PROJECT TECHNICAL PLAN

Project 1: Chemical Process Alternatives for Radioactive Waste

Performance Period: September 29, 2017 to September 28, 2018

Date submitted:

October 20, 2017

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Submitted to:

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Program Services Division, ME-643.1
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Cooperative Agreement DE-EM0000598

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INTRODUCTION

The U.S. DOE Hanford Site has the largest number of high-level waste (HLW) storage tanks and the largest volume of HLW in the United States. The safe storage, retrieval, treatment, and disposal of approximately 53 million gallons of highly toxic, high-level radioactive waste stored in Hanford's 177 underground tanks are a national priority. Retrieval and treatment of waste from these tanks pose a considerable challenge.

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Florida International University has been conducting research on several promising alternative processes and technologies that can be applied to address several technology gaps in the current waste retrieval and conditioning plans. Specifically, FIU has been involved in: the evaluation of non-metallic materials in the waste transfer system, evaluation of alternative HLW instrumentation for in-tank applications and the development of technologies to assist in the inspection of tank bottoms at Hanford.

TECHNOLOGY NEEDS

The implementation of advanced technologies to address challenges faced with baseline plans for HLW operations is of great interest to the Hanford Site. Specifically, this includes the use of field-deployable or in-tank technologies, as well as sensor and material evaluations that can improve the transport and retrieval processes with HLW. FIU has worked with site personnel to identify three focus areas related to technology and process improvement needs that can benefit from FIU's core expertise in areas related to HLW operations.

Focus Area 1: Experimental testing of HLW transport

Although a significant amount of work has been conducted on evaluating issues related to critical velocities and the re-suspension of pipeline sediment, there are still a number of technical gaps that need to be investigated. FIU is working with engineers at PNNL, WRPS and SRNL to develop a test loop that can be used to address a number of these issues. One of the areas that will initially be addressed is to develop a technical basis for flushing procedures. After waste has been transferred from one location to another, the line needs to be flushed which creates additional waste material. Currently, there is little information regarding the volume of fluid needed to flush the line and minimizing the volume can reduce costs significantly. The test loop will also be multi-functional and capable of investigating additional areas of concern. In future studies, the test loop will be used to assist in evaluating erosion in pipelines and expanding the technical basis for critical velocity requirements.

Focus Area 2: Technology development and innovative instrumentation evaluation for HLW tanks

Hanford engineers have a need to develop technologies that can provide inspection and possibly repair capability for their double-shell tanks (DSTs). Small amounts of waste have been found in the annulus of AY-102, prompting the need for developing inspection tools that can identify the cause and exact location of the leak. The inspection tools will have to navigate through complex cooling channels of the DST refractory pad or through air supply lines and provide visual feedback of the tank bottom. FIU has developed and tested initial prototype tools and is currently working with site engineers to expand the capability of the systems and investigate deployment mechanisms.

Additionally, FIU has efforts supporting Hanford and Savannah River needs to evaluate instrumentation and sensors that may improve personnel and environmental safety. These efforts focus on utilizing commercial off-the-shelf-technologies that assist in providing data that can improve the operational processes in the Hanford tanks. Currently, FIU is investigating the use of infrared sensors for the monitoring of wall temperatures of the DSTs. These temperature measurements, coupled with ultrasonic transducer (UT) measurements, can refine the accuracy and viability of UT sensors.

Focus Area 3: Structural integrity analysis for HLW pipelines

Understanding the current and future status of the structural integrity of the waste transfer system at Hanford is of paramount importance to DOE, engineering contractors and the local community. The tank contractor, Washington River Protection Solutions, LLC (WRPS), has implemented a Fitness-for-Service program that focuses on evaluating the structural integrity of waste transfer system components including primary piping, encasements, and jumpers when they are removed for disposal. FIU is assisting site engineers with evaluating sensors that can provide thickness data on transfer system components that are still operating and provide data in real time. The objective is to provide a means to measure the remaining useful life of the components and incorporate the data into future design plans.

Additionally, support is needed for Hanford engineers with regard to understanding the integrity of non-metallic components in the HLW transfer system. There are four primary stressors that can affect the performance of non-metallic components. These include temperature, pressure, radiation, chemistry. In general, it has been well established how the non-metallic components respond to the stressors individually, but the cumulative effect is less understood. FIU will assist site engineers with understanding how the combined effect of the stressors can degrade the performance of non-metallic components via bench scale testing.

TASK DESCRIPTIONS

Based on the aforementioned technology and research needs, three tasks (with a total of five subtasks) have been identified for the next performance period. FIU will work with WRPS personnel, national laboratory contacts, and collaborators from industry and academia to identify shortcomings of the baseline approach and past research efforts. This knowledge will be incorporated into the planning and execution of these tasks detailed below.

Note: Task numbers are not continuous because task numbers have been assigned chronologically over the past 5 years and several tasks have been completed.

TASK 17 – ADVANCED TOPICS FOR MIXING PROCESSES

Subtask 17.3 – Evaluation of pipeline flushing requirements for HLW at Hanford and Savannah River (New)

Recently, the Defense Nuclear Facilities Safety Board has expressed concerns about situations where turbulent or homogeneous laminar flow of non-Newtonian waste could not be achieved in transfer pipelines and flushing requirements need to be imposed. This task will focus on the study of flushing operations using simulants that possess non-Newtonian fluid characteristics similar to Hanford waste and supports site flushing operations. The effort will require the development and implementation of a test plan that is currently being developed with input from site engineers. Focus will be on developing relevant pipe/sediment initial conditions and providing data that can assist in minimizing flushing waste streams.

Objective

The test loop being developed at FIU will be multifunctional and can be operated in two modes: (1) flushing mode and (2) critical velocity test mode. In the flushing mode, the objective is to develop and implement methods which lead to optimum conditions (i.e., sufficient pipeline cleaning using the minimum amount of water necessary). By altering the valve configuration, the system can operate in a critical velocity mode where the objective will be to determine the minimum velocity necessary to avoid particle deposition in the pipeline. FIU's initial effort will focus on flushing studies and includes the following objectives:

- Implementing optimal flush operations with minimized waste, erosion, and possibility of water hammer and plug formations.
- Developing a correlation for flush parameters based on characteristics of the system at the start of flushing. Data and correlations will be useful for pump selection and improving guidelines.
- Establishing a criterion for flushing satisfaction thorough discussions between FIU and experts from Hanford and the national labs.

Benefits

The proposed activities under this subtask at FIU will provide the necessary data and guidelines for the engineering staff at the sites to use in order to understand various flushing scenarios that can occur during flushing operations at DOE sites. Successful completion of the subtasks will result in the development of guidelines that can: (1) save a significant amount of water, (2) reduce the waste resulting from the water used in flushing, (3) avoid over-flushing of the pipeline using excess water and, therefore, reduce operation time, (4) reduce the possibility of damaging the pipeline due to water hammer or granular plug formation as a result of aggressive flushing, and (5) validate tools and instruments used in evaluation of the flush streams and quality assessment. It is expected that this work will generate correlations that guide the site engineers to accurately estimate pumping requirements that lead to more efficient flushing operations.

TASK 18 – TECHNOLOGY DEVELOPMENT AND INSTRUMENTATION EVALUATION

Subtask 18.2 – Development of Inspection Tools for DST Primary Tanks

As part of the Hanford DST integrity program review, engineers at Hanford are investigating robotic technologies that can be used for the evaluation of DST tank floors. The technologies are intended to provide video feedback of the tank refractory and base pad so that an assessment can be made regarding the structural integrity of the tank bottom. There are three paths of access: 1) refractory air slots though the annulus, 2) 4-in annulus air supply pipe to central plenum, and 3) 6-in leak detection pit drain from the central sump. In previous years, engineers at Hanford have requested information from industry regarding their capability to inspect the tank insulating refractory pad and provide visual feedback as well as potential for conducting repairs.

Objective

The objective of this task is to develop inspection tools that can provide visual feedback of DST bottoms from within the insulation refractory pads and other pipelines leading to the tank floor. FIU engineers will continue to work directly with site engineers to develop and test the alternative designs. Specific subtasks include:

- Develop deployment platforms and improve on design concepts that will allow for the navigation of a remotely controlled device through the refractory pad channels and/or the drain slots of DST tanks and provide visual feedback. A prototype of the inspection tool has been developed and validated in a full-scale sectional mock-up test bed constructed at FIU.
- Develop and improve on design concepts that will allow for the navigation of a crawler inspection tool that can navigate through a 3-in and 4-in air supply pipe that leads to the central plenum of the Hanford tanks in the AY Farm.
- Develop a larger scale crawler that can navigate through the 6-inch drain pit pipeline and potential deploy the miniature rover.

Benefits

The proposed subtask will provide alternative solutions for monitoring the structural integrity of the bottoms of the DSTs. Tools developed in this subtask will allow for the detection of potential leaks, allowing site engineers to obtain the necessary information that is needed to generate viable approaches for repair. Additionally, the tools can be outfitted with sensors that provide additional information on the environmental conditions within the DSTs as well as the important details on the health of the tank floors.

TASK 19 – PIPELINE INTEGRITY AND ANALYSIS

Subtask 19.1 – Pipeline Corrosion and Erosion Evaluation

The Hanford Site Tank Farm has implemented a Fitness-for-Service (FFS) program for the Waste Transfer System. The FFS program, based on API-579-1/ASME FFS-1, examines structural parameters of the waste transfer systems in order to develop erosion/corrosion rates for relevant system components. The FFS information is acquired from opportunistic evaluations of pipelines that have been removed from service. FIU ARC engineers will work closely with key Hanford HLW personnel on the FFS program, delivering solutions for sensor evaluations, conducting bench scale testing followed by data acquisition and analysis for corrosion and erosion assessment.

Objective

The objective of this task is to evaluate potential sensors for obtaining thickness measurements of HLW pipeline components. Specific applications include straight sections, elbows and other fittings used in jumper pits, evaporators, and valve boxes. FIU will assess the accuracy and use of down selected UT systems for pipe wall thickness measurements under static and dynamic (real-time) conditions on a test loop constructed at FIU.

Benefits

The proposed task will provide information that will assist engineers with understanding the failure potential of HLW transfer components due to corrosion and erosion. This information can assist in determining if and when lines need to be removed, saving time and resources on the unneeded excavation of transfer lines. This information will also assist engineers with designing new transfer systems by establishing more detailed/accurate guidelines governing the life expectancy of the transfer system and its components.

Subtask 19.2 – Evaluation of Nonmetallic Components in the Waste Transfer System

Nonmetallic materials are used in the Hanford Site Tank Farm waste transfer system. These materials include the inner primary hoses in the hose-in-hose transfer lines (HIHTLs), Teflon® gaskets, ethylene propylene diene monomer (EPDM) O-rings, and other nonmetallic materials. These nonmetallic materials are exposed to β and γ irradiation, caustic solutions as well as high temperatures and pressure stressors. How the nonmetallic components react to each of these stressors individually has been well established. However, simultaneous exposure of these stressors has not been evaluated and is of great concern to Hanford Site engineers. FIU ARC engineers has worked closely with key Hanford HLW personnel to develop a test loop and an experimental test plan to determine how these nonmetallic components react to various simultaneous stressor exposures.

Objective

The objective of this task is to provide the Hanford Site with data obtained from experimental testing of the hose-in-hose transfer lines (HIHTLs), Teflon® gaskets, EPDM O-rings, and other nonmetallic components used in their tank farm waste transfer system under simultaneous stressor exposures. To date, FIU has evaluated HIHTLs and material coupons that have been aged for 6 months and 1 year. Due to experimental testing limitations, radiation exposure was not conducted. The stressor exposure experiments was limited to various combinations of simultaneous stressor exposure of caustic solutions and high temperatures. Evaluation of baseline materials was conducted and compared with materials that were conditioned with the various stressors.

Benefits

This task will provide information that will assist engineers with understanding how the nonmetallic components of the tank farm waste transfer system react to simultaneous stressor exposures of caustic solutions, high temperatures and high pressure. This will help in determining the service life of the waste transfer system parts that contain nonmetallic components. This information will also assist engineers with designing new transfer systems by establishing more detailed/accurate guidelines governing the life expectancy of the transfer system parts.

FIU YEAR 8 TASK EXECUTION PLANS

Subtask 17.3.1 – Test plan development

FIU will continue to work with engineers at Hanford and Savannah River to develop a test loop that meets the needs of the sites. In addition, FIU will continue to refine a test plan that is being developed to evaluate flushing parameters after waste has been transferred. Consideration for both nominal and extreme scenarios at the sites will be evaluated for testing. Initial tests will be developed that can provide baseline data for nominal cases at the sites. Subsequent phases of this effort will potentially include scenarios in which extreme conditions are evaluated. The initial testing conditions will be selected to provide data that is easily reproducible and will include selection of solids, carrier fluids, percent loading and shape of the sediment bed. This information will be obtained from reports, simulations and discussions with key personnel. Characterization of pipe conditions, pre- and post-flushing, will also be explored in the development of the test plan. To flush the system, parameters including flow volume, velocity and number of flushes will be varied. The loop will have multiple lengths so pipeline geometry will be varied to establish its effects on the flushing performance.

To emulate the conditions at the sites, a means to control the temperature of the simulant will be investigated and incorporated into the test plan. Temperature may also be considered as an independent variable in the testing.

The test will loop will be instrumented with pressure transducers, thermocouples, Coriolis meters and instrumentation for pre- and post-flushing characterization. Pipe sections will also be added that allow for visual inspection of the sediment. Additionally, FIU will consider incorporating novel erosion sensors being developed by Savannah River. Engineers from SRNL will assist in incorporating the sensors into the test loop.

Subtask 17.3.2 – Construction and commission of test loop

Upon finalizing the test plan, FIU will begin procuring equipment, instrumentation, and materials for simulant production. Additional activities will include precise installation and calibration of instrumentation, completion of test loop assembly, the potential development of a control feedback system, and commission of the test loop. FIU will provide a summary document that explains the details of the test loop design and construction prior to initiating the flushing tests.

Subtask 17.3.3 – Flushing tests

FIU will initiate the first phase of testing in accordance with the test plan approved by all the key stakeholders. In the initial tests, nominal cases will be conducted for a variety of pipe lengths that can be correlated with the simple geometry of the cross site lines.

FIU will terminate each flushing test upon reaching a specific flush volume and measure the amount of solid residuals in the loop using two different approaches to the capture solids. The data will be compared for all tests to determine optimal flushing conditions.

Future flushing tests will potentially involve different simulants and bed formations that can emulate more extreme conditions in the pipeline. Additional flow control methods will be considered to optimize the flushing procedures.

Subtask 18.2.1 – Sensor integration and full-scale testing

FIU has developed a full-scale sectional mock-up of the DSTs at Hanford. The peristaltic crawler has demonstrated that it can successfully navigate through the 3- and 4-inch air supply lines and reach the tank central plenum. Efforts will continue to improve the functionality of the crawler by integrating a number of sensors into the system. These additions include: (a) a thermal infrared camera to provide thermal imaging mapping, hot spot detection and temperature gradient analysis; (b) ambient temperature, pressure and humidity sensors to provide environmental conditions; (c) a wall scanner module to provide radiation, ultrasound, and visual surface mapping; (d) a load cell to provide tether drag estimation; (e) contact pressure sensors to provide grip conditions; and (f) inclinometers to provide slope and orientation of each module of the crawler. The addition of an automated cable management systems will also be considered. After completion of the integration of these sensors/systems, the improved crawler will be demonstrated in the full-scale mock-up.

Subtask 18.2.2 – 6-inch crawler development

Based on discussions with WRPS engineers, there is a need to develop an inspection tool that can traverse the drain pit lines to reach the drain pit slots in the tank foundation. Previous inspection tools deployed at the site did not complete the goal of reaching the central plenum due to unforeseen conditions in the pipeline. Recent inspections within the annulus of the Hanford DSTs has also revealed that significant thinning is occurring in the secondary liners of multiple tanks. During the last performance period, FIU developed a conceptual design for a 6-inch version of the crawler. This year, FIU will manufacture a prototype of the 6-inch crawler that can provide video feedback and reach the drain line slots. Special consideration will be made to utilize the crawler as a deployment platform for the mini rover. This will allow the mini rover to be deployed within the drain slot lines and provide video and potentially provide environmental conditions and UT measurements for difficult-to-reach sections of the secondary liner.

Subtask 18.2.3 – 2-inch crawler design

Discussions with WRPS engineers have also exposed a need to develop a 2-inch version of the peristaltic crawler. Multiple pipeline systems at Hanford have 2-inch diameter lines and developing a means to inspect these lines will improve the understanding of transfer line integrity and potentially assist in improving operational processes. The 2-inch version of the crawler will likely be similar to the current version but alternative actuators will need to be investigated. For this subtask, a conceptual design will be developed and discussed with site engineers. Based on the feedback received, future efforts will involve developing an initial prototype.

Subtask 18.2.4 – General support for testing and evaluation of tank inspection tools

In the previous performance period, FIU completed the development of a full-scale sectional mock-up of the Hanford DSTs. The mock-up includes an 8-foot wide carbon steel section of the tank floor that stretches the entire radius of the tank and includes the knuckle and approximately 3 feet of wall above the knuckle. The mock-up also includes both liners, the annulus, the refractory pad and slots as well as the concrete foundation and drain slots. The system is modular so various plates thicknesses can be incorporated into the set up and different refractory channel configurations can be incorporated. In this subtask, the mock-up will be used to evaluate additional inspection systems and sensors identified by the sites that have potential to be deployed. FIU will work with site engineers to make modifications to the set up as needed, and conduct tests that demonstrate the viability of the selected systems.

Subtask 18.2.5 – Finalize enhancements and cable management system for the mini rover

Based on the lessons learned from the field evaluation on the full-scale sectional mock-up, FIU will continue to fine tune the mini inspection tool to improve its overall robustness and functionalities. This includes replacing the current tether with a composite cable that is comprised of an ethernet cable and a dedicated coaxial cable for signal communication to reduce cross-talk interference. Tests will be conducted to compare the noise resiliency of the composite cable. In addition to the tether, FIU will also allocate efforts to further improve the performance of the semi-autonomous operation, as well as the operation of the automated cable management system. This will include fine-tuning the control parameters of both the PID controller of the inspection tool and the cable management's release/retrieval controller, exploring the feasibility of applying machine learning techniques for semi-autonomous control, and minimizing the delay in the camera system of the inspection tool.

Subtask 18.2.6 – Feasibility study of ultrasonic transducer (UT) and IR sensor integration

After discussions with site engineers, it was determined that one of the important tasks is to inspect the structural integrity of the tank, especially the condition of the primary liner of the DST. Following the last year's task on UT sensor evaluation on the pipeline, FIU will continue the effort to conduct a feasibility study of UT sensor integration into the mini inspection tool. FIU plans to conduct a review of the commercially available UT sensors that fit into the limited space of the inspection tool. Critical characteristics include the dimension of the transducer as well as electrical, communication and contact force requirements. Once a sensor is selected, FIU will develop a conceptual design for the inspection tool that meets these requirements.

FIU will also continue to investigate the integration of an IR sensor onto the inspection tool. Incorporation of the IR sensor will allow for measurement of tank floors and wall temperature, which in turn is needed for calibration of temperature dependent UT sensors. A review of commercially available IR sensors will be conducted to evaluate a suitable sensor that fits onto the inspection tool. Significant modification of the inspection tool would likely be needed to incorporate the UT and IR sensors. After the design modifications are completed, engineering-scale testing using the sensor will be conducted on the full-scale sectional mock-up at FIU.

Subtask 18.2.7 – Acquiring, testing and integration of the mini rover onto the deployment platform

To streamline the inspection effort with WRPS, FIU will acquire a deployment platform that is similar to the one used at Hanford. This would facilitate the transition of the integrated platform to the engineers on the site. FIU will work closely with the site engineers to make the necessary modifications to integrate the mini inspection tool, controller box and cable management system onto the platform. Integration efforts include both the hardware and software systems of the inspection tool. Once fully integrated, inspection tests will be conducted on FIU's full-scale sectional mockup. Parallel modification and/or improvement efforts on the integrated platform will also be carried out during the testing, if deemed necessary. If procurement of the deployment platform is delayed or cancelled, FIU will proceed with an in-house deployment platform prototype for the above mentioned experiments.

Subtask 19.1.1 – Evaluation of UT sensors for erosion and corrosion analysis

In the previous year's performance period, FIU worked with Hanford Site engineers to evaluate and downselect two potential ultrasonic transducer systems that can be used to obtain real time data on the structural integrity of pipelines in the waste transfer system. One of the downselected systems was the wave guided system from Permasense, which has been procured and initial assessment of the accuracy of the system has been completed under static conditions (no real-time thinning). For the evaluation, a test loop was developed using various pipe fittings such as straight sections, elbows and reducers for 2- and 3-inch diameter pipes. During this performance year, FIU will assess the accuracy of the Permasense UT system under dynamic conditions (real-time thinning). To conduct this evaluation, FIU will develop an experimental test loop with the objective of using sand-water slurry and/or abrasive/chemical simulants that can be used to age and erode the pipes. The sensors will be evaluated over four months with various percent loadings or concentration levels. Follow up phases will include evaluating the sensors at elevated temperatures and humidity to determine how they function in extreme environments. Finally, FIU will work with SRNL to integrate novel erosion sensors being developed at their labs into the test loop. Data from both sets of sensors will be used to assess their viability for long term real time thickness measurements.

Subtask 19.2.1 – Development of the Phase 2 test plan

In the previous year, FIU aged non-metallic materials that included inner hose-in-hose transfer lines (HIHTLs), EPDM O-rings and Garlock® gaskets in a test loop that simultaneously exposed the components to caustic material and elevated temperatures. Material coupon specimens as well as the in-service configuration components were exposed to the combination of simultaneous stressors for 6 months and 1 year. Results have shown that little degradation has occurred to the components but the material properties of the Garlock and EPDM changed significantly.

After discussing the results with engineers at WRPS and SRNL, a test plan will be developed that will focus on leveraging past results from FIU, SRNL and others related to polymer aging. The plan will likely include creating material coupons from the baseline and aged HIHTL specimens. This will allow for correlations to be drawn between the previously analyzed material coupons and the HIHTL components.

In addition, FIU will work with SRNL to script a plan to irradiate some of the specimens, both before and after temperature/caustic aging. Although the stressors will not be loaded simultaneously, this approach will provide additional information regarding the cumulative effects. Dose rates and total dosage will be determined that will likely define the overall time needed for testing. Finally, FIU will also consider the need to load the specimens to emulate operational pressures. It is anticipated that the effect of pressure in conjunction with radiation could be significant.

Subtask 19.2.2 – Experimental aging and testing of non-metallic materials

After a test plan has been developed, FIU will work with SRNL and WRPS to implement the plan to age the specimens. It is expected that material coupons will be the focus of this phase of the research and specimens that have been aged will be analyzed via SEM-EDX, FTIR and other analytical tools to assess changes in the their chemistry and microstructure. As done previously, material properties will also be evaluated for baseline and aged specimens in accordance with the relevant ASTM standards. Below is a list of the potential tests that will be conducted.

Table 1. Coupon Material Tests

Test 1	Dimension change (ASTM 543)
Test 2	Specific gravity and mass change (ASTM D792, ASTM 543)
Test 3	Tensile strength (ASTM D412)
Test 4	Compression stress relaxation (ASTM D6147)
Test 5	Ultimate elongation (ASTM D412)
Test 6	Hardness measurements (ASTM 2240)

After results are obtained from the aged material, they will be compared with the baseline data to determine any changes in strength and material properties. The results will be used to develop a means to predict the remaining useful life of non-metallic components after exposure to HLW.

Project Milestones

Milestone No.	Milestone Description	Completion Criteria	Due Date
2017-P1-M17.3.1	Finalize the loop design.	Summary email sent to Hanford and Savannah River contacts and DOE HQ	1/19/2018
2017-P1-M17.3.2	Complete the construction of the test loop	Summary email sent to Hanford and Savannah River contacts and DOE HQ	6/29/2018
2017-P1-M18.2.1	Integration and validation of sensor integration into inspection tools	Summary email sent to Hanford contacts and DOE HQ	7/27/2018
2017-P1-M18.2.2	Development of 6-inch crawler prototype	Summary email sent to Hanford contacts and DOE HQ	8/31/2018
2017-P1-M18.2.3	Development of 2-inch crawler conceptual design	Summary email sent to Hanford contacts and DOE HQ	9/28/2018
2017-P1-M18.2.6	UT and IR sensor integration into mini inspection tool	Summary email sent to Hanford and Savannah River contacts and DOE HQ	8/31/2018
2017-P1-M19.1.1	Complete the real-time thinning tests and evaluation of the UT sensor systems	Summary email sent to Hanford and Savannah River contacts and DOE HQ	8/10/2018

Deliverables*

Client Deliverables	Responsibility	Acceptance Criteria	Due Date
Draft Project Technical Plan	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	10/20/2017
Monthly Progress Report	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	Monthly
Quarterly Progress Reports (all tasks and projects combined)	Principal Investigator	Acknowledgement of receipt via E-mail two weeks after submission	Quarterly
Draft Year End Report (all tasks)	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	11/2/2018
Draft Test Plan for Subtask 17.3.1	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	7/20/2018
Draft Summary Report for Subtask 18.2.1	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	8/10/2018
Draft Summary Report for Subtask 18.2.6	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	9/14/2018
Draft Summary document on UT assessment for Subtask 19.1.1	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	8/24/2018
Draft Test Plan for Subtask 19.2.1	Project Manager	Acknowledgement of receipt via E-mail two weeks after submission	1/26/2018
Presentation overview to DOE HQ/Site POCs of the project progress and accomplishments (FIU Research Review)	Project Manager	Presentation to DOE HQ and Site POCs	4/6/2018**
Presentation overview to DOE HQ/Site POCs of the project progress and accomplishments (FIU Research Review)	Project Manager	Presentation to DOE HQ and Site POCs	9/28/2018**

**Final documents will be submitted to DOE within 30 days of the receipt of comments on the draft documents.*

***Completion of this deliverable depends on availability of DOE-HQ official(s.)*

COMMUNICATION PLAN, ISSUES, REGULATORY POLICES AND HEALTH AND SAFETY

Communication Plan

The communication with the research collaborators and other stakeholders at the DOE sites, national laboratories, and DOE HQ is a critical component of the project. The mode of communication will be e-mails, telephone/conference call, and meetings at the site. Though site-specific contact persons have been identified, constant communication will be maintained with client stakeholders at DOE HQ and the DOE sites to ensure all parties involved are aware of the project progress.

Information Item	Client Stakeholder	When?	Communication Method	Responsible Stakeholder
Status Update Teleconferences	DOE EM WRPS, SRNL, PNNL	Monthly	Phone	Project Manager
EM-HQ Status Update Phone Call	DOE EM Liaison to FIU	Bi-Weekly	Phone	Principal Investigator
Quarterly Report	DOE EM WRPS, SRNL, PNNL	End of Q1, Q2, Q3,Q4	E-mail	Principal Investigator
Annual Year End Report	DOE EM WRPS, SRNL, PNNL	45 days after completion of performance period	E-mail	Principal Investigator/ Project Manager
Deliverables/ Milestones	DOE EM WRPS, SRNL, PNNL	At completion of deliverable/ milestone	E-mail	Project Manager
Coordination of project activities	DOE EM, WRPS, SRNL, PNNL	As needed to discuss issues and reach consensus	Phone, E-mails	Project Manager

Anticipated Issues

Every year, South Florida has a 6-month hurricane season. Twice in the past decade FIU has been closed 1-2 weeks due to hurricane storm damage. Care will be taken to minimize the impacts on the overall schedule of milestones and deliverables due to hurricanes.

Project 1 tasks are supported by DOE Fellows and FIU graduate students. It is anticipated that 8 to 10 DOE Fellows and FIU graduate students will be supporting this project during FIU Performance Year 8. It is anticipated that research under this project may be used by students as the basis for a thesis or dissertation towards a graduate degree and would be impacted by a re-direction of the project task scope. FIU will communicate closely with DOE HQ and site contacts throughout the performance of the research tasks in order to accurately forecast the duration of the research tasks and minimize the potential negative impact of scope redirection on the graduate studies of any students working on that task.

Regulatory Policies and Health and Safety

Since laboratory experiments will be conducted on this project, FIU will ensure test plans are developed and reviewed that cover staff health and safety issues. The nature of waste simulants is that they are chemically the same as HLW and therefore highly caustic and hence hazardous. In addition, FIU will set up, operate, and dismantle experimental test beds using proper procedures from FIU and that comply with standards issued by the Occupational Safety and Health Administration (OSHA). In order to minimize hazards, individuals will require documentation of all needed online and classroom health and safety training prior to their being authorized to work in the lab, on equipment, or on the test beds. Further, mandatory training is provided to these individuals on workplace safety multiple times:

- Safety training at the time of initial assignment.
- Safety training prior to assignment involving new exposure situation (e.g., new equipment or technology).

No undergraduate student will perform research in a lab without direct oversight of faculty, staff, or a qualified graduate student.

The Department of Health and Safety at FIU also provides other training relevant to specific tasks or subtasks. Either FIU EHS or FIU ARC may request an audit by FIU EHS of safety documentation, lab set up and procedures when there are any concerns by any staff working on the task.