QUARTERLY PROGRESS REPORT

January 1, 2012 to March 31, 2012

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

Principal Investigators:

David Roelant, Ph.D.
Leonel E. Lagos, Ph.D., PMP®

Prepared for:

U.S. Department of Energy
Office of Environmental Management
Under Grant No. DE-EM0000598

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 January 1 to March 31, 2012.

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 three 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 High-Density Ratio, Multiphase Flows
- Task 15: Evaluation of Advanced Instrumentation Needs for HLW Retrieval

Task 2: Pipeline Unplugging and Plug Prevention

Task 2 Overview

Over the past few years, FIU has found that commercial technologies do not meet the needs of DOE Sites in terms of their ability to unplug blocked HLW pipelines. FIU has since undertaken the task of developing alternative methods/technologies with the guidance from engineers at the national laboratories and site personnel. The new approaches that are being investigated include an asynchronous pulsing method and a peristaltic crawler. Both technologies utilize lessons learned from previous experimental testing and offer advantages that other commercially available technologies lack. The objective of this task is to continue efforts on the development of the two novel technologies for pipeline unplugging. The first phase of experimental testing conducted during the previous performance period demonstrated the technologies' potential for successful pipeline unplugging operations. The research that is being carried out during this performance period focuses on the experimental testing of the technologies on a larger scale.

Task 2 Quarterly Progress

- For the 3rd generation peristaltic crawler, bench-scale tests to determine the maximum anchor force of the rims and pulling force of the external bellow were completed. Manufacturing of the stainless steel front and back rims were completed. The crawler assembly was approved for welding and surface preparation of the parts was performed. The 3rd generation crawler was successfully assembled and welded together (Figure 1-1). Leak tests for the bellows and assembly were performed and the flexible cavities for the front and back rims were clamped into place. A 500 ft tether assembly was received from the vendor, which included pneumatic, hydraulic and electrical lines jacketed together. The effect of the length of tether

on cycle time for the crawler was evaluated by performing parametric tests at different supplied pressures. A bench-scale test was performed to determine the capability of the crawler to navigate in a straight section and to turn in a 90° elbow. The design of the bracket used for mounting the pipeline unplugging tool on the 3rd generation crawler was finalized and it is being manufactured. An unplugging tool consisting of a rotating nozzle was procured and adapted to comply with the crawler's size requirements. Testing of the crawler will be performed to ensure that the unit can still clear a 90° elbow with the nozzle attached. A design for utilizing a secondary stage capsule has been initiated that will decrease the crawler cycle time as well as increase its operational distance. The capsule will consist of three micro-pneumatic valves located in close proximity to the crawler. A first prototype of the secondary stage manifold was fabricated and it is currently being adjusted to eliminate existing air leaks between the pressurized compartments. The next phase will focus on assembling the complete system (crawler, tether assembly, reel system, and control unit). Additionally, the assembly details on connecting the tether assembly to the crawler will be completed.

Figure 1-1. 3rd generation peristaltic crawler.

- For the Asynchronous Pulsing System (APS), the system's piston pumps have been overhauled and reinstalled in the system. Work continued on the design of the large-scale test loop. To increase the rigidity of the large-scale test loop and make it more representative of the cross-site transfer lines, the design will utilize 3" schedule-40 threaded pipes. The engineering-scale test bed has been designed, the components have been identified, quotes for the components have been obtained, and purchase orders have been placed. In addition, a test plan for testing the APS in an engineering-scale test bed has been generated and sent to the Hanford site engineers and the DOE headquarter representatives (Mr. Steve Schneider and Mr. John De Gregory) on February 10, 2012. Due to unanticipated construction plans in the location were the large-scale loop was planned to be setup, an alternate location to setup the loop was selected and university space committee approval is currently being obtained. In order to minimize the schedule impact from the test bed location, the CFD validation portion of the testing will be conducted within the high-bay lab. In preparation for the validation test loop setup, the lab-scale loop was decommissioned and the electric service to the APS was

relocated to its new location. The APS data acquisition chassis software has been redesigned to perform all engineering units scaling on field-programmable gate array (FPGA). APS controller chassis software has been modified to operate the pump pistons on a position-based algorithm. Work on the modified controller high-level software has been started to reduce CPU utilization and improve user-interface and timing performance.

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

Task 12 Overview

This task uses the knowledge acquired at FIU on implementing the Lattice Boltzmann Model (LBM) for multiphase flow modeling to create a multiphase LBM using multiple-relaxation-time (MRT) collision models in three-dimensions having high performance computing capabilities. Focus is given to bubble dynamics in liquids, and the simulation results are being validated against the analytical and experimental data published in the literature for buoyant bubbles rising in liquid columns under the influence of gravity. The objective of this task is to provide the sites with mathematical modeling, validation, and testing of computer programs to support critical issues related to HLW retrieval and processing.

Task 12 Quarterly Progress

- FIU developed a parallel 2D MRT LBM parallel code to be able to handle large-scale simulations and conducted performance improvement comparison against the serial code which can run on single processor. A 128-node high performance computer cluster at FIU has been used for this purpose. It was observed that for a static bubble simulation, the time to achieve the same result with a serial code was reduced by 10 times using the parallel code (Figure 1-2).

  The 2D MRT LBM code was used to conduct parametric testing for a benchmark bubble rising problem. The thickness of the interface between the two phases was varied between 1 - 10 lattice units and it was observed that the LBM results are in best agreement with the benchmark solution when the thickness is set to 5 lattice units.

  The wall boundary condition implemented in the 2D BGK and MRT LBM parallel codes was revisited in order to include the calculation of the derivative terms necessary to calculate the gradients used in the interfacial force term in the lattice Boltzmann. The boundary conditions were set for a case where the top and the bottom boundary of the domain is a solid wall. The performance of the serial BGK code was improved; however, the parallel BGK code needs additional work regarding domain splitting. The prestreaming subroutine in the 2D MRT LBM code needs to be modified in order to implement the current update to the wall boundary condition.

  Work has continued with the parallelization of the 3D MRT LBM code and is approximately 50% complete. Additionally, 90% of the 3D LBM MRT code was documented line-by-line with references to scientific publications.

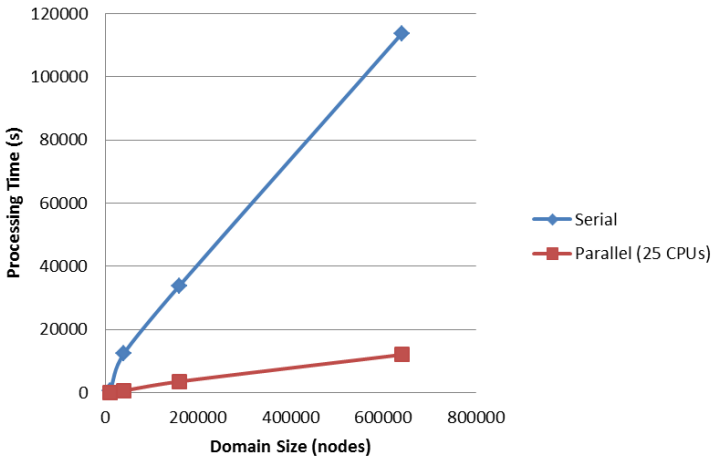

Figure 1-2. Performance comparison of the parallel MRT LBM code compared to the serial version.

- In addition to the LBM code development, hardware and software issues with the high performance computer cluster at FIU were resolved. Issues related to inconsistent power to the cluster have been noted and alternative approaches to the problem are being investigated. In addition, routine maintenance of the high performance computer cluster at FIU has been provided.
- The technical tasks for future work have been identified and discussed with PNNL researchers. Possible applications that were identified are: Newtonian and non-Newtonian multiphase flow found in tank mixing with hybrid pulsed-jet/sparger systems.
- Finally, a professional poster related to the 3D bubble simulations (Figure 1-3) and a student poster regarding the parallelization of the 2D MRT LBM code were prepared and presented at the Waste Management 2012 Symposia.

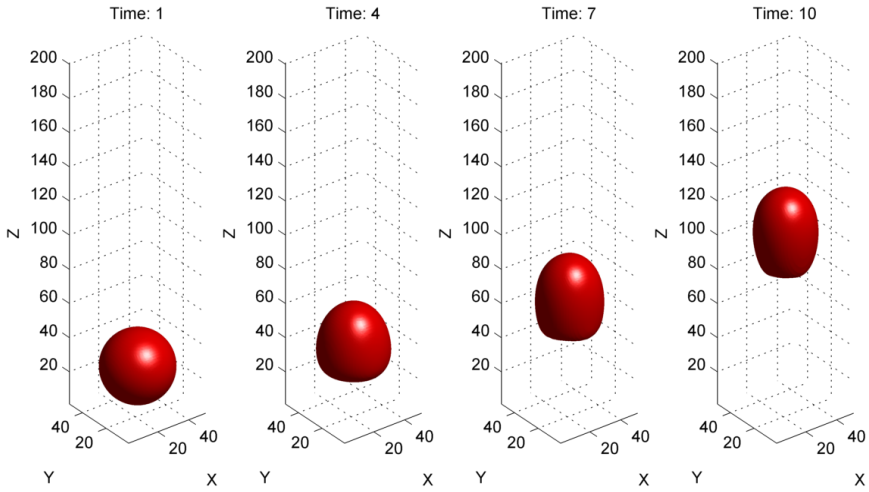

Figure 1-3. Snapshots of a rising bubble obtained by the 3D MRT LBM.

Task 15: Evaluation of Advanced Instrumentation Needs for HLW Retrieval

Task 15 Overview

The purpose of this task is to evaluate the maturity and applicability of commercial and emerging technologies capable of addressing several instrumentation needs for HLW feed mixing and retrieval. This task continues the laboratory evaluation of the identified candidate technologies that began during the previous performance period. The objective of this year's work is to continue laboratory investigations of the identified alternative and promising instrumentation for HLW mixing and retrieval. Specifically, the task continues the evaluation of an Ultrasonic Spectroscopy System (USS) and a Coriolis-based system as viable techniques for the measurement of bulk density directly within the tank. Also, FIU is assessing additional prototype and conceptual instrumentation alternatives in an infancy stage through modeling, computer simulation and laboratory evaluation.

Task 15 Quarterly Progress

- FIU presented the results of the ultrasonic spectroscopy system (USS) at Hanford during a January site visit. Several discussions were held during and after the presentation on the technology path forward based on the issues faced with the specific system tested. FIU (and WRPS) began work on a schedule to determine whether additional testing can be performed in light of the limited time prior to possible deployment in Tank AY-102, slated for retrieval in June of 2013. At the request of the Hanford contacts for this task, FIU reviewed the baseline schedule developed by WRPS for the development timeline for the USS system. Based on past experiences, FIU developed a detailed schedule that identified a path forward with the USS, and defined July 31st as the earliest date to make a feasibility decision on this system. In order to accomplish this by the defined date, WRPS initiated communication with the vendor in order to communicate their critical interest in deployment of this technology within the Hanford tank farms.
- In addition, FIU continued discussions with the USS vendor on possible explanations for the unexpected spectral response profiles. Additional information was sent on the data collected, as well as reference files that were collected on multiple days of testing for comparison. FIU performed additional analysis of the data collected during the USS evaluation, at the suggestion of the vendor. This analysis ran the individual data sample files through a vendor-developed software package, using the valid reference files for that test date. The vendor suspected that this could address the data anomalies. The analysis results yielded the same values and spectral profile as those found during testing. FIU met with a representative of the USS vendor and identified the path forward plan for addressing the issues related to the data analysis and to perform additional verification testing. The plan was presented to WRPS during a teleconference call where representatives from all parties were present. It was decided that additional testing could be performed before the deadline set forth in FIU's revised schedule, and that the tests will include a system with a larger transducer, and with the capability to operate at a lower frequency. The tests would be split between several initial trials at ITS facilities and several at FIU. FIU began the modification of the test plan to address what tests will be performed at ITS and how those will be repeated at FIU. Identifying test components such as a mixing system and a reference measurement system have begun.

- FIU began a search for radiation effects on piezoelectric materials and piezo-ceramics. Several studies performed by Iowa State University were identified and requested from information repositories. Also, FIU began the search and selection of polymers that could be used as transducer buffers in a HLW tank application. The list of possible candidates was reduced to polyimide, PEEK, and polyurethane. FIU will identify manufacturers for these buffers and collect samples for ultrasonic performance.

Milestones and Deliverables

The milestones and deliverables for Project 1 are shown on the following table. A draft verification test plan for the asynchronous pulsing system was submitted to Hanford site engineers on February 10, 2012. Milestones and deliverables associated with the engineering scale validation of the pipeline unplugging technologies (2011-P1-M2.2 and 2011-P1-M2.3) may be delayed due to issues related to FIU space committee approval.

Work Plan for Next Quarter

- Task 2: Complete assembly of the peristaltic crawler and assemble the new engineering scale test bed. Experimental testing will then be conducted for both the peristaltic crawler and asynchronous pulsing system. Computational models for the asynchronous system will be developed to project its viability on longer pipe runs.
- Task 12: The parallelization of the 3D LBM MRT code will be completed and performance comparison against the serial code will be conducted.
- Task 15: Work with the USS vendor on completing a detailed test plan and carrying out the work scope associated with the test plan. Data will then be analyzed to determine if the technology is a viable solution for measuring slurry density in HLW tanks.
- Draft the Year End Report for DOE.

Milestones and Deliverables for Project 1

Task	Milestone/ Deliverable	Description	Due Date	Status
Task 2: Pipeline Unplugging and Plug Prevention	Deliverable	Draft Verification Test Plan for bench scale asynchronous pulsing	09/16/2011 Re-forecasted to 10/12/2011	Completed 10/12/2011
	2011-P1-M2.1	Complete bench scale pipeline unplugging using the asynchronous pulsing system	11/18/2011 Re-forecasted to 12/9/2011	Completed 12/9/2011
	Deliverable	Summary Document for 2011-P1-M2.1	11/18/2011 Re-forecasted to 12/9/2011	Completed 12/9/2011
	Deliverable	Draft Verification Test Plan for engineering scale asynchronous pulsing	02/10/2012	Complete
	2011-P1-M2.2	Complete experimental testing of third generation peristaltic crawler	5/06/2012	May be delayed – under evaluation
	Deliverable	Summary Document for 2011-P1-M2.2	5/06/2012	May be delayed – under evaluation
	2011-P1-M2.3	Complete engineering scale pipeline unplugging testing using the asynchronous pulsing system	5/11/2012	May be delayed - under evaluation
	Deliverable	Summary Document for 2011-P1-M2.3	5/11/2012	May be delayed – under evaluation
Task 12: Multiple-Relaxation-Time Lattice Boltzmann Model for Multiphase Flows in Three Dimensions	2011-P1-M12.1	Development of the multiphase MRT LBM in 3D	10/17/2011	Completed 10/17/2011
	Deliverable	Summary Document for 2011-P1-M12.1	10/17/2011	Completed 10/17/2011
	2011-P1-M12.2	Verification of the multiphase SRT LBM in 3D for dynamic bubbles in closed domains	12/22/2011	Completed 12/22/2011
	Deliverable	Summary Document for 2011-P1-M12.2	12/22/2011	Completed 12/22/2011
	2011-P1-M12.3	Parallelization of the 3D multiphase MRT LBM	05/09/2012	On target
	Deliverable	Summary Document for 2011-P1-M12.3	05/09/2012	On target
Task 15: Evaluation of Advanced Instrumentation Needs for HLW Retrieval	2011-P1-M15.1	Complete candidate technology testing at FIU	9/30/2011 Re-forecasted to 10/31/2011	Completed 10/31/2011
	Deliverable	Summary Document for 2011-P1-M15.1	9/30/2011 Re-forecasted to 10/31/2011	Completed 10/31/2011
Project-wide	Deliverable	Draft Project Technical Task Plan	09/17/2011	Complete
	Deliverable	Quarterly Progress Reports (all tasks and projects combined)	End of Q1, Q2, Q3,Q4	On target
	Deliverable	Draft Annual Progress Report	06/17/2012	On target

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 FY11, FIU ARC continues to provide support on uranium contamination and remediation at the Hanford Site with research under Project 2. This project includes two subtasks for FY11: continued research on uranyl mineral formation and co-precipitation by soil pH manipulation (Task 1.1) and microbial- uranium interactions that include dissolution of autunite mineral and bio-adsorption of uranium (VI) in the presence of bicarbonate and Ca ions (Task 1.2).

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

The study under subtask 1 involves a series of batch experiments to evaluate the mechanisms and effectiveness of NH_3 gas injection, which has significant uncertainties under Hanford VZ site-specific conditions. The injection of a NH_3 gaseous mixture causes the formation of NH_4OH and a subsequent increase in pH. This manipulation will significantly alter the pore water chemistry and promote the formation of various aluminosilicates during recrystallization of minerals followed by co-precipitation of U(VI) [as uranyl (UO_2^{2+})] and Al at higher pH conditions. These chemical reactions can potentially control the mobility of uranyl cations in soil systems since co-precipitated contaminants are less available for migration. This study is evaluating the role of major pore water constituents such as Al, Si, bicarbonate, and Ca on the formation and solubility of uranium – bearing precipitates created after NH_3 gas injection.

Task 1.1 Quarterly Progress

- Continued experiments to determine the structure and composition of obtained U-bearing precipitates. Obtained SEM/EDS analysis results for samples prepared with 130 ppm of U(VI). EDS analysis confirmed the presence of uranium in the dried precipitate but the atomic percentage was low, in the range of 0-1.27%. The maximum atomic percentage of 1.27 was found in the sample composed of 050 mM Si, 03 mM HCO_3, 5 mM Al, and 130 ppm U.
- Plotted FTIR spectra and carried out spectra identification. Due to the low atomic percentage of uranium, a small peak appeared from 800 to 1000 cm^{-1}. Additional peaks identified include: strong absorption bands 4000 -2500 cm^{-1} from stretching vibrations between hydrogen and some other atoms with a mass of 19 or less. In this range, O-H and N-H stretching frequencies fall in the 3700 to 2500 cm^{-1} region. H_2O bending vibrations were observed from 1590 to 1700 cm^{-1}, structurally incorporated H_2O at ~1630 cm^{-1} as well as

surface absorbed H_2O at ~1530 cm^{-1}. Absorption peaks were identified at 1300 to 1000 cm^{-1} from the couplings of C-O and C-C stretches. CO_3 peak appeared at ~1390 cm^{-1}; SiO_4^{4-} bending appeared from 390 to 570 cm^{-1}. Presence of the uranyl ion was identified by the stretching from 800 to 1000 cm^{-1}, and by the detection of O-U-O asymmetric stretching vibration from 920 to 980 cm^{-1}, but this was found only in one sample spectra belonging to the sample composed of 050 mM Si, 03 mM HCO_3, 5 mM Al, 130 ppm U. Further research needs to be completed to find functional groups in the dried precipitates.

- Prepared stock solutions and ran experiments to determine kinetics of U(VI) removal vs. time. Experimental solutions were composed of 50 mM of Si and 100 mM of Si; other ingredients included 50 mM of HCO_3, 5 mM of Al and 2 ppm of U(VI). Si/Al ratios for the precipitates were 10 and 20, respectively. Finalized U(VI) analysis via KPA instrument. The removal of U(VI) in the presence of 100 mM of Si was gradually increased to 94% over a 48-hr period. The removal of U(VI) at Si/Al ratio 10 was observed to be not higher than 10%.

- Sent out samples for XPS analysis. Received results on XPS data for four samples prepared with 130 ppm of U(VI). Two out of four tested samples containing U(VI) showed definitive peaks between the binding energies (BE) of 375 and 385 eV. The third sample showed a weaker peak between 380 and 384 eV, while the fourth sample does not provide a peak due to the low atomic percentage of U in the sample determined previously via EDS analysis. Sample 3, containing 50 mM Si, 3 mM HCO_3, 5 mM Al and 130 ppm U(VI), showed a BE peak at 382.6 eV, confirming that uranium in the precipitate sample occurs in the hexavalent state. The sample containing 50 mM Si, 50 mM HCO_3, 5 mM Al and 130 ppm U (Sample 2) and the sample containing 100 mM Si, 50 mM HCO_3, 5 mM Al and 130 ppm U (Sample 4) indicated two peaks of uranium in the range from 375 to 410 eV (U4f7 and U4f5). Two peaks suggest two oxidation states; the peak for 382.6 eV corresponded to U(VI), but the second one was found at about 377.7 eV. Further research is needed in order to determine the U oxidation state and evaluate what chemical reaction is taking place.

- In order to continue studies of precipitate characterization, samples containing a higher uranium concentration (200 ppm) are needed to be prepared. In preparation for this new sample set, the concentrations of each stock solution were calculated, and the speciation prediction was also completed using Visual Minteq software. In order to obtain the speciation data, input files were calculated based on each element that would be added to each sample. The speciation predictions for 130 ppm and 200 ppm uranium were similar; in general, the main phase of uranium was uranyl carbonate.

- In order to carry out the new FTIR analysis, a method for polishing KBr plates for future sample preparation was found in a literature search. KBr plates were cleaned to reuse them in future analysis.

- Based on previous discussions with Dr. Dawn Wellman, a new approach for determining the structure and composition of U-bearing precipitates has been developed. This approach involves preparation an appropriate set of samples containing the desired Si, Al, and HCO_3^- concentrations and amended with 200 ppm of U(VI). Multiples of each sample were prepared to analyze over time in a sacrificial mode. One sample would taken for precipitate drying after 2 days of being prepared and kept on the shaker; the next samples would be taken at 2 weeks, 1 month, 1.5 months, 2 months, 3 months and 4 months. The increase in U(VI) concentration to 200 ppm helps to increase the atomic percentage of U(VI) in the sample and

to determine if any crystalline U-bearing phases could be observed. In preparation for the experiment, the procedures were modified in adaptation for the samples prepared with 100 mM Si, 5 mM Al, 3 mM HCO_3^-, 200 ppm U and 100 mM Si, 5 mM Al, 50 mM HCO_3^-, and 200 ppm U. A total of 16 sample test tubes of 5 mL were prepared. U(VI) was injected out of the 10,000 ppm stock solution. All the samples were placed on the shaker and kept at constant temperature for future SEM-EDS, FTIR, XRD and XPS analysis. So far, the 2-day precipitate sample has been separated for drying at 30 °C.

- Continued the experiments to investigate the uranium removal in the sample-matrix solution containing Ca, Al, Si, HCO_3 and 2 ppm of U(VI). Set up the experiment using six Si/Al ratios (1, 10, 20, 30, 40, 50) with 0 mM and 3 mM bicarbonate. Adjusted pH to 8 and then injected ammonia gas until the pH of the testing solutions reached 11. After 2 days of equilibrium time, obtained supernatant to prepare samples to test the remaining U(VI), inorganic carbon and Al, Si, and Ca concentrations. Three analytical instruments were used in these analyses: KPA, ICP-OES, and TOC analyzer.
- Increased the concentration of bicarbonate for the next two new sets of samples containing 25 mM and 50 mM of HCO_3 and prepared stock solutions from aluminum $Al(NO_3)_3.9H_2O$, silicate $Na_2SiO_3.9H_2O$, bicarbonate $KHCO_3$, and calcium $CaCl_2$. H_2O to be amended with 2 ppm of U(VI). Calibrated the KPA, ICP-OES and TOC analyzer to test the removal of U(VI), Si, Al, and Ca, and to monitor the changes in TOC concentrations after ammonia gas injection.
- Prepared a Powerpoint presentation entitled, "The Effect of Si and Al Concentration Ratios on the Removal of U(VI) under Hanford Site 200 Area Conditions," and Dr. Yelena Katsenovich gave the oral presentation during Session 76 of the Waste Management 2012 Symposium. Two DOE Fellow students co-authored a paper on this topic to be published in the Symposium's proceedings. In addition, a poster entitled, "Investigation of Effect of Water Quality Parameters on the Dissolution of Sodium Meta-Autunite," was presented by Ravi Gudavalli in the student poster competition at the Waste Management 2012 Symposium (Figure 2-1).

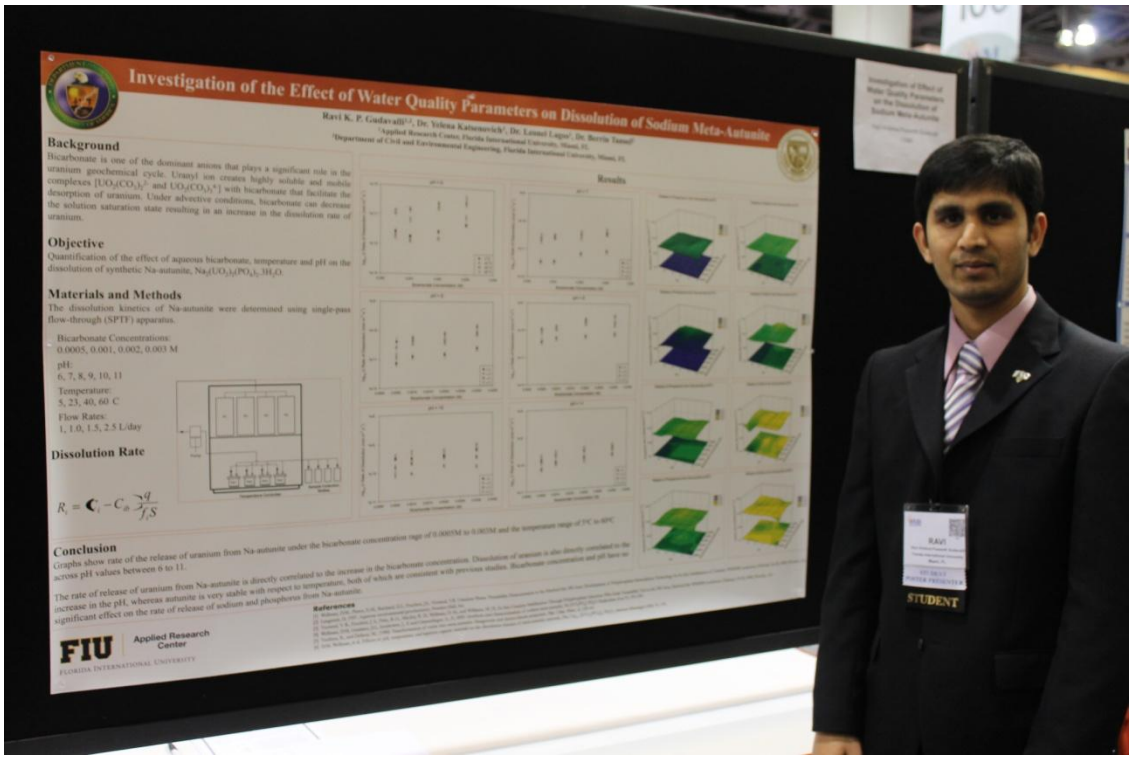

Figure 2-1. FIU graduate student Ravi Gudavalli at WM2012 Conference.

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

Task 1.2 Overview

Research under subtask 2 continues to investigate the effect of bicarbonate on the autunite mineral microbial leaching and U(VI) biouptake by *Arthrobacter* sp., soil bacteria previously isolated from Hanford Site soil. The obtained data suggests that bacteria is responsible for autunite dissolution and is able to influence U(VI) leaching while are even not in direct contact with the mineral. The G975 strain U(VI) biouptake, found in the 83-90% range for the aqueous solutions at equilibrium with CO_2 atmospheric pressure, was shown to exponentially reduce as the bicarbonate concentration was increased. Experiments are exploring other *A.* sp strains on autunite bioleaching and U(VI) biouptake and determining possible mechanisms for their efficacy.

Task 1.2 Quarterly Progress

- Completed a progress report on the results of U(VI) biosorption in the presence of bicarbonate and calcium ions and sent it out as a deliverable to Dr. Dawn Wellman at PNNL on January 12, 2012 as well as to Mr. Justin Marble and Mr. Kurt Gerdes at DOE HQ on January 14, 2012.
- Initiated development of a manuscript on U(VI) biosorption in the presence of bicarbonate and calcium ions by the *Arthrobacter* G975 strain.
- Obtained results for U(VI), Ca, and P bio-dissolution using the G968 strain and graphed results analyzing the concentration of calcium or phosphorus with time. Checked the pH of

all reactors used in the bio-dissolution experiments, to ensure that they are still within the range of 8. The data were not consistent and the experiment was required to repeated. Completed preparations to repeat the bio-dissolution experiments by using the G968 strain: measured autunite for bioleaching bottles, prepared sterile 20 mM Hepes buffer media solutions augmented with 0-10 mM of HCO_3^-, and sterilized the glassware to be used in the experiments. Began bio-dissolution experiments with the G968 *Arthrobacter* sp. strain. Thirteen sample bottles were prepared with concentrations of bicarbonate ranging up to 10 mM. Sampled experimental bottles periodically for three weeks and prepared samples for U(VI) analysis via KPA instrument and P and Ca by means of ICP-OES instrument. Grew the G968 bacterial culture and calculated cell concentration via hemocytometer in preparation for the bacterial injection into the 13 bottles.

- Conducted biosorption experiments with the G968 strain with and without 5 mM of calcium and 2.5 mM of bicarbonate. Results were inconclusive as biosorption values were too low and occasionally fell into negative values for different uranium concentrations. Contacted the SMCC collection to get a fresh culture of *Arthrobacter* G975 sp. and *Arthrobacter* G968 to continue experimentation. The collection is now housed at the University of Alabama in Tuscaloosa, AL. Once the new cell cultures were received, they were frozen for future use.
- A manuscript entitled, "Enhanced U(VI) release from autunite mineral by aerobic *Arthrobacter* sp. in the presence of aqueous bicarbonate," that was prepared by FIU (Y. Katsenovich, D. Carvajal, and L. Lagos) in collaboration with PNNL (D. Wellman) came back from the Chemical Geology Journal for revision. The revision was then finalized and was submitted back to the journal. The final manuscript was accepted for publication by the Chemical Geology Journal.
- A poster entitled, “Investigation on Uranium Biosorption by DOE-Hanford Site Soil Isolates: Effects of Calcium and Bicarbonate,” was presented in the student poster competition at the Waste Management 2012 Symposium by DOE Fellow Bryant Thompson (Figure 2-2). A presentation on this topic was also given by two DOE Fellow students during a weekly DOE Fellow meeting.

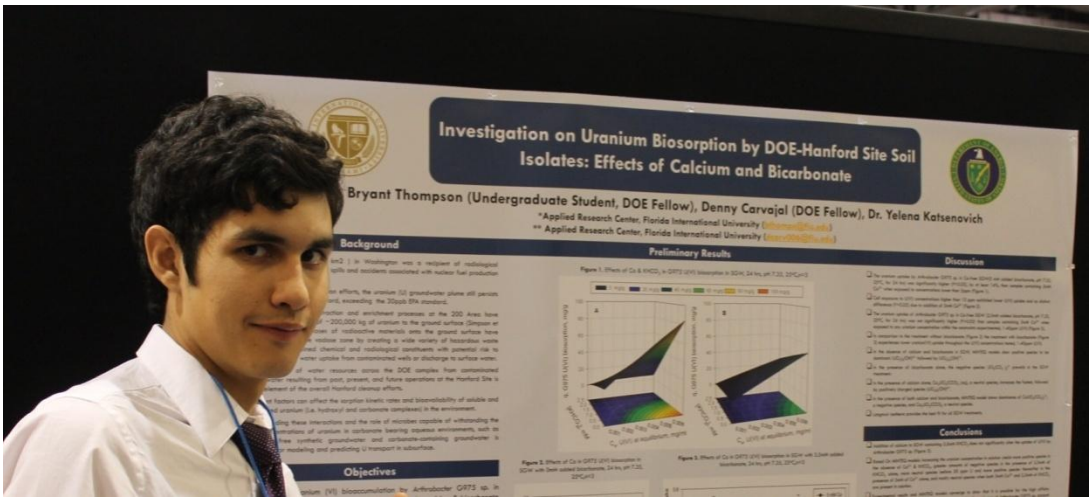

Figure 2-2. DOE Fellow, Bryant Thompson, at WM2012 Conference.

Milestones and Deliverables

The milestones and deliverables for Project 2 are shown in the following table. A progress report on the experimental results of U(VI) biosorption in the presence of bicarbonate and calcium ions was completed and sent as a deliverable to Dr. Dawn Wellman at PNNL (1/12/12) as well as Mr. Justin Marble and Mr. Kurt Gerdes at DOE HQ (1/14/12). Milestone 2011-P2-M1 for the completion of testing the removal efficiency of U(VI) using various Si:Al rations in the presence of bicarbonate was completed on 2/28/12. The project is on schedule to meet all milestones and deliverables by their due dates.

Work Plan for Next Quarter

- Task 1.1: Finalize experiments on the removal of U(VI) in the solution containing Ca, Al, Si, HCO_3 and 2 ppm of U(VI). Obtain SEM/EDS analysis on morphology and composition, and the atomic percentage of U(VI) in dried precipitates prepared with 200 ppm of U(VI). Obtain FTIR spectra and carry out spectra identification on U-bearing precipitates with 200 ppm of U(VI). Prepare samples for XRD analysis.
- Task 1.2: Finalize bioleaching experiments with *Arthrobacter* sp. G968 strain and obtain data on U(VI), P and Ca release from autunite mineral in the presence of G968 strain. Continue a study on the effect of Ca on biosorption and viability of *Arthrobacter* G968 bacteria. Conduct microscopic studies on bacterial cells exposed to U in the presence of bicarbonate and Ca.
- Draft the Year End Report for DOE.

Milestones and Deliverables for Project 2

Task	Milestone/ Deliverable	Description	Due Date	Status
Task 1: Sequestering Uranium at the Hanford 200 Area Vadose Zone by In Situ Subsurface pH Manipulation Using NH3 Gas	2011-P2-M1	Completion of testing on the removal efficiency of U(VI) using various Si:Al ratios in the presence of bicarbonate	2/28/2012	Complete
	Deliverable	Progress report on results on biosorption and bacterial tolerance to uranium in the presence of bicarbonate ion	1/11/2012	Complete
Task 2: Effect of bicarbonate on the autunite mineral bioleaching and U(VI) biouptake by Arthrobacter sp	2011-P2-M2	Completion of assessment of the role of bacteria on U(VI) leaching from autunite using *Arthrobacter* sp. strains	4/30/12	On target
Project-wide	Deliverable	Draft Project Technical Plan	6/17/2011	Complete
	Deliverable	Draft Year End Report	6/18/2012	On target

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.

Quarterly Progress – Project-Wide Activities

A project review was presented to Dr. Eric Pierce and Dr. Liyuan Liang from ORNL during their visit to FIU. After the presentation, discussions were held to identify areas of potential work scope for FIU for FY2012. Discussions of the FIU laboratory work carried out during FY2011 to support the mercury remediation efforts at ORR as well as new work scope for FY2012 were also held with Dr. Yong Cai from the FIU Department of Chemistry. Meeting minutes and a copy of the presentation were forwarded to all attendees and to DOE HQ. DOE HQ recipients included Justin Marble and Kurt Gerdes as well as Paul Beam and Karen Skubal. The following were identified as potential tasks to be added to the current work scope that can be carried out by FIU-ARC in collaboration with ORNL during FY2012:

- Statistical analysis of observed data and development of timeseries, probability exceedance curves, and probability distribution models of flow, concentration and load data that integrates already downloaded data, and new data that will be obtained from contactors with the support of ORNL personnel. The data will include groundwater well monitoring, concentrations in groundwater wells, outfall flow, concentration and load data. The task will also provide a refinement of the existing EFPC model by inclusion of 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. The deliverable of this subtask will include timeseries, probability exceedance curves, load exceedance curves, probability distribution models for each monitoring point and a report. The subtask will provide support for the team developing the mercury conceptual model and will provide considerably better estimates for the stochastic nature of mercury fluxes within the EFPC domain.
- Re-creation of the existing ORNL stormwater management system layout via a numerical surface water one dimensional model (SWMM or similar) to provide a better understanding of the flow patterns on site, including flow rates as a function of rainfall intensity and the fraction of drainage volumes and rates reaching each outfall. The objective is to create a detailed surface water flow and contaminant transport model for

the ORNL area using XPSWMM, incorporating flow data and other significant drainage system parameters, initially starting with a smaller model for the ORNL.

- Simulations of surface water flow and contaminant transport utilizing collected piezometric data for EFPC. This will facilitate calibration and validation of the existing EFPC model developed by FIU and will provide data for comparison with new measurements to be taken by ORNL in their effort to refine the existing conceptual model for EFPC. This task will be executed in collaboration with ORNL. Additionally, modifications of the flow hydrology along EFPC, including reduction of the flow augmentation, addition of a down-gradient diversion ditch, alternatives which result in reduced mercury fluxes in major outflows and simulation of flow and transport of other contaminants whose partitioning coefficients vary several orders of magnitude (including uranium and other contaminants of interest) will be investigated within this subtask. This would be a benchmark study to be extended to the Y-12 NSC (once reviewed and accepted by ORNL and the site). The deliverable of this subtask will be a calibrated and validated drainage model that will provide detailed analysis of how much water reaches each outfall and the source of the water. By providing better understanding of the drainage system, the site will be provided with a tool that can be used to investigate the best remediation scenarios for setting up remediation priorities, e.g. what are the greatest contributors to mercury loads.
- *Modeling the dissolution of cinnabar in the presence of DOM and Cl^-:* Based on the chemical thermodynamics and adsorption/desorption of released Hg^{2+} on cinnabar, a model will be developed to predict the dissolution of cinnabar in the presence of DOM and Cl^- under different conditions of pH and dissolved O_2. Two important parameters for this model, the binding constants of Hg^{2+} and DOM and adsorption/desorption constants of Hg^{2+} in the presence of DOM and Cl^-, will be experimentally measured. The model will be validated through simulating the observed experimental results. The model will be used to determine through which process DOM and Cl^- affect the dissolution of cinnabar.

A paper entitled "Simulation of Flow and Mercury Transport in Upper East Fork Poplar Creek, Oak Ridge, Tennessee", which is based on the development of the integrated surface and groundwater model for flow and mercury transport in EFPC was also recently published in the Spring 2012 edition of the Remediation Journal. The paper was authored by Dr. Siamak Malek-Mohammadi, Dr. Georgio Tachiev, Elsa Cabrejo and Angelique Lawrence.

In addition, FIU-ARC researchers and students attended the annual Waste Management Symposium from February 26 to March 1, 2012, in Phoenix, AZ, and presented DOE project-related work:

- DOE Fellow, Lilian Marrero, presented a student poster entitled, "Improvements in the Suspended Sediment Interactions Module of an Integrated Flow and Mercury Transport Model for East Fork Poplar Creek Watershed, Oak Ridge, Tennessee" (Figure 3-1).

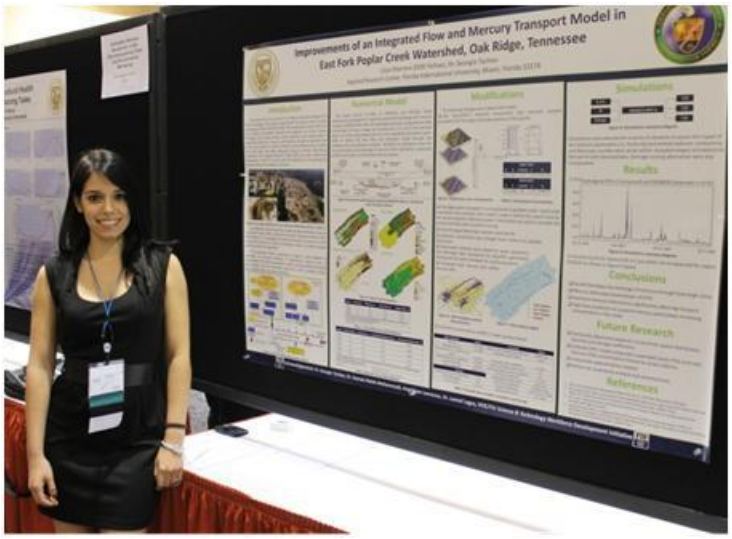

Figure 3-4. DOE Fellow, Lilian Marrero, at Waste Management 2012 Symposia.

- Dr. Siamak Malek-Mohammadi and Dr. Georgio Tachiev received the ANS Award for Best Poster Presentation and Paper for Track 7 (Environmental Remediation) for their poster entitled, "Transport of Organic Compounds in the Old Salvage Yard, Oak Ridge, TN" (Figure 3-2).

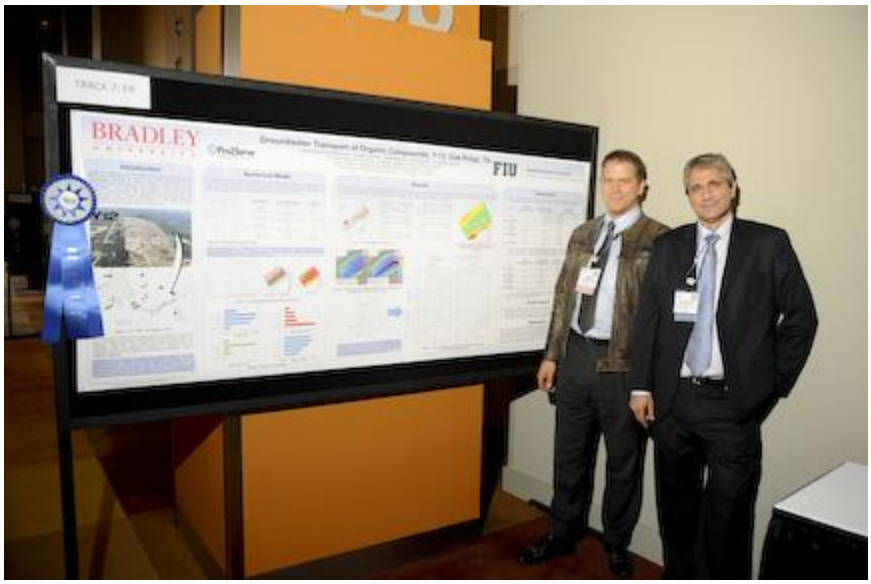

Figure 3-5. Drs. David Roelant and Georgio Tachiev beside FIU's award winning poster at WM12 Symposia.

- Dr. Siamak Malek-Mohammadi received the award for **WM11 Best Professional Poster** entitled, "Simulation of Flow and Mercury Transport in Upper East Fork Poplar Creek (UEFPC), Oak Ridge, TN" which he presented at the Waste Management (WM) Conference in 2011 (Figure 3-3). This poster described the development of the integrated surface and groundwater model for flow and mercury transport in UEFPC developed by FIU. The model is currently being used to predict transport patterns of mercury and

evaluate risks during deactivation and decommissioning of mercury contaminated facilities at the Y-12 National Security Complex in Oak Ridge, TN.

Figure 3-6. Dr. Siamak Mohammadi receiving his award for WM11 Best Professional Poster.

- While at the conference, a meeting was held with Drs. Georgio Tachiev, Leonel Lagos, Eric Pierce, and Yvette Collazo, as well as DOE Fellows Heidi Henderson and Lilian Marrero, during which current and future project work and student summer internship opportunities were discussed.

Task 1: EFPC model update, calibration & uncertainty analysis

Task 1 Overview

The main objectives of this task are to extend the existing EFPC model by adding a reactive transport and sedimentation module, and use the model to perform numerical simulations. The simulations will provide a better understanding of the flow and transport within the watershed on a regional scale. Simulations will be conducted using historic observations of rainfall, evapotranspiration, and contaminant distribution, within the watershed to determine transport patterns within the domain. During FY11, the focus is on extending the sedimentation module to include the entire EFPC and Bear Creek. In addition, the proposed research will provide stochastic modeling of the system and will include an analysis of the spatial and temporal patterns as a result of the stochastic variations of selected properties of the sub domain.

Task 1 Quarterly Progress

- *EFPC Model Extension:* A series of observed data stations were added within the model domain for discharge and water elevation data (Figure 3-4). Additional stations were

transferred from the existing Y-12 Model to EFPC Model. Spreadsheets containing the processed lab and field data, as well as GIS shapefiles used to update the model's network file, and timeseries were developed in the process. Data has also been processed for methylmercury and total mercury. The model errors that resulted from the conflicting network modifications with respect to the addition of observed data stations containing discharge and water elevation data were fixed. Simulations were executed and results will be reported once the model outputs are collected and analyzed. EFPC model timeseries for the new stations were finalized.

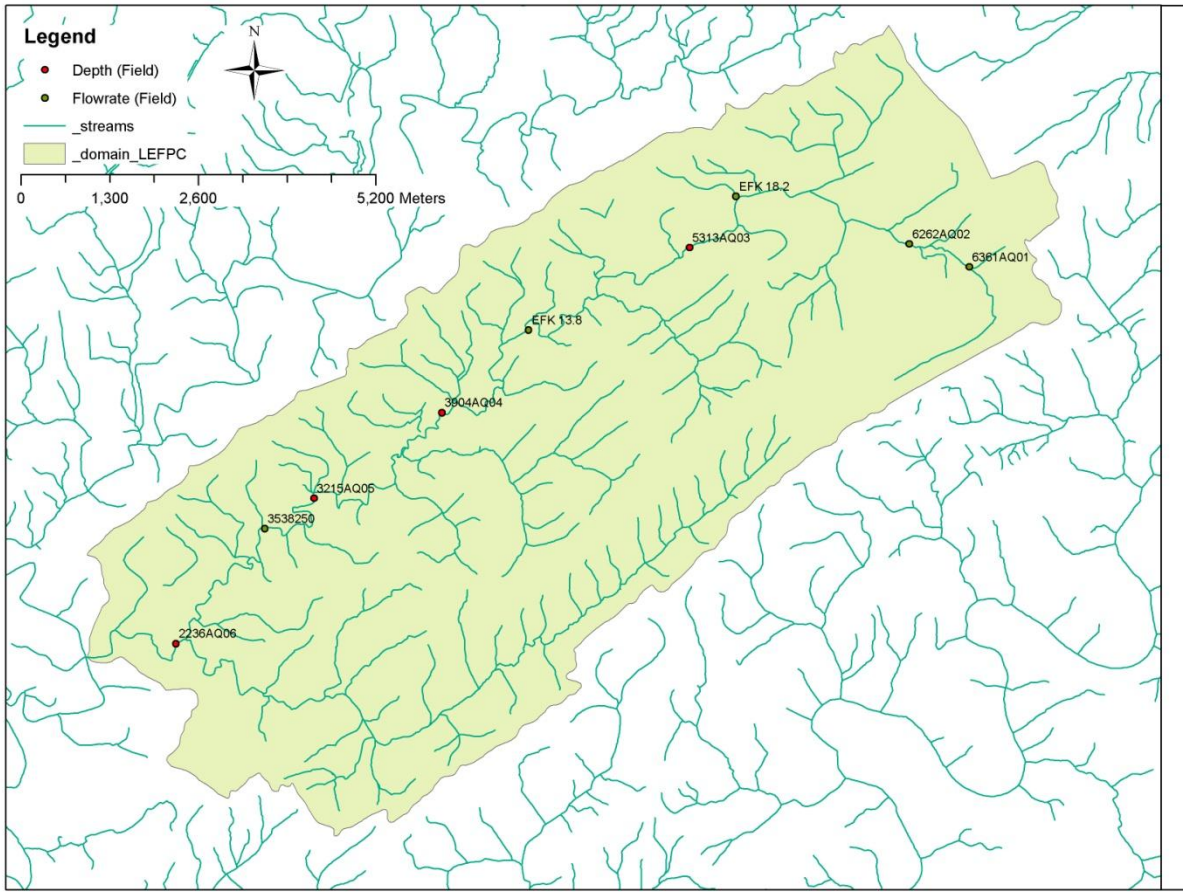

Figure 3-7. Incorporated observation stations for updated discharge and water elevation data.

- A PowerPoint entitled, "Mercury Contamination Characterization via an Integrated Flow and Transport Model, East Fork Poplar Creek, Oak Ridge, Tennessee" was generated and presented to the Korea Advanced Institute for Science & Technology (KAIST) as part of the DOE Fellows Series' program activities.
- A poster entitled, "Improvements in the Suspended Sediment Interactions Module of an Integrated Flow and Mercury Transport Model for East Fork Poplar Creek Watershed, Oak Ridge, Tennessee" was developed and presented at the Waste Management 2012 Symposium.
- A literature review on "Hydraulic Conductivity Spatial Distribution Methods" was conducted.

- Powerpoint presentations on the development of the EFPC model were given during Recruitment Sessions at ARC for new DOE Fellows under the DOE-FIU Science & Technology Workforce Development Program.

Task 2: TMDL Analysis for the entire EFPC

Task 2 Overview

The numerical model of the EFPC will simulate fate and transport of mercury and VOC plumes within the EFPC watershed, and will assist in analyzing the TMDL requirements for surface water and groundwater within the EFPC watershed. The main objectives of this task are to:

- Develop a TMDL methodology for analysis of flow and load duration exceedance probabilities for key monitoring stations along Bear Creek and the EFPC from numerical simulations and observed data; and
- Provide analysis of the relative contribution of point and non-point sources to mercury pollution in the watershed including the contributions from the floodplain of the two watershed creeks (EFPC and Bear Creek), the remobilization of stream sediments during stormwater events, the groundwater exchange with the creeks, and the transport within the creeks.

Task 2 Quarterly Progress

- The Task 2 progress report on "Simulation of TMDL for entire EFPC" was drafted for internal review (Milestone 2011-P3-M7). The report was internally reviewed and prepared for release. Multiple sections underwent revision and additional figures were generated to accompany the relevant information provided. The report will be sent to DOE on April 3, 2012.

Task 3: Parameterization of Major Transport Processes of Mercury Species

Task 3 Overview

The overall objective of this task is to provide laboratory measurements for critical mercury transport, transformation, and exchange processes (i.e., methylation/demethylation, and dissolution) to be used in the numerical model. The laboratory experimental work will provide insight on parameters relevant to the Oak Ridge Reservation (ORR) and which are required in the numerical model, such as dissolution rate of mercury and the proportion of mercury species available for methylation/demethylation in sediments. In addition, experimental work will be conducted to analyze the effect of significant environmental factors (pH, Eh, sunlight) on the major transport and transformation processes of Hg.

Under this task we will systematically investigate the stability, bioavailability, and mobility of the aged mercury species in soils and sediments. The proportion of Hg species available for methylation and demethylation in sediments will be estimated by using isotope addition techniques. In addition, the dissolution of cinnabar and Hg bead, which have often been observed at this site and are thought to be recalcitrant mercury species, will be investigated by using both experimental and theoretical calculation methods. Three factors, oxidation-reduction, pH, and

complexation with organic ligands (e.g., low molecular weight thiols such as cysteine and glutathione and large molecular NOM), will be particularly investigated for their role in mobilizing the aged mercury species. These studies will provide a better understanding of the bioavailability and dissolution of aged Hg species in soils and sediments.

Task 3 Quarterly Progress

- Experiments were conducted to estimate the difference of newly input and ambient Hg species in Hg methylation/demethylation efficiency. This parameter was then used to improve the estimation of the net MeHg production or reduction flux in aquatic ecosystems. Data of these experiments has been analyzed and a paper was submitted to the Environmental Science and Technology and is currently under review.
- Conducting ongoing experiments to investigate the chemical mechanism of HgS dissolution and the role of pH, Eh, and thiol-containing compounds in this process. Experiments were conducted to measure the dissolution of cinnabar (HgS) under anoxic or oxic conditions without the addition of cysteine (a thiol-containing compound). Experiments were also conducted to measure the dissolution of cinnabar (HgS) under anoxic or oxic conditions in the presence of cysteine. Experiments are being conducted to measure the effect of pH on dissolution of cinnabar (HgS).
- A model based on chemical thermodynamics and adsorption/desorption equilibrium is being developed to calculate the dissolution of cinnabar under different pH and Eh conditions and thiol concentrations. Current studies on the chemical thermodynamics of HgS dissolution were summarized. A conceptual model has been developed and the model is being parameterized. Values of the parameters for the chemical thermodynamics of HgS dissolution in the absence of oxygen were summarized. Parameters associated with the adsorption/desorption of Hg on cinnabar are being measured.

Task 4: Geodatabase Development for Hydrological Modeling Support

Task 4 Overview

The main objective of this task is to create a geodatabase to support hydrological model development and simulation of contaminant fate and transport at Oak Ridge Reservation (ORR), TN. The geodatabase will serve as a centralized data management system which facilitates storage, editing, and versioning of model parameters. A working prototype was developed by FIU ARC during FY 2010. As FIU ARC continues to conduct model simulations to support the D&D remediation activity at ORR, there will be an ongoing need for the update of the geodatabase and the utilization of the integrated GIS-hydrological modeling system developed.

The two objectives for this task for FY 2011 are:

- Configuration of the database to provide remote access to input and output files.
- Import of simulation input and output files for the Y-12 NSC, WOC and EFPC models into the geodatabase along with versioning.

Task 4 Quarterly Progress

- Database was refined and updated with newly imported simulation output files (Figure 3-5).

OBJECTID *	DHI_ID	Name	Origin	StartTime	EndTime	TimeStep	TimeStepUnit	TimeType	ValueType	EUMType	EUMUnit
4359	183	55-2B		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4360	184	55-2C		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4361	185	AB8110-1		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4362	186	AB8110-2		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4363	187	AB8110-3		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4364	188	AB8110-4		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4365	189	AB8110-5		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4366	190	AB8110-6		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4367	191	ED4		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4368	192	EU4		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4369	193	EW-01		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4370	194	GW-064		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4371	195	GW-087		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4372	196	GW-108		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4373	197	GW-115		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4374	198	GW-141		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4375	199	GW-149		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4376	200	GW-151		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4377	201	GW-152		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4378	202	GW-153		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4379	203	GW-154		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4380	204	GW-156		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4381	205	GW-159		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4382	206	GW-161		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000
4383	207	GW-168		4/9/1997	3/4/2009	-1	1400	4	0	100059	1000

Figure 3-8. Imported timeseries data stored as an ArcGIS object class.

- The Task 4 progress report on "Geodatabase development for hydrological modeling support," was drafted and submitted for internal review (Milestone 2011-P3-M9).

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

Task 5 Overview

FIU, in collaboration with DOE's Moab site project director, will use 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 two main objectives of Task 5 are to:

1. Use an existing groundwater numerical model to simulate the fate and transport of contaminants including uranium and ammonia in the subsurface at the Moab, Utah site.
2. Perform numerical simulations of remedial scenarios proposed by DOE including pumping of contaminated groundwater from the shallow plume to an evaporation pond on top of the tailings pile, and injecting the diverted Colorado River water into the alluvial aquifer in order to predict the outcome of each remedial action and to investigate the effectiveness of each scenario. Numerical simulation of remedial actions assists DOE in deciding their effectiveness.

Task 5 Quarterly Progress

- *Moab Model:* Ran simulations for the Moab SEAWAT model with updated well data (Figures 3-6 and 3-7) from 44 different monitoring wells for improving the accuracy of the model. Reviewed and analyzed the additional data.

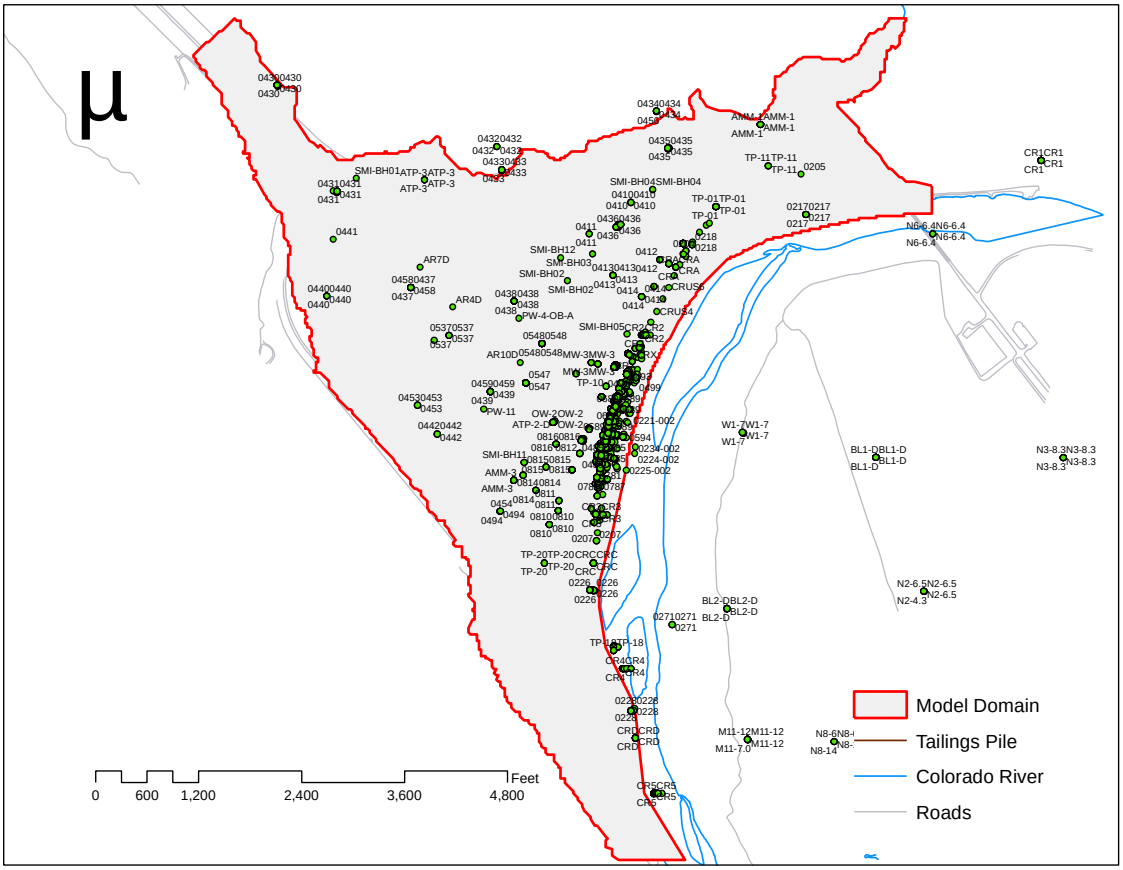

Figure 3-9 Ammonia monitoring wells.

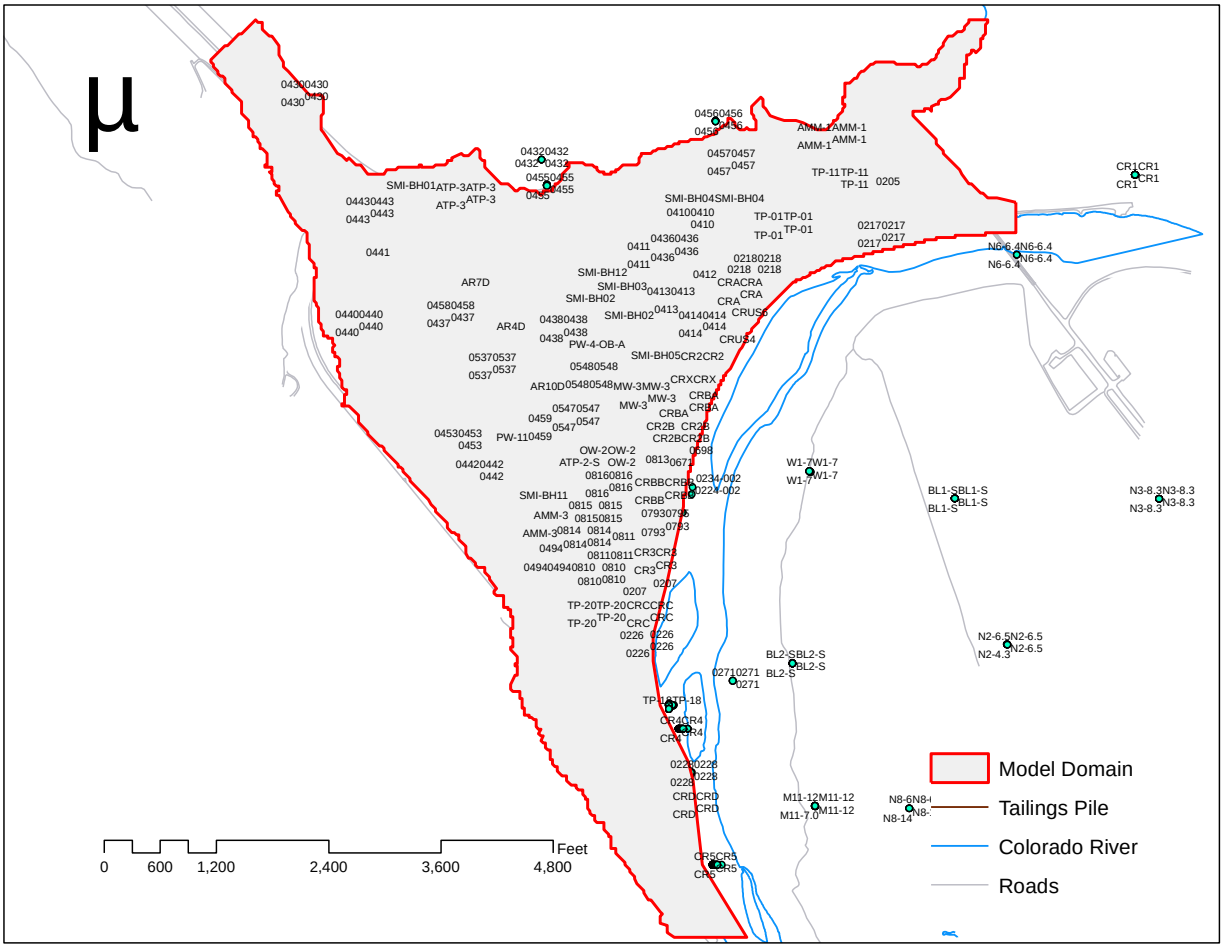

Figure 3-10. Uranium monitoring wells.

- Continued review and analysis of data for creating geostatistically interpolated ammonia and uranium plumes, as well as current well operation data which will be used to update the existing Moab model for evaluating effects of pumping on contaminant concentrations (Figure 3-8).

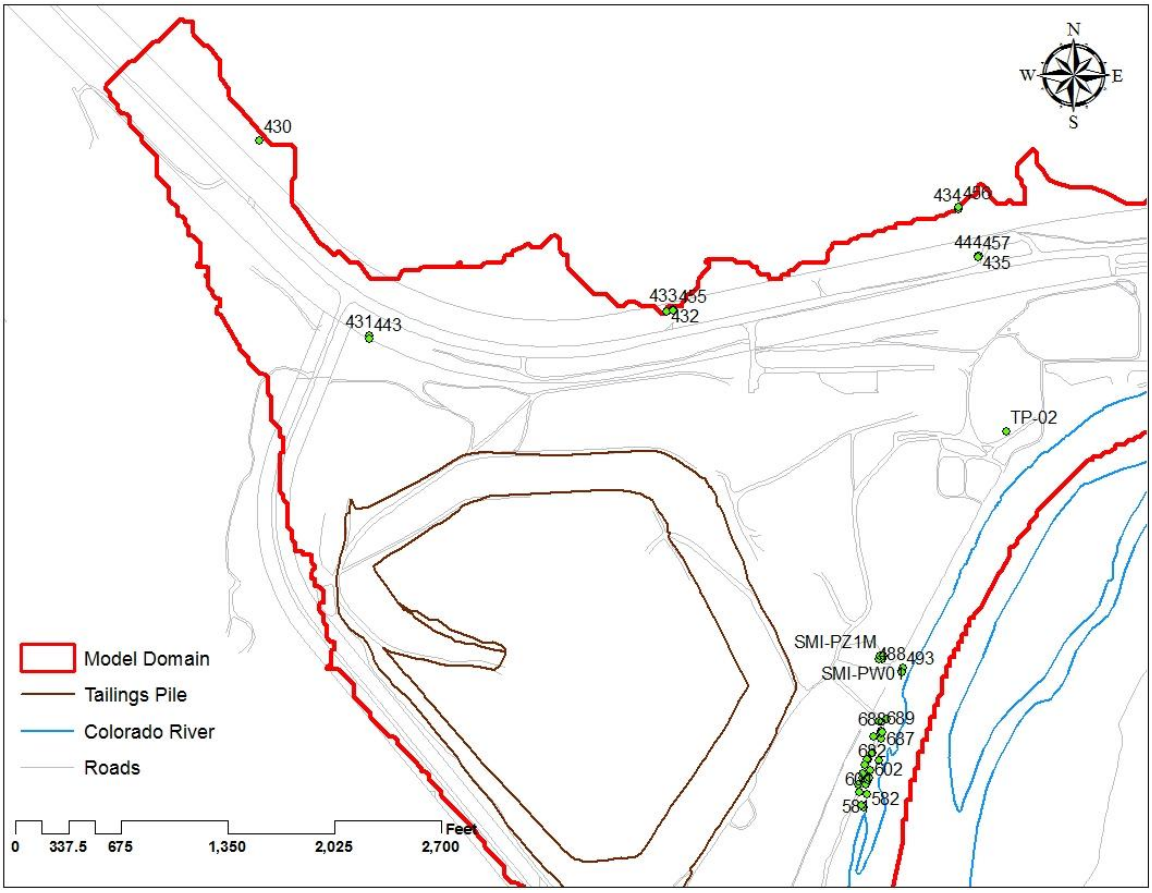

Figure 3-11. Target points used for updating and calibrating Moab model.

- Continued running simulations with updated pumping test data to analyze the effect of pumping on ammonia and uranium concentrations.
- Finalized the model and its configuration according to ASCEM specifications. Further updates to the model will be made as deemed necessary as simulation results are acquired until project completion.
- Task 5 progress report on the Moab groundwater flow and transport model was drafted and submitted for internal review on Feb 17, 2012 (Milestone 2011-P3-M6). The progress report is being updated following the analysis of new simulation results and will be an ongoing process until project completion.

Milestones and Deliverables

The milestones and deliverables for Project 3 are shown in the following table. The Task 2 progress report (Milestone 2011-P3-M7) on "Simulation of TMDL for entire EFPC" has been completed and submitted for internal review on February 1, 2012. The Task 2 report will be sent to DOE on April 3, 2012. In addition, the Task 5 progress report (Milestone 2011-P3-M6) on the Moab groundwater flow and transport model was completed and submitted for internal review on Feb 17, 2012. The Task 5 report will be sent to DOE on April 10, 2012. Milestone 2011-P3-M8, "Presentation overview to DOE HQ of the project and accomplishments," was due on

2/17/2012 and has been reforecasted to 5/31/2012 due to scheduling conflicts. Meeting arrangements will be coordinated between FIU-ARC and ORNL personnel.

Work Plan for Next Quarter

- Submit Task 4 progress report on "Geodatabase development for hydrological modeling support" to DOE following internal review.
- Prepare Task 3 progress report on "Parameterization of major transport processes of mercury species" and submit for internal review.
- Present an overview to DOE HQ of the project and accomplishments
- Draft the Year End Report for DOE.

Milestones and Deliverables for Project 3

Task	Milestone/ Deliverable	Description	Due Date	Status
Task 1: EFPC Model Update, Calibration, Uncertainty Analysis	2011-P3-M5	Task 1 progress rpt on "EFPC model update, calibration, uncertainty analysis"	11/17/2011	Complete
Task 2: Simulation of TMDL for the Entire EFPC	2011-P3-M7	Task 2 progress rpt on "Simulation of TMDL for entire EFPC"	2/1/2012	Complete
Task 3: Laboratory experiments for methylation/ demethylation and transport parameters of mercury	2011-P3-M1	Task Plan for Prof. Cai (after visit & coordination with ORNL)	8/1/2011	Complete
	2011-P3-M11	Task 3 technical report entitled, "Parameterization of major transport processes of mercury species"	5/17/2012	On target
Task 4: Geodatabase Development for Hydrological Modeling Support	2011-P3-M9	Task 4 progress report on "Geodatabase development for hydrological modeling support"	3/1/2012	Complete
Task 5: Student Support for Modeling of Groundwater Flow and Transport at the site of Moab, Utah	2011-P3-M3	Student summer internship at Moab Site	9/23/2011	Complete
	2011-P3-M6	Task 5 progress report on "Student support for modeling of groundwater flow and transport at Moab, UT site"	12/1/2011 Reforecasted to 2/17/2012	Completed 2/17/2012
	2011-P3-M10	Finalize model and its configuration according to ASCEM specifications (after visit to Moab Site)	03/17/2012	Complete
Project-wide	2011-P3-M2	Submit 2 abstracts to Waste Management Symposium 2012	8/19/2011	Complete
	2011-P3-M4	Rpt on project coordination w/ applied field research center (ORNL) & ASCEM (after site visit)	9/28/2011 Reforecasted to 11/18/2011	Completed 11/18/2011
	2011-P3-M8	Presentation overview to DOE HQ of the project and accomplishments	2/17/2012 Reforecasted to 5/31/2012	Reforecasted
	2011-P3-M12	Submit publications to relevant journals	5/17/2012	On target
	Deliverable	Draft Technical Task Plan	08/12/11	Complete
	Deliverable	Quarterly Status and Progress Summary Reports	Quarterly	On target
	Deliverable	Year End Report	06/15/2012	On target

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 and includes support of the Office of Innovation and Technology Development R&D Plan. 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-30 with the Nuclear Decommissioning Authority (NDA) in England and the International Atomic Energy Agency (IAEA). Efforts on this project 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)
- Task 4: IT Support to EM and DOE Sites

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

- 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.
- Discussed the 2012 data set for incorporation into WIMS with DOE EM. Data is anticipated to be collected, reviewed, and transmitted to FIU in April. No data format changes from last year are expected.
- Developed and presented a WIMS poster at the Waste Management 2012 Symposium (Figure 4-1).

Figure 4-1. Poster presentation at WM12 for the Waste Information Management System.

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

Task 2 Overview

This task provides direct support to DOE EM for D&D technology innovation, development, evaluation and deployment. The objective of Task 2 is to use an integrated systems approach to develop a suite of D&D technologies (D&D Toolbox) that can be readily used across the DOE complex to reduce technical risks, improve safety, and limit uncertainty within D&D operations. FIU directly supports DOE-EM's Office of Innovation and Technology Development and affiliated DOE sites, national laboratories, and institutions contributing to the development of innovation in D&D. This task will also collaborate with DOE-EM's international partnerships and agreements by providing D&D expertise, knowledge and support when requested to do so by DOE EM. The technical approach for this task is to identify and demonstrate new technologies, methodologies, and approaches to support EM's collaborative international activities.

Task 2 Quarterly Progress

- Purchase order for the technology vendor to perform a feasibility study for the removal of strippable coatings using a remote controlled platform was completed and sent to vendor. The vendor researched and identified suitable tools for remote removal of strippable coating. After considerable discussion and fundamental testing with the various strippable coatings, two approaches were identified that merited further investigation: a scraper/gripper combination tool to get under the coating and then grab the peeling edge of the coating, and a stiff bristled cylindrical brush with an attached vacuum collection unit to break up and collect the cured coating (Figure 4-2). Completed the bench-scale testing of the tools identified for remote removal of strippable coatings. A scraper/gripper combination tool was tested to determine its ability to get under the coating and then grab the peeling edge of the coating. A stiff bristled cylindrical brush with an attached vacuum collection unit to break up and collect the cured coating was also tested. A draft feasibility study report for the removal of strippable coatings using the two approaches via a remote controlled platform was developed.

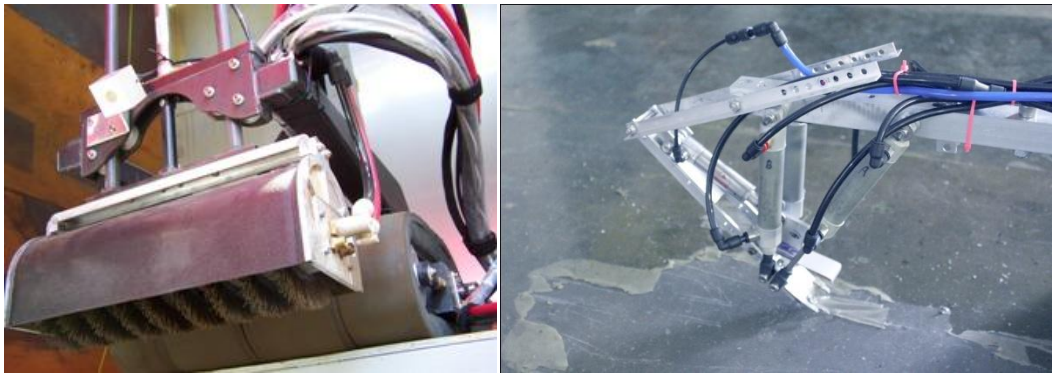

Figure 4-2. Cylindrical brush (left) and scraper/gripper tool (right).

- Prepared a technical summary of feasibility study and submitted it to the ANS's DD&R conference scheduled for June 2012. The paper was accepted for oral presentation at the upcoming DD&R conference.
- 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.
- During the month of January, FIU staff and students continued to work with the PIs from all four institutions in the final installation, connections and systems check. During the week of January 9, 2012, PIs and graduate students from all four institutions and Mr. Mike Serrato from Savannah River Site gathered at FIU for the final installation of the sensors and grouting of the concrete monolith (Figures 4-3 through 4-5). A total of 270 sensors were installed in the 10 ft x 10 ft x 8 ft cube. PIs worked alongside FIU personnel and DOE Fellows during the troubleshooting, connections, and placement of 9 sensor racks into the concrete monolith. On January 12, 2012, CEMEX delivered 32 cubic yards of a special grout formula to encapsulate the sensors in the precast monolith test bed. Sensors began collecting data and will continue to collect data for a period of six months. FIU also began drafting the Final Construction Report for the Meso-Scale Test Area and Cube. In addition, an interim report was drafted for the sensor remote access system (SRAS) installation.
- During the months of February and March, FIU staff and students continued supporting SRS and the four institutions in the monitoring the experimental setup and data collection tasks. FIU also completed the draft of the Final Construction Report for the Meso-Scale Test Area and Cube and the Sensor Remote Access System (SRAS) Installation Report. Both reports

were sent to SRS for review and comments. Comments received from SRS on the Final Construction report were resolved and incorporated into the final draft of the report.

Figure 4-3. Installation of Cube

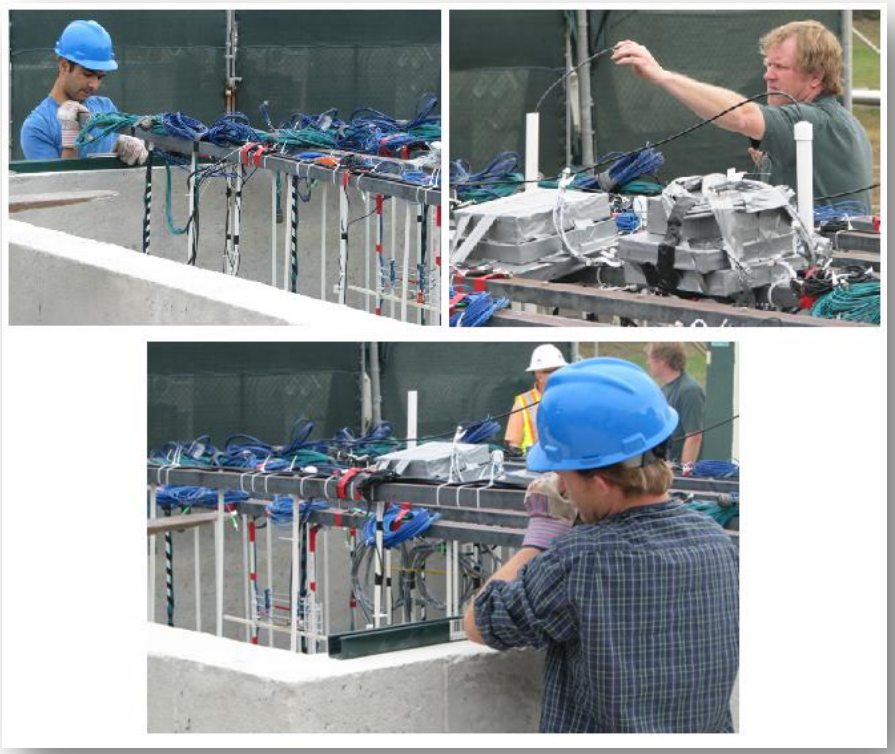

Figure 4-4. PI's Testing Sensors

Figure 4-5. Grout pump and filling the cube with grout.

- FIU also participated in regular teleconference calls 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.

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 (EM44 & EM72), 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.
- Completed development and deployment of the mobile application for the vendor and specialist directory modules for DOE review on January 30, 2012. D&D KM-IT Mobile allows access to features like the Vendor Directory and Specialist Directory on mobile devices, including iPhone, iPad, Blackberry, Android, and Windows smart devices. Deployed beta-test version of the mobile application for demonstration at the Waste Management 2012 Symposium.
- Completed identifying and adding D&D vendors from the Waste Management Symposia 2011 to the Vendor module of the D&D KM-IT. Also completed identifying and adding D&D vendors from the Nuclear Plant Journal Product and Service Directory 2012. As of March 22, the Vendor module includes a total of 457 vendors.
- Continued adding technologies to the Technology module from technologies identified in Hanford ALARA newsletters as well as technologies from the newly added vendors. The Technology module includes 423 technologies as of March 22, 2012.
- Continued discussions on and revisions of a charter, including potential members, for forming a D&D KM-IT user group to assist in reviewing the current features/enhancements of the D&D KM-IT system to improve the user experience.
- Based on discussions with and input from DOE, developed multiple revisions of a white paper entitled, "Leveraging Wikipedia and Wiki-Based Technologies," on the use of internet resources (e.g., Wikipedia) and how they are of value to the D&D KM-IT site.
- Completed monthly analysis of web analytics and prepared a report on the results. Began development of an annual report of the web analytics.
- Search Engine Optimization process continues to be deployed on the D&D KM-IT web application.
- Began design and development of the Training Module.

- Made significant preparations to demonstrate and market the D&D KM-IT at the Waste Management 2012 Symposium. Created Powerpoint presentation for oral presentation. Developed postcards on D&D KM-IT for handing out at presentation and at exhibiter booth as well as developed tabletop displays for both D&D KM-IT and the newly developed mobile application.
- An oral presentation of the D&D Knowledge Management Information Tool – 2012 was given at the Waste Management 2012 Symposia (Figure 4-6). The D&D KM-IT web and mobile systems generated a lot of interest in the D&D community when presented to the conference participants, which included U.S. and international attendees.

Figure 4-6. Himanshu Upadhyay presenting the D&D KM-IT system to the Waste Management 2012 Symposia.

- ARC also hosted an exhibitor booth at the Waste Management 2012 Symposia (Figure 4-7). The booth showcased the D&D Knowledge Management Information Tool and provided demonstrations of the D&D KM-IT and the beta-test version of the mobile app systems to the conference attendees. Tabletop displays of D&D KM-IT were exhibited at the booth and postcards on D&D KM-IT were distributed.

Figure 4-7. ARC Staff and DOE Fellows at WM2012 booth.

- Prepared a technical summary of D&D KM-IT and submitted it to the ANS's DD&R conference scheduled for June 2012. Summary was accepted for presentation at the conference.

Task 4: IT Support to EM and DOE Sites

Task 4 Overview

DOE EM expressed a need for enhancing the DOE EM website and developing a system of knowledge management, similar to our current Knowledge Management Information Tool (KM-IT) being developed for EM-44, to allow sharing of DOE EM information among the DOE community. To address this need, FIU-ARC subsequently received additional funding toward the end of FIU's FY10; due to the late arrival of this additional funding, DOE and FIU agreed to treat this funding as carryover funding with the expectation that the scope of work delineated in the proposal document would be carried out during FIU's FY11 period of performance. FIU-ARC proposed 3 subtasks as described in the Task 4 section of this document. A fourth subtask, separate from the additional $500K scope was added to provide support to SRS with data acquisition through wireless sensors and access through the D&D KM-IT system.

Task 4 Quarterly Progress

- Further activities on the DOE EM Website and Knowledge Base for Environmental Management are currently being held on standby pending further input from EM-72.
- For the ISDSN IT subtask, the Sensor Remote Access System (SRAS) was installed to capture raw data from various sensors installed in the test cube pouring of the grout. All of the participating universities and national labs (Mississippi State University, University of Houston, University of South Carolina, Idaho National Lab and Savannah River National Lab) have installed their sensors in the test bed and connected to a data acquisition and logging system (DALS). These data acquisition systems are connected to the local work

station which in turn is connected to SRAS remote server. The sensor local area network (LAN) is the first interaction that SARS has with the sensors. The LAN includes two components which are the DALS and a workstation. This LAN is physically located inside the mobile office next to the test bed. The LAN is hard wired to the main FIU network for internet connectivity and the system implements FIU's network security policies. The DALS collects the data from the sensors and passes it to workstation in the LAN which acts like a file server. Its primary role is to transfer the raw data from the DALS to itself. This data is transferred daily and stored locally in the file system of the workstation for archive.

- The Sensor Remote Access System (SRAS), data acquisition and logging system and sensor local area network are fully operational and collecting data on a regular basis. This data is published over the web using the D&D KM-IT platform. All the pictures and videos of the installation and operation are published over the SRAS system for project stakeholders.
- All the subsystems of the ISDSN project are being administered and maintained by ARC IT. ARC IT is supporting all the participating universities and national labs (Mississippi State University, University of Houston, University of South Carolina, Idaho National Lab and Savannah River National Lab) for their VPN access to their individual systems. Raw data flow to the SRAS from the sensor local area network is being monitored continuously. Any issues arising from these processes are resolved on a regular basis. A draft SRAS report was completed and submitted to SRS for review and comment.

Milestones and Deliverables

The milestones and deliverables for Project 4 are shown in the following table. Milestone 2011-P4-M3.3, Deployment of mobile application for vendor and specialist modules to DOE for review, was completed on January 30, 2012. The project is on schedule to meet all remaining milestones and deliverables on schedule with the exception of two deliverables associated with Task 4, since further activities on the DOE EM Website and Knowledge Base for Environmental Management are currently being held on standby pending further input from EM-72.

Work Plan for Next Quarter

- Perform database management, application maintenance, and performance tuning to WIMS (Task 1).
- Integrate new waste forecast data into WIMS, if a new dataset is received from DOE (Task 1).
- Finalize feasibility study report for remote removal of strippable coatings and decon gels (Task 2).
- Complete work with university PIs and SRNL and INL in the testing of remote sensors at FIU for in situ decommissioning (Task 2).
- Complete development and deploy Training Module to DOE for review/testing (Task 3).
- Incorporate DOE review comments and input on Mobile Application feature (Task 3).
- Incorporate DOE review comments and input on Collaboration Tools module (Task 3).
- Draft DOE EM website analysis report (Task 4) – on standby pending input from EM-72.

- Maintain the Sensor Remote Access System (SRAS), data acquisition and logging system and sensor local area network for collecting data on a regular basis (Task 4).
- Participate in ANS's DD&R conference scheduled for June 2012.
- Draft the Year End Report for DOE.

Milestones and Deliverables for Project 4

Task	Milestone/ Deliverable	Description	Due Date	Status
Task 1: Waste Information Management System (WIMS)	2011-P4-M1.1	Import 2011 data set for waste forecast and transportation data	Within 60 days after receipt of data from DOE	Complete
Task 2: D&D Support to DOE EM for Technology Innovation, Development, Evaluation, and Deployment	2011-P4-M2.1	Complete In-Situ Decommissioning Experiments	04/30/12	On target
	Deliverable	Draft technical report for review of mercury D&D issues at Oak Ridge	One month after receiving documents	On target
	Deliverable	Draft Tech Fact Sheet for in-situ decommissioning experiments	One month after experiments are completed	On target
	Deliverable	Draft Feasibility Report for remote removal of strippable coatings	4/20/2012	On target
Task 3: D&D Knowledge Management Tool (D&D KM-IT)	2011-P4-M3.1	Deployment of Vendor Management module to DOE for review/testing	7/31/2011	Complete
	2011-P4-M3.2	Deployment of Collaboration Tools to DOE for review/testing	10/31/2011	Complete
	2011-P4-M3.3	Deployment of mobile application for vendor and specialist modules to DOE for review/testing	1/31/2012	Complete
	2011-P4-M3.4	Deployment of training module to DOE for review/testing	4/30/2012	On target
	2011-P4-M3.5	D&D KM-IT data mining	5/17/2012	On target
	Deliverable	Draft report of internal C&A audit findings and responses	30-days after internal audit	On target
	Deliverable	Draft report of external C&A audit findings and responses	30-days after external audit	On target
	Deliverable	Draft Tech Fact Sheet for new modules or capabilities of D&D KM-IT	30-days after deployment of new module or capability	On target
Task 4: IT Support to EM and DOE Sites	2011-P4-M4.1	Draft static prototype for EM knowledge base to DOE for review	8/31/2011	Complete
	Deliverable	Draft DOE EM website analysis report	11/28/2011	On hold
	Deliverable	Draft knowledge base requirements document for EM	2/28/2012	On hold
Project-wide	Deliverable	Draft Project Technical Plan	6/17/2011	Complete
	Deliverable	Draft Year End Report	06/18/2012	On target
	Deliverable	Quarterly status and progress summary reports	Quarterly	On target

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.

Quarterly Progress

- Fellows continue their support to 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.

- The DOE Fellows program director coordinated with DOE sites, DOE national laboratories, DOE contractors, and DOE-HQ for placement of DOE Fellows for summer 2012 internships. DOE Fellows prepared/updated their resumes to send to site representatives. A total of 9 DOE Fellows has been placed for summer internships as of 3/30/12 and an additional 2 Fellows are expected to be placed by the end of April. The following table details the DOE Fellows summer 2012 internships.

DOE Fellow	DOE Site/National Lab/Contractor	Location	Mentor
Janty Ghazi	DOE-HQ EM-23 (Tank Farm Program)	Washington, DC	James Poppiti
Claudia Cardona	DOE-HQ	Washington, DC	TBD
Joshua Midence	Savannah River Site	Aiken, NC	Alex Cozzi
Eric Inclan	Oak Ridge National Laboratory	Oak Ridge, TN	Dr. Prashant Jain
Jaime Mudrich	Oak Ridge National Laboratory	Oak Ridge, TN	Dr. Prashant Jain
Heidi Henderson	Oak Ridge Reservation	Oak Ridge, TN	Dr. Eric Pierce
Ximena Prugue	Washington River Protection Solutions, Hanford Site	Richland, WA	TBD
Lillian Marrero	Sullivan International Consulting	Chicago, IL	JD Campbell
Elicek Delgado	Sullivan International Consulting	Chicago, IL	JD Campbell

- DOE Fellows continued to assist EFCOG in developing Lessons Learned and Best Practices documents. The best practice on the historical hazard identification process for D&D has been finalized and posted on the EFCOG and D&D KM-IT websites. A significant revision of the best practice on the 185-3K Cooling Tower Demolition was completed with the assistance of a new site point-of-contact and sent to EFCOG for review; EFCOG comments were received and incorporated and the document was sent to DOE for review; initial DOE comments were received and incorporated; document is awaiting final DOE review and approval. 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 was reviewed by EFCOG, revised by FIU, and sent to DOE HQ for review; DOE comments were received and FIU is working with the site point-of-contact to resolve.

Doc	BP/ LL	Title	POC	Status as of 3/31/2012
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	Received site release of document. Sent to EFCOG for review on 3/19/2012. Sent to DOE-HQ on 3/21/12. DOE comments received and incorporated on 3/21/2012. Awaiting final DOE review and approval.
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	Received review comments from EFCOG. Worked with site POC to resolve comments. Sent to DOE HQ for review on 3/19/2012. DOE comments received 3/21/2012. FIU & site POC working to resolve.
6	LL	Unanticipated High Dose During the Removal of Wire Flux Monitor Cabling from the HWCTR Reactor Vessel	Bill Austin	New site POC assigned. Site POC comments received and incorporated. Awaiting site release of document.

- The DOE Fellows program at FIU hosted Dr. Soon-Heung Chang during his visit to FIU (Figure 5-1). Dr. Soon-Heung Chang is the current President of the Korean Nuclear Society, as well as the Dean and Vice President at the prestigious Korea Advanced Institute for Science and Technology (KAIST). During his visit to FIU, Dr. Chang had the opportunity to visit FIU's laboratories and facilities where DOE Fellows and Applied Research Center (ARC) staff showcased on-going applied research projects sponsored by the US Department of Energy's Office of Environmental Management (DOE-EM) (Figure 5-2).

Figure 5-1. Dr. Leonel Lagos (Program Director) and FIU/DOE Fellows with Dr. Soon-Heung Chang.

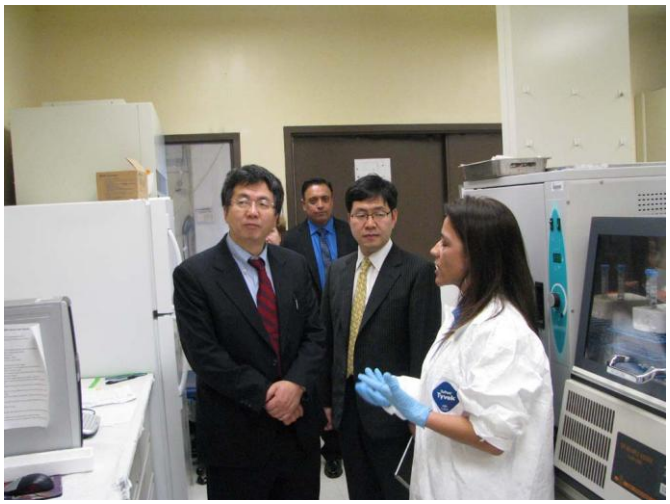

Figure 5-2. DOE Fellow presents her research to Dr. Soon-Heung Chang.

- Dr. Chang also participated as a distinguished lecturer at the DOE Fellows Lecture Series conducted at MARC International Pavilion on 02/10/12. Dr. Chang's presentation, "Perspective on Korea's Nuclear Future after Fukushima," discussed the cutting edge research being conducted at KAIST as well as provided a perspective on Korea's nuclear energy program after the Fukushima Daiichi nuclear accident in Japan.

- In addition, Mr. James Auld (Director, College Coordinator Nuclear Programs), representing Florida Power & Light Company (FPL), attended the DOE Fellows Lecture Series and provided his perspective on an aging nuclear workforce and the need to train and mentor the new generation of college students in nuclear science and engineering disciplines. He also made comments on the plans of FPL to construct two new nuclear reactors at FPL's facility in Homestead, Florida.

- Seventeen DOE Fellows and other STEM students attended the Waste Management 2012 Conference and met with Mr. David Huizenga (DOE Senior Advisor for Environmental Management) to discuss their EM applied research work being performed at FIU's Applied Research Center as well as their summer internship experiences at DOE sites, national laboratories, and site contractors (Figure 5-3). The DOE Fellows Program is being supported by EM in order to create a pipeline of minority students and engineers to help span the science and engineering talent gap necessary to complete EM's mission. This occasion also appeared in an article in the March 1 EM Program Update (http://www.em.doe.gov/pdfs/EM%20Program%20Update%20-%20EM%20Renews%20Information-Sharing%20Agreement%2003-01-12.pdf).

Figure 5-3. David Huizenga (DOE Senior Advisor for EM, 8th from left) with FIU's DOE Fellows, Dr. Leo Lagos (DOE Fellows Program Director, 10th from left), and Ms Rosa Ramirez (DOE Fellow Class of 2008 and current DOE-EM employee, 11th from left) at WM2012.

- Fourteen DOE Fellows from the DOE – FIU Science and Engineering Workforce Development Initiative prepared and presented technical posters during the session entitled, "Student Poster Competition: The Next Generation – Industry Leaders of Tomorrow" (Session 30). Presentations by the students were based on the hands-on research they performed at the Applied Research Center at FIU and during their summer internships at DOE sites, national laboratories, and site contractors. The Fellows and students presented EM research in the areas of waste processing/high level waste, decontamination & decommissioning, soil and groundwater, and knowledge management (Figures 5-4 through 5-10).

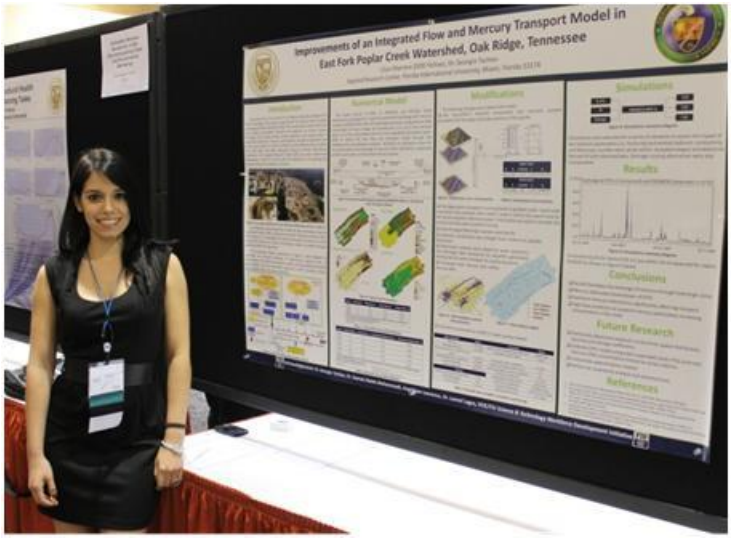

Figure 5-4. DOE Fellow, Lilian Marrero, at Waste Management 2012 Conference.

Figure 5-5. DOE Fellow, Jose Matos, at Waste Management 2012 Conference.

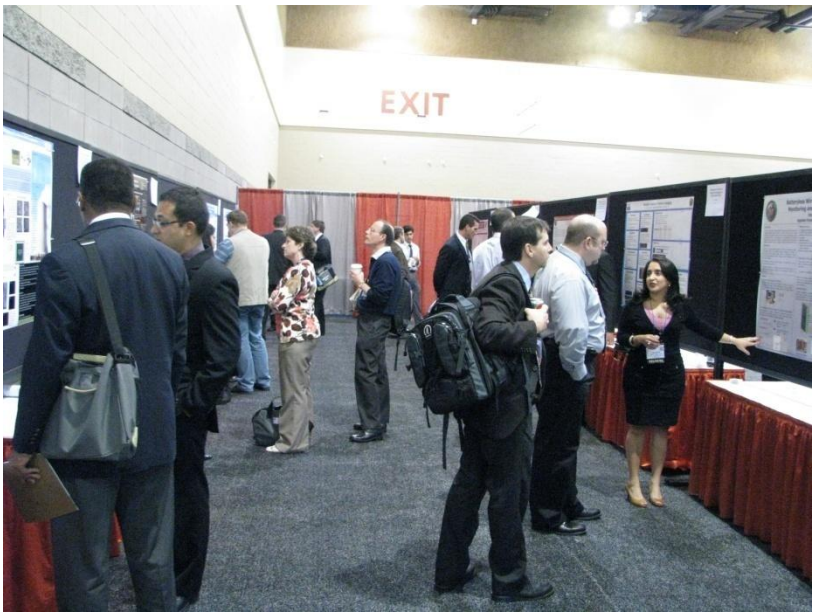

Figure 5-6. DOE Fellow, Elicek Delgado-Cepero, at Waste Management 2012 Conference.

Figure 5-7. DOE Fellow, Alessandra Monetti, at Waste Management 2012 Conference.

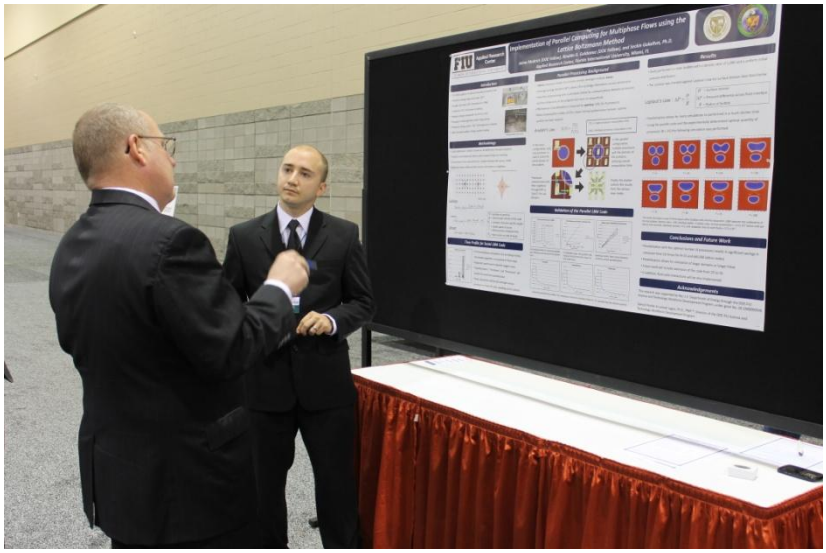

Figure 5-8. DOE Fellow, Jaime Mudrich, at Waste Management 2012 Conference.

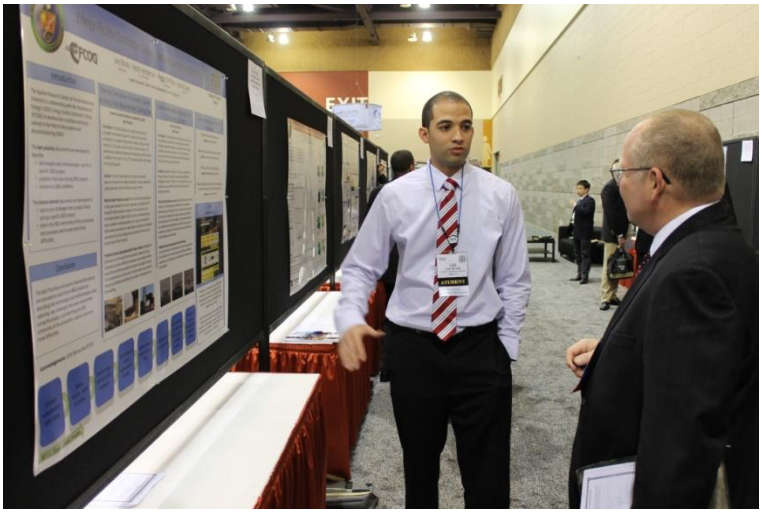

Figure 5-9. DOE Fellow, Lee Brady, at Waste Management 2012 Conference.

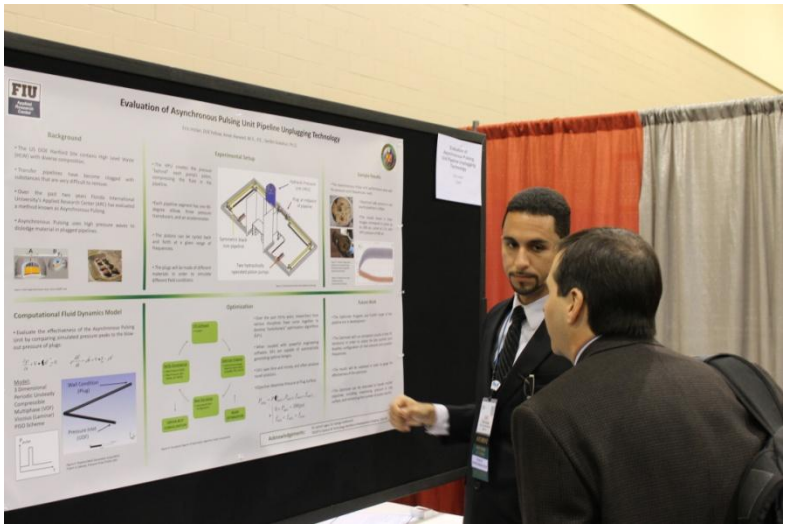

Figure 5-10. DOE Fellow, Eric Inclan, at Waste Management 2012 Conference.

- Dr. Leonel Lagos and DOE Fellow Heidi Henderson participated in Waste Management 2012 conference panel sessions – "Graduating Students and New Engineers – Wants and Needs – Are Companies Even Listening?" (Session 44) and "Young Professionals" (Session 45) (Figure 5-11).

Figure 5-11. Dr. Leonel Lagos and Heidi Henderson with panel members at WM2012.

- The DOE Fellows Spring recruitment period was initiated on 3/19/12. Recruitment tables were setup at the FIU Engineering Center and College of Arts and Sciences. Recruitments efforts will continue until April 13, 2012 and an DOE Fellows Information Session has been scheduled for April 4, 2012.
- The DOE Fellow, Heidi Henderson, prepared and submitted paper to the American Nuclear Society's Decontamination, Decommissioning, and Reutilization (DD&R) conference. Her paper details the DOE Fellows and ARC staff in the development of lessons learned and best practices for DOE-EM and the EFCOG group.

Milestones and Deliverables

The milestones and deliverables for Project 5 are shown on the following table. No milestones or deliverables were due in this reporting period and the project is on schedule to meet all milestones and deliverables by the due dates.

Work Plan for Next Quarter

- Complete Spring 2012 campaign to recruit DOE Fellows into the program.
- Complete coordination of internship placements for summer 2012 at DOE sites, national laboratories, DOE-HQ, and DOE contractors. DOE Fellows will begin summer internships.
- Participate in ANS's DD&R conference scheduled for June 2012.
- Draft the Year End Report for DOE.

Milestones and Deliverables for Project 5

Task	Milestone/ Deliverable	Description	Due Date	Status
Task 4: Selection of DOE Fellows	2011-P5-M1	Selection of new DOE Fellows - Spring 2011	06/30/11	Complete
	2011-P5-M4	Selection of new DOE Fellows – Fall 2011	10/31/11	Complete
	Deliverable	List of identified/recruited DOE Fellow (Class of 2011)	10/31/11	Complete
Task 6: Summer Internship Program (SIP)	Deliverable	List of 2011 Student Summer Interns and their research assignment	06/06/11	Complete
	2011-P5-M2	DOE Fellows Complete Summer Internships	08/31/11	Complete
	2011-P5-M3	Summer Internships Reports Completed	10/03/11	Complete
	Deliverable	Deliver Summer 2011 Interns reports to DOE	10/14/11	Complete
Task 8: Program Presentations/ Communication/ Conferences	2011-P5-M5	Conduct Induction Ceremony – Class of 2011	11/30/11	Complete
Program-wide	Deliverable	Draft Technical Task Plan	06/17/11	Complete
	Deliverable	Quarterly Status and Progress Summary Reports	Quarterly	On target
	Deliverable	Draft Year End Report	06/17/12	On target
	Deliverable	Update Technical Fact Sheet	30 days after end of project	On target