QUARTERLY PROGRESS REPORT

April 1, 2012 to June 30, 2012

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

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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 April 1 to June 30, 2012. Information is provided for April 1 to May 17, 2012, which represents the end of FIU Year 2 and from May 18 to June 30, 2012, which represents the beginning of FIU Year 3.

Highlights during this reporting period include:

- Year End Reports for FIU Year 2 were completed for all projects and sent to DOE as well as site points of contact.
- Draft Project Technical Plans for FIU Year 3 were completed for all projects and sent to DOE as well as site points of contact.
- FIU ARC staff and students participated in the 2012 American Nuclear Society (ANS) Annual Meeting and Decommissioning, Decontamination and Reutilization (DD&R) Conference in Chicago, Illinois, from June 24 to June 28, 2012. Participation included hosting an exhibitor booth in the vendor hall, presenting technical research at oral and poster presentations, and chairing technical sessions. A total of three professional oral and poster presentations were given by FIU Applied Research Center staff and students in the areas of D&D technologies, D&D knowledge management, and D&D best practices and lessons learned. Professional oral and poster presenters included Dr. Leo Lagos, Mr. Himanshu Upadhyay, and DOE Fellow Heidi Henderson. Two additional DOE Fellows (Lilian Marrero and Elicek Delgado-Cepero) also attended and participated in the conference as "Student Assistants," providing technical support during the technical sessions.
- Under Project 1 (Task 2), the third-generation peristaltic crawler, designed and developed to maneuver in a pipeline within close proximity to a plug and provide various means to remove it, was successfully assembled and welded together. The crawler was experimentally tested and a summary document was prepared and submitted to DOE. The report includes conclusions from the tests performed as well as recommendations for further improvement of the peristaltic crawler
- A manuscript by D.A. Carvajal, Y.P Katsenovich, and L. Lagos entitled, "The effects of aqueous bicarbonate and calcium ions on uranium biosorption by *Arthrobacter* G975 strain," was submitted to the Chemical Geology Journal for peer review Under Project 2 (Task 1.2). After the manuscript came back with comments, a revision was initiated and the revised manuscript will be re-submitted to the journal for publishing consideration.

- As part of the work being performed for Project 3 (Task 1), a peer-reviewed article entitled "Simulation of Flow and Mercury Transport in Upper East Fork Poplar Creek, Oak Ridge, Tennessee," was published in the Spring 2012 edition of the Remediation Journal.
- As part of the Project 4 (Task 1) activities, FIU received the new 2012 waste forecast and transportation data set from DOE on May 2, 2012, completed the data import into the master database and modified the WIMS modules to incorporate the new data set. The new data set was deployed on 5/25/2012 onto the test server and onto the public server on 6/21/2012.
- The Project 4 (Task 2) accomplishments included finalizing a best practice based on the Savannah River Site (SRS) 185-3K Cooling Tower demolition on May 22, 2012, by working in collaboration with DOE and the Energy Facility Contractor's Group (EFCOG). SRS's massive K Cooling Tower was safely demolished on May 25, 2010 as part of the Site-wide Footprint Reduction Initiative funded by the American Recovery and Reinvestment Act.
- Also as part of Project 4 (Task 3), FIU completed the development of the Training Module for the D&D Knowledge Management and Information Tool and sent it to DOE for review. Main features of the training module include: D&D conferences and workshops, classroom training, available D&D certifications, training videos, and training documents.
- A total of 11 DOE Fellows were placed for summer internships, starting on June 4, 2012, as part of Project 5. The internship placements included: 2 at DOE HQ in Washington DC (EM-12 and EM-23), 1 at SRS, 3 at ORNL and 1 at Y-12 NSC, 2 at Richland, WA (PNNL and WRPS), and 2 at Sullivan International Consulting in Chicago, IL. The DOE Fellows interning at the DOE HQ had the opportunity to attend a breakfast reception with FIU president Mark Rosenberg and members of the Florida delegation at the US Capital Building on June 25, 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 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 April 1 to May 17, 2012

- The assembly of the the 3rd generation Peristaltic Crawler unit was successfully completed. 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 includes 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 on a straight section and to turn through a 90° elbow.

- The third generation crawler unit and controls systems were assembled and were experimentally tested. The PLC that controls the sequencing of the pneumatic valves was reprogrammed to operate using a 500-ft long tether. Tests included measuring its navigational speed and anchoring force, determining its ability to negotiate thru a 90° elbow and determining the effectiveness of its unplugging ability. Two unplugging tests were performed, each one using a different type of high pressure nozzle. A 6-ft-long bench-scale testbed was assembled to perform the unplugging operations. The plug used for each test was a 2-ft potassium-magnesium sulfate (Kmag) plug fabricated inside a steel pipeline section. Using the data collected from the experimental results, a summary document is being prepared and will be submitted to the DOE Headquarters representatives. The report will include conclusions from the tests performed as well as recommendations for further improvement of the Peristaltic Crawler.

- A summary document for milestone 2011-P1-M2.2 on the completion of experimental testing of the third-generation peristaltic crawler was completed and submitted to Hanford engineers and DOE EM personnel on 5/6/2012.

- For the Asynchronous Pulsing System (APS), all the components for both the CFD validation and the large scale loop were received. The CFD validation loop has been constructed in the high-bay lab and leak tested and university space committee approval has been obtained for the alternate location to setup the large-scale loop. Modifications on the real-time (RT) software were underway. Many of the intensive subroutines have been transferred onto the controller FPGA to minimize any lags during operation, and to ensure the system CPU utilization is maintained at 50% during operation. Several memory leak issues were addressed during this RT re-write. Two modules on the data acquisition modules were replaced to provide faster collection and processing of the pressure data.

- The RT software modifications for the asynchronous pulsing system (APS) were completed during this performance period. The system control strategy will focus on achieving a pulse with a maximum user-define pressure at the piston outlet, and adjustable piston position while the system is not in a pulsing mode. This will allow the user to adjust the piston position prior to pulsing, in order to maximize the pulse energy and duration. Several test trial were performed with the software to address any possible issues with system start-up, data logging, and system control. In addition, a computational fluid dynamics (CFD) model derived from the method of characteristics was developed to simulate pressure variation in the pipeline.

Task 2 Quarterly Progress for May 18 to June 30, 2012

- For the peristaltic crawler subtask, wiring of the electrical cables from the PLC controller to the on-board pneumatic valves was completed. System tests were conducted to ensure proper valve functionality and to check and remediate any leaks in the system. Preliminary navigational tests of the crawler using the tether-reel assembly were conducted in a clear pipeline PVC section. By using the on board valves, it was determined that the navigational speed increased from 1 foot per hour to 7.2 feet per hour.

- For the APS controller, wiring issues were addressed and the RT software was adjusted for improved timing and control during test start/stop cycles. This led to better piston position control during system start and stops. Also, a modified binary file reader was developed to format the data files written by the controller into an Excel/Matlab usable format. In preparation for experimental runs, shakedown tests on the APS system were conducted; this included testing the operation of both the control and power units. Initial system settings were also derived from these tests.

- The APS was utilized to perform experimental trials that focused on the ability to predict the system performance at various lengths and configurations as well as the effect of air in the system. The APS was used to generate a pressure pulse in each of the pipeline loops that were fully flooded as well as with varying amounts of air in each loop. The input pressure pulse profiles were subsequently input into the CFD model that was developed during the previous month's work and the simulated results were compared to experimental results.

- In order to determine if the effects of air entrained in the pipeline loop could be mitigated, each loop was filled with a preset amount of air. The air/water mixture volume was then compressed using the APS' piston, to determine the static pressure rise for a certain volumetric compression. Tests were performed for 0% air, half-piston stroke and full-piston stroke of air, and for 1% and 2% of air. The test results indicated that the effects of an air bubble entrained in the system on a transient pulse can be effectively removed by increasing the static pressurization of the water above atmospheric pressure. This behavior can be exploited to ensure larger pressure changes (i.e. more force loading) at the plug face. The observed relationship can now be used to determine a minimum static pressure required so that the air/water mixture can act as a water-only system.

- A summary document for milestone 2011-P1-M2.3 on the completion of experimental testing of the effect of the pipeline length and configuration on the APS performance was completed and submitted to Hanford engineers and DOE EM personnel on 7/29/2012.

- A technical manuscript was submitted to the AIChE Journal summarizing the evaluation of a previously tested pipeline unplugging technology at FIU.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE EM-21, other DOE-HQ personnel and FIU's site contact at Hanford on June 18, 2012.

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 for April 1 to May 17, 2012

- The prestreaming subroutine in the 2D MRT LBM code was modified in order to update the wall boundary condition. The performance of 2D MRT and BGK LBM codes were evaluated for the rising bubble simulation case where the top and the bottom boundary of the domain is a solid wall. It was found that the MRT code performed better than the BGK code in matching the benchmark results for bubble circularity and Reynolds number; however, the Reynolds number profile obtained with the MRT code was not as smooth as the BGK. Alternative solutions are being investigated. The parallelization of the 3D MRT LBM code was completed and performance analysis of the code for a various number of processors was investigated.

- The bugs in the data output file format used in the LBM code were fixed in order to use the Paraview post-processing software. A test case for Rayleigh-Taylor instability problem was created using the 2D MRT LBM code in order to evaluate the performance of the method for strongly changing fluid interfaces. The rising bubble simulations have been continued in order to compare the results against benchmark data.

- Summary document for milestone 2011-P1-M12.3 on the parallelization of the 3D multiphase MRT LBM was completed and submitted to Hanford engineers and DOE EM personnel on 5/9/2012.

Task 12 Quarterly Progress for May 18 to June 30, 2012

- Linux operating software was installed on a new head node for the computer cluster in order to replace the old head node. The new head node will improve the simulations run on the cluster since it has a better video card, more memory and faster CPUs. The cluster management utility was improved in order to provide CPU temperature information in the web-based online monitoring website. An automatic shut-off procedure is implemented in order to protect the cluster hardware in case of air conditioning failure and a resulting increase in room temperature. A portable air conditioning unit has been installed in the cluster room in order to provide cooling in the case that the building A/C does not function. It was observed that the portable A/C was able to sustain the room temperature at 75° when the cluster is loaded at 75%.

- After the preparation and debugging process was over, the head node of the cluster was replaced, which included installation of the new machine, installation of the operating system, migration of user data and account information, and the creation of automated scripts and documentation to assist future cluster administrators in performing this kind of task. Additionally, the high rate of partitioning failure during node installation was corrected. Eighteen additional nodes became available as a result of this work.

- A benchmark study of a single-phase LBM code (PRATHAM) using the classical case of a two-dimensional, shear-driven cavity was conducted. The appropriate publications with the required validation data were acquired. Cases with Reynolds numbers of 1,000, 5,000, and 10,000 were simulated. It was concluded that finer lattices need to be explored for the lesser conforming simulation cases of Re = 5,000 and Re = 10,000. In addition, a profiling tool called "gproof" was used to profile and optimize the lattice Boltzmann code. The most time consuming components of the code were identified for optimization. Afterwards, each of the targeted subroutines was examined and points of interest were identified. Additionally, CartGen meshing code was used to produce lattice geometry for the LBM code. Paraview software was used to isolate surfaces from the primary geometry of CAD data. The geometry data obtained from the primary CAD file was read in the STL format in order to enable CartGen to read boundary files. Finally, the boundary condition errors in the parallel version of the code MRT-LBM multiphase code were corrected. Simulations of the Rayleigh-Taylor instability problem in two dimensions were initiated.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE EM-21, other DOE-HQ personnel and FIU's site contact at Hanford on June 18, 2012.

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. Finally, FIU will evaluate the use of Lamb and Stoneley waves for measurement of density and viscosity *in situ* by performing computational simulations.

Task 15 Quarterly Progress for April 1 to May 17, 2012

- FIU completed the scope and requirements of the activities that will be performed at the ITS facilities, to retest a revised USS system and compare that data to those collected by FIU during verification tests that were completed in 2011. FIU also began collecting the necessary materials required for those tests, which are the same as those used by FIU.

- In addition to these activities, FIU collected several samples of polymers that can be used for a transducer buffer to be deployed in an aggressive chemical and radiological environment. These samples will be tested for ultrasonic performance characteristics in the coming months. FIU completed the search and data collection for ultrasonic characteristics of Hanford HLW waste streams. Some of this work was performed by Iowa State University, and provides a very detailed picture of the expected attenuation and group velocities to be expected with the HLW tank in mixed and un-mixed conditions. This data will be used as part of the numerical model being developed by ITS for the ultrasonic transducer sizing.

- FIU completed the necessary documentation and procurement activities to fund the activities that will be performed at ITS. As a result, ITS began the modeling of the expected attenuation based on the parameters of the solids material and liquid supernate. FIU reviewed the model results and held a teleconference with Hanford personnel to discuss the details. The results will be used to determine the maximum required transducer size and sensitivity, and will be validated with the solids loading profiles performed at ITS during FY2012 (FIU Year 3). As a final activity in FY2011 (FIU Year 2), the concentrations profile tests using sodium nitrate were completed at ITS.

Task 15 Quarterly Progress for May 18 to June 30, 2012

- FIU completed the procurement and shipment of solid materials used for the solids loading tests by ITS in the UK. FIU also provided ITS with the Matlab code and data used to generate sodium nitrate speed of sound profiles as a function of molar concentration. FIU discussed several alternative tests to be performed with a larger transducer on the same concentration ladder tests performed in May.

- The results of the May tests indicate good agreement between the USS system and the expected speed of sound and attenuation data collected during the FIU trials, and the information available in the literature. This suggests that the system performance in varying supernate densities will not pose a problem. Some of the acquisition and analysis

methods used in the software of the system may have been the reason why the system could not detect a return echo during some of the higher solids loading tests. This may have been due to the visco-thermal behavior of the sodium nitrate solution under a pressure wave. ITS is working to establish a method that allows this behavior to be addressed as part of the system performance.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE EM-21, other DOE-HQ personnel and FIU's site contact at Hanford on June 18, 2012.

Task 16: Computational Simulation and Evolution of HLW Pipeline Plugs

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 for May 18 to June 30, 2012

- This is a new seed task which will be used to develop computational models describing the build-up and plugging process of retrieval lines. A literature review is just underway that focuses on evaluating plug development studies from WRPS, PNNL etc. Technical gaps will be identified and a work plan will be developed to address the relevant issues. Staff and students have begun preliminary modeling exercises utilizing the multi-physics software package, COMSOL.

Milestones and Deliverables

FIU Year 2

The milestones and deliverables for Project 1 for FIU Year 2 are shown on the following table. Milestones 2011-P1-M2.2 and 2011-P1-M12.3 and associated deliverables were completed and submitted on time to Hanford engineers and DOE EM personnel (May 6 and May 9, 2012, respectively). Milestone 2011-P1-M2.3 and the associated deliverable was completed and submitted to Hanford engineers and DOE EM personnel on June 29, 2012. The milestone was delayed from the original due date (5/11/12) because of issues related to FIU space committee approval and unanticipated instrumentation and control software problems. The draft Year End Report was submitted on time to site personnel and DOE HQ personnel (June 18, 2012).

FIU Year 2 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	Complete
	Deliverable	Summary Document for 2011-P1-M2.2	5/06/2012	Complete
	2011-P1-M2.3	Complete engineering scale pipeline unplugging testing using the asynchronous pulsing system	5/11/2012	Completed 6/29/12
	Deliverable	Summary Document for 2011-P1-M2.3	5/11/2012	Completed 6/29/12
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	Complete
	Deliverable	Summary Document for 2011-P1-M12.3	05/09/2012	Complete
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	Complete
	Deliverable	Draft Annual Progress Report	06/17/2012	Complete

FIU Year 3

The milestones and deliverables for Project 1 for FIU Year 3 are shown on the following table. The draft Project Technical Plan was completed and sent to DOE and site personnel on June 18, 2012.

FIU Year 3 Milestones and Deliverables for Project 1

Task	Milestone/ Deliverable	Description	Due Date	Status
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 Multiphase Flows in Three Dimensions	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	On Target
	Deliverable	Summary Document for 2012-P1-M15.1	8/15/2012	On Target
	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	Submit Waste Management Symposium 2013abstract(s)	8/17/2012	On Target
	Deliverable	Draft Project Technical Plan	06/18/2012	Complete
	Deliverable	Quarterly Progress Reports	Quarterly	On Target
	Deliverable	Draft Year End Report	06/28/2013	On Target

Work Plan for Next Quarter

- Task 2: FIU will continue analyzing the data from the pressure pulse experiments to determine what effect the pipeline length and number elbows have on the performance of the APS and how the simulated results from the CFD model compare to the experimental results. Experiments will be performed on clear pipe sections to determine the maximum volume of air that can be removed from a pipeline at various vacuum pressures. This will aid in estimating the maximum air removal that can be realistically removed before implementing the APS. Based on the previous experiments, the design of the APS will be optimized by implementing a vacuum source and a pressurized water source into the design.

  FIU will purchase a fiber-optics camera and display system for the peristaltic crawler and conduct initial tests. Modifications will be made to accommodate the unplugging nozzle and camera at the front end of the unit. A contraction mechanism for the bellow will be investigated to shorten the overall cycle time. Initial navigational tests will be conducted using the on-board pneumatic valves and tether-reel system.

- Task 12: FIU will investigate the appropriate boundary conditions for the MRT LBM method for the wetting characteristics of droplets on solid surface with various hydro-phobicity properties. Modifications will be implemented to the existing code regarding the interactions of the two-fluid interface with the solid surfaces. Results will be verified for a static droplet on a flat plate at varying contact angles.

- Task 15: FIU will analyze the data collected by the USS vendor during their backup experiments. This analysis will be compared to the results obtained from the FIU testing. FIU will also work with Hanford personnel on defining the next steps for an in-situ bulk monitor technology development program utilizing either the USS, or some of the other candidate technologies identified by FIU. If the USS test results show promise, FIU will commence work on evaluating the appropriate buffer materials to support the development of a full-scale USS prototype for the application. Additional USS testing is possible if Hanford recommends that the system undergo more parametric testing. This will occur after a prototype USS module is complete.

- Task 16: FIU will continue to investigate previous research efforts and develop a path that addresses technical gaps. We will also continue the early stages of developing a model that can be used to study the effects of pipeline geometry on plug formation.

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

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 for April 1 to May 17, 2012

- Continued 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 experiment using six Si/Al ratios (1, 10, 20, 30, 40, 50) with 25 mM, 50 mM, 75 mM, and 100 mM bicarbonate to complete this set. Adjusted pH of tested solutions to 8 and then injected ammonia gas until the pH of the 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. Calibrated KPA, ICP-OES and TOC analyzer to test the removal of U(VI), Si, Al, Ca, and monitor the changes in TOC concentrations after ammonia gas injection.

- Following the planned new approach for determining the structure and composition of U-bearing precipitates over time, three sample sets were prepared for analysis during the reporting period: after 1 week (set #2), 2 weeks (set #3) and 1 month (set #4). Each sample set consisted of two samples precipitated out of the following solutions: a) 100 mM Si, 5 mM Al, 3 mM HCO_3 , and 200 ppm U(VI); and b) 100 mM Si, 5 mM Al, 50 mM HCO_3 , and 200 ppm U(VI). In each case, the sample's precipitate was extracted by centrifugation followed by decantation of the supernatant. They were then placed in the incubator for drying in preparation for the SEM/EDS and FTIR analysis. Two samples were set up for FTIR analysis in KBr plates containing 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U. One of the samples provided spectral information while the other one resulted in noise only. These samples need to be repeated with a higher sample amount to be able to carry out peak identification. The samples from set #1 (which was precipitated after 2 days of preparation in March) and set #2 were also analyzed with SEM/EDS. The EDS results were collected and the average atomic percentage composition was calculated for the main elements considered for this study, including oxygen, sodium, aluminum, silica, potassium and uranium. Comparison of the calculations show that the precipitate from the sample of 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U after one week (set #2) has increased oxygen atomic percentage and decreased aluminum, silica, potassium and uranium percentages, while the sodium atomic percentage remained almost the same. On the other hand, the precipitate from the sample of 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm U after 1 week increased in sodium atomic percentage while still decreasing in aluminum, silica, potassium and uranium percentages; however, the oxygen atomic percentage remained almost the same. The SEM images pertaining to these precipitates show that the sample of 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U after 1 week contains elongated forms that were not observed after 2 days. This was not observed in the case of the samples of 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm U, which presented rather irregular flake looking surfaces, on which after 1 week white aggregates were observed. These aggregates had been observed in the past with a sample of 50 mM Si, 3 mM HCO3, 5 mM Al, and 130 ppm U, and in the same way the area of such aggregate is the one with the highest uranium atomic percentage on the sample. Analysis of the remaining sets belonging to the study of uranium precipitation over time will be continued through the course of the next month, paying close attention to the behavior of the percentage atomic compositions as well as the changes in morphology.

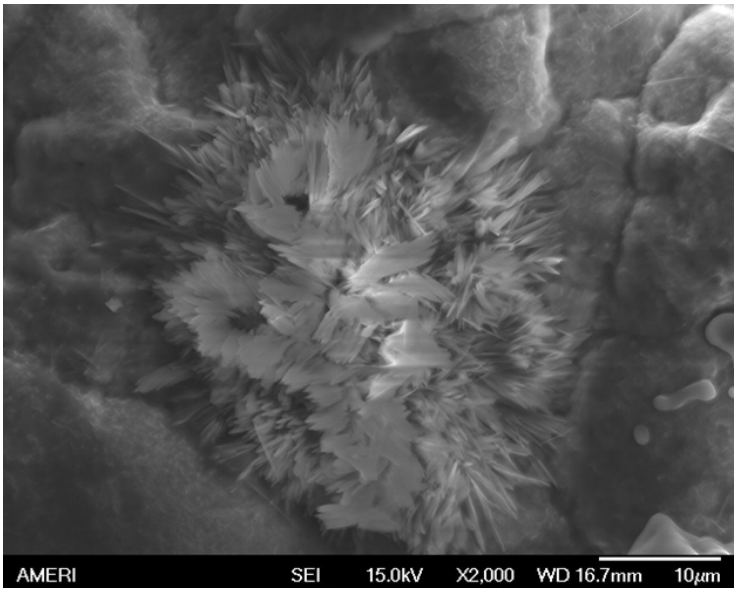
- Continued experiments to determine the structure and composition of U-bearing precipitates over time. Samples for set #5 (1½ month from preparation date) were prepared for analysis. As previously, this set consisted of two samples precipitated out of the following solutions: a) 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U(VI); and b) 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm U(VI). Each sample's precipitate was extracted by centrifugation followed by decantation of the supernatant. Samples were then placed in the incubator for drying in preparation for SEM/EDS and FTIR analyses.

- Began preparation of the Year End Report: wrote the results section, referred to the literature research to back-up the report findings, and included a discussion of the analyses that have been completed since last year (XRD, FTIR, SEM/EDS, XPS). Searched literature to back-up speciation modeling results and completed discussion on

XRD and SEM/EDS results. Visual Minteq software was used to calculate uranium speciation in the presence of previously used concentrations of Si, Al, HCO_3 in addition to 5 mM Ca ions and 2 ppm of U. The removal of Ca^{2+} ion from the solution occurs apparently due to the precipitation of calcium carbonate; however, Visual Minteq predicted a lower percentage of $CaCO_3$ formed than was observed in experiments. The variances between speciation modeling prediction and experimental results on Ca removal are probably due to carrying down of dissolved and already precipitated Ca compounds with Si gel.

Task 1.1 Quarterly Progress for May 18 to June 30, 2012

- Sample sets #3 (2 weeks), and #4 (1 month) were analyzed with SEM/EDS. As in the previous two sets, the EDS results were collected and the average atomic percentage composition was calculated for the main elements considered for this study, including oxygen, sodium, aluminum, silica, potassium and uranium. Comparing calculations after 1 week (set #2) and after 2 weeks (set #3) showed that the precipitate from the sample of 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U after 2 weeks has increased silica, potassium, and uranium atomic percentages and decreased oxygen and aluminum percentages, while the sodium atomic percentage remained almost the same. On the other hand, the precipitate from the sample of 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm U after 1 week increased in oxygen, aluminum, silica, and uranium atomic percentages while still decreasing in sodium percentages; however, the potassium atomic percentage remained almost the same. The SEM images pertaining to the 2-week precipitate show that the sample of 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U after 2 weeks presented irregular surface of granules on which white aggregates of higher uranium atomic percentage were observed. The morphology of white aggregates and the measured atomic percentage of U(VI) confirmed our previous observations on similar samples. In the case of the sample of 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm U, the surface was rather irregular amorphous with inclusion of some crystalline form; no aggregates were observed in this opportunity and the recorded uranium percentages were not as high as in the previous sample. Then, comparison of samples' surface composition after 2 weeks (set #3) and after 1 month (set # 4) showed that the precipitate from the sample of 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U after 1 month has increased in atomic percentage of sodium and decreased in aluminum, silica, and uranium, while oxygen and potassium percentages remained almost the same. On the other hand, the precipitate from the sample of 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm U after 1 month increased in potassium and uranium atomic percentage while decreasing in oxygen, sodium, aluminum, and silica percentages. The SEM images pertaining to the 1-month-precipitate show that the sample of 100 mM Si, 5 mM Al, 3 mM $HCO3^{-}$, and 200 ppm U contains the elongated forms that had been similarly observed in the 1-week-precipitate. Quantitative measurements of composition in these elongations showed little to no uranium and considerably higher sodium. Also, some lighter in color aggregates were found on the surface, but they were not as high in uranium as expected based on previous results. The most interesting results in this opportunity were observed in the samples of set #4 composed of 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm U, which presented crystalline structures.



Crystals growth on the surface of precipitates.

- These structures had not been observed before in our experiments. Several EDS points were taken and one of them resulted in a uranium atomic percentage as high as 2.31%. However, it was observed that not all of these crystals were high in uranium. The ones that were smaller and seemed that they had only started forming were low in uranium percentage. The study of uranium precipitation over time will be continued through the course of the next month. There is one remaining set belonging to the 3rd month after sample preparation and attention will be dedicated to studying the change in precipitates' surface morphology and finding more crystalline phases to determine their identity.

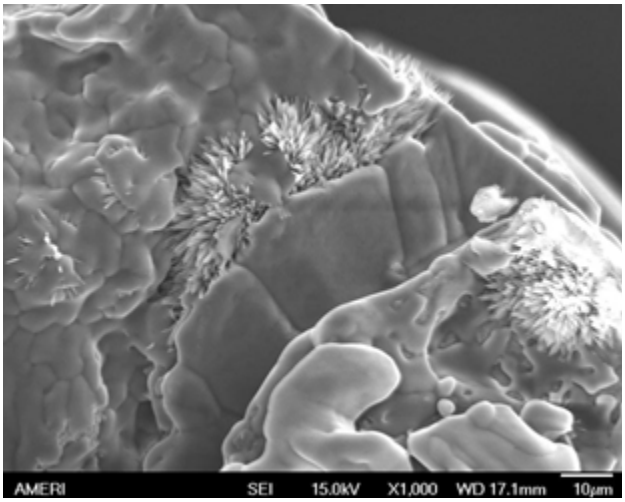
- Obtained quote for Sorvall ST 16R Centrifuge (75818382) with click seal safety lids and prepared a requisition for it purchasing from Fisher Scientific.

- As part of the determination the structure and composition of U-bearing precipitates over time, FTIR spectral data were obtained for two sets of samples combined of 100 mM Si, 5 mM Al, 3 mM HCO_3^- , 200 ppm U, and of 100 mM Si, 5 mM Al, 50 mM HCO_3^- , and 200 ppm U. The first sample set was collected after keeping precipitates for 2days in the "mother" solution and the second set of samples was collected after 1.5 month. The analysis identified C-O, C=O, Si-O-Si, Si-OH, O-U-O, functional groups that are consistent with the chemicals used to prepare samples and pH conditions the experiments were conducted. Less pronounced peaks found at 990-950 cm^{-1} and 1100-1000cm^{-1} suggest the presence of a Si-O-C functional group. Perhaps this functional group can explain the mechanism of uranyl carbonate binding to silica gel during co-precipitation process. Additional research is needed before we draw any conclusions on the mechanism of uranium incorporation into silica precipitates.

- A new 2nd batch of samples for the characterization of uranium-containing precipitates study over time was prepared during this period; in this batch a new parameter will be assessed, the effect of calcium on the formation of precipitates. Therefore, this batch consists of 2 sets, one of 100 mM Si, 5 mM Al, 3 mM HCO_3^-, 200 ppm U, and the other

one of 100 mM Si, 5 mM Al, 50 mM HCO_3^-, 200 ppm U, each having duplicate samples amended with 5 mM Ca. These 2 sets are subdivided into the smaller samples that will be assessed in time for precipitate characterization: 2 days (#1), 2 weeks (#2), 1 month (#3), 2 months (#4) and 3 months (#4) after samples preparation. For the start of these new sets, the stock solutions of Si, Al, HCO_3^-, Ca were prepared and then mixed them into the test solutions containing the appropriate concentrations of all constituencies. The pH was adjusted to 8 with concentrated nitric acid before the addition of ammonia gas to increase pH to 11. Lastly, uranium at 200ppm was injected in every sample. A total of 20 samples were prepared, and they were placed in the incubator/shaker. After 2 days, the first set of samples was extracted, the samples were decanted and the gel precipitate was placed in the incubator for drying in preparation for precipitate analysis.

- The SEM images of 1½-month sample (set #5) composed of 100 mM Si, 5 mM Al, 50 mM $HCO3^{-}$, and 200 ppm showed crystalline structures similar to the observed in the set #4 prepared after keeping 1month in the "mother" solution.



Crystalline forms on the surface of precipitates.

- Several EDS points taken on the crystals and around the sample surface showed that the distribution of uranium is not uniformed with the atomic percentage ranging between 0.01-2.57%. The higher U atomic percentage correlated with higher Si, Al and C atomic percentages. The study of uranium precipitation over time will be continued through the course of the next month and attention will be dedicated to studying the change in precipitates' surface morphology and finding more crystalline phases to determine their identity.

- Initiated literature search on minerals' solubility measurements. These experiments are necessary to evaluate the stability of U-bearing precipitates and uranium mobility within the vadose zone and the potential for its diffusion into the ground water.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE and FIU's site contact at Hanford on June 18, 2012.

Task 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 1.2 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 bio-enhanced 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 bacteria-uranium interactions during U(VI) leaching as well as possible biogenic transformations that might occur during the dissolution.

Task 1.2 Quarterly Progress for April 1 to May 17, 2012

- Continued to sample experimental bottles periodically for the bio-dissolution experiments with the G968 *Arthrobacter* sp. strain. Eighty-one microliters of the bacterial stock solution were added to the thirteen bioreactors after 27 days, giving time for the autunite dissolution to reach steady state. Also, to account for viable bacteria, a well-mixed homogeneous aliquot (0.01 mL - 0.1 mL) of the suspension from each test vial was uniformly spread on the sterile petri dishes. Viable microorganisms were calculated from the number of colony-forming units (CFU) found on a specific dilution. In addition, the agar plating was used to provide a quick visual check for contamination and to maintain colonies from each stage of the enrichment for the duration of the experiment.

- When the sampling of the bioreactors was completed, it was analyzed for dissolved U(VI) by means of kinetic phosphorescence analyzer (KPA-11). The dilution factors for sample analysis were 100 for low concentrations of bicarbonate, and 200 for high concentrations of bicarbonate. Furthermore, aqueous concentrations of calcium and phosphorus were determined from the digested samples by means of Optima 7300 ICP-OES. The data from both of these analyses were obtained and organized. .

- After completion of the autunite biodissolution experiments, samples were prepared for the SEM/EDS analysis. G968 cells were harvested by centrifugation at 4000 rpm for 5

min from PTYG media amended with certain concentrations of U(VI) during natural autunite bio dissolution and washed twice with deionized water. The cells were fixed in 5 ml of 2% glutaraldehyde for 2h at 4^{o}C in 0.1M HEPES buffer at pH adjusted to 7.2 with concentrated Fisher Scientific nitric acid (HNO_3). The material was removed by centrifugation and washed with 50 mM HEPES buffer three times for 10 min. The rinsed cells were then dehydrated in ethanol/water solutions of 35% (v/v), 70% (v/v), and 90% (v/v) each for 10 min, and two times in 100% (v/v) for 10 min. Dehydrated samples were immersed for 10 min each in 50% and 100% pure hexamethyldisilazane (HMDS) followed by 10 min of air-drying to allow liquid to evaporate from the sample. The dehydrated specimens are kept in the desiccators until the time of SEM/EDS assay.

- The manuscript by D.A. Carvajal, Y.P Katsenovich, and L. Lagos entitled, "The effects of aqueous bicarbonate and calcium ions on uranium biosorption by *Arthrobacter* G975 strain" was submitted to the Chemical Geology Journal for peer review.

- Began working on the Year End Report to present data on autunite biodissolution experiments using *Arthrobacter* strain G968, a less U(VI)-tolerant strain determined in our assessments.

Task 1.2 Quarterly Progress for May 18 to June 30, 2012

- Cleaned and organized radiation laboratory to prepare it for the hurricane season and make sure it is up to standard for health inspections.

- Dehydrated samples of G968 cells from bio-dissolution experiments in the mixed reactors free of bicarbonate and amended with 3mM of bicarbonate were analyzed via SEM/EDS. SEM images showed strong attachment of bacteria to the autunite surface.

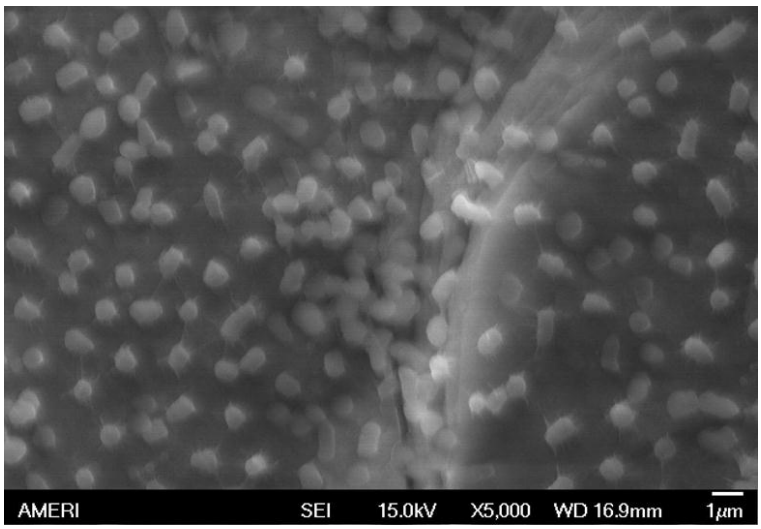


Figure 2-1. Attachment of G968 cells to the autunite mineral surface in the media solution amended with 3mM of bicarbonate.

- The manuscript “The effects of aqueous bicarbonate and calcium ions on uranium biosorption by *Arthrobacter* G975 strain" came back for revision from the Chemical Geology journal after peer –review. The revision was initiated and the revised manuscript is expected to submit back to the journal in the month of July.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE and FIU’s site contact at Hanford on June 18, 2012.

Milestones and Deliverables

FIU Year 2

The milestones and deliverables for Project 2 for FIU Year 2 are shown in the following table. Milestone 2011-P2-M2, the completion of the assessment of the role of bacteria on U(VI) leaching from autunite using *Arthrobacter* sp. strains, was completed on 4/30/2012.

FIU Year 2 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	Complete
Project-wide	Deliverable	Draft Project Technical Plan	6/17/2011	Complete
	Deliverable	Draft Year End Report	6/18/2012	Complete

FIU Year 3

The milestones and deliverables for Project 1 for FIU Year 3 are shown on the following table. The draft Project Technical Plan was completed and sent to DOE and site personnel on June 18, 2012. The project is on schedule to meet all milestones and deliverables by their due dates.

FIU Year 3 Milestones and Deliverables for Project 2

Task	Milestone/ Deliverable	Description	Due Date	Status
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
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
Project-wide	Deliverable	Draft Project Technical Plan	6/18/2012	Complete
	2012-P2-M1	Submit Waste Management Symposium 2013 abstract(s)	8/17/2012	On Target
	Deliverable	Draft Year End Report	6/28/2013	On Target
	Deliverable	Quarterly Progress Reports	Quarterly	On Target

Work Plan for Next Quarter

- Task 1.1: Initiate experiments for the removal of U using a synthetic groundwater composition and synthesize precipitates for uranium-bearing precipitates solubility studies. Continue assessment of previously prepared uranium-bearing precipitates via SEM/EDS, XRD and FTIR.
- Task 1.2: Set up 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: EFPC 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 for April 1 to May 17, 2012

- Model experienced numerical instabilities when simulations were executed for an extended period of time (more than 2 years). These numerical instabilities were addressed by modifying river cross sections for Branch 28 at chainage = 1385.653 meters and Branch EFPC at chainage = 7647.66 meters. The model continued to experience instabilities; therefore, FIU reviewed all cross sections to determine if there were discrepancies with elevations in the topography.

- Executed simulations to evaluate whether these modifications have stabilized the model.

Task 1 Quarterly Progress for May 18 to June 30, 2012

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 25, 2012.

Subtask 1.3: Surface Water Flow and Contaminant Transport Model of ORNL 4500 Area
Currently in the process of developing a water balance model of the areas contributing to Outfall 211 using TSS as a tracer.

1. *Construction Drawings*
    a. Met with ORNL engineering personnel and copies of construction drawings are being made of the area of interest which include buildings 4500N, 4500S, 4501, 4505, 4507, 4508 and 4556.
    b. As these buildings were built at different times and stages, it will be necessary to conduct an in-depth review of the construction drawings provided to determine how much of the drainage system is still located underground at this time.
2. *Data*
    a. Tracer
        i. Very limited amount of data available for this area.
            1. TDS data is available at Outfall 211 but not within the system.
            2. A few chlorine measurements are available within the system that will be used as a tracer for this model.
    b. Flows
        i. A very rudimentary estimate of flow rates leaving the buildings via storm drains has been provided by ORNL Engineering for some of the buildings.
        ii. Reviewing a 'sink and drain' survey and floor plans via ORNL website in order to compare the number and locations of the storm drains leaving the buildings.
3. *XPSWMM*
    a. Received shapefiles for the area and have inserted them into XPSWMM. ArcGIS was used to convert the contours into an xyz file to view the DTM in XPSWMM.
    b. Received an aerial photo from OREIS with poor resolution, so in the process of acquiring one with higher resolution.
    c. The preliminary view of the model in XPSWMM is shown below.

Figure 3-1. Preliminary view of the model in XPSWMM

Task 2: Simulation of NPDES and TMDL Regulated Discharges from Non-Point Sources for EFPC and Y-12 NSC

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 for April 1 to May 17, 2012

- The progress report on "Simulation of TMDL for the entire EFPC" was internally reviewed and prepared for release. Multiple sections have undergone revision and additional figures were generated to accompany the relevant information provided.

- A set of MATLAB scripts were developed for analysis and visualization of each simulation and for comparative analysis between simulations. The computed and observed data for subsurface water levels, EFPC water levels and flows, contaminant concentration in rivers, subsurface and surface, were extracted from the grid files. Extracted data is stored for subsequent analysis of daily probability exceedances, weekly, monthly and annual summaries.

- Automated the calculation of statistical parameters used to determine the accuracy of model calibration. Prepared scripts which automatically provide series of plots and tables as needed for data analysis and preparing the annual report.

- Prepared a series of probability exceedance plots for flows and mercury loading which are used to provide understanding of the TMDL and NPDES criteria, exceedances and median values.

- Completed the final series of simulations and conducted analysis of results.

Task 2 Quarterly Progress for May 18 to June 30, 2012

- Completed a series of simulations which provided correlation with the water discharge, mercury concentration, and TSS field data recorded at different stations along the creek. The results showed acceptable level of accuracy and reliability of the model (using indicators as mean error, root square of the mean error and Nash-Sutcliffe coefficient for comparison between observed and computed data).

- Determined the main mechanisms of mercury transport within the model domain, and quantified the sediment-mercury interactions and their effect on the fate and transport of mercury along the creek.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 25, 2012. The Year End Report contained results figures, tables and comparative analysis of observed and computed data.

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 for April 1 to May 17, 2012

- Parameters associated with the adsorption/desorption of Hg(II) on cinnabar were measured.

- 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. Parameters associated with the model were summarized or measured. The proposed model is being validated by comparing modeled

results with experimental data. Effects of pH, Eh, and cysteine on cinnabar dissolution are being evaluated using this model.

- Conducted analysis of results and submitted technical progress report on "Parameterization of Major Transport Processes of Mercury Species" which was due 5/17/2012.

Task 3 Quarterly Progress for May 18 to June 30, 2012

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 25, 2012.

- Summarized current studies on the effects of environmental factors (e.g., DOM, pH, redox condition) on 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. This technique will be used to study the effects of various environmental factors on cinnabar dissolution in the next step. A flow injection system was coupled to ICP-MS in order to analyze mercury isotopes in aqueous phase in the past month.

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 for April 1 to May 17, 2012

- The progress report for this task was internally reviewed and revisions made based on feedback and comments provided. The report was updated for inclusion in the project Year End Report.

Task 4 Quarterly Progress for May 18 to June 30, 2012

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 25, 2012.

- Conducted background research for development of a draft Project Technical Plan (PTP) for proposed FY12 work scope related to the use of Model Builder and Python scripts

within the ArcGIS environment for automating data import/export and for conducting certain geoprocessing tasks.

- Currently conducting preliminary literature review for the use of Python scripting to automate various geoprocessing tasks and the use of ArcGIS Model Builder to generate process flow diagrams. This is to support external query and retrieval of mercury and hydrological model data from the existing ORR geodatabase.

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

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 for April 1 to May 17, 2012

- Updated the Moab groundwater model with pumping test data. Conducted a series of simulations for understanding the effect of seasonal variations of hydrologic parameters and the responses to other stresses.

- Updated the progress report for the Moab groundwater flow and transport model. Added a section describing the simulations using pumping and determined the changes of water and contaminant flux in the river.

- Prepared figures and tables which will be used in the annual report.

- Conducted 5 different simulations with different pumping and injection well rates to understand the effects of these variations on the existing site conditions.

Task 5 Quarterly Progress for May 18 to June 30, 2012

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 25, 2012.
- Currently updating the Moab groundwater model with new groundwater data and conducting simulations for longer durations (10 yrs as opposed 1 yr which was run previously).
- Developing plumes for the aqueous species of concern (nitrate and uranium) in the vicinity of the tailings pile.
- In process of determining how to implement diversion ditch into the flow model (as drain cells) and will update the model once the technical details are received.

Milestones and Deliverables

FIU Year 2:

The milestones and deliverables for Project 3 for FIU Year 2 are shown in the following table. Milestone 2011-P3-M11, the Task 3 technical report entitled "Parameterization of Major Transport Processes of Mercury Species" was completed by the due date of 5/17/2012. The results of this report will be included in the project Year End Report.

Milestone 2011-P3-M12 was completed by the due date of 5/17/2012 with the submittal of a project related publication to a relevant journal. A peer reviewed article entitled "Simulation of Flow and Mercury Transport in Upper East Fork Poplar Creek, Oak Ridge, Tennessee," was published in the Spring 2012 edition of the Remediation Journal.

Milestone 2011-P3-M8 "Presentation overview to DOE HQ of the project and accomplishments" was originally due on 2/17/2012 and has been delayed due to scheduling conflicts. Meeting arrangements are being coordinated between FIU-ARC and ORNL personnel and a similar milestone has been included in the FIU Year 3.

FIU Year 2 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	Complete
	Deliverable	Draft Technical Task Plan	08/12/11	Complete
	Deliverable	Quarterly Status and Progress Summary Reports	Quarterly	Complete
	Deliverable	Year End Report	06/15/2012	Complete

FIU Year 3:

The milestones and deliverables for Project 3 for FIU Year 3 are shown in the following table. A draft Project Technical Plan was completed and sent to DOE and site personnel on June 25, 2012

FIU Year 3 Milestones and Deliverables for Project 3

Task	Milestone/ Deliverable	Description	Due Date	Status
Task 1: EFPC Model Update, Calibration, Uncertainty Analysis	2012-P3-M1.1	Finalize XPSWMM model preliminary configuration parameters	9/14/2012	On Target
	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
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	On Target
	Deliverable	Technical Report for Simulation of NPDES and TMDL for EFPC and Y-12 NSC	4/16/2013	On Target
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
Task 4: Geodatabase Development for Hydrological Modeling Support	2012-P3-M4.1	Sample Python scripts and Model Builder process workflow diagram	2/1/2013	On Target
	Deliverable	Technical Report for Geodatabase Development for Hydrological Modeling Support	4/1/2013	On Target
Task 5: Student Support for Modeling of Groundwater Flow and Transport at the 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
Project-wide	Deliverable	Draft Project Technical Plan	6/18/2012	Complete
	2012-P2-M6.1	Submit Waste Management Symposium 2013 abstract(s)	8/17/2012	On Target
	2012-P3-M8.1	Submit publications to relevant journals	5/17/2013	On Target
	Deliverable	Draft Year End Report	6/28/2013	On Target
	Deliverable	Quarterly Progress Reports	Quarterly	On Target

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 statistic 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.
    - Finalize XPSWMM model preliminary configuration parameters and send memo to DOE EM and ORNL by email.
    - Update observed monitoring stations, timeseries data, and statistical analysis for the entire EFPC watershed using the latest OREIS data. Extend the model to provide simulations to end of 2012.
- Task 2:
    - Conduct 20 to 25 simulations for the entire EFPC using of probability exceedance curves for each scenario; this data will provide additional insight of the effect for the entire range of hydrologic regimes (very wet to very dry conditions) on the load duration curves. Provide analysis of the simulations and compile a report.
    - Develop a fine scale model which will analyze the possibility of hydraulic isolation and geochemical sequestering high concentrations of mercury in soil beneath the facilities. The fine scale model will be extracted by the EFPC model and a very fine mesh will be used to determine the advection and diffusion of total mercury (or dissolved elemental mercury). The model domain is proximity to EFPC. This approach will provide understanding of contaminant flux from saturated zone to the creek
    - Presentation overview (postponed from the previous quarterly period) to DOE ORO/DOE HQ of the project progress and accomplishments.
- Task 3:
    - A new technique using isotope tracers will be developed to simultaneously determine the dissolution of cinnabar and re-adsorption of released Hg2+ on cinnabar surface in the following three months. A flow injection system coupled with ICP-MS will be used to measure the isotope ratios of mercury in samples. A calculation model will be developed to calculate the dissolution rate of cinnabar and the re-adsorption rate of released Hg2+ on cinnabar surface. This technique will be used to measure the dissolution rates of cinnabar under both anaerobic and aerobic conditions.

- The role of common functional groups within NOM (e.g., alcohol, carboxyl) in cinnabar dissolution will be investigated and compared with the effect of cysteine.

- Task 4:
  - Complete literature review for use of Python scripting to automate various geoprocessing tasks and the use of ArcGIS Model Builder to generate process flow diagrams.
  - Begin compiling basic Python scripts using Pythonwin to query and retrieve data from the existing ORR geodatabase.
  - Produce process flow diagrams for the geoprocesses executed with the preliminary Python scripts using ArcGIS model Builder.
- Task 5:
  - Update the Moab groundwater model with plumes for the aqueous species of concern (nitrate and uranium) in the vicinity of the tailings pile.
  - Implement diversion ditch into the flow model. Conduct simulations with the updated groundwater data for determining the effect of mixing water from the river and the diversion ditch.
  - Conduct simulations to determine the effectiveness of running both (injection and extraction) systems at the same time and derive the benefits from running the extraction wells.
- Project-wide: Submit Waste management Symposium 2013 abstract(s).

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 for April 1 to May 17, 2012

- 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.
- The 2012 waste forecast and transportation forecast data set was transmitted from DOE to FIU on May 2, 2012. FIU began preparations for incorporating the new data into WIMS.

Task 1 Quarterly Progress for May 18 to June 30, 2012

- 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.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 18, 2012.

Carryover funding activity

Received the new 2012 waste forecast and transportation data set from DOE on May 2, 2012. Completed the data import into the master database and modified the WIMS modules (Forecast, Disposition Map, GIS, and Transportation) to incorporate the new data set. Added 3 new commercial sites and facilities to the system as well as 2 new onsite locations. New data set was deployed on 5/25/2012 onto the test server for DOE testing and review. Incorporated feedback from data review and deployed new data on public server on 6/21/2012.

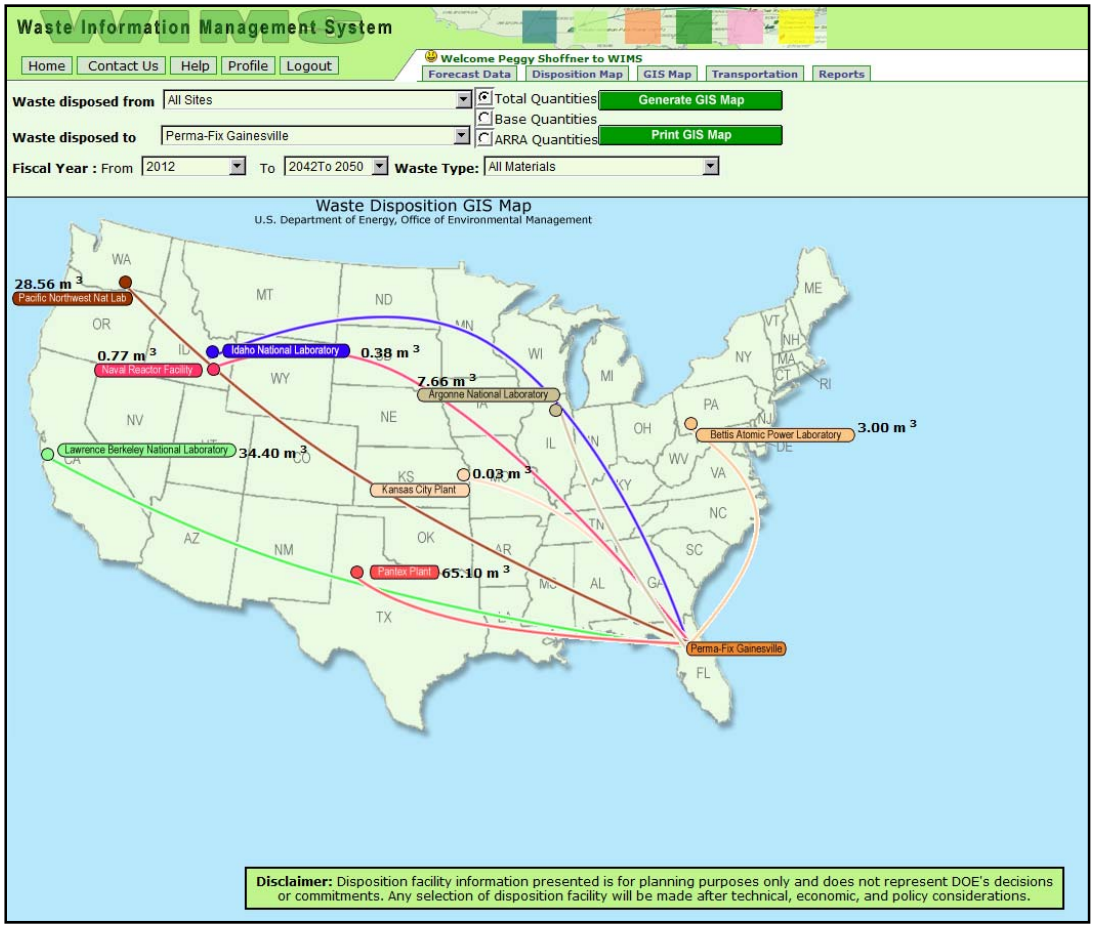


Figure 4-1. Sample screen shot for new WIMS data set shown as GIS map.

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 for April 1 to May 17, 2012

- Began preparation of a presentation for the feasibility study to present at the American Nuclear Society's Decontamination, Decommissioning, and Reutilization (DD&R) conference scheduled for June 2012. Began travel arrangements to participate in the conference.

- Continued preparation of a presentation for the remote removal of strippable coatings feasibility study to present at the American Nuclear Society's Decontamination, Decommissioning, and Reutilization (DD&R) conference scheduled for June 2012. Finalized travel arrangements to participate in the 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 months of April and early May, FIU staff and students continued supporting SRS and the four institutions in monitoring the experimental setup and data collection tasks. FIU also continued regularly inspecting the curing process of the grout and taking photos of the cube's surface and shell to identify visible cracks formed on the surface of the monolith. Three days after the grout dried and started to shrink, some cracks became visible around the edges of the cube and on the shell. By the end of March, some cavities had formed around some of the rods of the sensor racks. Inspections and documentation of the curing process continued through April.

- 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.

- Prepared Year End Report (FIU Year 2) and Project Technical Plans documents scheduled for delivery to DOE and site points of contact on 06/18/12.

Task 2 Quarterly Progress for May 18 to June 30, 2012

- Finalized a best practice based on the Savannah River Site (SRS) 185-3K Cooling Tower demolition on May 22, 2012, by working in collaboration with DOE and the Energy Facility Contractor's Group (EFCOG). SRS's massive K Cooling Tower was safely demolished on May 25, 2010 as part of the Site-wide Footprint Reduction Initiative funded by the American Recovery and Reinvestment Act. The cooling tower became obsolete and no other economical use was available due to its unique and dedicated design and location. In 2003, the DOE selected implosion as the safest approach to ensure the fewest number of man hours at risk for demolishing this unique structure at one of the DOE's premier facilities. Problems/issues associated with the best practice include the height of the building not allowing for typical self-propelled man-lifts to be utilized for drilling at all of the explosives locations, health concerns with the potential carcinogenic effects of silica, and air monitoring noise. The success of the project was measured by clocking 7,000 man hours without a lost time accident and achieving a zero incident rating. The benefits of the best practice were measured by safety, schedule, and the controlled and efficient demolition of the 185-3K Cooling Tower.

- FIU began the design of a renewable energy system sized to support two of the sensor systems currently in use on the Meso-Scale Test Bed (MSTB).The power system will support Idaho National Lab's electrical resistance tomography (ERT) and temperature system. It will also support Mississippi State University's (MSU) fiber loop ring down (FLRD) system. The system will comprise of a 1kW PV array configured for a 120 VAC and 24 VDC output. This will allow the INL system direct connection to the DC bus bar to reduce conversion losses. This power system will be implemented on a stand-alone structure that will provide the appropriate wind-load capabilities for Miami, FL. The system will be fabricated for setup next to the cube.

- In addition to the power system design, FIU is working on reducing the energy demand on one of the INL systems by employing a low-cost microcontroller board to pull data from the temperature system, and make it accessible via the network connection. Finally,

FIU began research into the use of a shared variable engine to compile all system data into a central data location. This engine will be deployed on a main PC and the other systems will communicate with this machine to transfer data between acquisition cycles.

- A conference paper was prepared and sent to the American Nuclear Society DD&R conference held in Chicago (June 24 – June 28, 2012). The paper detailed the accomplishments under the feasibility study for the development of a remote platform for the removal of strippable coatings. This research was conducted in support of Department of Energy Office of Environmental Management (DOE-EM) and aims to identify, develop, demonstrate and deploy innovative technologies for decontamination and decommissioning (D&D). This work is being conducted in collaboration with International Climbing Machines.

- Dr. Lagos, Ms. Peggy Shoffner, and Mr. Himanshu Upadhyay attended the American Nuclear Society's Decontamination, Decommissioning, and Reutilization (DD&R) conference and participated as presenters during technical sessions as well as exhibiters at the FIU-ARC booth. Dr. Lagos and Ms. Shoffner presented the paper on the remote removal of strippable coating via a robotic platform. Dr. Lagos also had the opportunity of co-chairing a session on D&D Lessons Learned at the DD&R conference.

Figure 4-2. Dr. Leo Lagos presenting at the DD&R Conference.

- DOE Fellow Heidi Henderson, from the DOE – FIU Science and Engineering Workforce Development Initiative, presented a technical poster during the DD&R Poster Session. Her presentations was based on the collaboration between DOE, FIU, and the Energy Facility Contractor's Group (EFCOG) to identify and develop lessons learned and best

practices from across the DOE complex and disseminate the final documents to the DOE community by publishing them on the EFCOG website (www.efcog.org) and the D&D Knowledge Management Information Tool (www.dndkm.org). The poster was entitled, "EFCOG Best Practices and Lessons Learned."

Figure 4-3. DOE Fellow Heidi Henderson presenting her poster at the DD&R Conference.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 18, 2012.

Carryover funding activity

FIU participated in a conference call with the technology vendor, International Climbing Machine, on June 11, 2012, to discuss the carryover task to complete the bench scale testing and feasibility study for the remote removal of strippable coatings. ICM took an action to draft a scope of work to complete the feasibility study and sent the draft to FIU on June 13, 2012. The draft proposal is currently under review and revision by FIU.

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 for April 1 to May 17, 2012

- Held bi-weekly teleconferences with DOE on project task status and action items.
- Revised PowerPoint slides based on review and discussion with DOE. The slides will be used to present the D&D KM-IT project to upper level DOE management.

Figure 4-4. Title slide for D&D KM-IT PowerPoint presentation.

- Added new vendors to the D&D KM-IT vendor module. As of May 8, the Vendor module includes a total of 492 vendors. Revised vendor information based on vendor feedback received after marketing the system at the Waste Management Conference. Also continued adding technologies to the Technology module from technologies identified in Hanford ALARA newsletters as well as technologies from the newly added vendors. Additional technologies were added based on vendor feedback. The Technology module includes 443 technologies as of May 8, 2012.
- Completed development of a draft annual report on the web analytics and sent to DOE for review and discussion. 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. Made revisions to the draft annual report on the web analytics and based on preliminary comments from DOE and re-submitted for further review and discussion.

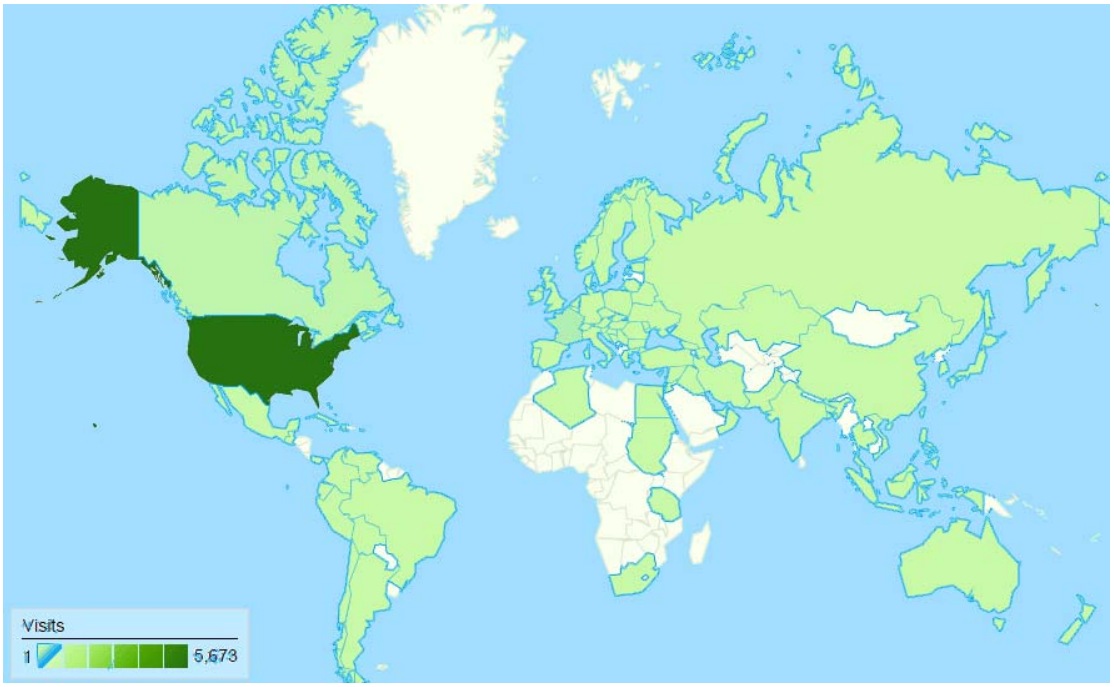


Figure 4-5. Global D&D KM-IT visitor map, from annual web analytics report.

- Search Engine Optimization process continued to be deployed on the D&D KM-IT web application.
- Completed development of the Training Module and sent to DOE for review. Main features of the training module include: D&D conferences and workshops, classroom training, available D&D certifications, training videos, and training documents.

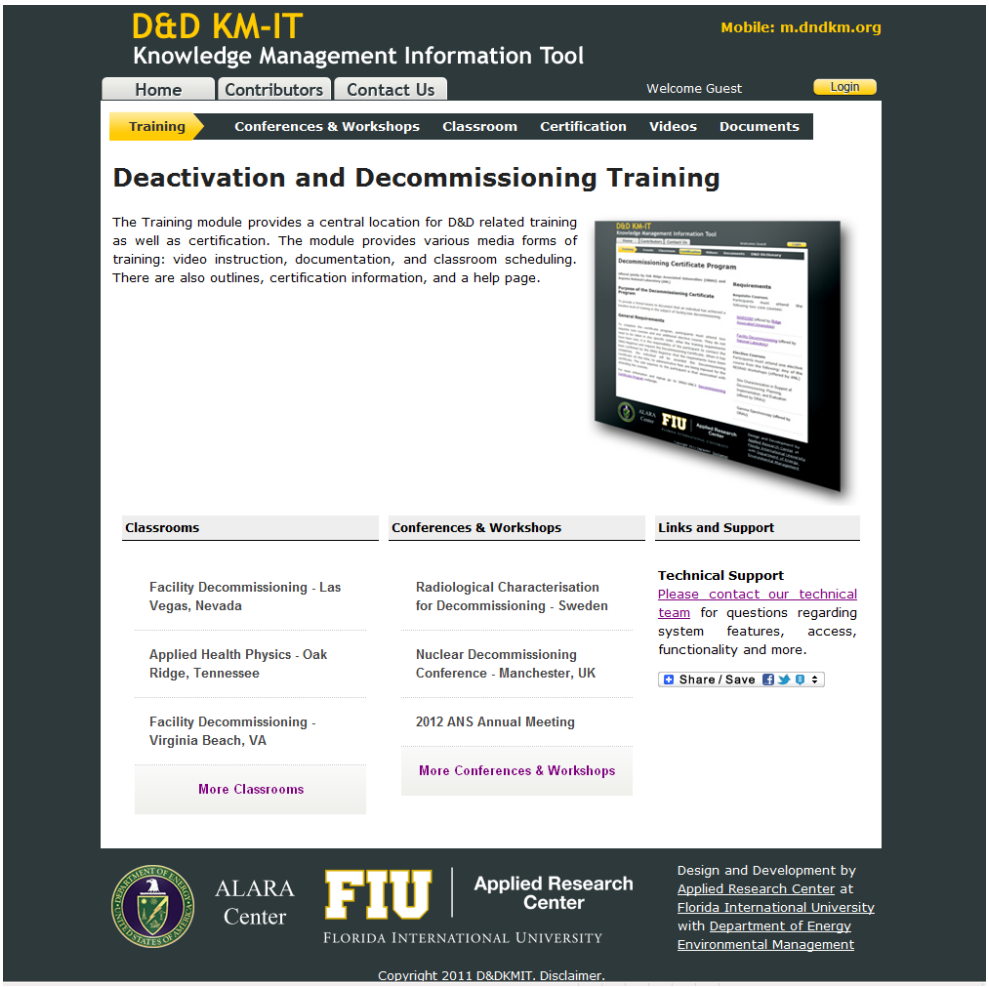


Figure 4-6. Home page of the new D&D KM-IT Training Module.

- Began preparation of a poster presentation D&D KM-IT for the American Nuclear Society's Decontamination, Decommissioning, and Reutilization (DD&R) conference scheduled for June 2012. Finalized travel arrangements to participate in the conference.

- Completed performance of the Certification and Accreditation (C&A) internal audit of the D&D KM-IT system and infrastructure by the FIU security team.

Task 3 Quarterly Progress for May 18 to June 30, 2012

- Held bi-weekly teleconferences with DOE on project task status and action items.

- Added new vendors to the D&D KM-IT vendor module. As of July 9, the Vendor module includes a total of 497 vendors. Also continued adding technologies to the Technology module from technologies identified in Hanford ALARA newsletters as well as technologies from the newly added vendors. Additional technologies were added based on vendor feedback. The Technology module includes 452 technologies as of July 9, 2012.

- 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.

- Began design and development for integrating SRS ALARA reports into the D&D KM-IT system. FIU contacted Robbie Bates, at SRS, for information related to the reports and to coordinate the activity.

- Presented D&D KM-IT during a technical session to the American Nuclear Society's Decontamination, Decommissioning, and Reutilization (DD&R) conference on June 27. 2012. Himanshu Upadhyay presented the Service Oriented Architecture Based Framework for D&D Knowledge Management to a live audience at the conference. 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. The web system can be viewed at www.dndkm.org and the mobile version can be seen at http://m.dndkm.org.

Figure 4-7. Himanshu Upadhyay presenting D&D KM-IT at DD&R 2012

- Hosted an exhibitor booth at the DD&R Conference. The booth was managed by Himanshu Upadhyay, Peggy Shoffner and DOE Fellows to showcase the D&D Knowledge Management Information Tool, the DOE Fellows Program, and DOE-EM applied research being conducted at the Applied Research Center in the areas of waste processing, soil and groundwater remediation, and deactivation and decommissioning. Fact sheets describing ARC research and projects were distributed to participants visiting the booth to increase awareness about FIU and ARC.

- A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 18, 2012.

Carryover funding activity

The D&D KM-IT application and infrastructure was audited by FIU security team for vulnerability and issues with the system. The audit was completed in the second week of May. After testing the system and auditing the procedures and documentation based on NIST guidelines, the findings were provided to ARC by the audit team. The FIU ARC IT team compiled the findings into a report and sent it to DOE on June 19. FIU is working on fixing the issues raised by the C&A internal audit. Once all the issues are resolved, a follow-up audit will be performed by the security team to test the resolutions against the identified vulnerabilities.

Task 4: IT Support to EM and DOE Sites

Task 4 Overview

This task was developed for FIU Year 2 when 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. This task did not continue into FIU Year 3.

Task 4 Quarterly Progress for April 1 to May 17, 2012

- Further activities on the DOE EM Website and Knowledge Base for Environmental Management were held on standby pending further input from EM-72.

- 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.

- During April and early May, FIU supported the PI from INL in the installation and configuration of the SSL on their data acquisitions systems for remote access based on the security needs of Idaho National Lab. FIU also worked on their data access application and configured them to work with the remote sensors.

Task 4 Quarterly Progress for May 18 to June 30, 2012

Task 4 is not continuing into FIU Year 3.

Milestones and Deliverables

FIU Year 2

The milestones and deliverables for Project 4 for FIU Year 2 are shown in the following table. Two milestones were due on April 30, 2012. Milestone 2011-P4-M2.1, the completion of the *in situ* decommissioning experiments, was completed on 04/30/12 and delivered to the SRNL point of contact. Milestone 2011-P4-M3.4, deployment of the training module for review and testing, was completed and sent to John De Gregory (DOE EM-13) on April 30. Milestone 2011-P4-M3.5, D&D KM-IT data mining was complete by 5/17/2012 and included data mining throughout the year to add vendors, technologies, best practices, and lessons learned to the D&D KM-IT system.

Two deliverables associated with Task 4 were put on hold and then canceled, since further activities on the DOE EM Website and Knowledge Base for Environmental Management were put on standby pending further input from EM-72. An additional milestone associated with Task 2 was also canceled, since the draft technical report of mercury D&D issues at Oak Ridge was not received by FIU for review. The deliverables for the draft tech fact sheet for in situ decommissioning experiments as well as the draft tech fact sheet for new modules or capabilities of D&D KM-IT have been delayed due to other project documents being developed. It is anticipated that the project technical fast sheets will be completed by mid-July 2012.

FIU Year 2 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	Complete
	Deliverable	Draft technical report for review of mercury D&D issues at Oak Ridge	One month after receiving documents	Canceled
	Deliverable	Draft Tech Fact Sheet for in-situ decommissioning experiments	One month after experiments are completed	Delayed
	Deliverable	Draft Feasibility Report for remote removal of strippable coatings	4/20/2012	Complete
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	Complete
	2011-P4-M3.5	D&D KM-IT data mining	5/17/2012	Complete
	Deliverable	Draft report of internal C&A audit findings and responses	30-days after internal audit	Complete
	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	Delayed
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	Canceled
	Deliverable	Draft knowledge base requirements document for EM	2/28/2012	Canceled
Project-wide	Deliverable	Draft Project Technical Plan	6/17/2011	Complete
	Deliverable	Draft Year End Report	06/18/2012	Complete
	Deliverable	Quarterly status and progress summary reports	Quarterly	Complete

FIU Year 3

The milestones and deliverables for Project 4 for FIU Year 3 are shown on the following table. Milestone 2012-P4-M1.1, importing the new waste forecast and transportation data set received from DOE in calendar year 2012, was due within 60 days of receipt of the data from DOE. This data was received on May 2, 2012; deployed onto the test server for DOE review and approval on May 25, 2012; and deployed on the public server on June 21, 2012. In addition, the draft Project Technical Plan deliverable was completed and sent to DOE on June 18, 2012.

FIU Year 3 Milestones and Deliverables for Project 4

Task	Milestone/ Deliverable	Description	Due Date	Status
Task 1: Waste Information Management System (WIMS)	2012-P4-M1.1	Import 2012 data set for waste forecast and transportation data	Within 60 days after receipt of data from DOE	Complete
	2012-P4-M1.2	Import 2013data set for waste forecast and transportation data	Within 60 days after receipt of data from DOE	On Target
	2012-P4-M1.3	Submit Waste Management Symposium 2013 abstract(s)	08/17/2012	On Target
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	On Target
	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	On Target
	Deliverable	Lessons Learned and Best Practices	30 days after final approval from DOE & EFCOG	On Target
	Deliverable	Draft technical reports for demonstrated technologies	30-days after evaluation/demo	On Target
	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	On Target
	2012-P4-M3.2	Deployment of global search feature to DOE for review/testing	08/17/2012	On Target
	2012-P4-M3.3	Waste Management Symposium 2013 abstract submitted	08/17/2012	On Target
	2012-P4-M3.4	Deployment of D&D dictionary module to DOE for review/testing	09/28/2012	On Target
	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 deployment of new module or capability	On Target
Project Wide	Deliverable	Draft Project Technical Plan	6/18/2012	Complete
	Deliverable	Draft Year End Report	06/28/2013	On Target
	Deliverable	Quarterly Progress Reports	Quarterly	On Target

Work Plan for Next Quarter

- All tasks: Submit technical abstracts to the Waste Management Symposium
- Task 2: Complete meso-scale testbed system demonstration
- Task 3: Deploy SRS Integrated Safety Solutions Center (ISSC) report integration to DOE for review/testing
- Task 3: Deploy global search feature to DOE for review/testing
- Task 3: Deploy D&D dictionary module to DOE for review/testing

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

Quarterly Progress for April 1 to May 17, 2012

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 completed coordination 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 11 DOE Fellows were placed for summer internship, starting on June 4, 2012. During the month of May, the DOE Fellows program director and the DOE Fellows organized and conducted teleconferences with most of the summer mentors at the respective facilities. In addition, the DOE Fellows contacted their summer mentors and developed a preliminary scope of work document containing a description of their summer internship assignments at the various locations. 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 EM-12 (Soil/Groundwater Remediation	Washington, DC	Kurt Gerdes
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
Revathy Venkataraman	Y-12 National Security Complex	Oak Ridge, TN	Steve Payne
Ximena Prugue	Washington River Protection Solutions, Hanford Site	Richland, WA	Leo Thompson
Robert Lapierre	Pacific Northwest National Laboratory	Richland, WA	Dr. Dawn Wellman
Lillian Marrero	Sullivan International Consulting	Chicago, IL	JD Campbell
Elicek Delgado	Sullivan International Consulting	Chicago, IL	JD Campbell

Completed DOE Fellows Spring recruitment efforts which started March 19 and closed on April 13, 2012. During this period, the current DOE Fellows and program director hosted an Information Session for potential candidates, conducted recruitment campaigns by placing recruitment tables at College of Engineering, participated in the FIU College of Arts and Science's Job and Internship Fair, and made short presentations at targeted classes within the College of Engineering and College of Arts and Sciences. A total of 23 application packages were received and reviewed by the DOE Fellows Selection Committee integrated by representatives from DOE-HQ, FIU's College of Engineering and Art & Sciences, and ARC staff. A pre-selection process was conducted and 16 applicants were selected for formal interviews. Completed formal interviews of the 16 selected applicants during the last week of April and first week of May. A total of 13 students were extended offers of which 11 accepted and were hired as DOE Fellows. The selected students start the DOE Fellowship on 06/04/12. A list of the new selected Fellows, their classification, and areas of study is provided below:

First Name	Last Name	Classification	Major
Jennifer	Arniella	Under Graduate	Mechanical Engineering
Francisco	Bolanos	Under Graduate	Mechanical Engineering
Dania	Castillo	Under Graduate	Structural Engineering
Robert	Lapierre	Under Graduate	Chemistry
Joel	McGill	Under Graduate	Civil Engineering
Lucas	Nascimento	Under Graduate	Electrical Engineering
Raul	Ordonez	Under Graduate	Electrical Engineering
Mariela	Silva	Graduate	Engineering Management
Gabriela	Vazquez	Under Graduate	Mechanical Engineering
Revathy	Venkataraman	Graduate	Information Technology
Ashley	Wardlow	Under Graduate	Biochemistry & Criminal Justice

DOE Fellows continued to assist EFCOG in developing Lessons Learned and Best Practices documents. As of April 30, the 185-3K Cooling Tower Demolition best practice was awaiting final DOE review and approval. FIU is working 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 will then be ready for final DOE review and approval. Site release of the document was received for the lesson learned for the unanticipated high dose during the removal of wire flux monitor cabling from the HWCTR reactor vessel. This document is ready for EFCOG review. Finally, a new lesson learned was initiated for a radiological contamination event during the demolition of the Separations Process Research Unit (SPRU) building at the Knolls Atomic Power Laboratory. The draft of this document by a DOE Fellow is in progress.

The DOE Fellow, Heidi Henderson, prepared a poster on the development of lessons learned and best practices for DOE-EM and the EFCOG group to present at the American Nuclear Society's

Decontamination, Decommissioning, and Reutilization (DD&R) conference. Finalized travel arrangements to participate in this conference.

Prepared Year End Report (FIU Year 2) and draft Project Technical Plan documents scheduled for delivery to DOE on 06/18/12

Quarterly Progress for May 18 to June 30, 2012

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 and eleven (11) DOE Fellows made final plans and arrangements to start their summer internship assignments on June 4, 2012 (see table of DOE Fellows and internship assignments in the previous section). The DOE Fellow program director coordinated with FIU and the Y-12 National Security Complex to quickly put a contract in place to allow DOE Fellow Revathy Venkataraman to start her internship on time as planned.

The DOE Fellow, Heidi Henderson, attended the American Nuclear Society's Decontamination, Decommissioning, and Reutilization (DD&R) conference and presented a student poster on the development of lessons learned and best practices for DOE-EM and the EFCOG group. Heidi also participated as "student assistant" during the conference and helped out at the various sessions during the conference. In addition, two other DOE Fellows (Elicek Delgado-Cepero and Lilian Marrero) are conducting a summer internship in Chicago and were able to participate in this conference as "student assistants," supporting conference organizers by working in the various technical sessions at DD&R and ANS meetings.

Also, while attending the DD&R conference in Chicago during this month, Dr. Lagos had the opportunity to visit DOE Fellows summer interns (Lilian Marrero and Elicek Delgado-Cepero). Lilian and Elicek are performing a 10-week summer internship in Chicago and working for Sullivan International Consulting. As described below, Lilian and Elicek also had the opportunity to attend and participate in ANS's DD&R conference.

Figure 5-1. ARC Booth at DD&R 2012. From left, Himanshu Upadhyay, Elicek Delgado-Cepero, Lilian Marrero and Dr. Leonel Lagos

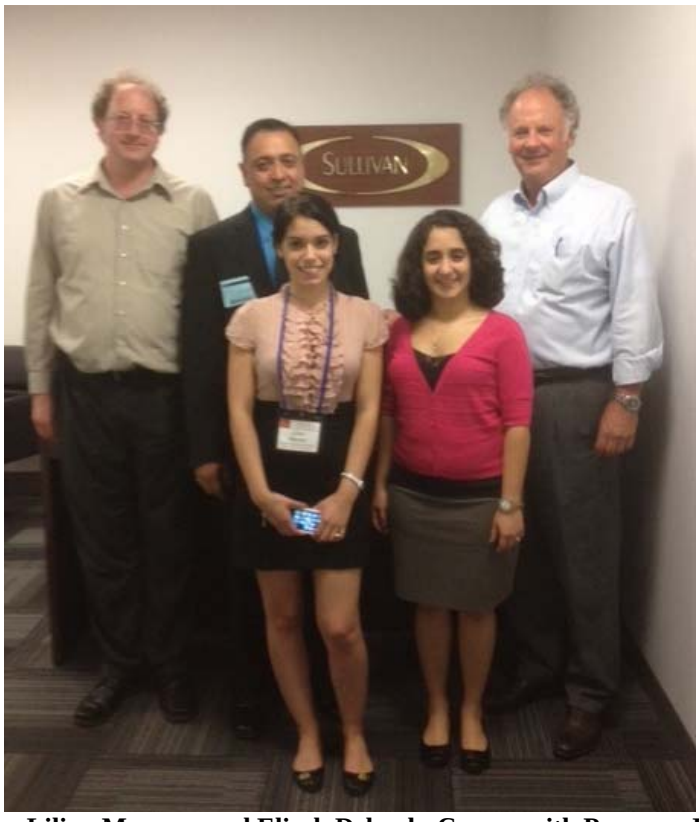


Figure 5-2. DOE Fellows Lilian Marrero and Elicek Delgado-Cepero with Program Director Dr. Leo Lagos and mentors at Sullivan International Consulting

Also this month, DOE Fellows interning at the Department of Energy (DOE) Headquarters in Washington, DC, attended a breakfast reception with FIU president Mark Rosenberg and members of the Florida delegation at the US Capital Building on June 25, 2012. The students included DOE Fellows Claudia Cardona and Janty Ghazi from the FIU-DOE Science and

Technology Workforce Development Program (http://fellows.fiu.edu), as well as other interns from FIU. Among the delegation present were Congresswoman Ileana Ros-Lehtinen, Congressman Mario Diaz-Balart, Congresswoman Frederica Wilson, and Congressman David Rivera.

Discussions at the breakfast reception included various aspects of FIU, ranging from finances to class availability. President Rosenberg was pleased to get the detailed feedback from the FIU interns about their views on subjects pertaining to the university. President Rosenberg also recognized that Claudia and Janty were with FIU's Applied Research Center (ARC) as part of the DOE Fellowship program. President Rosenberg was very proud of the work and research that goes on at ARC and expressed his support in the program. He mentioned the great job Dr. Leonel Lagos (DOE Fellow Program Director) and his DOE Fellows are doing at ARC as well as at the DOE sites throughout the country.

The Florida delegates expressed how impressed they were with the internships being performed by FIU students at the different government agencies and departments. They spoke of their support for FIU and the various programs that made the internships possible.

Figure 5-3. DOE Fellows with FIU President, Dr. Mark Rosenberg

Figure 5-4. DOE Fellow, Janty Ghazi, with Florida Delegates (Ileana Ros-Lehtinen, Mario Diaz-Balart, Frederica Wilson, and David Rivera) in front of US Capitol

During the month of June, the new Fellows have completed the FIU's Environmental Health & Safety courses required by the university and ARC prior to conducting any work in ARC's lab facilities. The new Fellows also spent the month of June getting familiar with the DOE-EM applied research and working on their bios, schedule, and preliminary description of their DOE-EM assigned tasks. The new Fellows were also paired up with ARC mentors/supervisors. The Fellows also participated in weekly meeting conducted by program director, Dr. Lagos.

DOE Fellows continued to assist EFCOG in developing Lessons Learned and Best Practices documents. As of May 22, the 185-3K Cooling Tower Demolition best practice received final DOE review and approval. FIU is working 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 will then be ready for final DOE review and approval. Site release of the document was received for the lesson learned for the unanticipated high dose during the removal of wire flux monitor cabling from the HWCTR reactor vessel. This document was sent for EFCOG review. Finally, 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 has been drafted by a DOE Fellow and is undergoing review and revision by FIU.

Doc	BP/LL	Title	POC	Status as of 6/30/2012
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 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	Received site release of document on 4/16. Document sent to EFCOG for review.
7	LL	SPRU Lesson Learned	Brad Smith	Drafted by DOE Fellow and FIU review in progress.

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). The DOE Fellows website has also been updated to reflect a new tab showing the DOE Fellows Summer Internships Technical Reports. As a first attempt, last year's internships (summer 2011) are available on the website (http://fellows.fiu.edu). Previous years (2008-2010) will be made available during the month of July 2012.

A draft Project Technical Plan for FY2012 (FIU Year 3) and the technical Year End Report were prepared and sent to DOE on June 18, 2012.

Milestones and Deliverables

FIU Year 2

The milestones and deliverables for Project 5 for FIU Year 2 are shown on the following table. The Year End Report was due in June and was completed and sent to DOE on June 18, 2012. The deliverable to update the technical fact sheet is delayed due to other project documents being developed. It is anticipated that the project technical fact sheet will be completed by mid July, 2012.

FIU Year 2 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	Complete
	Deliverable	Draft Year End Report	06/17/12	Complete
	Deliverable	Update Technical Fact Sheet	30 days after end of project	Delayed

FIU Year 3

The milestones and deliverables for Project 5 for FIU Year 3 are shown on the following table. Milestone 2012-P5-M1, selection of new Spring 2012 DOE Fellows, was completed on May 30, 2012. The draft Project Technical Plan deliverable was completed and sent to DOE on June 18, 2012. The deliverable for the list of 2012 student summer interns and their research assignment was completed and sent to DOE by the due date of 6/29/2012.

FIU Year 3 Milestones and Deliverables for Project 5

Milestone/ Deliverable	Description	Due Date	Status
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	Submit Waste Management Symposium 2013 abstract(s)	8/17/2012	On Target
2012-P5-M3	DOE Fellows Complete Summer Internships	08/31/12	On Target
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
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	12/31/2012	On Target
Deliverable	Draft Year End Report	06/28/13	On Target

Work Plan for Next Quarter

- Submit abstract to Waste Management 2013 Symposium.
- Complete summer internships and begin preparation of summer internship reports.
- Begin preparation and coordination for DOE Fellows Poster Exhibition & Competition.