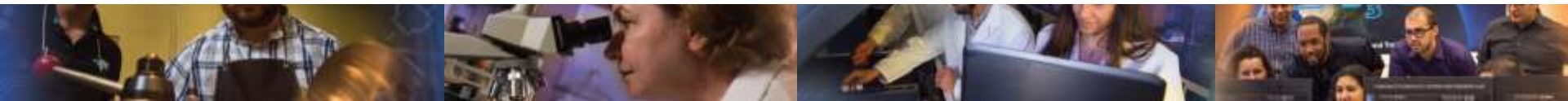
SULLIVAN

OAK RIDGE
National Laboratory

washingtonriver
protectionsolutions

TM

SRNL
SAVANNAH RIVER NATIONAL LABORATORY



# Annual DOE Fellows Poster Exhibition

FIU Applied Research Center


# Major Accomplishments

- **108** students recruited/inducted as DOE Fellows since program inception in 2007.
- **8** Fellows hired by DOE, DOE national labs, and DOE contractors.
- **13** Fellows hired by other federal, state, and local gov't agencies (Dept. of Defense, NASA, Dept. of Commerce, Dept of the Navy (NAVSEA), etc.).
- **41** Fellows hired by STEM industry (GE, Lockheed Martin, Raytheon, Texas Instruments, Motorola, Florida Power & Light, Boeing, Inter Corporation, MWH Global Inc., and others) .
- Won **one (1)** Best Professional Poster (Leydi Velez) and **five (5)** Best Student Posters (Denisse Aranda, Danny Carvajal, Stephen Wood, Alexandria Fleitas, Christine Wipfli) at Waste Management Symposia since 2008.
- **80** internships completed at DOE sites, DOE national labs, DOE-HQ, and DOE contractors across the Complex.
- Graduation rate of DOE Fellows – 99%
- Retention rate of DOE Fellows in the program – 75%

# Major Accomplishments

- Presented over **140** papers and posters at Waste Management (2008-2014) and other national/international conferences, including two (**2)** presentations at ICEM13 (Brussels, Belgium), and **5** at ANS conference
- Waste Management Symposia Best Student Posters awarded to Christine Wipfli (WM15), Alexandra Fleitas (WM14), Stephen Wood (WM11), Denny Carvajal (WM10) and Denisse Aranda (WM09). Best Overall Professional Poster awarded to Leydi Velez (WM09)
- **35** Fellows started program as undergraduates and continued to obtain a Masters and/or PhD degree at FIU
- Other DOE Fellows have obtain bachelors degrees at FIU and continued their graduate education at MIT, Michigan, Purdue, Stanford, Virginia Tech, and other institutions

# Masters & Ph.Ds

FIU Applied Research Center

| DOE Fellow | Exp. Degree | Major | Topic of Research |
|---|---|---|---|
| Robert Lapierre | M.S. | Chemistry | Characterization of the uranium-bearing products of novel remediation technologies |
| Joel McGill | M.S. | Civil engineering | The synergy effect of SI and humic acid on the removal of U(VI) |
| Valentina Padilla | M.S. | Environmental engineering | A microcosm study on mineralogical changes of post molasses injection with SRS F-area sediments |
| Mariela Silva | M.S. | Engineering management | SharePoint based secured collaboration system |
| Revathy Venkataraman | M.S. | Information technology | Performance analysis of mobile applications accessing web services built using windows communication foundation |
| Claudia Cardona | Ph.D. | Civil engineering | Evaluating the effects of Si and Al concentration ratios on the removal of uranium |
| Elicek Delgado-Cepero | M.S. | Electrical engineering | Developing wireless monitoring systems and instrumentation |
| Heidi Henderson | M.S. | Environmental engineering | Developing water balance model to similar surface water and total suspended solids transport |
| Janty Ghazi | M.S. | Engineering management | Asynchronous pulsing as a means of unplugging high level waste transfer pipelines |
| Jose Matos | B.S. | Mechanical engineering | Development of peristaltic crawlers for unplugging of Hanford waste transfer pipelines |
| Joshua Midence | B.S. | Civil engineering | Saltstone Processing of Low-Level Waste at Savannah River Site |
| Lillian Marrero | M.S. | Civil engineering | Modeling of mercury and suspended solids |

# Masters & Ph.Ds

FIU Applied Research Center

| | | | |
|---|---|---|---|
| Paola Sepulveda-Medina | M.S. | Biomedical Engineering | Investigating the role of a less uranium tolerant strain, isolated from the Hanford site soil, on uranium interaction in polyphosphate remediation technology |
| Jaime Mudrich | M.S. | Mechanical engineering | Multiphase simulations with an emphasis on solid-fluid interaction in complex domains |
| Eric Inclan | M.S. | Mechanical engineering | Asynchronous pulsing method for unplugging high-level waste pipelines |
| Yulyan Arias | M.S. | Environmental engineering | Sequestering uranium by in situ subsurface pH manipulation using NH3 gas |
| Melissa Sanchez | M.S. | Environmental engineering | Uranium remediation in the vadose zone |
| Elsa Cabrejo | M.S. | Environmental engineering | Modeling interactions of sediment with mercury |
| Denny Carvajal | B.S. | Biomedical Engineering | Uranium remediation in the vadose zone |
| Mario Vargas | B.S. | Mechanical engineering | Development of a remote platform for characterization of nuclear stacks |
| Amaury Betancourt | M.S. | Environmental engineering | Effects of mercury in anaerobic bacteria |
| Lee Brady | M.S. | Mechanical engineering | Technologies for unplugging of high-level waste pipelines |
| Duriem Calderin | M.S. | Biomedical Engineering | Pilot scale experimental design for a wiped film evaporator |
| Charles Castello | Ph.D. | Electrical engineering | Development of a methyl-mercury analyzer |

# Masters & Ph.Ds

FIU Applied Research Center

| | | | |
|---|---|---|---|
| Melina Idarraga | B.S. | Civil engineering | Quantifying the dissolution of autunite as a function of aqueous bicarbonate. |
| Rosa Ramirez | M..S. | Biomedical Engineering | Study of mercury speciation in a contaminated watershed |
| Stephen Wood | M.S. | Mechanical engineering | Investigation of methods for high-level waste pipeline unplugging |
| Edgar Espinoza | M.S. | Mechanical engineering | Design Optimization of Submerged Jet Nozzle to Enhance Mixing. |
| Serkan Akar | M.S. | Biomedical engineering | Developing a Biosensor for Detection of Phosphate Species in Uranium Contaminated Ground Water and Wastewater Sediments by Employing Advanced Biotechnological Methods |
| Merlin Ngachin | M.S. | Geosciences | Tests and evaluate a new technology, namely SIMWyPES®, by Babcock & Wilcox and used at the Y-12 National Complex at Oak Ridge National Laboratory (ORNL) |
| William Mendez | M.S. | Engineering Management | Development of a conceptual design of a robotic mechanism. This device was developed as a survey tool for physical and chemical characterization of contaminated nuclear stacks. |
| Erika McKinney | M.S. | Biomedical Engineering | Department project |
| Leydi Velez | M.S. | Engineering Management | Lessons Learned (LL) and Best Practices (BP) acquired in most DOE sites. Also, involved in the development of the D&D Knowledge Management Information Tool (KM-IT) |
| Nantaporn Noosai | Ph.D. | | Developing thermodynamic database of mercury species and integrating interactions within a flow and transport model |

# DOE Fellows Having Fun & Helping the Community

FIU Applied Research Center

Phoenix, Arizona

Great Smoky Mountains, TN

Beach Cleanup, Key Biscayne FL

Snowbowl Mountain, AZ

White Salmon, Washington

DOE Fellows Christmas Party 2009

# Program Website and Facebook

FIU Applied Research Center

**http://fellows.fiu.edu**


Follow us in Facebook at:

**FIU Science and Technology Workforce Development Initiative**

# Project 5 – Future Work

- Continue selection & recruitment of qualified, talented FIU minority STEM students
- Engage all DOE Fellows in EM applied research conducted in projects 1-4
- Conduct summer internships at DOE sites, HQ, nat. laboratories and DOE contractors
- Conduct DOE Fellows Poster Competition (Oct. 2015)
- Conduct Induction Ceremony 2015 (Nov. 2015)
- Participate in WM Symposia 2015
- Coordinate efforts with EM-70 to identify employment opportunities for DOE Fellows