QUARTERLY PROGRESS REPORT

July 1 to September 30, 2012

Florida International University's Continued Research Support for the Department of Energy's Office of Environmental Management

Principal Investigators:

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Prepared for:

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Introduction

The Applied Research Center (ARC) at Florida International University (FIU) executed work on five major projects that represent FIU-ARC's continued support to the Department of Energy's Office of Environmental Management (DOE-EM). The projects are important to EM's mission of accelerated risk reduction and cleanup of the environmental legacy of the nation's nuclear weapons program. The information in this document provides a summary of the FIU-ARC's activities under the DOE Cooperative Agreement (Contract # DE-EM0000598) for the period of July 1 to September 30, 2012.

Highlights during this reporting period include:

- On August 21, 2012, Dr. Lagos and his colleagues (Dr. Dwayne McDaniel and Dr. Georgio Tachiev) visited DOE-HQ and provided a debriefing and presentations of the DOE-FIU Cooperative Agreement to several DOE-EM HQ personnel. Mr. Mark Gilbertson (DOE EM DAS) and several of his DOE-HQ colleagues participated in this debriefing by FIU. The intention of the presentations and debriefing was to provide an update on FIU-ARC activities and research being performed under this cooperative agreement.

  DOE-HQ representatives included Mr. Mark Gilbertson (Deputy Assistant Secretary for Site Restoration), Mr. William Levitan (Associate Deputy Assistant Secretary for Site Restoration), and representatives from EM-12 (Mr. Kurt Gerdes - Director Office of Soil/Groundwater, and Beth Moore), EM-13 (Mr. Andy Szilagyi - Director Office of D&D and Facility Engineering, and Mr. John De Gregory - Technical Monitor for DOE-FIU Cooperative Agreement), and EM-21 (Mr. Gary Petersen), EM-71 (Mr. Desi Crouther - Director Office of Human Capital). In total approximately 10 DOE HQ personnel attended the presentations and additional DOE-HQ individuals were able to call in for the presentations. All five FIU projects were presented and the DOE Fellows video was also showcased. Excellent feedback was received from Mr. Mark Gilbertson and Mr. Bill Levitan and the rest of our DOE colleagues.

In addition, individual meetings with DOE-EM program offices (D&D, Soil/GW, Tank Waste Management, and EM Human Capital) were conducted to discuss project specific research. An additional meeting was scheduled and conducted with Mrs. Rosa Ramirez-Elmitti (DOE-EM International Programs) and Ms. Yvette Collazo (EM-1 Senior Advisor). FIU's Project Technical Plans were reviewed and discussions on FIU's Year 3 scope of work were carried out. DOE-HQ comments and input for each one of the five DOE-FIU cooperative agreement PTPs were discussed and path forward identified.

- Project 1 A summary document for milestone 2012-P1-M15.1 was completed on time and sent to DOE HQ and site personnel on 8/15/2012.

- Project 3, Milestone 2012-P3-M1.1 was completed and a progress summary sent via email on 09/14/12 to the relevant DOE personnel providing information related to the XPSWMM model preliminary configuration parameters.

- Project 4 Milestone 2012-P4-M3.1, deployment of the SRS ISSC report integration into D&D KM-IT for DOE for review and testing, was successfully completed and sent to DOE personnel on July 12, 2012, a day earlier than scheduled.

- Project 4 Milestones 2012-P4-3.2, the deployment of the global search feature on D&D KM-IT to DOE for review and testing, was completed and sent to DOE on 8/17/2012.

- Project 4, Milestone 2012-P4-M2.1 (due date 09/30/12) was revised based on shipping delays from the equipment manufacturer which will delay test start date. The revised date

reflects the system arrival in October; therefore, completion of Meso-Scale Testbed System Demonstration has been re-forecasted to be completed on 11/23/12.

- Project 4 Milestone 2012-P4-M3.4 (deployment of the D&D Dictionary to DOE for review and testing) was completed by the due date of 9/28/2012.

- Project 5 Milestone 2012-P5-M3 "DOE Fellows Complete Summer Internships" was completed by the due date of 08/31/12. Technical Internships reports will be prepared by DOE Fellows and completed by 10/19/12.

- All projects successfully completed the milestone related with abstracts submission to the Waste Management Symposium 2013. A total of 11 professional abstracts were submitted by the due date of 08/17/12. The abstracts are based on the DOE-EM applied research being conducted as part of the DOE-FIU Cooperative Agreement. The submitted abstracts are listed below:

    - Project 1:
        - *Design Advances of Innovative Unplugging Technologies for High-Level Waste Pipelines*
        - *Implementation of Surface Wetting Effects in Computational Fluid Dynamics Simulations Using the Lattice Boltzmann Method*
    - Project 2:
        - *Investigation on microbial dissolution of uranium (VI) from autunite mineral*
    - Project 3:
        - *Long-Term Performance of Uranium Tailings Disposal Cells*
        - *Prioritization for Remediation of Mercury Contaminated Areas in the Upper East Fork Poplar Creek Watershed, Oak Ridge, TN*
        - *Coupling and Testing the Fate and Transport of Heavy Metals and Other Ionic Species in a Groundwater Setting at Oak Ridge, Tennessee*
    - Project 4:
        - *Waste Information Management System with 2012-13 Waste Streams*
        - *Application and Removal of Strippable Coatings via Remote Platform and Sensor*
        - *Network Demonstration for In Situ Decommissioning*
        - *Knowledge Framework Implementation with Multiple Architectures*
    - Project 5:
        - *Training and Mentoring the Next Generation of Scientists and Engineers to Secure Continuity and Successes of the DOE's Environmental Remediation Efforts*

- Approximately an additional 20 abstracts will be submitted by DOE Fellows and ARC students that are projected to attend and present at WM13's Student Poster Exhibition and Competition. All students' abstracts and posters will reflect their "hands-on" applied DOE-EM research being conducted as part of the DOE-FIU Cooperative Agreement.

Project 1
Chemical Process Alternatives for Radioactive Waste

Project Manager: Dr. Dwayne McDaniel

Project Description

Florida International University has been conducting research on several promising alternative processes and technologies that can be applied to address several operational shortcomings in the current high-level waste processing strategy. The implementation of advanced technologies to address challenges faced with baseline methods is of great interest to the Hanford site.
Specifically, the use of field or *in situ* technologies, as well as advanced computational methods can improve several facets of the retrieval and transport processes of HLW. FIU has worked with site personnel to identify technology and process improvement needs that can benefit from FIU's core expertise in HLW. These needs are being addressed by the following tasks:

- Task 2: Pipeline Unplugging and Plug Prevention
- Task 12: Multiple-Relaxation-Time, Lattice Boltzmann Model for Multiphase Flows in Three Dimensions
- Task 15: Evaluation of Advanced Instrumentation Needs for HLW Retrieval
- Task 16: Computational Simulation and Evolution of HLW Pipeline Plugs (New Task for FIU Year 3)

Task 2: Pipeline Unplugging and Plug Prevention

Task 2 Overview

The objective of this task is to qualify (test & evaluate) pipeline unplugging technologies for deployment at the DOE sites. Due to the lack of maturity and/or success previously demonstrated by commercial technologies, FIU has focused on developing alternative unplugging approaches during FY10-FY11. The approaches included: 1) a Peristaltic Crawler that can maneuver in the pipeline within close proximity to a plug and provide various means to remove it; and 2) an asynchronous pulsing method that utilizes pressure pulses from both sides of the plug to break the bonds between the plug and the pipe wall. During FY11, efforts focused on improving the design for the crawler and validating both methods in lab scale and engineering scale test beds.

During FY12 (FIU Year 3), FIU will work with Hanford Site engineers to optimize the design of the crawler and maximize its capabilities. FIU will also investigate alternative pressure sources for the asynchronous pulsing system to increase its effectiveness at longer distances from the pipe inlet to the blockage. Efforts will focus on developing realistic test beds and evaluating the effects of pipe geometry and plug types on the systems' ability to unblock plugs. FIU will also work with Site engineers to identify potential opportunities to test the technologies in the field.

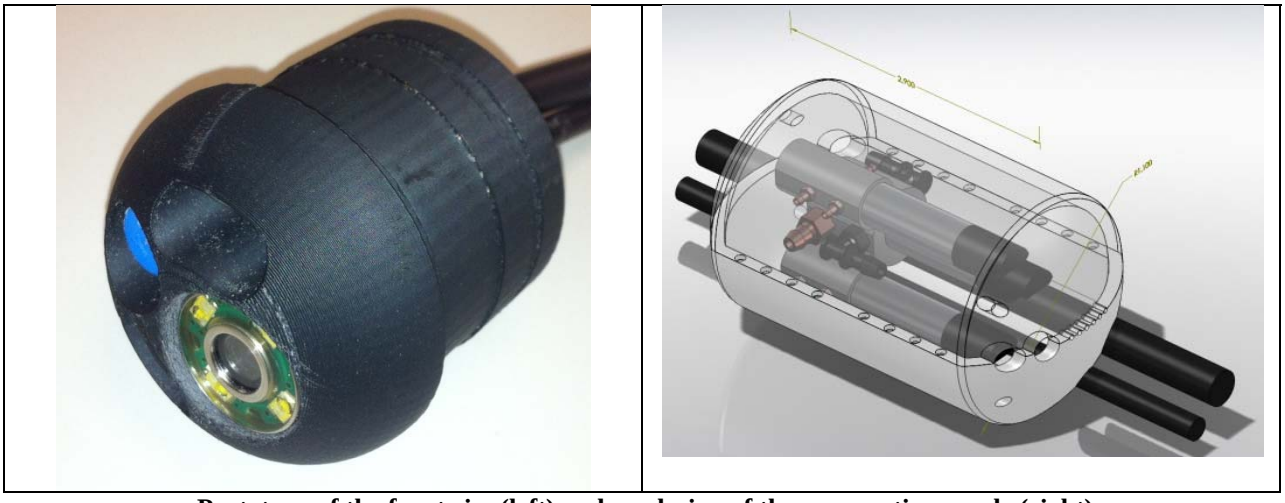
Task 2 Quarterly Progress

- For the peristaltic crawler subtask, a flexible sleeve was assembled over the outer bellow to decrease the compression time of the unit. Navigation tests were conducted using

different sleeve thicknesses on a clear PVC pipe. The best performance achieved was with a 1/16" thick sleeve providing a navigation speed of 19.63 ft/hr. The camera system that will be positioned at the front of the crawler was received and tested for functionality.

- The 3-D design of the rim and the hemisphere that will be located at the front of the crawler was completed. The front rim was modified to have an outside diameter of 2 inches and the pneumatic internal lines were relocated to provide the space necessary for the camera and hydraulic systems. In the design, the fiber optic camera is nested into the hemisphere to remain protected from making contact with the pipeline walls. A prototype of the rim and hemisphere assembly was fabricated with acrylonitrile butadiene styrene (ABS) using a rapid prototyping machine. In addition to the work conducted on the front assembly of the crawler, a capsule that will enclose the pneumatic valves was designed.

- 2-D engineering drawings for the crawler assembly were completed. Quotes for the manufacturing of the parts were received and fabrication is currently ongoing. The high pressure nozzle that will be mounted at the front of the unit was ordered and received. In addition, a prototype of the capsule that will house the crawler's pneumatic valves was fabricated and tested for functionality. The figure below shows the prototype of the front rim with the camera and a rendering of the capsule containing the pneumatic valves. Additional valves were ordered to test different pneumatic arrangements. A presentation and video of the peristaltic crawler was prepared for the 2nd Annual Nuclear D&D Supply Chain Conference. For the next period, font and back rims will be received from manufacturer and the unit will be assembled and tested for functionality. Also, the hydraulic system that operates the unplugging tool will be connected and tested.



Prototype of the front rim (left) and rendering of the pneumatic capsule (right)

- For the Asynchronous Pulsing System's (APS) subtask, previous experimental results revealed that the damping effects of air on the system's performance can be reduced through static pressurization. Due to the Hanford working pressure limit of 300 psig on most cross-site transfer lines, there exists a maximum water/air volume ratio that will

allow for the system to eliminate the effects of entrained air using low levels of pressurization, and provide maximum dynamic force loading on the blockage. If the system were be operated above this range, the static pressurization will be too close to the working pressure limit set by Hanford. This month's work concentrated on determining methods of reducing or eliminating the air from the pipeline by applying a vacuum to the pipeline, which will assist in addressing conditions where the water/air ratio will exceed those viable for optimal pulsing. A test apparatus was designed and fabricated to test vacuum pressurization of the modified test pipeline using a commercial refrigeration pump. The modified pipeline consists of an eight-foot long clear PVC pipe that has caps on both ends with valves. One end was attached to a vacuum pump while the other end was attached to a water source. A pressure transducer was attached to the system to measure the pressure inside the pipe from vacuum to a maximum working pressure of 200 psig. In addition, a Labview VI was developed to collect and analyze the pressure reading during these planned tests.

- Vacuum tests were conducted to observe the effect of residual air affecting the system performance. Tests included applying a vacuum for 25 min, 2 hrs, 4 hrs, and 8 hrs to a 70-foot long 3-inch diameter pipeline. The effect of the residual air was reduced as the vacuum duration was increased. However, at 8 hours the effect of the residual air increased. In light of this anomaly work began on researching various vacuum technologies and techniques. The clear 8-foot test apparatus that was fabricated during the previous reporting period was used to quantify the residual air and correlate it to different vacuum pressures (1 psia, 0.75 psia, 0.5 psia and 0.4 psia).

- As expected, the results showed that as the pressure is lowered the quantity of residual air in the pipe was also reduced. The 70-foot 3-inch test pipeline has been reconfigured to have a 0.5-degree slope to better simulate the site's pipelines. To measure the volume of air that remains in the pipeline, a graduated clear pipe has also been installed vertically at the inlet to the pipeline. Experiments to be conducted on the 70-foot test pipeline will include measuring the residual air in the pipeline after applying vacuum pressures of 1, 0.75, 0.5 and 0.4 psia.

Task 12: Multiple-Relaxation-Time, Lattice Boltzmann Model for High-Density Ratio, Multiphase Flows

Task 12 Overview

The objective of this task is to develop stable computational fluid dynamics models based on the multiple-relaxation-time lattice Boltzmann method (MRT LBM) that can be used to generate computer simulations relevant to the waste mixing operations. The research focus is to improve the knowledge base of modeling multiphase flow systems found in HLW tanks. Specific applications include modeling air sparger systems used in tank mixing. Understanding the fluid mechanics of the air sparger system will aid in the design and proper operation of hybrid pulse jet mixer/sparger units. The results will provide the sites with mathematical modeling, validation, and testing of computer programs to support critical issues related to HLW retrieval and processing.

During FY12 (FIU Year 3), the 3D parallel LBM code developed at FIU during FY11 will be used to obtain large scale simulations of bubble generation and liquid mixing in tanks. In order to generate the computational domains with complex geometries, a computer interface will be produced that can convert CAD data into voxels that LBM code can read. Appropriate wall boundary conditions will be implemented in the LBM code that will result in correct wetting characteristics of the fluid phases with the solid surfaces. Finally, the applicability of the LBM method for non-Newtonian flows will be investigated and possible solutions will be proposed. FIU also will work with Site engineers to integrate the modeling findings with specific field operations which will assist in the overall performance of the operation being modeled.

Task 12 Quarterly Progress

- The interface tracking model based on the Lee-Lin method in the MRT LBM code was investigated in order to evaluate whether the Cahn-Hilliard equation which is used to track the interface between fluids is obtained via the current implementation of the numerical algorithm used. In order to achieve this, derivation of the macroscopic equations from the discrete Boltzmann equations (DBEs) was performed using a Chapman-Enskog expansion procedure starting from the lattice Boltzmann equation for non-linear fluids. The result of the analysis has concluded that there are inconsistencies in the literature regarding the forcing terms used in the numerical method published by the authors of the Lee-Lin method. Dr. Lin has been contacted regarding this issue and a manuscript is being prepared outlining the procedure followed.

- A post-processing software called VisIt, developed by the Lawrence Livermore National Lab, has been investigated in order to visualize the output data obtained with the LBM code. The advantages of VisIt over Paraview is being studied and the parallel performance of VisIt was found to be superior. In addition, the CartGen mesh generator is also being evaluated to prepare STL files to be used in the LBM solver. Boundary tagging and missing-voxel fixing is underway.

- In order to obtain flow simulations in computational domains with complex geometries such as the mixing of waste in tanks with cooling coils, the methods that can convert the outputs of conventional CAD packages into a voxel representation for LBM was investigated. The suite of C++ libraries called CartGen was studied and various flaws in the algorithm has been found that needed to be fixed in order to obtain a robust and reliable process for the conversion of the surface mesh into a binary format. Instead, software called Binvox (http://www.cs.princeton.edu/~min/binvox/) has been identified and evaluated.

- The Binvox algorithm for converting CAD files into a voxelized data that LBM can read has been evaluated for a number of complex geometries. The performance of the voxelation was found to be satisfactory. The 3D LBM code was modified to integrate the voxelated geometry by the use of a new subroutine that creates an array storing the cell information ranging from 1 to 255 which is interpreted in the LBM as a solid node or a fluid node depending on the value of the cell. In addition to the identification of solid nodes from fluid nodes, this array obtained from the voxel data will be used in the future

to distinguish different boundary conditions such as inflow, outflow, periodic and surface. The bounceback routine in the LBM code is currently being updated in order to implement no-slip boundary condition on the solid surfaces. In addition, a contact dynamics procedure is identified in the LBM literature in order to implement wetting characteristics in areas where the fluid interface gets in contact with the solid boundaries. This procedure includes the addition of an external forcing term on the right hand side of the lattice Boltzmann equation for momentum conservation which calculates the attraction or repulsion force exerted on the fluids by the solid surface depending on the phobicity of the material. The method will be first validated in a 2D MRT code for varying contact angle droplet cases and then integrated in the 3D MRT LBM code.

Task 15: Evaluation of Advanced Instrumentation Needs for HLW Retrieval

Task 15 Overview

The objective of this task is to evaluate the maturity and applicability of commercial and emerging technologies capable of addressing several instrumentation needs for DSTs that will be used for HLW mixing and transport to WTP. Efforts will be focused on the instrumentation needs for tank AY-102; however, the lessons learned will be applicable to other tanks and sites.

During FY12 (FIU Year 3), based on the test results of the ultrasonic spectroscopy system (USS), FIU will evaluate the candidate technologies selected during the FY10 technology search and evaluation process, with a focus on those technologies that showed limited research and development activities during the initial search. Second, a lessons-learned document will be prepared to address technical and operational issues in the development of an in-tank bulk density meter. This meter will be a simplified version of the in-tank solids monitor (ITSM) already developed by FIU during FY09.

Task 15 Quarterly Progress

- All testing was completed at ITS facilities. A draft summary report was submitted to FIU for review. Much of the data from the testing remains to be analyzed. Analysis of the NaNO3 solutions show good agreement with the expected wave speed, and agrees with the data collected during FIU testing. The attenuation data shows that these solutions experience less attenuation than a water mixture; this behavior can be a reason for the unusual behavior seen during FIU testing. This particular issue is being evaluated. Analysis of some of the collected measurements from the initial solids loading tests shows the multiple scattering occurring in the samples with high concentration of aluminum hydroxide. The velocity values were increasing with the increase of the concentration of the solid in a mixture. The measurements collected from the suspensions of Zirconium oxide in water showed the inversely proportional velocity to the concentration of the sample. The repeated experiment proved good reproducibility of the collected results on the low concentration system. Also the multiple scattering in the high concentrated samples was observed. The stainless steel data shows significant variations, which indicates possible sedimentation in the test vessel. All this data has not been analyzed as of yet.

- The USS vendor submitted their final test report, detailing the results of confirmatory testing. The results and conclusions indicate that the technology still suffers several technical limitations that inhibit its ability to effectively track the change in bulk density of the higher concentration slurries. These limitations are the result of the attenuation experienced by the ultrasonic pulse as it propagates through the slurry. Even with a through-transmission configuration utilized for the tests (i.e. one transducer detecting the pulse generated by another transducer x distance away), the attenuation through the complex mixtures was significant. Based on these results, FIU held a teleconference that summarized the results to Hanford. A final recommendation and path forward summary document will be prepared for in accordance with Milestone M15.2. FIU will also work with Hanford and DOE-EM personnel in defining the path forward on future instrumentation needs for the DOE complex.

Task 16: Computational Simulation and Evolution of HLW Pipeline Plugs (New Task)

Task 16 Overview

The objective of this task is to develop computational models describing the build-up and plugging process of retrieval lines. In particular, the task will address plug formation in rigid and flexible piping, with a focus on the multi-physical (chemical, rheological, mechanical) processes that can influence the formation. During FIU Year 3, based on data collected from a literature review of recent research conducted, this task will create a multi-physical model that simulates the formation of a pipeline plug, and looks at the influence of pipeline geometry/configuration on the plug development process. The task will utilize lessons learned from pipeline unplugging testing at FIU, as well as data collected during development of simulated plugs, to develop the model. Ultimately, the task will create several lab-scale tests to verify simulation results, and develop guidelines to address plug evolution, and allow site operators to modify the retrieval parameters in the event of a possible plug formation process.

Task 16 Quarterly Progress

- As the success of this particular task depends on the advancement of plug formation knowledge base from prior efforts, it was necessary to identify and review all the relevant prior research. A plan for a literature search and review was developed. The relevant search queries and variants were identified, and major search engines were selected. The literature search and review focused on the chemical, rheological and physical mechanisms that contribute to plug formation in HLW pipelines. The mechanisms identified thus far include solids settling, depositions at pipe elbows and constrictions, and surface deposition and crystallization. In addition, the literature was reviewed to pinpoint slurry transport models that simulate plug formation (Mississippi State University, PNNL). It is expected that many of these models can be utilized in the formation of a multi-physical model that will provide insight into the mechanisms at play during plug formation.

- The initial literature review for this task focused on the influence of piping components on the solids build-up and formation of plugs. Gaskill et al. (1996) observed a decrease in flow due to solids build-up in the 3-way valve of the melter feed transfer line of the Hanford Waste Vitrification Plant. Reynolds (2000) concluded that plugs had occurred during salt well pumping at sharp turns like those of Hanford PUREX connectors on pipe jumpers found in valve pits. Moreover, plugs in cross-site transfer lines had also occurred in pipelines well away from the valve pits. Prior literature review formed a basis for the physical, rheological and chemical factors that contributed to the plug formation. The work was expanded to include the types of plugs formed from those factors in the WTP vessels. Examples include chemical plugs observed in the transfer lines in tanks 241-SX-104 and 241-U-103 reported by Lindner (2008). The crystallization of sodium phosphate dodecahydrate resulted in plug formation. The plug formed during salt well pumping of tank BY-102 was attributed to the precipitation of sodium carbonate in the waste stream.

- The literature review was further extended by focusing on the critical velocity models used to predict and prevent solids deposition in the transfer lines. Estey & Hu (1998) examined eight documented correlations (Durand, Spells, Sinclair, Zandi and Gavatos, Babcock, Shook, and Oroskar and Turian) for critical velocity using the best-estimated properties of anticipated Hanford waste slurries. The author concluded that correlation of Oroskar and Turian provided the most conservative critical velocity estimate for the vast majority of Hanford waste and is currently the basis to WTP design guide for predicting critical velocity. For process lines that transfer Newtonian slurries, the design guides states that flow in these pipelines would be turbulent and exceed an empirical prediction of critical velocity. For process lines that transfer non-Newtonian slurries, the design guides relies on pressure drop and does not impose critical velocity or turbulent flow criteria. The design guide indicates that particles will not settle in the WTP process lines with non-Newtonian slurries, contrary to findings reported by Poloski et.al (2009a, 2009b). Hence the use of current design guide for non-Newtonian slurries would result in a *decrease* in predicted critical velocities.

  A spreadsheet consisting of the papers related to critical velocity models, plugging mechanisms, types of plugs found and computational models was compiled and sent to engineers at AEM and AREVA for their feedback.

Milestones and Deliverables

The milestones and deliverables for Project 1 for FIU Year 3 are shown on the following table. A summary document for milestone 2012-P1-M15.1 was completed on time and sent to DOE HQ and site personnel on 8/15/2012. Also, milestone 2012-P1-M1.0 was completed by the submission of two abstracts to the Waste Management Symposium 2013.

Milestones and Deliverables for Project 1

Task	Milestone/ Deliverable	Description	Due Date	Status	OSTI
Task 2: Pipeline Unplugging and Plug Prevention	2012-P1-M2.1	Complete engineering scale pipeline unplugging using the asynchronous pulsing system	5/10/2013	On Target	
	Deliverable	Summary Document for 2012-P1-M2.1	5/10/2013	On Target	
	2012-P1-M2.2	Complete experimental validation of improvements to peristaltic crawler	11/09/2012	On Target	
	Deliverable	Summary Document for 2012-P1-M2.2	11/09/2012	On Target	
	2012-P1-M2.3	Complete engineering scale pipeline unplugging testing using the modified peristaltic crawler	5/03/2013	On Target	
	Deliverable	Summary Document for 2012-P1-M2.3	5/03/2013	On Target	
Task 12: Multiple-Relaxation-Time, Lattice Boltzmann Model for High-Density Ratio, Multiphase Flows	2012-P1-M12.1	Integration of mesh generation with appropriate boundary conditions in the 3D MRT LBM for simulation in complex geometries	5/16/2013	On Target	
	Deliverable	Summary Document for 2012-P1-M12.1	5/16/2013	On Target	
	2012-P1-M12.2	Investigation of multiphase LBM models for Non-Newtonian fluids and turbulence modeling	5/16/2013	On Target	
	Deliverable	Summary Document for 2012-P1-M12.2	5/16/2013	On Target	
Task 15: Evaluation of Advanced Instrumentation Needs for HLW Retrieval	2012-P1-M15.1	Complete Phase II candidate technology testing at Vendor facility	8/15/2012	Completed	
	Deliverable	Summary Document for 2012-P1-M15.1	8/15/2012	Completed	
	2012-P1-M15.2	Complete USS analysis and recommendations for Hanford	10/15/2012	On Target	
	Deliverable	Summary Document for 2012-P1-M15.2	10/15/2012	On Target	
Task 16: Computational Simulation and Evolution of HLW Pipeline Plugs	2012-P1-M16.1	Complete literature review on plug prevention methods	1/31/2013	On Target	
	Deliverable	Summary Document for 2012-P1-M16.1	1/31/2013	On Target	
Project-wide	2012-P1-M1.0	Waste Management Symposium 2013abstract submitted	8/17/2012	Completed	OSTI[1]
	Deliverable	Draft Project Technical Plan	06/18/2012	Completed	
	Deliverable	Quarterly Progress Reports (all tasks and projects combined)	Quarterly	On Target	OSTI

[1] Announcement of published journal or conference paper will be submitted to OSTI

	Deliverable	Draft Year End Report	06/28/2013	On Target	OSTI

Work Plan for Next Quarter

- Task 2: FIU will perform vacuum experiments on the lab scale 3"-pipelines that vary from 70 to 140 feet in length. Similar to the experiments conducted on the clear pipe sections, experiments will be performed on the steel pipelines to determine the maximum volume of air that can be removed from a pipeline at various vacuum pressures. This will aid in determining what effect the pipe's length has on the amount of air that can be removed and what is the optimal vacuum pressure that maximizes the Asynchronous Pulsing System's performance. In addition we will be generating pressure vs. change in volume to determine the optimal pipeline initial static pressure.
- FIU will assemble the Peristaltic Crawler System. This includes: welding together the crawler unit parts, assembling the pneumatic valves capsule, mounting the fiber-optic camera to the unit, mounting the unplugging hydraulic tool to the unit. Once the complete system is assembled, it will be tested for functionality and then its navigational performance will be evaluated. A laboratory scale testbed will be assembled consisting of two three foot long straight sections connected together by a 90 degree Victaulic® elbow. Measurements of the navigational speed of the unit in the straight sections as well as through an elbow will be recorded. Additionally, pulling force tests will be conducted that will allow extrapolating the unit's performance on longer pipeline lengths.
- Task 12: FIU will finish the implementation of the wall boundary conditions in the MRT LBM code in order to generate simulations with complex geometry from voxelated data and wetting of droplets on solid surfaces with various hydrophobicity properties. For this purpose, a new subroutine that reads the voxel data obtained from the Binvox algorithm will be developed and the bounce-back procedure in the streaming subroutine will be updated to generalize the no-slip boundary condition for all solid surfaces. In addition an extra body force will be added to the pre-streaming and post-streaming subroutines in order to implement the attraction/repulsion force exerted on the fluid phases by the solid surfaces. A paper/poster summarizing the results will be submitted to the Waste Management Symposium.
- Task 15: FIU will review the documentation/report provided by ITS on their testing of the USS. Recommendations and paths forward regarding the USS will be discussed with Site engineers and EM HQ personnel. In the event that the engineers do not wish to proceed with the USS as a potential bulk density meter, alternative strategies will be developed to utilize FIU's resources that best serve the Site's needs in HLW instrumentation.
- Task 16: FIU will continue investigating relevant literature related to pipeline plugging that includes (i) physical and chemical factors that influence plug formation, (ii) empirical correlations of critical velocity and pressure drop that are used to predict the particle deposition and settling behavior of slurries and (iii) computational models that simulate plug formation and provide an insight into the factors at play during plug formation. Efforts will also focus on gathering the initial requirements to

develop a simple model in COMSOL sand will include slurry composition data, particle size, viscosity, fluid velocity, geometry information on pipe diameter and length.

Project 2
Rapid Deployment of Engineered Solutions to Environmental Problems

Project Manager: Dr. Leonel E. Lagos

Project Description

This project focuses upon delivering solutions to environmental challenges at the DOE Hanford Site. During FY12 (FIU Year 3), FIU ARC is providing support on uranium contamination and remediation at the Hanford Site with research under Project 2. This project includes two subtasks: Subtask 1.1 – Sequestering Uranium at the Hanford 200 Area by In Situ Subsurface pH Manipulation using Ammonia (NH3) Gas; and Subtask 1.2 - Investigation on Microbial-Meta-Autunite Interactions - the effect of bicarbonate on the autunite mineral microbial dissolution and U(VI) biouptake by Arthrobacter G968.

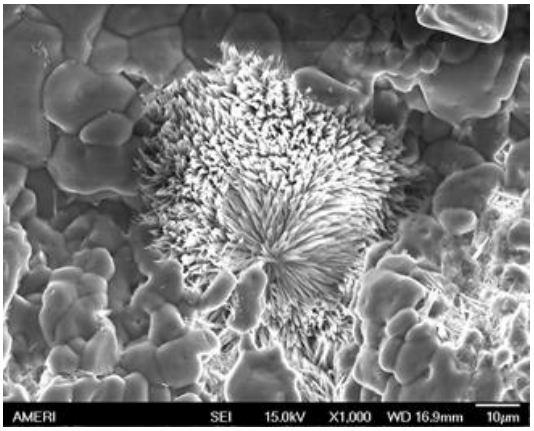
Task 1.1: Sequestering Uranium at the Hanford 200 Area by *In Situ* Subsurface pH Manipulation using Ammonia (NH_3) Gas Injection

Task 1.1 Overview

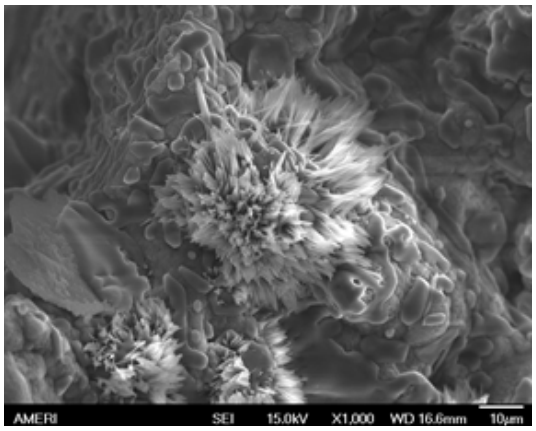
This task is being developed to evaluate the role of major pore water cations and anions on the U(VI) sequestration process in the presence of bicarbonate and calcium ions and study their effects on the mineralogy of formed precipitates after NH_3 (5% NH_3 in nitrogen) injection. The study will also examine the solubility of formed uranium precipitates under environmental conditions relevant to the Hanford vadose zone. Solubility studies will be conducted over the pH range of 6-11 in the presence of bicarbonate, calcium, and major pore water constituents such as sulfate, nitrate, Mg, and chloride. Studies will analyze mineralogical and morphological characteristics of precipitates by means of XRD and SEM-EDS to confirm the identity of the solid phase before and after solubility experiments. X-ray photoelectron spectroscopy (XPS) analysis will help in chemical identification of the samples' constituencies and uranium oxidation state to determine the mechanisms of U incorporation within a material.

Task 1.1 Quarterly Progress

- Experiments on the determination of the structure and composition of U-bearing precipitates changing over time were continued. Samples belonging to the 2nd batch prepared at the end of June were decanted, and precipitates were extracted and then placed in the incubator for drying. The sets placed for drying were #1, #2, #3, and #4 after 2 days, 2 weeks, 1 month and 2 month from the initial day of samples preparation, respectively. Additionally, the last sample from the 1st batch (3 months old, sample #7) was also dried. The morphology of samples #7 (Ca-free) and #1 for Ca-bearing set were assessed with SEM-EDS.



Crystalline structures on the surface of precipitates from the solution composed of 100 mM Si, 5 mM Al, 50 mM HCO_3^- , and 200 ppm U(VI) (sample #7 after 3month in the "mother" solution)



Crystalline structures on the surface of precipitates from the solution composed of 100 mM Si, 5 mM Al, 50 mM HCO_3^- , 5mMCa and 200 ppm U(VI) (sample #1 after 2 days in the "mother" solution)

- The samples' morphology was similar to previous observations featuring crystalline structures on the surface. However, the development of crystalline structures on the surface of Ca-free samples were noted after keeping for 1.5 months in the "mother" solution compared to two days in the set composed with the addition of 5 mM of Ca.

- New peaks from the previous XPS results were identified; these include: C-Si at 284.1 eV for carbon 1s, O-Si at 532.6 eV for oxygen 1s, and Si-O (possibly Si-O_4) at 103 eV for silicon 2p3.

- XRD was conducted for the high bicarbonate concentration sample in set #5 from the 1st batch of samples for the study of U-bearing precipitates over time. This sample consisted of 100 mM Si, 5 mM Al, 50 mM HCO_3 and 200 ppm U. Peak identification was carried out using the library provided by the software *Match!* The pattern that matched the most was the one for sodium nitrate, followed by the pattern for potassium nitrate. This might be explained by the addition of nitric acid in the sample preparation process for lowering solutions' pH, as well as the fact that the uranium added to the samples comes from a uranium nitrate stock. Another identified pattern close to that of the sample was sodium silicate; however, patterns for uranium compounds could not be identified though this software. The results obtained will be converted to the same scale as the results obtained in the past so that they can be compared, and further research will be conducted on XRD methodology to improve examination of the results.

- In an attempt to simplify the interpretation of XRD patterns from our samples, a new approach has been discussed and will be attempted. This approach entails preparation of control samples so that the control's XRD pattern can be obtained and compared to the patterns of uranium-containing samples; in this way, the presence of uranium compounds could be readily assessed. These "XRD controls" have been prepared during this period as part of a new 3rd batch of samples for the U-bearing precipitates over time study. This 3rd batch is different from the first 2 batches in the sense that 2 main sample solutions

were prepared from which, when the time comes, smaller samples will be extracted and set to dry. The point in doing this is that all samples over time will be extracted from the same aging source instead of preparing separate samples for each aging time. In order to ensure that each extraction will be homogeneous, the main sample solutions will be vortexed before the extraction. The variation between the 2 main sample solutions is the bicarbonate concentration: one sample of 100 mM Si, 5 mM Al, 3 mM HCO3, 5 mM Ca, and 238 ppm U and another one of 100 mM Si, 5 mM Al, 50 mM HCO3, 5 mM Ca, and 238 ppm U. From this 3rd batch, sample set #1 was extracted 5 days after sample preparation, and placed in the incubator for drying for future analysis. It should be noted that it was decided to increase the uranium concentration in this 3rd batch in an attempt to improve the identification of uranium's effect in the formation of the precipitates through the various analysis.

- Experiments on the determination of the structure and composition of U-bearing precipitates changing over time were continued. The uranium content in the supernatant solutions decanted previously from samples sets #1, #2, #3, and #4 were assessed with kinetic phosphorescence analyzer (KPA). Also, samples to the 3rd batch prepared at the beginning of August were decanted, and precipitates were extracted and then placed in the incubator for drying. For the set #3 the samples placed for drying were #1, #2, #3, and #4 after 2 days, 2 weeks, 1 month, and 2 month from the initial day of samples preparation, respectively.
  The variation between the 2 main sample solutions tested is the bicarbonate concentration: one sample of 100 mM Si, 5 mM Al, 3 mM HCO3, 5 mM Ca, 230 ppm U and another one of 100 mM Si, 5 mM Al, 50 mM HCO3, 5 mM Ca, 230 ppm U. Also, one extracted sample from each of the 2 sample solutions were centrifuged for 5 minutes at 4000 rpm.

- The U(VI), Si, Ca and Al content in the supernatant solutions decanted previously from samples sets #1, and #2, were assessed with kinetic phosphorescence analyzer (KPA) and ICP-OES. Data showed that supernatant solution of samples amended with 5mM Ca and 50mM of HCO_3 were lower in U(VI) and Ca content compared to samples prepared with 3mM HCO_3.

- Preparations of experiments that include 5mM of magnesium (Mg) in the synthetic mixture were iniciated. The initial testing to evaluate the removal percentage of U(VI) included preparation of two sets amended with 0 and 2.9mM of bicarbonate for six different Si/Al ratios (1, 10, 20, 30, 40, and 50). The concentration of Al in the solution mixtures remained 5mM. After adjustment of pH and injections of NH_3 until pH reached 11, samples were amended with 2ppm U(VI). After keeping for 2 days in the incubator/shaker, samples were centrifuged and supernatant solutions were processed with KPA for U(VI) content. The experiment is on-going to analyze for TOC and Si, Al, Ca and Mg using Shimadzu TOC analyzer and ICP-OES.

- A manuscript authored by Ravi K. P. Gudavalli, Yelena Katsenovich, Dawn Wellman, Leonel Lagos, and Berrin Tansel entitled, "Effect of bicarbonate on the dissolution of

sodium meta-autunite," was submitted to the Geochimica et Cosmochimica Acta for peer-review.

- Finalized a journal manuscript entitled "Quantification of kinetic rate law parameters for the dissolution of sodium meta-autunite as a function of aqueous bicarbonate concentration" and submitted it in the Geochimica et Cosmochimica Acta. The manuscript quantifies the dissolution of synthetic Na-autunite and presents calculations for kinetic rate law parameters under bicarbonate concentrations ranging from 0.0005 to 0.003 M, pH 6 to 11 and temperature variations from 5 to 60^{o}C. Results indicate the activation energies were unaffected by temperature and bicarbonate concentration variations, but were strongly dependent on pH conditions. As pH increased from 6 to 11, activation energy values were observed to decrease from 29.94 kJ mol^{-1} to 13.07 kJ mol^{-1}. The calculated activation energies suggest a surface controlled dissolution mechanism. Geochemical modeling results supported an increased dominance of aqueous uranyl hydroxide and bicarbonate complexes as a function of pH. The presence of these complexes decreases the chemical affinity of uranium within the system and concurrent increase in the dissolution rate of synthetic sodium autunite. The calculated theoretical and experimental values of U(VI) rate of release differ within a ±10% error range.

- Two graduate students, Robert Lapierre and Claudia Cardona finalized internship final reports. Robert Lapierre report entitled "Single pass flow-through testing method" presents results on the extensive SEM/EDS training received over the duration of the internship and the knowledge he gained by learning SPFT testing protocol. Claudia report entitled "Database of groundwater pump-and-treat systems" presented a database on ten DOE sites using pump-and-treat (P&T) systems for groundwater remediation and summarizes the P&T area, contaminants of concern (COC), contaminants treated, capital and maintenance costs, year of operation, status, gallons treated, and life-cycle costs.

- Continued review of uranium solubility literature for the preparation of laboratory set up.

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

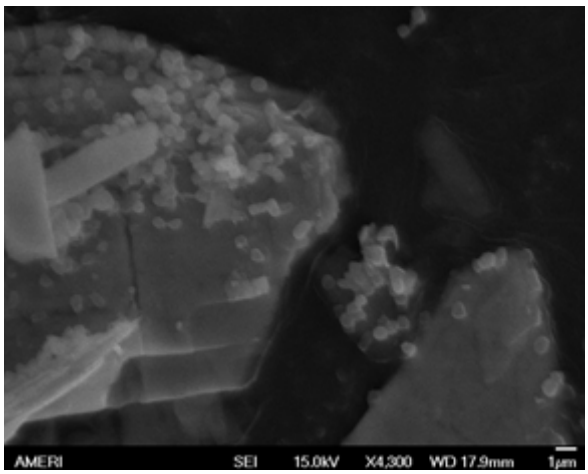
Task 1.2 Overview

The objective of this task is to examine microbial- uranium interactions that include biodissolution of autunite mineral and bio-adsorption of uranium (VI) in the presence of bicarbonate ions. The experiments will involve oligotrophic microbial species *Arthrobacter* spp. that have previously been isolated from Hanford Site soil to study their influence on the dissolution of meta-autunite. Our previous results showed that the *Arthrobacter* G975 strain bioenhanced the dissolution of the natural Ca-autunite in the presence of various concentrations of bicarbonate up to 10 mM and was able to dissolute U(VI) even while not in direct contact with the mineral. Cells exposed to U(VI) in the presence of bicarbonate were more active in TOC degradation compared to those without bicarbonate, attained higher cells densities, and colonized deeper and larger regions of autunite crystals. The study planned for 2012 will attempt to examine mechanisms of bacterial dissolution of autunite mineral to understand the interaction of the microorganisms with the meta-autunite.

In addition, experiments on the mechanisms of U bioleaching from autunite mineral will include autunite dissolution in the low-phosphorous growth media substrate augmented with various concentrations of bicarbonate, which is left after culturing G975 and G968 strains. These experiments will supplement a study conducted with cultureware where autunite and bacteria were separated by a 0.45 um membrane and help to understand if organic acids produced by microorganisms may play a role in the solubilization of U(VI). Post-experimental assessment of bacteria and mineral will apply SEM-EDS and FIB/SEM methods to characterize bacteriauranium interactions during U(VI) leaching as well as possible biogenic transformations that might occur during the dissolution.

Task 1.2 Quarterly Progress

- Dehydrated samples of G968 cells from the bio-dissolution experiments in the mixed reactors free of bicarbonate and amended with 5 mM and 10 mM of bicarbonate were analyzed via SEM/EDS. SEM images showed strong attachment of bacteria to the autunite surface along with the secondary minerals created during dissolution.



Attachment of G968 cells to the autunite mineral surface in the media solution amended with 10mM of bicarbonate

- Initiated dissolution experiments using cultureware with inserts. Autunite leaching solutions were made from 5% minimal PTG media consisting of 5 g/L peptone, 5 g/L tryptone, 10 g/L glucose, 0.6 g/L $MgSO_4.7H_2O$, and 0.07 g/L $CaCl_2.2H_2O$. Yeast extract, due to the high phosphorus content, was not included in the media. Media was prepared in deionized water (DIW), autoclaved at 121^oC, 15 psi for 15 minutes, and allowed to cool down to about 30^oC. Then the media solution was equally distributed between four 250 ml bottles and separately amended to contain 0, 3 mM, 5 mM and 10 mM of $KHCO_3$. Media pH in each bottle was adjusted to pH 7.5 with 0.1 mol/L HCl or NaOH and buffered with 20 mM 2-(2-hydroxyethyl)-1-piperazine ethanesulfonic acid sodium salt hydrate (HEPES-Na). Each bicarbonate media solution was filter-sterilized (0.2 µm) and kept refrigerated until the time of the experiment. Periodically, 0.2 uL sample aliquots were ashed on a hot plate in the presence of concentrated plasma grade nitric acid and hydrogen peroxide solutions. Wet digestion in 7-ml scintillation glass vials was continued until a dry white precipitate was obtained, then vials were dry ashed in a furnace at 450^oC

for 15 min to prepare for the KPA instrument uranium analysis.

- Continued dissolution experiments using cultureware with inserts. 20 µL samples aliquots were taken according to the sampling schedule and ashed on a hot plate in the presence of concentrated plasma grade nitric acid and hydrogen peroxide solutions. Wet digestion in seven mL scintillation glass vials was continued until a dry white precipitate was obtained, then vials were dry ashed in a furnace at 450^{o}C for 15 min. On the fifteenth day of sampling, 5,700,000 G968 bacterial cells were inoculated into all wells (excluding wells 1, 5, 9 and 13 served as abiotic controls). The samples were analyzed by means of KPA with a dilution factor of 200. However, because the results were incongruent with previous studies, it was necessary to scrap the work and restart the experiment. To restart experiments, all media preparation procedures were repeated and then the media solution was equally distributed between four 250 mL bottles and separately amended to contain 0, 3 mM, 5 mM and 10 mM of $KHCO_3$. Sterile 6-well cell culture plates with inserts were used in the non-contact bioleaching experiments where natural Ca meta-autunite and bacteria cells were kept separately. The cultureware inserts have 0.4 µm cylindrical pores that transverse the membrane and only allow the diffusion of soluble uranium. Ten mg (10 mg) of sterilized autunite powder was added to the bottom of each well. A 3.2 mL aliquot of sterile media was dispensed in the appropriate well and 2.5 mL inside the insert receptacle. The total volume inside each well added up to 5.7 mL.

- 20 µl samples aliquots were taken according to the sampling schedule and ashed on a hot plate in the presence of concentrated plasma grade nitric acid and hydrogen peroxide solutions. Wet digestion in seven ml scintillation glass vials was continued until a dry white precipitate was obtained, then vials were dry ashed in a furnace at 450^{o}C for 15 min. On the fourteenth day of sampling, 396,666,667 cells/mL G968 bacterial cells were inoculated into all wells (excluding wells 1, 5, 9 and 13 served as abiotic controls). The samples were analyzed by means of KPA with a dilution factor of 200. The KPA results are currently being analyzed. Preliminary results, however, indicate that data points were too high, and do not correlate with previous data conducted with a different bacterial strain.

- The revised manuscript entitled, “The effects of aqueous bicarbonate and calcium ions on uranium biosorption by *Arthrobacter* G975 strain," was submitted back to the Chemical Geology journal, after peer review, and accepted for publication on Aug 17.

- The abstract entitled “Investigation on microbial dissolution of uranium (VI) from autunite mineral” was submitted to the 2013 Waste Management Symposia and was accepted in an Oral Session #097.

Milestones and Deliverables

The milestones and deliverables for Project 2 for FIU Year 3 are shown on the following table. Milestone 2012-P2-M1 was completed on time by the submission of one abstract to the 2013 Waste Management Symposium.

FIU Year 3 Milestones and Deliverables for Project 2

Task	Milestone/ Deliverable	Description	Due Date	Status	OSTI
Task 1.1: Sequestering Uranium at the Hanford 200 Area Vadose Zone by *In Situ* Subsurface pH Manipulation Using NH3 Gas	2012-P2-M2	Completion of testing on the formation of U(VI)-bearing precipitates using various Si:Al ratios in the presence of bicarbonate	11/30/2012	On Target	
	Deliverable	Subtask 1.1 Progress report on over time morphological changes of U-bearing precipitates' via SEM/EDS.	1/11/2013	On Target	OSTI
Task 1.2: Investigation on Microbial-Meta-Autunite	2012-P2-M3	Completion of AFM assessment on bacteria exposed to U(VI) in bicarbonate-bearing solutions.	4/30/2013	On Target	
	Deliverable	Subtask 1.2 Progress report on AFM assessment on bacteria exposed to U(VI) in bicarbonate-bearing solutions	4/30/2013	On Target	OSTI
Project-wide	Deliverable	Draft Project Technical Plan	6/18/2012	Completed	
	2012-P2-M1	Waste Management Symposium 2013 abstract(s) submitted	8/17/2012	Completed	OSTI[2]
	Deliverable	Draft Year End Report	6/28/2013	On Target	OSTI
	Deliverable	Quarterly Progress Reports	Quarterly	On Target	OSTI

[2] Announcement of published journal or conference paper will be submitted to OSTI

Work Plan for Next Quarter

- Task 1.1: Continue experiments for the removal of U using a synthetic groundwater composition and synthesize precipitates for uranium-bearing precipitates characterization studies.
  Continue assessment of previously prepared uranium-bearing precipitates via SEM/EDS, XRD and FTIR.
- Task 1.2: Finalize dissolution experiments with G968 strain using culture cells inserts and obtain training for AFM to evaluate the effect of uranium on the bacterial surface in the presence of bicarbonate ions.

Project 3
Remediation and Treatment Technology Development and Support

Project Manager: Dr. Georgio Tachiev

Project Description

The overall objective of this project is to provide technical assistance and perform research in support of the remediation efforts at the Oak Ridge Reservation. Student support for research at the Moab Site will also be provided. Research efforts will be executed in collaboration with DOE EM and DOE ORO and will be closely aligned with the ASCEM program objectives. The numerical modeling and experimental work will provide a better understanding of the fate and transport of inorganic and organic pollutants.

Task 1: East Fork Poplar Creek Model Update, Calibration & Uncertainty Analysis

Task 1 Overview

For Task 1, FIU will use the numerical model of EFPC to determine the impact of remediation alternatives on the complete hydrologic cycle, the transport overland and in surface water and rivers, sediment transport and reactions, and mercury exchange with sediments. The research will be coordinated with the site and ORNL personnel. The major objective of this task is to provide analysis of the coupling between hydrology and mercury transport within the context of decreasing the risk of D&D activities. The major deliverable of this task will be numerical and stochastic analysis of observed and computed time series for flow and contaminant concentration for NPDES-regulated outfalls within the watershed. Model simulations will be used to account for a range of hydrological impacts related to planned remediation alternatives.

Task 1 Quarterly Progress

- ***Subtasks 1.1 & 1.2***
  - A student internship involving research techniques related to these tasks such as standard procedures for performing remedial work, as well as concepts such as data quality verification, GIS mapping and familiarization with instrumentation for sampling and testing for U.S. EPA compliance, was completed with DOE contractor Sullivan International Group, Inc. in Chicago, IL, and a presentation and report submitted for review. The knowledge gained from this experience is being applied to assist in execution of these tasks.
  - A literature review was conducted related to various mercury transformation processes in the environment. A review of available and updated mercury data was also conducted.
  - The existing model is currently being reviewed and updated to incorporate available mercury data.
  - Transects with known mercury data are also being currently developed.

- The EFPC Model settings are currently being evaluated to decrease simulation time. Test simulations have been and will continue to be performed throughout the next month.
- A thesis draft has been started pertaining to the work being conducted under Project 3 Task 1.
- A poster entitled "An Evaluation of Volatile Organic Compound Contamination at Two Superfund Sites" has been submitted for review. The poster details the procedures and findings of the 2012 summer internship of which data quality assurance and quality control (QA/QC) along with data management processes can be directly applied to the development of timeseries.

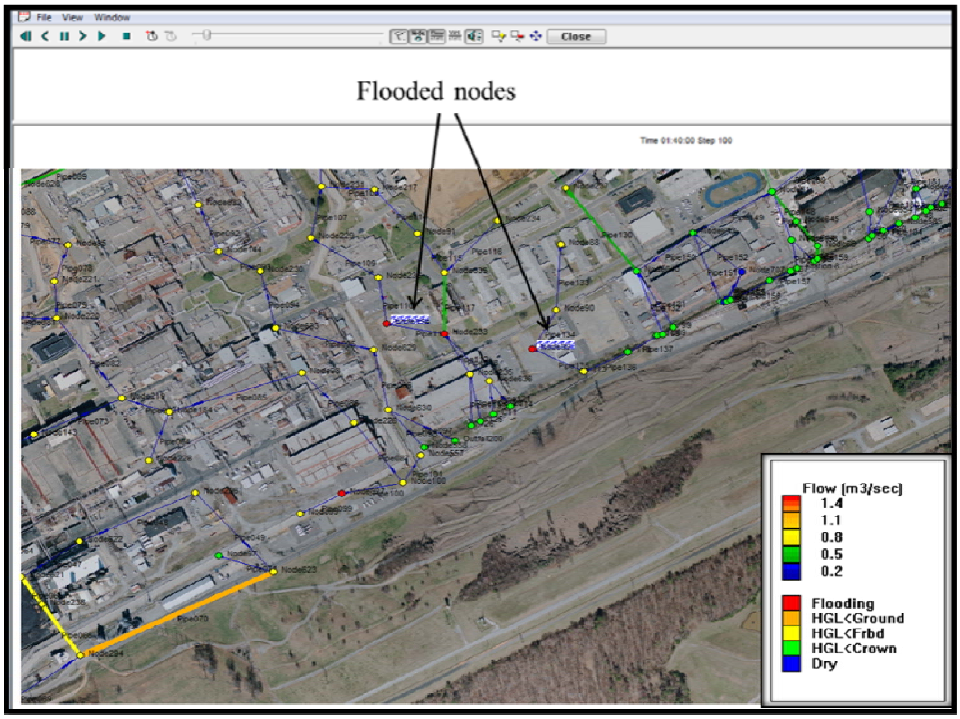
- ***Subtask 1.3: Surface Water Flow and Contaminant Transport Model of ORNL 4500 Area***
  - Meetings
    - Water Quality Programs, Environmental Protection & Waste Services Division
      - Walked the site and took photos
      - Found flow and chlorine data for the OF211 storm trunk line
    - Engineering Department
      - Received and reviewed construction drawings
  - XPSWMM
    - Received aerial
    - Received shape files for the area of interest
    - Drew preliminary storm system
  - 'New' ATLAS Maps
    - These maps are believed to be the latest out of information found
  - ArcGIS/ XPSWMM
    - Contours: Isolated area of interest via ArcGIS to make file smaller for XPSWMM to read and create a DTM.
    - Storm drains: Received 'new' atlas drawings via ArcGIS and isolated area for model.
    - Redrew system in model based on GIS 'new' atlas drawings
  - Issues/Assumptions
    - 'New' ATLAS drawings have inconsistencies.
      - Inlet to the west of MH211-3 is not shown on the drawing
      - Inlet east of 4500N Wing 1 is shown on the left of the centerline (should be on the right per field reviews)
      - Inlets east of 4500N Wing 2 are either not shown or have no symbol
      - East storm drain believed to end just east of the MH near 4500N Wing 3 (indicated by old drawings seen from Elizabeth Wright via MapInfo)
    - ArcGIS storm drain files do not contain correct elevation attribute tables.
    - Some inverts, manhole, and inlet elevations are unknown. Will make reasonable assumptions from surrounding or similar data.
    - Assumptions will be made for the building area contributing to the roof drains.
    - A single lateral for each building (possibly 2 if needed) will be shown in places where there are multiple storm laterals/roof drains because there is an overwhelming amount to begin with. There will be as a constant 2 gpm/lateral for

condensate and/or cooling water discharging into the system. The 2 gpm/lateral is an estimate provided by the ORNL Engineering Department.

- ***Subtask 1.3a: Surface Water Flow and Contaminant Transport Model of ORNL 4500 Area***
  - Preliminary research related to this task was carried out during an on-site student internship in collaboration with Eric Pierce at ORNL, to develop a replica of the storm water management system of ORNL's Outfall 211 and its contributing drainage areas using XPSWMM modeling software in order to assess flood risks. Based on availability of data, modifications to the work scope were made to incorporate:
    - Flood risk analysis of the following storm events:
      - 25 year – 24 hour
      - 100 year – 24 hour
      - 500 year – 24 hour
    - Probability of exceedance analysis of outfalls within the domain
    - Probability distribution function analysis of outfalls within the domain
  - Based upon the modified work scope, new internal deadlines have been set for completion of simulations as well as analysis and reporting of results.
  - Drew profiles for the 53 link – 52 node network.
  - Input node parameters into the model:
    - Ground elevation (spill crest elevation)
    - Invert elevation
  - Input link parameters into the model:
    - Diameter
    - Length
    - Slope
    - Manning's roughness coefficient
  - Completed and submitted the XPSWMM preliminary model configuration parameters to DOE.
  - Refined the XPSWMM stormwater model by the following revisions:
    1. Input user inflow for AC units.
    2. Input stage-stage for Boundary Condition.
    3. Input infiltration parameters (Horton's equation).
    4. Revised Outfall 211 node by adding a storage area held back by a weir prior to its discharge via an orifice.
  - Completed a Technical Report of the internship at ORNL outlining the research conducted for this subtask.
  - A student thesis is also being developed based on the research being carried out for this task and a first draft has been written and submitted for review.

- ***Subtask 1.3b: Surface Water Flow and Contaminant Transport Model of Y-12 NSC***
  - A one-dimensional surface water model of the Y-12 NSC was created using XPSWMM. This test model consists of:
    - Runoff mode (70 sub-catchments and 70 nodes).
    - Hydraulics mode (298 nodes and 311 links).

- Much of the data for this study area is currently unavailable due to security restrictions, therefore parameters used in this test model (rainfall data, location and elevation of nodes and pipes, etc.) were assumed.
- Infiltration was calculated using the Horton method.
- An imported GIS file was used to locate the outfall locations of Y-12. All the flows were linked to these outfalls.
- The test model was run for a 24-hr period and the flow at each outfall and pipe generated.
- A draft report of work conducted to date was prepared and will serve as a working document which will be continuously updated as data becomes available and results are generated throughout the project period.
- Adjustment of sub-catchments and pipes.
- Division of sub-catchments with respect to land use (parking lot, building, irrigation, etc).
- Imported the Global Database (rainfall SCS type I, II, and III).
- Applied the global storm, rainfall SCS type II, into the model.
- The test model was run a for 24-hr period.
- Used the "Dynamic Plan View" to examine the flooding nodes or the point that the water lost from the system (Fig 1).



Flooded nodes in the system.

- Used the design tool to calculate the pipe sizes then simulated the model again (with dynamic plan view) to make sure that all the nodes are not getting flooded. Thus, the final designate pipes can carry the flow without flooding.

Task 2: Simulation of TMDL for the Entire EFPC

Task 2 Overview

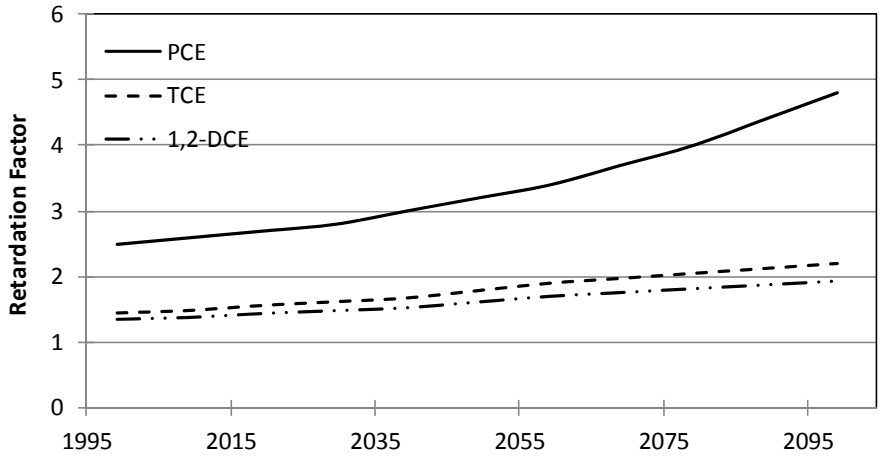
Task 2 will provide numerical analysis of contaminant flow and transport within the EFPC watershed and will determine the impact of model parameters on NPDES and TMDL regulations. During FY2012 (FIU Year 3), the objective will be to determine the effect of the hydrological events (including changes in hydrology caused by D&D activities on the site) on contaminant loading (changes in external and internal loading in time and space), and how imminent ecosystem restoration may affect existing contaminant pools.

Task 2 Quarterly Progress

- Updated and modified the hydraulic conductivities of the upper layer downstream Station 17 to improve the response of the model for high precipitation events and to provide a better surface to groundwater exchange.
- Modified water quality parameters (sorption/desorption constants) to provide a better match of observed total mercury peaks downstream.
- Updated the map of mercury concentrations in soil based on additional data reported in published reports and obtained from OREIS.
- Investigated the mechanisms of complexation and provided a summary of available equilibrium constants that influence the precipitation and dissolution of mercury species.
- Conducted sensitivity analysis of the thermodynamic constants to determine the partitioning of total dissolved species within the creek.
- Drafted a report on available thermodynamic constants.
- Collected from contractors and from OREIS updated information for contamination measurements (mercury, volatiles) within the EFPC watershed.
- Conducted 6 simulations which were used to determine the response of the most recent version of the model and to determine the match between observed and computed data.
- Identified areas of low performance of the model and worked on revising kinetic and hydrologic parameters to improve the match between observed and computed data.
- Prepared first draft of paper to be submitted to the Journal of Remediation.
- Prepared an abstract for the 9th International Symposium on Persistent Toxic Substances that will be held in Miami on October 25, the topic of the article is “Hydrologic and Kinetic Parameters Impacting the Total Mercury Transport within the EFPC Watershed, Oak Ridge Reservation”.
- Provided updates of the map of mercury concentrations in soil based on additional data reported in published reports and obtained from OREIS.
- Prepared a library of MATLAB scripts which are used for post processing and comparison of observed and computed data. Generated a series of figures which are used for presentation of the model capabilities.
- Conducted 12 simulations for the EFPC watershed using the complete model: hydrology (overland flow, flow in vadoze zone, subsurface flow, flow in EFPC), advection dispersion

modeling (overland flow, unsaturated zone, vadoze zone, flow in EFPC), and reaction kinetics and sedimentation across the entire domain. The simulations were conducted for a 10 year period. Probability exceedance figures were determined for each simulation for more than 100 monitoring points (coinciding with USGS flow, levels and well monitoring data) and selected key locations. The computed probability excedance curves were compared and compared with observed probability exceedances.

- A series of test simulations were used to show that the model response was improved along the entire EFPC river bed.
- Completed a journal article that was accepted by the Journal of Remediation. The article provides analysis Migration of VOC (PCE, TCE, 1,2-DCE) plume in the Subsurface Domain at the Y-12 Site. Considered were a range of hydrogeological and transport parameters, and the uncertainty of the results are discussed. The modeling predicted that tetrachloroethene, trichloroethene, and 1,2-dichloroethene may exceed human health-related risk levels for the next 10 to 20 years. It was determined that the contamination is unlikely to migrate to surface water under the current hydrogeological conditions and will decay below acceptable risk levels within approximately 20 years. Retardation factors were analyzed and determined for one hundred years (shown on the figure below):



Retardation factor of VOCs computed using the numerical simulation of plume migration

- Prepared a conference paper which will be submitted to the 9th International Symposium on Persistent Toxic Substances that will be held in Miami on October 25, the topic of the article is "Hydrologic and Kinetic Parameters Impacting the Total Mercury Transport within the EFPC Watershed, Oak Ridge Reservation".

Task 3: Parameterization of Major Transport Processes of Mercury Species

Task 3 Overview

The proposed FY2012 (FIU Year 3) scope for this task will focus on further understanding of the important processes in modeling the cycling of Hg in aquatic ecosystems. Experiments will be conducted to determine 1) effects of various environmental factors (pH, Eh, mineral oxides, water content, NOM (natural organic matter)) on the percentage of legacy Hg species available

for methylation and demethylation in sediment, and 2) effects of DOM (dissolved organic matter) and other complexing reagents (e.g., Cl^-) on the dissolution of cinnabar, and through which process these factors affect the dissolution of cinnabar. In addition, experiments will be carried out to investigate the effects of DOM and Cl^- on the dissolution of cinnabar.

Task 3 Quarterly Progress

- Experiments were conducted to evaluate the relative importance of thiol group versus other groups in L-cysteine in cinnabar dissolution. Effects of L-serine (a chemical containing hydroxyl group) on cinnabar dissolution was examined and compared with that of L-cysteine. The concentrations of Hg (II) released from cinnabar after shaking for 24 hours were measured to be 3.2±0.9 and 116.6±1.7 μg L-1 in the presence of L-serine and L-cysteine, respectively. The molecular structures of L-serine and L-cysteine are almost identical besides the replacement of hydroxyl group in L-serine by thiol in L-cysteine. These results indicate that thiol is the functional group in L-cysteine that promotes the dissolution of cinnabar.
- A new technique using isotope tracers is being developed to simultaneously determine the dissolution of cinnabar and re-adsorption of released Hg^{2+} on the cinnabar surface. ID (isotope dilution) - FI (flow injection) -ICP-MS coupled with isotope addition technique was developed in the past month and the feasibility of applying this technique in studying cinnabar dissolution is being test.

Task 4: Geodatabase Development for Hydrological Modeling Support

Task 4 Overview

During FY11 (FIU Year 2), FIU developed a geodatabase to support the hydrological modeling work performed by FIU which serves as a centralized data management system, making terabytes of data generated from the simulations of contaminant fate and transport accessible to all users and facilitates storage, concurrent editing and import/export of model configuration and output data. The work for FY12 (FIU Year 3) will serve to extend the geodatabase capabilities by creating a model using ArcGIS Model Builder and Python scripting that will automate the process of querying the existing EFPC geodatabase and generating maps. This can then be further extended to facilitate online querying of the database using downloadable freeware and generation of maps, graphs and reports, to more easily share the data with other project stakeholders such as DOE personnel and ORR site contractors.

Task 4 Quarterly Progress

- Literature review of the use of ArcGIS Model Builder coupled with Python scripting to automate various geoprocessing tasks and generate process flow diagrams was conducted. This is to support external query and retrieval of mercury and hydrological model data from the existing ORR geodatabase. The following are some of the documents, presentations and technical workshops reviewed:
    1. ESRI International User Conference Technical Workshops:

1. "Model Builder Advanced Techniques," Scott Murrary, July 2010.
2. "Working with Temporal Data in ArcGIS," David Kaiser, Hardeep Bajwa, July 2010.

2. ESRI Southeast Regional User Group (SERUG) Conference 2010 Technical Workshop:
    1. "Intermediate ModelBuilder," Kevin Armstrong.
3. Wikihow: "Creating time-series raster mosaics in ArcGIS 10 for Eye on Earth."
4. "Model Builder Lab," Geoinformatics, Spring 2008, Purdue University Library.
5. "Time-Series Contaminant Interpolation using ArcGIS and Spatial Analyst," Mark K. Petersen, ESRI User Conference Proceedings 2006, Paper 1326.

- The aforementioned resources were utilized, and a preliminary model was developed and tested using ArcGIS Model Builder coupled with Python scripts which:
    1. Automates the retrieval of groundwater level daily timeseries well data derived from OREIS by date
    2. Interpolates the extracted values, and
    3. Generates raster images for each day in ESRI GRID and TIFF formats.

- Conducted research to assist in development of Python scripts to enable the raster images produced to be stored in a raster catalog archived by date to facilitate visualization and animation of the temporal changes in groundwater levels for the specified study domain over a given timeframe. To date the scripts developed have enabled storage of the raster images produced in a raster catalog, however, further development is necessary for automated archival of these images by date.
- A separate model was developed using Model Builder and Python scripting to enable the export of maps from an ArcMap document within a specified data frame in PDF format. Refinement of this model is now being conducted.

Task 5: Student Support for Modeling of Groundwater Flow and Transport at Moab Site

Task 5 Overview

FIU, in collaboration with the DOE's Moab site, is using an existing groundwater numerical model to evaluate the tailings pore-water seepage in order to assist in effective dewatering of the tailings pile and to optimize the groundwater extraction well field as part of the DOE Uranium Mill Tailings Remedial Action (UMTRA) for the Moab site. The work was carried out with support from student interns who assisted in the collection of groundwater samples and site data and applied the existing groundwater and transport model (SEAWAT available from the public domain) to analyze the groundwater flow and transport data of the Moab site. The objective of this model is to analyze the nitrogen and uranium cycle in the environment and provide forecasting capabilities for the fate and transport of contamination within the Moab site and to provide information which can be used to determine the efficiency of remedial actions in reducing the concentration and load of contaminants and to assist DOE in deciding the effectiveness of remedial actions. Modeling is to be performed with MODFLOW, SEAWAT and FEFLOW as a benchmark. The main objective is to determine the effect of discharge of a legacy

ammonia plume from the brine zone after the extraction wells and injection system have been shut off. The model will be used to predict capture zones for different operating scenarios, mass removal; and time to complete remediation.

Task 5 Quarterly Progress

- Updated the Moab groundwater model with new groundwater data which was obtained from USGS and other publically available hydrological data.
- Developed plumes for the aqueous species of concern (nitrate and uranium) in the vicinity of the tailings pile and used the plumes to provide initial conditions for the simulations.
- Conducted 20 simulations for a 10 year period and worked on verification of model response in terms of statistical parameters. Analyzed areas with high errors and adjusted the hydraulic conductivities.
- Incorporated a diversion ditch into the flow model (as drain cells), currently testing the model response for the diversion ditch. Investigating the extraction flow rates.
- Obtained from the contractor a new configuration of the diversion ditch which will be implemented for control of groundwater flow and contaminant transport into the flow model.
- Conducted a series of simulations to ensure that the updated model provides a correct response with respect to seepage flow collected in the drainage ditch.
- Conducted 6 simulations for a 10 year period and worked on verification of model response in terms of statistical parameters. Analyzed areas with high errors and adjusted the hydraulic conductivities.
- Compiled an abstract for the waste Management Conference in Arizona 2013. The topic of the paper will be “Long-term Performance of UMTRA Tailings Disposal Cells”.
- Conducted a series of simulations with the new configuration of the diversion ditch to determine the degree of control of groundwater flow and contaminant transport into the flow model and the seepage flow collected in the drainage ditch.
- The hydrologic parameters of the tailings were analyzed and a series of simulations were used to provide information which showed that prescribed-head variable upper boundary condition in eliminated the errors resulting from quantifying net infiltration and evaporation through the filter layer of the cover. Model results indicate long term a uniformly unsaturated hydraulic barrier with a low unsaturated hydraulic conductivity and a low flux under a gradient of unity and that after a few decades the tailings may transmit minimal amounts of seepage to the groundwater system.
- Analyzed the gravimetric moisture contents of more than 70 tailing samples at Moab for modeling. The volume of the sample and specific gravity of the sample was analyzed to determine the percent saturation. From the analysis it was determined that the % moisture ranges from 6.5% to 92.9%, with an average of 38.5%. The fine sand samples had the lowest values (from 6.5 to 8.4%). The data were introduced into the hydrological model and a set of simulations were performed to determine the difference with the previous simulations. This provides additional information about the uncertainty of the hydrological parameters.

Milestones and Deliverables

The milestones and deliverables for Project 3 are shown in the following table. Milestone 2012-P3-M6.1 was completed with the submission of three abstracts to WM2013:

> "Long-Term Performance of Uranium Tailings Disposal Cells" (Abstract#13340), by Kent Bostick (Pro2Serve), Georgio Tachiev (Florida International University) and Anamary Daniel (Pro2Serve), submitted in the professional track;
>
> "Prioritization for Remediation of Mercury Contaminated Areas in the Upper East Fork Poplar Creek Watershed, Oak Ridge, TN" (Abstract# 13349), by Kent Bostick (Pro2Serve), Anamary Daniel (Pro2Serve) and Georgio Tachiev (Florida International University), submitted in the professional track; and
>
> "Coupling and Testing the Fate and Transport of Heavy Metals and Other Ionic Species in a Groundwater Setting at Oak Ridge, Tennessee", by Nantaporn Noosai and Hector R. Fuentes, submitted in the student track.

Milestone 2012-P3-M2.1 "Presentation overview to DOE ORO/DOE HQ of the project progress and accomplishments" due 9/21/2012, was completed ahead of schedule during a visit by Georgio Tachiev to DOE HQ in Washington D.C. on 8/21/2012.

Milestone 2012-P3-M1.1 was completed and a progress summary sent via email to the relevant DOE personnel providing information related to the XPSWMM model preliminary configuration parameters.

Milestones and Deliverables for Project 3

Task	Milestone/ Deliverable	Description	Due Date	Status	OSTI
Task 1: EFPC Model Update, Calibration, Uncertainty Analysis	2012-P3-M1.1	Finalize XPSWMM model preliminary configuration parameters	9/14/2012	Completed	
	2012-P3-M1.2	XPSWMM model preliminary results summary	11/16/2012	On target	
	Deliverable	Technical Report for the EFPC Simulations	3/1/2013	On target	OSTI
Task 2: Simulation of NPDES- and TMDL-Regulated Discharges from Non-Point Sources for the EFPC and Y-12 NSC	2012-P3-M2.1	Presentation overview to DOE ORO/DOE HQ of the project progress and accomplishments	9/21/2012	Completed 8/21/2012	OSTI
	Deliverable	Technical Report for Simulation of NPDES and TMDL for EFPC and Y-12 NSC	4/16/2013	On target	OSTI
Task 3: Parameterization of Major Transport Processes of Mercury Species	2012-P3-M3.1	Preliminary results summary of laboratory experiments	1/18/2013	On target	
	Deliverable	Technical Report for the Parameterization of Major Transport Processes of Mercury Species	2/18/2013	On target	OSTI
Task 4: Geodatabase Development for	2012-P3-M4.1	Sample Python scripts and Model Builder process workflow diagram	2/1/2013	On target	

Hydrological Modeling Support	Deliverable	Technical Report for Geodatabase Development for Hydrological Modeling Support	4/1/2013	On target	OSTI
Task 5: Student Support for Modeling of Groundwater Flow and Transport at Moab Site, Utah	2012-P3-M5.1	Moab model preliminary results summary	10/19/2012	On target	
	Deliverable	Technical Report for the Modeling of Groundwater and Flow and Transport at the Moab Site in Utah	3/19/2013	On target	OSTI
Project-wide	2012-P3-M6.1	Submit 2 abstracts to Waste Management Symposium 2013	8/17/2012	Completed	OSTI[3]
	2012-P3-M8.1	Submit publications to relevant journals	5/17/2013	On target	OSTI[4]
	Deliverable	Draft Technical Task Plan	06/18/12	Completed	
	Deliverable	Quarterly Status and Progress Summary Reports	Quarterly	On target	OSTI
	Deliverable	Draft Year End Report	06/28/2013	On target	OSTI

Work Plan for Next Quarter

- Task 1:
  - Analyze the historical outfall flow data for the area extending from WEMA to Station 17 to determine the effects of precipitation and stormwater drainage on the flux of mercury into EFPC, determine the water balance, and analyze the rainfall and the outflow data to determine the statistical parameters of fraction of rainfall data recharging the aquifer and fraction draining into EFPC.
  - Using the previously developed probability distribution models for each monitoring point, generate stochastic data for each outfall for low to high flows and low to high mercury loads. Develop correlations of total mercury mass balance with hydrology (using the calibrated model) and provide stochastic analysis.
  - Refine XPSWMM model and conduct the following simulations:
    - 25-yr / 24 hour simulation.
    - 100-yr / 24 hour simulation.
    - 500-yr / 24 hour simulation.
  - Conduct flood risk analyses for each of these simulations and generate report.
  - Create MATLAB code for probability exceedance (PE) and probability distribution function (PDF), then conduct PE and PDF analyses for the outfalls and generate report.
  - Submit Milestone 2012-P3-M1.2, XPSWMM model preliminary results summary to be sent as a memo to DOE-EM and ORNL via email, due 11/16/2012.
- Task 2:
  - Complete reports of student internships at ORR.
  - Model proposed actions to facilitate IFDP and meet load discharge standards at Station 17.

[3] Announcement of published journal or conference paper will be submitted to OSTI
[4] Announcement of published journal or conference paper will be submitted to OSTI

- Conduct simulations that will facilitate risk analysis of volatiles and inorganic contaminants (U and Hg) within the watershed of the study domain.
- Conduct an analysis of the geochemical and engineering properties of structural fill mixtures for ORR used as engineering barriers and possibly affecting hydrological flow and transport patterns within the watershed.

- Task 3:
  - Finalize the development of the new technique using isotope tracers to simultaneously determine the dissolution of cinnabar and re-adsorption of released Hg^{2+} on the cinnabar surface. ID (isotope dilution) - FI (flow injection) - ICP-MS coupled with isotope addition technique was developed over the past few months. The next quarter will focus on the use of this technique to study cinnabar dissolution and calculate the dissolution rate with the correction of the re-adsorption of released Hg^{2+}.
  - Experiments will be conducted to study the difference of reduced glutathione (GSH) and oxidized glutathione (GSSG) in promoting cinnabar dissolution.
  - A new technique, isotope dilutions (ID)-phenylation-purge and trap-ICP-MS will be developed for analyzing organomercury species at trace levels.
- Task 4:
  - Model Builder tools coupled with Python scripts have been used to create a simplified model which (1) automates retrieval of timeseries data from geodatabase, (2) interpolates extracted timeseries data and (3) generates and exports raster images of interpolated data in ESRI GRID and TIFF formats which can be used for hydrological model development. A separate model was also developed to enable the export of maps from an ArcMap document within a specified data frame in PDF format. The next quarter will be spent refining and testing this model for more complex geoprocessing tasks such as automated archival of the generated raster images and maps by date.
  - Process flow diagrams will be generated at various stages of model development to visually document the various tools and scripts utilized.
- Task 5:
  - Model update by implementing geostatistically interpolated ammonia and uranium plumes and current well operation data, use the simulations to provide maps of long term transport at the site.
  - Study the unsaturated properties of the tailings and determine how layering of the tailings affects moisture distribution.
  - Review existing reports and compare modeling results to determine the moisture distribution within the layers.
  - Determine the impact of the full hydrological cycle on moisture distribution and contaminant transport (uranium and ammonia transport).
  - Conduct simulations with the SEAWAT model to analyze the nitrogen and uranium cycle.
    - Determine spatial extent of discharge zone for ammonia legacy plume in brine zone and effect on natural flushing.
    - Implement configuration including infiltration & provide information about reoccurrence of concentrations within recharge zone assuming existence of freshwater lens.

- Determine effectiveness of running both systems at same time and derive benefits from running extraction wells.

- Submit Milestone 2012-P3-M5.1, Moab model preliminary results summary, due 10/19/2012.
- Simulate proposed remedial actions.

Project 4
Waste and D&D Engineering & Technology Development

Project Manager: Dr. Leonel E. Lagos

Project Description

This project focuses on delivering solutions under the decontamination and decommissioning (D&D) and waste areas in support of DOE HQ (EM-13). This work is also relevant to D&D activities being carried out at other DOE sites such as Oak Ridge, Savannah River, Hanford, Idaho and Portsmouth or international efforts being conducted by EM-2.1 with the Nuclear Decommissioning Authority (NDA) in England and the International Atomic Energy Agency (IAEA). Efforts on this project for FIU Year 3 include the following tasks:

- Task 1: Waste Information Management System (WIMS)
- Task 2: D&D Support to DOE EM for Technology Innovation, Development, Evaluation and Deployment
- Task 3: D&D Knowledge Management Information Tool (KM-IT)
- An additional task from FIU Year 2, Task 4: IT Support to EM and DOE Sites, did not continue into FIU Year 3.

Task 1: Waste Information Management System (WIMS)

Task 1 Overview

This task provides direct support to DOE EM for the management, development, and maintenance of a Waste Information Management System (WIMS). WIMS was developed to receive and organize the DOE waste forecast data from across the DOE complex and to automatically generate waste forecast data tables, disposition maps, GIS maps, transportation details, and other custom reports. WIMS is successfully deployed and can be accessed from the web address http://www.emwims.org. The waste forecast information is updated at least annually. WIMS has been designed to be extremely flexible for future additions and is being enhanced on a regular basis.

Task 1 Quarterly Progress

- Periodically performed database management, application maintenance, and performance tuning to the online Waste Information Management System (WIMS) in order to ensure a consistent high level of database and website performance.

Carryover funding activity
The carryover funding activity for WIMS was completed on 6/21/2012 with the

deployment of the 2012 waste forecast and transportation data onto the public server.

- FIU submitted an abstract related to this project task entitled, *Waste Information Management System with 2012-13 Waste Streams*, to the Waste Management Symposium 2013, which was accepted for a poster presentation.

Task 2: D&D Support to DOE EM for Technology Innovation, Development, Evaluation and Deployment

Task 2 Overview

For FY12 (FIU Year 3)**,** FIU will focus on assisting DOE EM-13 in meeting the D&D needs and technical challenges around the DOE complex, including the following identified D&D needs: engaging with D&D organizations in the US and abroad to keep current and active in the identification of D&D technologies for the D&D complex as this interaction with DOE sites, DOE-HQ, contractors, focus groups and organizations will lead to the potential selection, evaluation, and deployment of D&D technologies with potential application/insertion to DOE project around the Complex. Information obtained through these efforts will directly benefit the D&D KM-IT performing technology development, demonstrations and deployments such as developing a technology prototype to remotely remove strippable coatings and decontamination gels; supporting Savannah River Site's *in situ* decommissioning efforts by evaluating several sensor network power and data transmission backbones that can be applied to a large-scale grouted structure and reviewing the software-based communication protocols required to gather and analyze data autonomously; collaborating with EFCOG in the development of Lessons Learned and Best Practices; and supporting the EM-2.1 International Program and the EM-13 D&D program by participating in D&D workshops, conferences, and serving as subject matter experts.

Task 2 Quarterly Progress

- FIU submitted two abstracts related to this project task to the Waste Management Symposium 2013:
  - *Application and Removal of Strippable Coatings via Remote Platform*
  - *Sensor Network Demonstration for In Situ Decommissioning*

  The two abstracts were accepted for oral and poster presentations at the Waste Management Symposium 2013.

- In an effort to aid in the evaluation of a sensor network for *in situ* decommissioning projects at SRS, a meso-scale concrete experimental test bed has been designed and constructed at FIU-ARC in order to deploy and evaluate various sensors embedded in a specially formulated grout mixture. The construction of the FIU facility was completed by the end of December 2011. This experiment consists of using various sensors including Electrical Resistivity Tomography, Advanced Tensiometers, Piezoelectric

Sensors, and Fiber Optic Sensors (ERT, AT, PES, FOS) to measure various parameters including strain, crack detention, corrosion, fluid mobility, moisture, pH and temperature. Principal Investigators (PIs) from Idaho National Laboratory (INL), Mississippi State University (MSU), University of Houston (UH), and University of South Carolina (USC) provided the sensors. The main purpose of the experiment is to recognize the limitations of these sensors for potential future use in monitoring decommissioned nuclear facilities.

- FIU also participated in teleconference call with the ISDSN working team. Conference calls are led by SRNL with participation of team members: INL, Mississippi State University, University of Houston, and University of South Carolina, and Florida International University.
- FIU completed the design of the renewable energy system to support the two sensor systems expected to be used for additional sensor evaluation during the next federal fiscal year (October 2012). The current design was submitted to a vendor for integration into a single remote system that can be deployed near the sensor testbed located at FIU. In addition, FIU is currently collecting information on possible 500 – 1000 W wind turbines that will provide a supplemental energy source during times of low irradiance. This turbine will be coupled unto the balance system that will be used by the photovoltaic modules. The turbine will likely require a small tilt-up tower, or will be attached to the building adjacent to the testbed. Additional information is being collected with regards to installation.
- FIU collected energy consumption data on the INL's ERT system during the period. The data was collected during idle operation to determine the current minimum energy consumption required. The system currently utilizes a laptop that must be factored into the consumption numbers, although the system does not perform any operations while in idle. This laptop could be one component that can be configured for sleep in the event of idle operations. Also, the system uses an external power source to deliver the current that is injected into the media under test. This supply is also continuously running, and could be shed during idle operations. This would extend the system's operational life, and reduce energy demands on the overall system.
- At the request of the University of South Carolina's team, FIU began disconnecting the data acquisition devices from their respective sensors, unplugging loggers, removing sensors and cables. Below is a list (provided by USC) of the items that were carefully packed and shipped to the USC team:

  1 Dell laptop
  1 UPS Unlimited Power Supply
  1 pH/Temperature data logger
  1 current supply connected to the pH data logger for power
  1 RH data logger
  8 Single channel AE wireless Nodes and Base station
  2 AE sensors attached to either side of the cube (sensors placed inside a small PVC connector)
  2 100 ft. AE cables

- FIU finalized procurement process for the remote photovoltaic system that will power the two systems expected to be used as part of the additional sensor test bed demonstration. Based on demand at the components delays to the manufacturing facility, the remote system will not arrive at FIU until the first week in October. Due to this procurement delay, FIU adjusted the baseline schedule for this task to accommodate the system arrival and setup.
- FIU collected energy information from INL's ERT system. Energy monitoring equipment was procured, and setup, for long-term energy analysis. Also, FIU prepared for several ERT current injection tests, but they were postponed due to the delays on the INL side. FIU supported the ERT system remote connection troubleshooting and subsequent repair.
- FIU completed collection of the ERT system energy consumption during idle mode. The data was imported into excel for analysis. Preliminary results indicate a mean energy consumption of approximately 4 kWhr per day. This number accounts for an expected current injection of 10A for a total of 45 minutes during an ERT scanning period. The value of current injected will be validated during the ERT tests that will be performed during the system demonstrations. This energy consumption, coupled with the ERT temperature system, are in good agreement with expected values sued to estimate the total required from the backup renewable energy source.

Aerial View of In-Situ Decommissioning Test Site at FIU

- Also, FIU is working on the design of a small-scale data network system for compiling information from the sensor systems during the demonstration, and showing it on a single host machine. Design work has been focused on how to collect the ERT temperature

values from the existing logging station to the data repository (i.e. an FIU machine on the same data network). The logging station contains an application that was developed by INL for temperature data acquisition and logging. FIU is developing a new VI that will allow data collection of this temperature data, and will also configure the data to be available through Labview® shared variable engine. This will allow for data retrieval, analysis and visualization outside of the logging station. This VI contains the bare essentials to acquire the data from the temperature system, without altering the existing system configuration. The VI will be installed on the INL logging station.

- FIU began design of the support pads needed to secure the PV system to the ground. These pads are required to support wind loads up to 150 mph, in the event of a hurricane. The pads will consist of either Sonotube forms buried to the appropriate depth, or an I-beam with sufficient weight to counter the wind load forces.

Carryover funding activity

FIU is working with the technology vendor, International Climbing Machine, to complete the Phase II feasibility study for the remote removal of strippable coatings. FIU obtained a quote from the vendor based on the scope of work and is putting a contract vehicle in place with the technology vendor.

Task 3: D&D Knowledge Management Information Tool (KM-IT)

Task 3 Overview

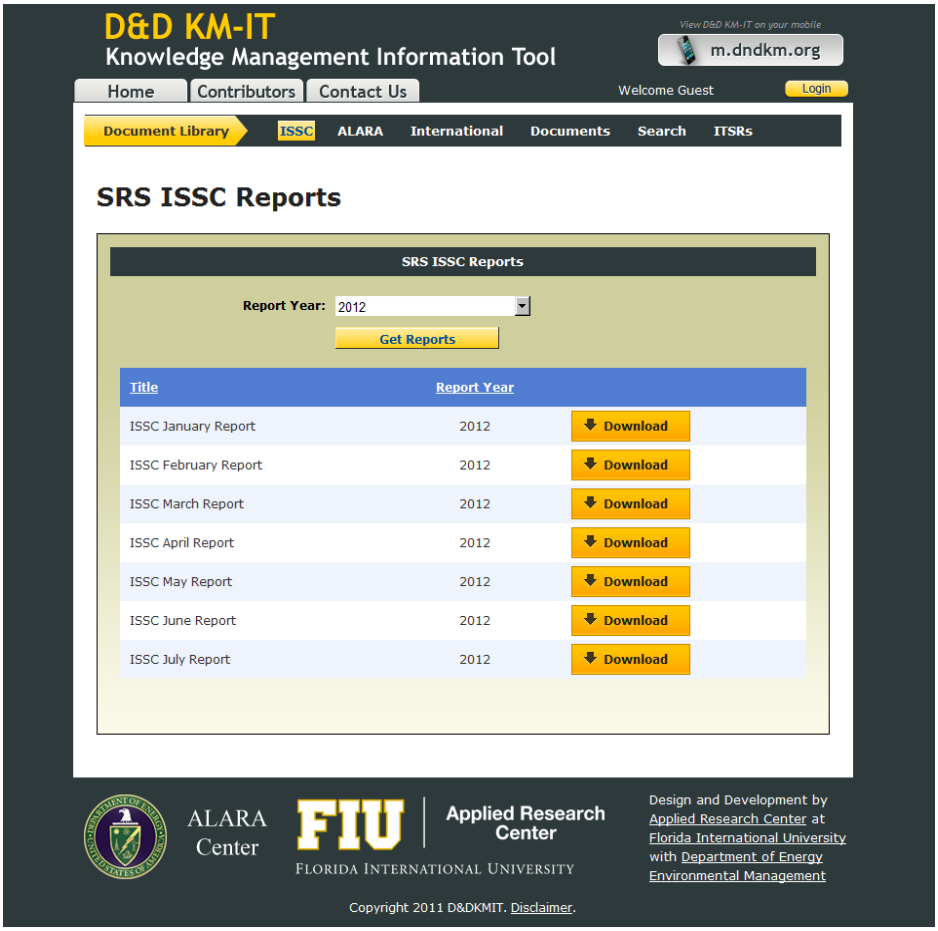
The D&D Knowledge Management Information Tool (KM-IT) is a web-based system developed to maintain and preserve the D&D knowledge base. The system was developed by Florida International University's Applied Research Center (FIU-ARC) with the support of the D&D community, including DOE-EM (EM-13 & EM-72), the ALARA centers at Hanford and Savannah River, and with the active collaboration and support of the DOE's Energy Facility Contractors Group (EFCOG). The D&D KM-IT is a D&D community driven system tailored to serve the technical issues faced by the D&D workforce across the DOE Complex. D&D KM-IT can be accessed from web address http://www.dndkm.org.

Task 3 Quarterly Progress

- Held bi-weekly teleconferences with DOE on project task status and action items.
- Made further revisions to a draft annual report on the web analytics based on comments from DOE. The purpose of the report is to take a "bird's eye view" of the web traffic on D&D KM-IT for the past year. The period covered is from February 2011 to February 2012.
- Search Engine Optimization process continues to be deployed on the D&D KM-IT web application.

- FIU successfully completed the integration of all reports from Savannah River Site's Integrated Safety Solutions Center into KM-IT on July 12, 2012. This is accessible from the Document Library section of KM-IT. The document library provides a digital archive for storing and retrieving D&D related documents. Main features of this module are as follows:

    - **SRS Integrated Safety Solutions Center (ISSC)** where the ISSC reports from 2003 to 2012 are published.
    - **International Reports** where the Sellafield Technology report is published and where any future international reports received will be available.
    - **Documents** section will contain a static links to all general documents that do not fit into other modules of KM-IT. It has one section dedicated to ARC EM D&D reports which will be expanded to include all reports related to D&D work performed by ARC for DOE HQ and field sites.
    - **Hanford ALARA** contains all of the available bi-weekly reports from the former Hanford ALARA Center.
    - **Report Search** is the implementation of the D&D web crawler for the SRS ISSC and ALARA reports. The ALARA reports are stored on the KM-IT server and are searched by the crawler using the search keywords. The SRS ISSC reports are stored on the SRS server and it is searched in real time by the D&D KM-IT web crawler. There is no duplication of reports as we search SRS reports on their server and bring the matched results links and display into KM-IT.
    - **Innovative Technology Summary Reports** (ITSRs), also known as Green Books, are also available from the D&D KM-IT Document Library.



Screenshot of SRS ISSC Reports Feature on D&D KM-IT

- FIU has been working with Sellafield Ltd to find areas of collaboration within the scope of D&D KM-IT.
    - Technical Centres of Expertise (CoEs) are invited/encouraged to register as subject matter specialists (SMS). The CoEs are Sellafield's community of recognized experts in a range of science and engineering subjects (similar to the subject matter specialists in D&D KM-IT). Four (4) SMS are currently registered from Sellafield Ltd.
    - Links to the D&D KM-IT have been placed on the Sellafield intranet for the technical organizations, along with a descriptor paragraph on its benefits. Coordination continues to get it placed on other Sellafield internal sites and through NDA.
    - Comparisons of the D&D KM-IT subject matter specialist (SMS) areas of expertise and the listing of UK Centres of Expertise (CoEs) were made. CoEs were invited/encouraged to register as SMS. Four (4) SMS are currently registered from Sellafield Ltd.
    - Report by Sellafield Ltd for the UK Nuclear Decommissioning Authority titled "Technology Development and Delivery Summary 2011-2012" has been

integrated into the D&D KM-IT Document Library and is available for download.

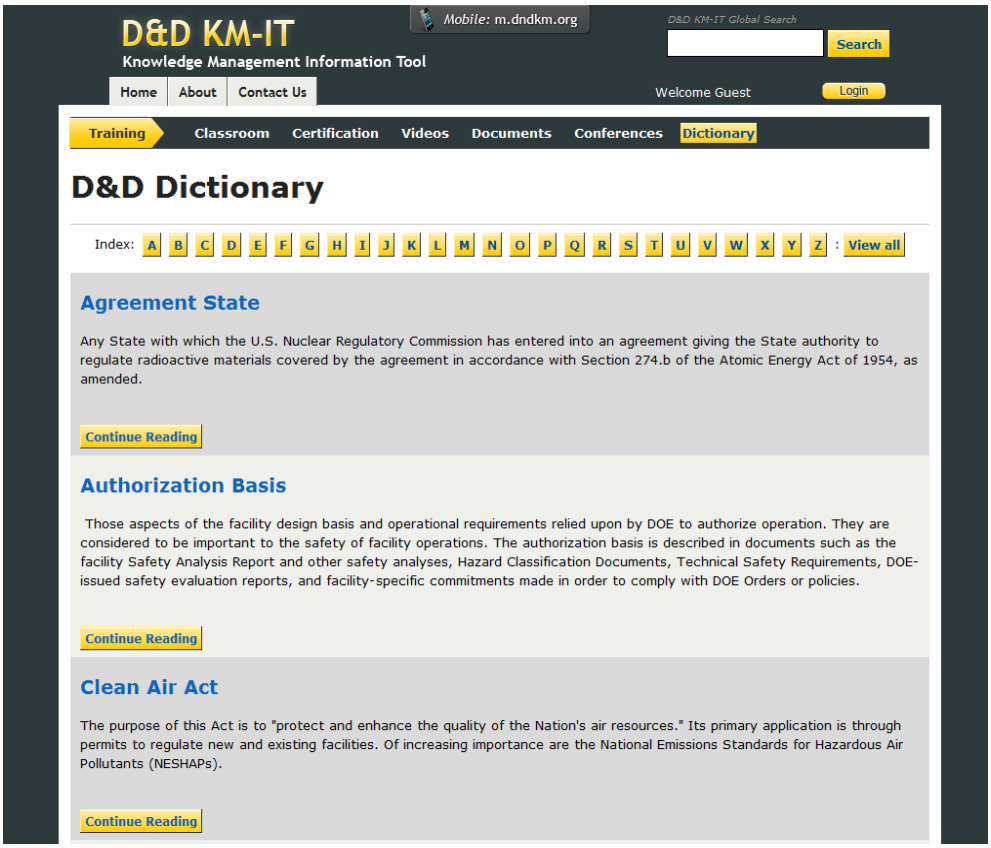
- FIU has been extracting D&D related technology information from the report for integration with the D&D KM-IT Technology Module. Initially, a description of two technologies were written and displayed within KM-IT for Sellafield review and comment.
- Sellafield reviewed the first two technologies that FIU extracted from their report and displayed within KM-IT. FIU incorporated their feedback and worked with Sellafield to resolve any issues related to integrating the technologies and associated vendor information. A total of 23 D&D-relevant technologies have been extracted from the Sellafield report and have been integrated into KM-IT for Sellafield review. Once Sellafield approves the technology and vendor information as displayed in the system, they will be made live to the public.

Screenshot of Technology Report from Sellafield in the Document Library Module of D&D KM-IT

- FIU successfully completed the Global Search Module of D&D KM-IT and it has been deployed on the staging server for DOE review and approval. The global search box appears on the top right corner of the screen on all of the modules. A user can enter a search keyword and click the search button. The global search process searches through all of the modules of KM-IT (including all documents and web screens) and displays matching results.

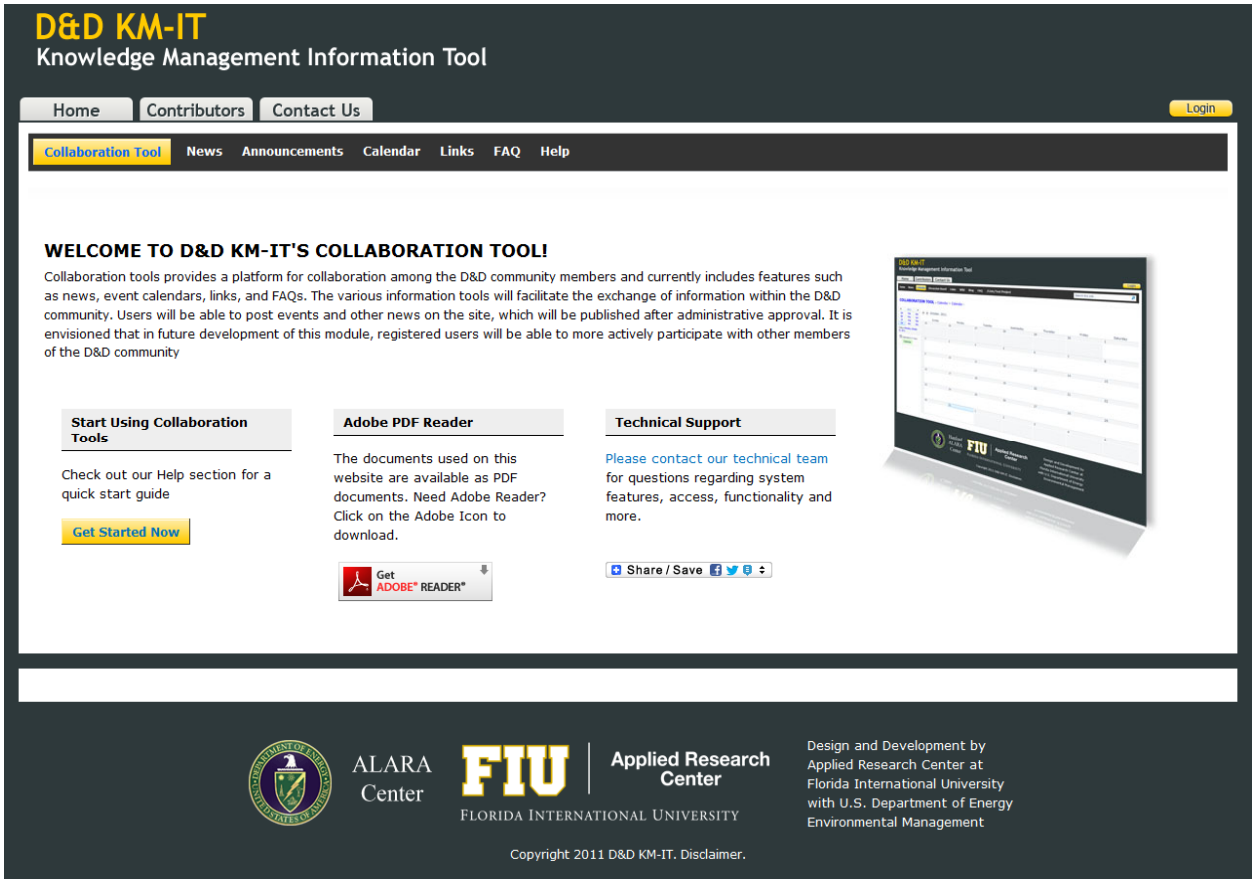
Global Search Feature at top right of D&D KM-IT Home Page.

- FIU successfully completed the development of the D&D Dictionary feature of D&D KM-IT and it has been deployed on the staging server for DOE review and approval (Milestone 2012-P4-M3.4). The D&D Dictionary is integrated into the training module and allows users the option to list keywords or to view all. The system then displays the summary results with a "continue reading" link to the details page. The D&D Dictionary has been populated with sample D&D keywords for testing and review of the functionality of the new feature. FIU is researching and collecting information on extensively searched D&D keywords, extracted from Google Analytics under the data management task. This information will be included in the D&D Dictionary once DOE has finished their review and approval of the new feature.



D&D Dictionary Feature in D&D KM-IT

- The Collaboration Tools module received DOE approval and was made live on September 20, 2012. Collaboration Tools provide a platform for collaboration among the D&D community members and currently includes features such as news, event calendars, links, and FAQs. The various information tools will facilitate the exchange of information within the D&D community. Users will be able to post events and other news on the site, which will be published after administrative approval. It is envisioned that in future development of this module, registered users will be able to more actively participate with other members of the D&D community.



D&D KM-IT Collaboration Tools Module

- FIU provides support to the D&D KM-IT user community. One registered user from Lawrence Livermore National Laboratory contacted FIU for assistance in using the D&D KM-IT system to find an answer to his question related to the possible use of liquid nitrogen to remove radiologically contaminated asbestos floor tiles. FIU provided the user with a demonstration of the various modules of the system and assisted him in performing a search for his problem within the Hotline module. An identical question had been captured from an archived Hanford ALARA newsletter (February 18, 2010) and made available within the D&D KM-IT; the user was able to review both the original question and the solutions provided and was highly satisfied.

- Another registered user contacted FIU for assistance in locating a report on various strippable coatings for radioactive materials. FIU was able to direct him to the several problems and solutions related to fixatives and strippable coatings in the KM-IT Hotline module as well as the Contamination Control Fixative List available within the Document Library. In addition, FIU provided a list of other related reports and subsequently sent him "Testing for Radiological Decontamination Strippable Coating for Cellular Bioengineering, Inc."
- Added new vendors to the D&D KM-IT vendor module. As of September 17, the Vendor module includes a total of 537 vendors. Also continued adding technologies to the Technology module from technologies identified in archived Hanford ALARA newsletters as well as technologies from the SRS ISSC newsletters and industry publications. The Technology module includes 480 technologies as of September 17, 2012.
- FIU submitted an abstract related to this project task entitled, *Knowledge Framework Implementation with Multiple Architectures*, to the Waste Management Symposium 2013. The abstract was accepted for an oral presentation.
- An article on D&D KM-IT entitled, *Deactivation & Decommissioning (D&D) Knowledge Management– A partnership between DOE, Contractors and Academia*, was published in the September-October edition of Radwaste Solutions.

Carryover funding activity

The D&D KM-IT team requested an audit of the system application and infrastructure by the FIU security team for vulnerability and issues with the system. An audit report was provided by the team which identified issues and categorized them as high, medium and low risks as well as provided control categories of management, operational and technical. FIU has resolved most of the issues identified by the internal audit team. A summary report of the audit findings and the resolutions implemented was completed and sent to DOE for their review on September 19, 2012. A follow-up internal audit will be performed within the next few months

Initiated the process of implementing Web semantics and the latest standards into KM-IT. ARC IT has developed a new template based on these standards. The new template includes placement of page elements and the addition of machine readable content which can be used by search engines for better ranking of the system. Many descriptors have been added to the template which can be picked up by popular search engines like Google and Bing as well as analytical tools like Alexa. It also provides the foundation for a uniform look across all modules and the ability to navigate to different modules from each screen. Multiple sections are added to the template for additional information on home page and child pages. The staging server has been configured to deploy the new template.

The Training Module was revised based on comments received from DOE and the collaborators from ANL and ORAU. The module was launched live on the D&D KM-IT website on July 30, 2012. The Training module provides a central location for information on D&D related training. The main features of the Training module include:

- D&D Conferences & Workshops
- Classroom Training Opportunities
- Available D&D Certifications
- Training Videos
- Training Documents

The technology module's new template was completed and sent to DOE for review on September 5, 2012. The new look is based on new HTML5 standards, machine semantic friendly HTML structure, dynamic meta data, and a more intuitive layout with element placement based on Google Analytic data. The data descriptors used are compatible with Google, Yahoo, and Bing search engines. The HTML5 standard used will help future proof the tool as well as provide a more dynamic user experience, such as animations, few page loading events, access to sharing tools, and so on. Once DOE approves of the new template, it will be used throughout the rest of KM-IT to create a unified look and feel, a more dynamic user experience, and better search engine indexing. The new template features more dynamic logins, faster access to other modules via a module list dropdown, greater page width, and larger fonts with type enhancements for more readability.

Milestones and Deliverables

The milestones and deliverables for Project 4 for FIU Year 3 are shown on the following table. Milestone 2012-P4-M3.1, deployment of SRS ISSC report integration to DOE for review/testing, was completed a day early, on July 12, 2012. Milestones 2012-P4-M1.3, 2012-P4-2.3, and 2012-P4-3.3 (submission of technical abstracts to the Waste Management Symposium 2013) were all complete by the due date of 8/17/2012. In addition, Milestone 2012-P4-3.2, the deployment of the global search feature on D&D KM-IT to DOE for review and testing, was complete on 8/17/2012. Milestone 2012-P4-M2.1 was revised based on shipping delays from the equipment manufacturer which will delay test start date. The revised date reflects the system arrival in October; therefore, the completion of Meso-Scale Testbed System Demonstration has been re-forecasted to be completed on 11/23/12. Finally, Milestone 2012-P4-M3.4 (deployment of the D&D Dictionary to DOE for review and testing) was completed by the due date of 9/28/2012.

FIU Year 3 Milestones and Deliverables for Project 4

Task	Milestone/ Deliverable	Description	Due Date	Status	OSTI
Task 1: Waste Information Management System (WIMS)	2012-P4-M1.1	Import 2012 data set for waste forecast and transportation data	Within 60 days of receipt of data from DOE	Completed	
	2012-P4-M1.2	Import 2013 data set for waste forecast and transportation data	Within 60 days after receipt of data from DOE	On Target	
	2012-P4-M1.3	Waste Management Symposium 2013 abstract submitted	08/17/2012	Completed	OSTI[5]
Task 2: D&D Support to DOE EM for Technology Innovation, Development, Evaluation, and Deployment	2012-P4-M2.1	Completion of Meso-Scale Testbed System Demonstration	09/30/2012 Re-forecasted to 11/23/2012	Re-forecasted	
	2012-P4-M2.2	Completion of preliminary prototype technology evaluation for remote removal of strippable coatings	04/26/2013	On Target	
	2012-P4-M2.3	Waste Management Symposium 2013 abstract submitted	08/17/2012	Completed	OSTI[6]
	Deliverable	Lessons Learned and Best Practices	30 days after final DOE/EFCOG approval	On Target	
	Deliverable	Draft technical reports for demonstrated technologies	30-days after evaluation/demo	On Target	OSTI
	Deliverable	Draft Tech Fact Sheet for technology evaluations/ demonstrations (ICM crawler)	30-days after evaluation/demo	On Target	
Task 3: D&D Knowledge Management Tool (D&D KM-IT)	2012-P4-M3.1	Deployment of SRS ISSC report integration to DOE for review/testing	07/13/2012	Completed	
	2012-P4-M3.2	Deployment of global search feature to DOE for review/testing	08/17/2012	Completed	

[4,5,6] Announcement of published journal or conference paper will be submitted to OSTI

	2012-P4-M3.3	Waste Management Symposium 2013 abstract submitted	08/17/2012	Completed	OSTI[7]
	2012-P4-M3.4	Deployment of D&D dictionary module to DOE for review/testing	09/28/2012	Completed	
	2012-P4-M3.5	Deployment of the multiple SMS support for the D&D Hotline	11/16/2012	On Target	
	2012-P4-M3.6	Deployment of picture lite mobile application to DOE for review/testing	01/18/2013	On Target	
	2012-P4-M3.7	Deployment of technology lite mobile application to DOE for review/testing	02/15/2013	On Target	
	2012-P4-M3.8	User interface enhancement completion	04/12/2013	On Target	
	2012-P4-M3.9	Help videos development complete and sent to DOE for review	05/17/2013	On Target	
	Deliverable	Draft Summary Report for Mobile Development Research	12/14/2012	On Target	
	Deliverable	D&D KM-IT Performance Analysis Report	Quarterly	On Target	
	Deliverable	Draft Tech Fact Sheet for new modules or capabilities of D&D KM-IT	30-days after new module deployed	On Target	
Project Wide	Deliverable	Draft Project Technical Plan	6/18/2012	Completed	
	Deliverable	Draft Year End Report	06/28/2013	On Target	OSTI
	Deliverable	Quarterly Progress Reports	Quarterly	On Target	

Work Plan for Next Quarter

- All tasks: Submit technical papers to the Waste Management Symposium
- Task 2: Complete meso-scale testbed system demonstration
- Task 3: Deploy multiple SMS support for the D&D Hotline
- Task 3: Complete Draft Summary Report for Mobile Development Research

Project 5
DOE-FIU Science & Technology Workforce Development Initiative

Project Manager: Dr. Leonel E. Lagos

Project Description

The DOE-FIU Science and Technology Workforce Development Initiative has been designed to build upon the existing DOE/FIU relationship by creating a "pipeline" of minority engineers specifically trained and mentored to enter the Department of Energy workforce in technical areas of need. This innovative program was designed to help address DOE's future workforce needs by partnering with academic, government and DOE contractor organizations to mentor future minority scientists and engineers in the research, development, and deployment of new technologies, addressing DOE's environmental cleanup challenges.

Project Overview

The main objective of the program is to provide interested students with a unique opportunity to integrate course work, Department of Energy (DOE) field work, and applied research work at ARC into a well structured academic program. Students completing this research program would complete the M.S. or Ph.D. degree and immediately be available for transitioning into the DOE EM's workforce via federal programs such as the Student Career Experience Program (SCEP) or by getting directly hired by DOE contractors.

Project Progress

- Fellows continue their support to the DOE-FIU Cooperative Agreement by actively engaging in EM applied research and supporting ARC staff in the development and completion of the various tasks. Also, the program director continues to work with DOE sites and HQ to fully engage DOE Fellows with research outside ARC where Fellows provide direct support to mentors at DOE sites, DOE-HQ, and DOE contractors.

- A total of 11 DOE Fellows completed their summer 2012 internships which began on June 4, 2012. During the month of July, the DOE Fellows provided information on their internship activities, which were added to the DOE Fellows program website (http://fellows.fiu.edu/) and are posted below.

DOE FELLOW: Heidi Henderson
LOCATION: Oak Ridge National Laboratory
MENTOR: Dr. Eric Pierce

DOE Fellow, Heidi Henderson, is currently in Tennessee for her summer internship with the Oak Ridge National Laboratory (ORNL) under the supervision of Eric M. Pierce, Ph.D., Applied Remediation Science Lead, within the Environmental Science Division. Ms. Henderson is gathering data from various departments for her thesis, Analysis of Outfall 211's Discharge. She is utilizing the XPSWMM software package to develop a conceptual storm-water management model for the contributing drainage areas of Outfall 211 as well as sources from the adjacent buildings such as cooling water and condensate from various AC units and boiler make-up water from the Creep Laboratory. Ms. Henderson is developing an approach that will be extensible to the Y-12 National Security Complex. ORNL is acting as a test bed for Y-12 because the area of interest is at a smaller scale and both facilities were built using similar construction and drainage methods.

DOE Fellow, Heidi Henderson with mentor Dr. Eric Pierce at Oak Ridge National Laboratory

DOE FELLOW: Eric Inclan
LOCATION: Oak Ridge National Laboratory
MENTOR: Dr. Prashant Jain

Eric Inclan started his internship on June 4th at the Oak Ridge National Laboratory under the mentorship of Dr. Prashant Jain. During his internship, Eric is supporting the Thermal Hydraulics and Irradiation Engineering Group (THIE, a subdivision of the Reactor and Nuclear Systems Division), conducting research in fluid dynamics and heat transfer, using computational, analytical, and experimental methods. Currently, THIE has begun the in-house development of a lattice Boltzmann computational fluid dynamics (LBM CFD) package. The program is in the very early stages of development, but will ultimately serve as a tool for the simulation of reactor fluids. If successful, the LBM CFD package can reduce the cost and risks involved with conducting research on nuclear reactors and related components.

His tasks include writing a program for tagging boundary conditions and assisting in rewriting an open-source meshing program named CartGen. Currently, CartGen imports stereo-lithography files and produces a uniform or octree mesh in a Visual Toolkit format. The upgraded version of CartGen will read the tagged input, and generate a pre-processed lattice for the LBM package.

DOE Fellow Eric Inclan with the Oak Ridge National Laboratory team

DOE FELLOW: Claudia Cardona
LOCATION: DOE-HQ EM-12 (Soil/Groundwater)
MENTOR: Kurt Gerdes

Claudia Cardona is participating in a summer internship at Department of Energy (DOE) Headquarters in Germantown, MD. She is working for the Office of Groundwater and Soil (EM-12), under the supervision of Mr. Kurt Gerdes. Claudia is assisting Mr. Paul Beam in reviewing and gathering data for the pump and treat systems located at DOE site: the location, area, major contaminants, remediation technologies, years of operation, status, gallons treated per year, capital and operating cost. Claudia is also revising the 2009 DOE Groundwater Plume Mapsbooklet and associated groundwater database. In addition, she is getting information directly from the sites to complete her assignment. This booklet compiles and shows the characteristics of contaminant plumes as well as the status of contamination and remedial approaches at major DOE sites to aid in the decision making for remediation prioritization. The compiled information will be used as an attachment to the end-states polices that are being developed by EM-12.

DOE Fellow Claudia Cardona at DOE-HQ EM-12

DOE FELLOW: Revathy Venkataraman
LOCATION: Y-12 National Security Complex in Oak Ridge, TN
MENTORS: Emma Jones, Jessica Metcalf, Dan Cannon, Andrew Dixson and Terry Richardson

Revathy Venkataraman started her internship on June 4th at Y-12 National Security Complex in Oakridge, TN. She is working on the EMBOS software under the supervision of Emma Jones and Jessica Metcalf and the EMBOS technical team Dan Cannon, Andrew Dixson and Terry Richardson.

EMBOS is an electronic medical records management system that is currently used at Y-12 medical offices to maintain medical histories, questionnaires, and manage case histories. It is also used to schedule patient appointments and store spirometry, X-ray, ECG, Vision, Audiometer and Urinalysis lab result files.

Revathy is designing and developing an automated .NET Batch Process to upload medical lab files to EMBOS oracle database. This will save time and help reduce manual work performed by lab assistants in uploading lab results to EMBOS.

Fellow Revathy Venkataraman with Dr. Lagos, other fellows and the Oak Ridge National Laboratory team

DOE FELLOW: Joshua Midence
LOCATION: Savannah River Site
MENTOR: Alez Cozzi

Joshua Midence is interning at the Savannah River Site (SRS) during the summer of 2012. Joshua is mentored by Alex Cozzi Ph.D., Materials Science.

3" x 6" cylinder salt stone sample in leaching process

Savannah River National River (SRNL) has provided support to the Z-Area Salt Stone Facility in the past by evaluating different vault pouring strategies (curing conditions) on various properties of the grout. One of Joshua's responsibilities is handling prepared simulated salt stone samples that have caustic materials infused. Joshua uses a testing method known as "leaching" in order to find the pH and conductivity of the deionized water surrounding the sample during different time intervals. He has also been measuring the compressive strength of the salt stone mixtures that are being mixed in order to absorb, some of the harsh chemicals and radio-nuclides that have been collected in the holding tanks at the Savannah River Site in Aiken, SC. Joshua is using a compression testing machine in order to measure the compressive strength of 3"x 6" cylinder salt stone samples which have different proportions of fly ash, Portland cement, and slag. He used the ASTM: C39/C39M – 12Standard Test Method for Compressive Strength of Cylindrical for all the samples tested.

DOE Fellow Joshua Midence working on a Concrete Compression project

DOE FELLOW: Jaime Mudrich
LOCATION: Oak Ridge National Laboratory
MENTOR: Dr. Prashant Jain

In the summer of 2012, Jaime interned at the Oak Ridge National Laboratory in the Reactor and Nuclear Systems Division of the Thermal Hydraulics and Irradiation Engineering group under the mentorship of Dr. Prashant Jain. During this time, Jaime assisted in the development of the lattice Boltzmann method computational fluid dynamics tool, PRATHAM-3D ({P}a{RA}llel {T}hermal-{H}ydraulics simulations using {A}dvanced {M}esoscopic methods).Jaime's tasks during the internship were benchmarking, optimization, and visualization.

To optimize PRATHAM with respect to speed and memory consumption, Jaime reviewed LBM and program optimization literature and made suitable alterations to the code. Also included in optimization efforts was the profiling of the code to see which subroutines were the most expensive and identify them as targets of optimization.

To verify the different features of PRATHAM, benchmark simulations were performed. Jaime was responsible for searching the literature for these cases and using PRATHAM to replicate the simulation. Among the features benchmarked were: density/pressure boundary conditions, velocity boundary conditions and body forcing. Benchmarking efforts were formally documented.

Jaime was also responsible for preparing visualizations of PRATHAM solutions. To prepare these images and videos, a parallel visualization tool developed by Lawrence Livermore National Laboratory called Visit was used. Jaime prepared 2D and 3D visualizations illustrating pressure, density, velocity and vortices distributions.

DOE Fellow Jaime Mudrich with Dr. Joshi at the High Flux Isotope Reactor

DOE FELLOW: Ximena Prugue
LOCATION: Washington River Protection Solutions
MENTOR: Ron Calmus

Ximena Prugue is currently a summer intern at Washington River Protection Solutions (WRPS) in Richland, WA working under Ron Calmus and Leo Thompson as part of the Strategic Planning and Technology Group. Her scope of work consists of evaluating dry retrieval technologies for solid waste in Hanford's single-shell tanks (SST) and observing the Mobile Arm Retrieval System (MARS) and control room activities. The MARS is a telerobotic arm based retrieval system capable of removing all types of tank waste including hard heel materials to well below 360 cubic feet, the allowed volume for a SST to be ready for closure. It consists of two systems: MARS-Sluicing and MARS-Vacuum. MARS-S is used for bulk retrieval on sound SSTs with waste up to 10ft in depth. Most of Ms. Prugue's research focuses on the MARS-V which is used on leaking SSTs with waste depth up to 5 feet. The MARS-V can be deployed in nearly any leaking or potentially leaking Hanford Site SST with a large diameter central riser.

In collaboration with the engineers at Columbia Energy and Environmental Services (CEES), Ms. Prugue is data mining conceptual dry retrieval alternatives based on the MARS-V system. She is investigating several high-density solids pumps that can increase the 20 vol% sludge concentration for waste transport to reduce the amount of water used in retrieval. Cross-site transfer lines, however, cannot transfer waste slurries with a concentration of sludge greater than 20 vol% and often become plugged. Therefore, in addition to high-density solids pumps, Ms. Prugue is also investigating high-volume thin-film vacuum evaporator systems to quickly dry, package, and transport the tank waste to the Integrated Disposal Facility (IDF) instead of a DST to eliminate the need of a transfer slurry line.

DOE Fellow Ximena Prugue at Washington River Protection Solutions (WRPS) in Richland, WA

DOE Fellow Ximena Prugue with mentor Ron Calmus

DOE FELLOW: Janty Ghazi
LOCATION: DOE-HQ EM-23 (Office of WTP and Tank Farm Program)
MENTOR: Dr. James Poppiti

Janty Ghazi is an electrical engineering master's student currently conducting an internship at DOE Headquarters in Germantown, MD. He is working under the supervision of his mentor, Dr. James Poppiti, at EM-23 Office of WTP and Tank Farm Program. Presently, Janty is working on reviewing various reports and documents dealing with the waste treatment plant (WTP) being built out at the Hanford Site in order to better analyze the hydrogen in pipes and auxiliary vessels (HPAV) issue. This issue deals with the formation of hydrogen, an explosive gas, within various

pipes and vessels throughout the WTP. Hydrogen is formed within the waste in three ways which include thermolysis, water and organic radiolysis, and corrosion. The reason hydrogen build up is an important issue is due to the possibility of igniting a pocket of hydrogen gas and the damage that would ensue from the resulting deflagration, detonation, or deflagration-to-detonation transition (DDT). These occurrences can lead to permanent deformation of pipes. This is of great concern in the black-cell areas of the plant which have been designed to be isolated, so repairs to that area would be extremely difficult or even impossible.

Mr. Ghazi has also worked on reviewing a request for approval of authorized limits for the release of personal property which was submitted to headquarters by the Idaho Cleanup Project. The request asks for changes to the limits for surface contamination of certain radioisotopes on personal property released to the public based on current exemptions at other DOE sites. It is important for Headquarters to carefully review such requests before approving them to make sure that they meet NRC and ANSI regulations. ALARA (as low as reasonably achievable) standards must also be strictly enforced, especially for items being released to the public.

DOE Fellow Janty Ghazi with mentor Dr. James Poppiti at DOE-HQ EM-23

DOE Fellow Janty Ghazi at DOE-HQ EM-23

DOE FELLOW: Elicek Delgado-Cepero
LOCATION: Sullivan International Consulting – Chicago Office
MENTOR: Jennifer Knoepfle

This summer of 2012, DOE Fellow Elicek Delgado-Cepero is interning at Sullivan International Consulting Group, Inc. in Chicago, IL. Under the supervision of her mentor, Jennifer Knoepfle, Elicek is learning about different phases of the remedial investigation/feasibility study (RI/FS) for EPA and Superfund sites. The Chicago office of Sullivan, Inc. has a major contract with the U.S. Environmental Protection Agency (EPA) Region 5 to perform remedial work on Superfund sites in EPA Region 5. Sullivan has approximately 25 ongoing active projects where field and office studies are underway at any given time. Several of the projects have a scope of work defined as a remedial investigation (RI) and feasibility study (FS), by which the EPA decides what remedial action, if any, is appropriate for the site. The RI/FS is part of the EPA Comprehensive Environmental Response, Compliance, and Liability Act (CERCLA) Superfund cleanup process where sites listed on the National Priorities List (NPL) undergo site characterization, delineation, and assessment of contamination extent and appropriate identification and evaluation of remedial alternatives. Therefore, at Sullivan, Elicek has performed a variety of office tasks such as performing quality control on the sample data, creating maps in ArcGIS, and learning about different instrumentation devices for field sampling of volatile organic components (VOCs). Also, fieldwork still in progress includes site characterization such as measuring structures for an estimation of areas that will be removed, properly posting the Superfund Site areas as no trespassing, and photo logging sites where work is still in progress. Additional studies including identifying contamination sources were also performed.

DOE Fellow Elicek Delgado-Cepero at Sullivan International Consulting Group, Inc. in Chicago, IL

DOE Fellows Elicek Delgado-Cepero and Lilian Marrero with other team members at Sullivan International Consulting Group, Inc.

DOE FELLOW: Lilian Marrero
LOCATION: Sullivan International Group, Inc. Chicago, IL.
MENTOR: Dr. Jennifer Knoepfle

Lilian Marrero started her internship on June 4th at Sullivan International Group, Inc. under the mentorship of Dr. Jennifer Knoepfle. Her project consists of performing a parallel study of volatile organic compounds (VOCs) contamination, specifically trichloroethene (TCE), at two Superfund sites: Industrial Site 'P' and Residential Site 'L'. The selected sites are at various stages in the U.S. Environmental Protection Agency (US EPA) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) "Superfund" cleanup process.

Industrial Site 'P' is at the end of the CERCLA Superfund cleanup process while Residential Site 'L' is at the remedial investigation/feasibility study (RI/FS) stage. Currently, groundwater and soil vapor continues to be sampled to monitor chemicals of concern (COC) changes due to past and on-going remediation and to ensure public safety at Industrial Site 'P'. In contrast, Residential Site 'L' is in the early stages of the RI; the source and extent of contamination are yet to be identified. Field samples are in the process of being collected to assess whether impacted groundwater with TCE poses a vapor intrusion threat to residents. Lilian will analyze groundwater VOC data for the years 2007 and 2012 retrieved from wells strategically placed in six distinct groundwater zones strategically equivalent to the Exposition Aquifer (Exposition Zones 'A' through 'E') that exists beneath Industrial Site 'P'. The 2007 data will serve as a baseline from which changes in contamination as a byproduct of the implemented remediation solutions may be assessed. Groundwater elevations for 2012 will be used to develop groundwater contour maps in an attempt to understand current groundwater flow patterns at the site. TCE plume maps will be developed for each zone along with chemical of concern (COC) box plots. Data extracted from 2007 through 2012 for soil sentry vapor (SSV) monitoring stations, specifically SSV-06 and SSV-07, will be reviewed in order to characterize soil gas VOCs near the residential areas adjacent to the Industrial Site 'P' Site.

Residential Site ‘L’ ground water contamination is present in the form of a plume. The contaminants of concern are chlorinated solvents (U.S. E.P.A., 2008). Soil–gas, sub-slab, and indoor air data will be collected at Residential Site ‘L’ during field visits. The data will be analyzed to determine if TCE concentrations are in violation of EPA standards. Similarly to Industrial Site ‘P’, groundwater contours, TCE plume maps and chemicals of concern box plots will be developed for Residential Site ‘L’. Based on the data analysis, an overview of the potential risk to the public as well as suggested clean up alternatives based on EPA screening criteria will be provided. If vapor intrusion is determined to be a threat at Residential Site ‘L’, then mitigation technologies will be recommended with the intent of minimizing to acceptable limits or completely eliminating human exposure to anthropogenic soil and groundwater contaminants.

During her internship, Lilian will also provide support by assisting in selected field activities, generating groundwater contours and contamination plumes in a geographic information system (GIS) for various projects, and performing quality control on chemical lab data packages, among other tasks.

DOE Fellow Lilian Marrero at Sullivan International Group, Inc.

DOE Fellow Lilian Marrero with mentor Dr. Jennifer Knoepfle

DOE FELLOW: Robert Lapierre
LOCATION: Pacific Northwest National Laboratory in Richland, WA
MENTOR: Dr. Dawn Wellman

Robert Lapierre is spending the summer of 2012 as an intern at the Pacific Northwest National Laboratory (Richland, WA) under the guidance of Dr. Dawn Wellman of the Environmental Systems Group. Over the course of 10 weeks, Robert will be trained in scanning electron microscope (SEM) analysis and perform research regarding the single-pass flow-through (SPFT) test as a system for corrosion evaluation.

In the past, SPFT testing has been done on glass, ceramics, and concrete. Mr. Lapierre's research will be part of a new approach that uses SPFT to analyze the corrosion properties of metals, in monolith form, under carefully controlled conditions. The SPFT test is a single part of a range of tests that have been grouped and used to create a model for corrosion of a material of interest. The resulting model can be used to estimate and extrapolate corrosion data to over 10,000 years.

In addition to the SPFT testing, Mr. Lapierre was trained on the SEM by a PNNL technician for the analysis of his metal samples before and after the SPFT test. Robert has contributed to

research in surfactant analysis, using a colorimetric crystal violet method to analyze surfactant content in samples.

DOE Fellow Robert Lapierre at Pacific Northwest National Laboratory in Richland, WA

- DOE Fellow, Alessandra Monetti, worked with ARC IT personnel in the update of the DOE Fellows bios on the DOE Fellows website (http://fellows.fiu.edu). Also, the website is being updated to add copies of the DOE Fellows' Waste Management posters and presentations. The DOE Fellows website has been updated to include the DOE Fellows Summer Internships Technical Reports. The reports from 2008 to 2011 are available on the website (http://fellows.fiu.edu).

- The new DOE Fellows who started at ARC in June began working with their assigned ARC mentors/supervisors on their DOE-EM research tasks. All Fellows also participated in a weekly meeting conducted by the program director, Dr. Lagos.

- The DOE Fellows prepared their DOE Fellows Summer Internship Reports which were due on 09/21/12 (internal milestone). The table below shows the DOE Fellows, summer mentors, and report titles.

DOE Fellow	DOE Site/ National Lab/ Contractor	Location	Mentor	Technical Report Title
Janty Ghazi	DOE-HQ EM-23 (Tank Farm Program)	Washington, DC	James Poppiti	Hydrogen in Pipes and Ancillary Vessels (HPAV)
Claudia Cardona	DOE-HQ EM-12 (Soil/Groundwater Remediation	Washington, DC	Kurt Gerdes	Database of Groundwater Pump-and-Treat Systems
Joshua Midence	Savannah River Site	Aiken, NC	Alex Cozzi	Saltstone Processing of Low-Level Waste at Savannah River Site
Eric Inclan	Oak Ridge National	Oak Ridge, TN	Dr. Prashant Jain	Development of Pre-processing Software for Lattice Boltzmann

	Laboratory			Fluid Dynamics Solver
Jaime Mudrich	Oak Ridge National Laboratory	Oak Ridge, TN	Dr. Prashant Jain	Development of a Parallel, 3D, Lattice Boltzmann Method CFD Solver for Simulation of Turbulent Reactor Flow
Heidi Henderson	Oak Ridge National Laboratory	Oak Ridge, TN	Dr. Eric Pierce	Analysis of Oak Ridge National Laboratory Outfall 211 Contributing Drainage Areas
Revathy Venkataraman	Y-12 National Security Complex	Oak Ridge, TN	Emma Jones/ Jessica Metcalf	Y-12 EMBOS Medical Lab Interface Batch Loader
Ximena Prugue	Washington River Protection Solutions, Hanford Site	Richland, WA	Leo Thompson	Development of Mechanical Systems for Dry Retrieval of Single Shell Tank Waste at Hanford
Robert Lapierre	Pacific Northwest National Laboratory	Richland, WA	Dr. Dawn Wellman	Single Pass Flow-Through Testing of Metals
Lillian Marrero	Sullivan International Inc.	Chicago, IL	Jennifer Knoepfle	An Evaluation of Volatile Organic Compound Contamination at Two Superfund Sites
Elicek Delgado	Sullivan International Inc.	Chicago, IL	Jennifer Knoepfle	Metal Remediation of the Zinc Site

- The Fellows have also started to present their summer internship experience as part of the DOE Fellows weekly meeting. Table below shows the presentation schedule for Fall 2012:

DOE Fellow	DOE Site/National Lab/Contractor	Location	Presentation Date
Jaime Mudrich Eric Inclan	Oak Ridge National Laboratory	Oak Ridge, TN	09/07/12
Ximena Prugue	Washington River Protection Solutions, Hanford Site	Richland, WA	09/12/12
Heidi Henderson	Oak Ridge Reservation	Oak Ridge, TN	09/19/12
Lillian Marrero	Sullivan International Consulting	Chicago, IL	09/26/12

Janty Ghazi	DOE-HQ EM-23 (Tank Farm Program)	Washington, DC	10/03/12
Revathy Venkataraman	Y-12 Security Complex, Oak Ridge	Oak Ridge, TN	10/10/12
	DOE Fellows Poster Exhibition/Competition		**10/17/12**
Josh Midence	Savannah River National Lab	Aiken, SC	10/24/12
Claudia Cardona	DOE-HQ EM-12 (Soil/Groundwater)	Washington, DC	10/31/12
Elicek Delgado	Sullivan International Consulting	Chicago, IL	11/0712
	DOE Fellows Induction Ceremony		**11/13/12**
Robert Lapierre	Pacific Northwest National Lab	Richland, WA	11/21/12
Gabriela Vasquez	ARC Research	Miami	11/28/12
Lucas Nacimiento	ARC Research	Miami	12/05/12
Dania Castillo	ARC Research	Miami	**12/12/12**

- FIU submitted an abstract related to this project entitled, Training and Mentoring the Next Generation of Scientists and Engineers to Secure Continuity and Successes of the DOE's Environmental Remediation Efforts, to the Waste Management Symposium 2013.

- **The "pipeline" created by the DOE Fellows Program is working!!!!!!** DOE Fellow, Lee Brady, joined the Department of Energy's Office of Environmental Management workforce this month!!!!

In 2010, Lee Brady graduated cum laude with a bachelor's degree in mechanical engineering from Florida International University (FIU). He continued his education at FIU where he later earned a master's degree in engineering management in the spring of 2012.

When inducted into the DOE/FIU Science & Technology Workforce Development Initiative in the fall of 2008, he dedicated his time to a project designed to solve operational shortcomings in the current high-level waste processing strategy at the Hanford Site; specifically, the ability to unplug blocked high-level waste pipelines. From 2008-2010, he worked under the supervision of Dr.

Dwayne McDaniel and Mr. Tomas Pribanic. During his senior year, with support from Mr. Pribanic and DOE Fellow Jose Matos, he successfully designed and produced the 1st functional prototype of a pneumatic crawler for unplugging radioactive waste under the metrics prescribed by the Hanford Site. The pneumatic crawler was also used for his senior design project which was titled Peristaltic Crawler for the Removal of Radioactive Plugs. The success of the prototype has paved the way for continued efforts in the development of additional prototypes thereafter. As of May 2012, the 3rd generation crawler was developed and featured major improvements to its structure and pneumatic operating system.

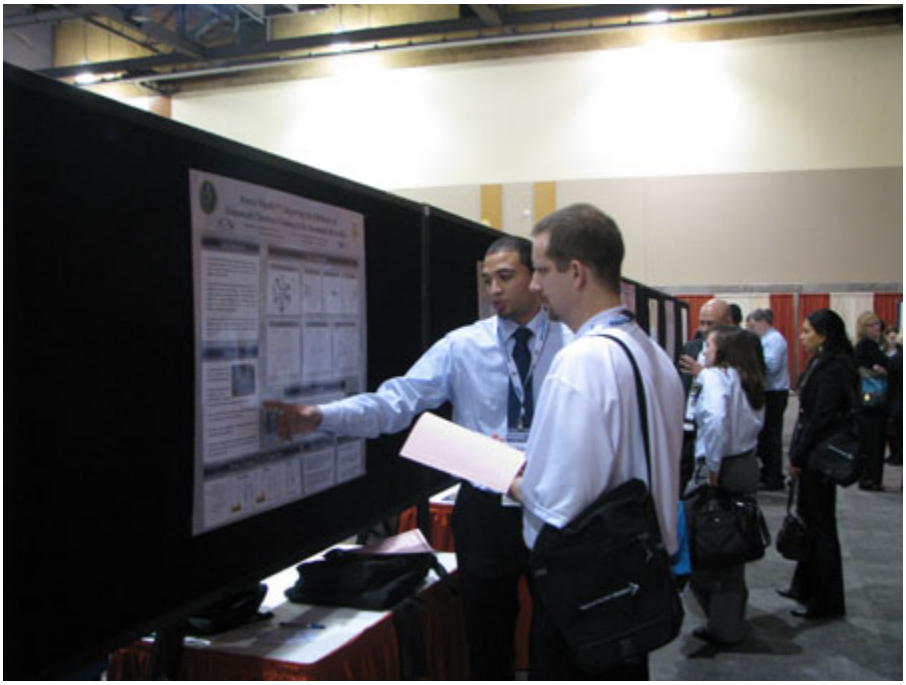
In 2009, Mr. Brady was a test engineering intern for NuVision Engineering, Inc., in Mooresville, N.C. Mr. Brady worked closely with the lead engineers to evaluate the performance during testing and modify the methods, parameters, and procedures as required. The goal of the testing was to demonstrate that NuVision's Power Fluidics™ technology is a viable mixing option to promote a fresh boundary layer, necessary for dilute-chemistry acid cleaning in the high-level waste tanks located at the Savannah River Site. When not contributing as a test engineer intern, Mr. Brady provided NuVision Engineering with 3D modeling and animations.

DOE Fellows Edgard Espinosa (left) and Lee Brady (right) with mentors at NuVision Engineering

As an engineering management student during 2010-2012, Mr. Brady contributed to multiple projects. He worked under Dr. Leonel Lagos, transcribing multiple lessons learned and best practice documents for the Energy Facility Contractors Group. Under Mr. Himanshu Upadhyay, he performed database quality control testing to the online Waste Information Management System (WIMS), ensuring a consistent high level of database accuracy. He was also significantly involved in identifying and adding D&D vendors from the Waste Management Symposia 2011 and Nuclear Plant Journal Product and Service Directory 2012 to the vendor module of the D&D KM-IT (dndkm.org).

Lee accepting poster award at 2010 Induction Ceremony

Over his four year tenure as a DOE Fellow, Mr. Brady presented his work in the 2010, 2011 and 2012 Waste Management Symposia in Phoenix, AZ. He also presented his work during the DOE Fellows Poster Exhibitions and won third place in 2010 for his research on the Peristaltic Crawler for the Removal of High Level Waste Plugs. He was involved in many other DOE Fellows' events and organized a few, including the DOE Fellows recruitment.



DOE Fellow Lee Brady presenting his research poster at Waste Management 2010 Conference

In 2011, Mr. Brady was one of six DOE Fellows to apply to the Student Career Experience Program (SCEP). From those six applicants, Mr. Brady and two other DOE Fellows were

accepted. His appointment began on May 8, 2011, in Washington, D.C. While in DC, he was involved in a broad range of program elements that included identification and development of new technologies for deactivation and decommissioning (D&D); D&D programmatic, policy, and guidance elements; and sustainability and greenhouse gas emission reduction. He aided in the development of several lessons learned documents for the demolition of the Brookhaven Graphite Research Reactor's bioshield. He also investigated non-destructive tests for characterizing concrete and alternative technologies for the demolition of unique high density concrete containing steel in confined spaces. After his SCEP summer assignment at DOE-HQ, Mr. Brady returned to FIU and to the DOE Fellows program. He also continued pursuing his master's degree in engineering management and successfully graduated in April of 2012.

Lee joined DOE-HQ on August 27, 2012, and is now a full-time federal employee working for the Office of Deactivation and Decommissioning (D&D) and Facility Engineering (EM-13) under the direction and supervision of Mr. Andrew Szilagyi.

- The DOE Fellows Fall 2012 recruitment process was also started. The DOE Fellows are actively recruiting new Fellows for the Class of 2012. During this recruitment effort, Environmental Engineering classes were targeted to encourage Environmental Engineering students to apply to the program. A total of 8 classes were targeted and DOE Fellows and the Program Director made short presentations about the DOE Fellows Program.
- DOE Fellows program was showcased by FIU administration to visitors from the Department of Defense. During this short visit, the DOE Fellows had a chance to present their DOE-EM research to the visitors and engage in a questions/answers sessions with the visitors.
- DOE Fellows attended a lecture by Rajiv Shah, who serves as the 16th Administrator of the United States Agency for International Development (USAID) and leads the efforts of more than 8,000 professionals in 80 missions around the world. The lecture, titled "Students and Universities: Leading the Future of Development", focused on how FIU can help drive the agency's priorities globally. Also, Dr. Rajiv Shah embraced and encouraged students, staff, and the entire FIU community to participate and support the efforts by USAID to facilitate development and action on critical issues worldwide.
- Preparations started for the DOE Fellows Poster Exhibition and Competition scheduled for October 17, 2012 and the DOE Fellows Induction Ceremony scheduled for November 13, 2012. For DOE Fellows Poster Exhibition and Competition, the Fellows are currently preparing their posters and getting ready for the presentations. Poster titles are shown in the table below.

DOE Fellow	Poster Title
Jennifer Arniella	High-Level Waste Pipeline Unplugging Technologies Asynchronous Pulsing System

Francisco Bolanos	Multiple-Relaxation-Time, Lattice Boltzmann Model for High-Density Ratio, Multiphase Flows
Claudia Cardona	The Effect of Ca Ions on the Removal of U(VI) at the Hanford Site 200 Area
Dania Castillo	Computational Simulation and Evolution of HLW Pipeline Plugs
Elicek Delgado-Cepero	Battery-less Wireless Sensors for Structural Health Monitoring for In Situ Decommissioning Tasks
Janty Ghazi	Hydrogen in Pipes and Ancillary Vessels
Heidi Henderson	ORNL Outfall 211 Stormwater Discharge and Chlorine Transport Model
Eric Inclan	Optimization of Asynchronous Pulsing Unit Operation
Robert Lapierre	Single Pass Flow-Through Testing of Metals
Lilian Marrero	An Evaluation of Volatile Organic Compound Contamination at Two Superfund Sites
Joel McGill	Degradation of Grout: Compressive Strength Comparitive Analysis
Joshua Midence	Salt Stone Processing of Low Level Waste at Savannah River Site
Carol Moreno	Uranium Remediation in the Hanford 200 Area by In Situ Subsurface pH Manipulation Using NH3 Gas
Jaime Mudrich	PaRAllel Thermal-Hydraulics simulations using Advanced Mesoscopic methods
Lucas Nascimento	Acoustic Pulse Reflectometry For Identifying Pipeline Properties
Raul Ordonez	Sensor Network Energy Demand
Ximena Prugue	Development of a Mechanical-Based System for Dry Retrieval of Single Shell Tank Waste at Hanford
Paola Sepulveda	Investigation on Microbial Dissolution of Uranium (VI) from Autunite Mineral
Gabriela Vazquez	Peristaltic Crawler for Removal of High-Level Waste Plugs in Pipelines
Revathy Venkataraman	D&D Technology Services Development using Windows Communication Foundation on Cloud

- DOE Fellows continued to assist EFCOG in developing Lessons Learned and Best Practices documents. As of September 30, all of the Best Practices and Lessons Learned documents were either final or sent to DOE for review and approval . FIU worked with the site point-of-contact to resolve DOE HQ comments on a lesson learned on the closure of the Reactor Maintenance, Assembly, and Disassembly Facility and the Pluto Disassembly Facility at the Nevada National Security Site. The document was then sent for final DOE review and approval. A new lesson learned for a radiological contamination event during the demolition of the Separations Process Research Unit (SPRU) building at the Knolls Atomic Power Laboratory and two new best practices on structural and electrical code guidance for D&D activities at DOE facilities were completed, reviewed by the site contacts and EFCOG, and sent to DOE for review.

Doc	BP/LL	Title	POC	Status as of 9/30/2012
1	BP	Explosive Demolition of Buildings 337, 337B, and the 309 Stack at the Hanford's 300 Area	Daniel Beckworth, Bob Smith, and Thomas Kisenwether	FINAL
2	BP	Open Air Demolition of Asbestos Gunite by Using a Track Mounted Wet Cutting Saw	Rob Vellinger	FINAL
3	BP	185-3K Cooling Tower Demolition	Bill Austin	FINAL
4	BP	Historical Hazard Identification Process for D&D	Paul Corrado	FINAL
5	LL	Closure of the Reactor Maintenance, Assembly, and Disassembly Facility and the Pluto Disassembly Facility at the Nevada National Security Site	Annette Primrose	Sent to DOE HQ for final review.
6	LL	Unanticipated High Dose During the Removal of Wire Flux Monitor Cabling from the HWCTR Reactor Vessel	Bill Austin	FINAL
7	LL	SPRU Lesson Learned	Brad Smith	Sent to DOE HQ for final review.
8	BP	Structural Code Guidance for D&D Activities at DOE Facilities	Kirk Dooley	Sent to DOE HQ for final review
9	BP	Electrical Code Guidance for D&D Activities at DOE Facilities	Kirk Dooley	Sent to DOE HQ for final review

Milestones and Deliverables

The milestones and deliverables for Project 5 for FIU Year 3 are shown on the following table. Milestones 2012-P5-M2 “Waste Management Symposium 2013 abstract submission,” and 2012-P5-M3 “DOE Fellows Complete Summer Internships” were completed on time.

FIU Year 3 Milestones and Deliverables for Project 5

Milestone/ Deliverable	Description	Due Date	Status	OSTI
2012-P5-M1	Selection of new DOE Fellows - Spring 2012	05/30/12	Complete	
Deliverable	Draft Project Technical Plan sent to DOE	06/18/12	Complete	
Deliverable	List of 2012 Student Summer Interns and their research assignment	06/29/12	Complete	
2012-P5-M2	Waste Management Symposium 2013 abstract submitted	8/17/2012	Complete	OSTI[8]
2012-P5-M3	DOE Fellows Complete Summer Internships	08/31/12	Complete	
2012-P5-M4	Summer Internships Reports Completed	10/05/12	On Target	
Deliverable	Deliver Summer 2012 Interns reports to DOE	10/19/12	On Target	OSTI
2012-P5-M5	Selection of new DOE Fellows – Fall 2012	10/30/12	On Target	
Deliverable	List of identified/recruited DOE Fellow (Class of 2012)	10/31/12	On Target	
2012-P5-M6	Conduct Induction Ceremony – Class of 2012	11/13/12	On Target	
2012-P5-M7	Waste Management Symposium 2013 Student Abstracts submitted	12/31/2012	On Target	OSTI
Deliverable	Draft Year End Report	06/28/13	On Target	OSTI

Work Plan for Next Quarter

- Submit paper to Waste Management 2013 Symposium
- Submit student poster abstracts to Waste Management 2013 Symposium
- Complete summer internship reports and deliver to DOE (scheduled for 10/19/12)
- Complete selection of new DOE Fellows – Fall 2012 and send list of recruited DOE Fellows to DOE
- Conduct the 5th Annual DOE Fellows Poster Exhibition & Competition
- Participate and present at the 2nd Annual D&D Supply Chain Conference on November 1-2, 2012. Three DOE Fellows will be presenting posters on their EM research
- Conduct the 6th Annual DOE Fellows Induction Ceremony – Class of 2012 (scheduled for 11/13/12)

[8] Announcement of published journal or conference paper will be submitted to OSTI