

Liquid Waste Operations Initiatives in Performance Assessment Evolution – 14469

Mark Layton, Savannah River Remediation, LLC
Building 705-1C, Aiken, SC 29808

ABSTRACT

The F-Area Tank Farm (FTF), H-Area Tank Farm (HTF) and Saltstone Disposal Facility (SDF) are owned by the U.S. Department of Energy (DOE) and operated by Savannah River Remediation LLC (SRR), the Liquid Waste Operations (LWO) contractor at DOE's Savannah River Site (SRS). Performance Assessments (PA) have been prepared to support the eventual closure of these LWO Facilities. The PAs provide the technical bases and results to be used in subsequent documents to demonstrate compliance with the pertinent requirements identified for final closure of the LWO Facilities. PAs have been prepared and approved for SDF, FTF and HTF; however activities associated with PA advancement have continued.

The LWO Facility PAs are performance-based, risk-informed analyses of the fate and transport of residual material inventories following final closure. The PAs are living documents that will progress and improve over time as more information is obtained. Since the PAs rely heavily on forward looking analyses, some amount of uncertainty will always be present, but that uncertainty can be diminished as PAs evolve. In order to most effectively minimize uncertainty, it is imperative that work geared toward PA improvement be collaborative and focused on those areas of greatest uncertainty.

SRR has multiple initiatives in place working towards not only improving the PAs, but ensuring that improvements can be utilized across multiple facilities (i.e., HTF, FTF, SDF) as much as possible. These initiatives include:

- PA Maintenance Plans - As required by DOE Manual 435.1-1, maintenance of the LWO PAs will include future updates to incorporate new information (including research & development), update modeling codes, analysis of actual residual inventories, etc., as appropriate. Formal PA Maintenance Plans and annual PA reviews ensure maintenance efforts are concentrated on reducing uncertainty.
- Unreviewed Waste Management Question (UWMQ) Program – The UWMQ Program provides a rigorous process for incorporating facility changes and new data into the PA knowledge base.
- Special Analysis Preparation - Special Analyses supplement the PAs by utilizing new information (e.g., tank-specific inventories) to update the PA fate and transport modeling and evaluate the potential impact of new information on PA assumptions. The Special Analyses can include sensitivity and uncertainty analyses specifically targeting new information.
- PA Monitoring Activities – Monitoring activities take place periodically to validate PA inputs and to better understand variability around those inputs. Dedicated procedures, documented monitoring plans and proceduralized inspections support these activities.
- Regulator/Stakeholder Interactions and Reviews – Regulator/Stakeholder meetings and document reviews provide feedback on the PAs and identify areas of interest and/or concern.

These initiatives are a necessary part of the PAs evolving over time and provide confidence that decisions based on the PAs remain valid.

INTRODUCTION

The FTF, HTF, and SDF are owned by the U.S. DOE and operated by SRR, the LWO contractor at DOE's SRS. The FTF and HTF are active radioactive waste storage and treatment facilities consisting of 51 carbon steel waste tanks and ancillary equipment such as transfer lines, evaporators and pump tanks. Operational closure of waste tanks through cleaning then grouting is ongoing at the Tank Farms. The SDF is part of the Saltstone Facility, which consists of two facility segments (the other segment is the Saltstone Production Facility, which receives and treats salt solution to produce saltstone). Saltstone is a non-hazardous cementitious waste form made by mixing decontaminated salt solution from the Tank Farms with a dry mix containing blast furnace slag, fly ash, and cement. The SDF consists of existing disposal units and will include future disposal cells which will be constructed as needed. PAs have been prepared to inform current operations and to support the eventual closure of these LWO Facilities. The PAs provide the technical bases and results to be used in subsequent documents to demonstrate compliance with the pertinent requirements identified for final closure of the LWO Facilities. PAs have been prepared and approved for SDF [1], FTF [2] and HTF [3]; however activities associated with PA advancement continue.

The LWO Facility PAs are performance-based, risk-informed analyses of the fate and transport of residual material inventories following final closure. DOE, through DOE Manual 435.1-1 [4] and associated guidance, requires the on-going maintenance of all PAs. The PAs are living documents that will progress and improve over time as more information is obtained. SRR has multiple initiatives in place working towards not only maintaining and improving the PAs, but ensuring that PA initiatives can be utilized across multiple facilities (i.e., HTF, FTF, SDF) as much as possible. It is important to note that the PA improvement programs are working in a defined regulatory framework, with various regulatory drivers playing a part in shaping the PA initiatives. These regulatory drivers include DOE Order 435.1 [5], the Federal Facility Agreement [6], State-issued permits, and Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 [7].

Because the PAs rely heavily on forward looking analyses, some amount of uncertainty will always be present, but that uncertainty can be diminished as PAs evolve. SRR LWO initiatives are in place to continue to reduce uncertainty in the inputs and assumptions, providing greater confidence in the results of the analyses and in the long-term plans for public and environmental protection. Additionally, a disciplined process to address potential changes in disposal and/or closure operations (e.g., change in disposal/closure unit design, new residual material characterization) is needed to ensure that proposed changes do not adversely affect conclusions reached using PA results. In order to most effectively minimize uncertainty, it is imperative that work geared toward PA improvement be collaborative and focused on those areas of greatest uncertainty. The SRR LWO Facilities have processes in place to support PA improvement and maintenance. The purpose of the programs is to confirm the continued adequacy of a PA and to increase confidence in the results of the PA.

Some of the key elements of the PA initiatives include 1) PA Maintenance Plans, 2) a UWMQ Program, 3) Special Analyses, 4) PA Monitoring Activities, and 5) Regulator/Stakeholder Interactions and Reviews.

DISCUSSION OF PA IMPROVEMENT INITIATIVES

PA Maintenance Plan

PA maintenance activities are required by DOE M 435.1-1 Chapter IV.P(4) *“to evaluate changes that could affect the performance, design, and operating bases for the facility. Performance assessment and composite analysis maintenance shall include the conduct of research, field*

studies, and monitoring needed to address uncertainties or gaps in existing data.” PA Maintenance includes future updates to incorporate new information (including R&D), updates to modeling codes, analysis of actual residual inventories, etc., as appropriate. Formal PA Maintenance Plans and annual PA reviews ensure maintenance efforts are concentrated on removing uncertainty.

The PA Maintenance Plan is prepared and updated annually and submitted to the DOE. The preparation and execution of the plan is consistent with the *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analysis* [8] as reflected in DOE Manual 435.1-1. The Liquid Waste Facilities PA Maintenance Plan [9] includes activities for FTF PA, HTF PA, and the SDF PA and is coordinated with the SRS Composite Analysis [10]. Future work items identified in PAs were incorporated in the plan, and each annual update to the plan incorporates the maintenance plan results to date and adjusted research items to continue to reduce model parameter uncertainty

The PA Maintenance Plan details the individual tasks planned to improve the PAs, and include activities such as research and development, comment resolution, future work resolution, and PA revisions. Provided below are examples of specific activities included within the current PA Maintenance Plan:

- Technetium Sorption Testing - Testing under this effort focused on the K_d of technetium in saltstone to support reduction of uncertainty or unnecessary conservatism in the SDF PA with respect to technetium sorption values and distributions assumed in the PA. Testing involved the examination of Tc-99 sorption onto cementitious materials with varying slag content. Pacific Northwest National Laboratory performed a column study where the waste form material was placed in a column and pore water simulant was passed through the waste matrix, and properties of interest were measured in the exiting fluid. The testing results showed that technetium release from reducing saltstone should be modeled as a solubility release model versus a sorption model.
- FTF Probabilistic Modeling improvements – Two different fate and transport models are used in the FTF PA. Benchmarking of the two models (for selected conditions) was performed to ensure the models are performing as expected and to document a degree of agreement between the models. The term “benchmarking” was chosen, rather than “calibration”, since this process establishes a point from which comparisons can be made rather than attempting to ensure that all results for the two models are identical for all configurations. During PA development, the need to improve the documentation of the benchmarking process to facilitate better understanding of the process was identified. The PA Maintenance Plan captured the need to apply a more methodical and systematic approach to the benchmarking process in future PA updates.
- PA revisions – The PA maintenance plan documents that the PAs will be revised when warranted, and the future PA revisions will consider the following items at a minimum: 1) analyses and results contained in all Special Analyses that have been completed to date, 2) analyses and results of all UWMQ evaluations (UWMQEs) completed to date, 3) changes in site future land use plans or closure plans, and 4) changes to PA guidance documents requirements. Future PA revisions will also consider regulator/stakeholder feedback (e.g., DOE technical review open items, regulator comments, Nuclear Regulatory Commission recommendations).

Having the PA Maintenance Plan in place ensures that PA improvement initiatives are pre-planned and documented.

Unreviewed Waste Management Question (UWMQ) Program

The SRR LWO Facilities have put a UWMQ Program in place to meet the requirements of DOE Manual 435.1-1 regarding PA change control. The UWMQ Program provides a rigorous process for incorporating facility changes and new data into the PA knowledge base and has been implemented through LWO procedures. The intent of the UWMQ process is to ensure that proposed activities or new data at SRS (e.g., waste streams, radionuclide inventories, facility design and operations) are reviewed to ensure that the inputs, assumptions, results, and conclusions of the DOE-approved PA and other relevant documents (e.g., the Section 3116 Waste Determination (WD), the SRS CA) remain valid.

The UWMQ process uses a graded approach to determine whether proposed activities or new data impact assumptions used in the existing performance envelope as defined by the PA, Special Analyses, CA and WD. Depending on scope of the activity addressed, some UWMQEs lead to Special Analyses (discussed in detail later).

Provided below are examples of specific activities that have been resolved through the UWMQ program:

- Evaluation of higher than expected water to cement ratio in tank grout - New information was discovered regarding the bulk fill grout that was used in an SRS waste tank. Some of the bulk fill grout had a slightly higher than expected water to cement ratio. While tank grout meeting the expected water to cement ratio will inherently meet the FTF PA assumptions, the fact that the water to cement ratio was slightly high does not necessarily lead to the grout not meeting the FTF PA assumptions, since the PA assumptions revolve around the final cured grout properties, not around the grout testing methods. A UWMQE was performed that showed the grout used in this waste tank met all of the PA inputs and assumptions even with a slightly higher than expected water to cement ratio.
- Evaluating the impact of cooling coil flushing - The proposed activity evaluated was the potential for chromium addition to two SRS waste tanks due to cooling coil flushing in preparation for tank closure. This proposed activity (cooling coil flushing) has the potential to cause coils to fail and introduce a limited amount of water containing chromate into the tank. The tank cooling coils are not a critical design feature in the closure documentation and the PA does not make any assumptions regarding cooling coil integrity. The quantity of chromium that could be introduced into the tank volume was evaluated in a bounding calculation which assumed all cooling coils failed and was shown to be insignificant (i.e., the bounding additional quantity of chromium would still not result in a significant release of chromium from the waste tank).

Having the UWMQ Program in place ensures that proposed activities and new data changes are evaluated to assess the potential impact on the PA inputs and assumptions in a rigorous and systematic manner.

Special Analysis Preparation

The *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses* [8] recognizes that PAs are not static documents, and states that, "Special analyses are expected to be needed as part of the routine maintenance of the PA." As described in the Maintenance Guide, "special analyses are analyses performed to evaluate the significance of new information or new analytical methods to the results of the PA, or to supplement or amend the analyses performed in the original PA. A special analysis is not the same as a revision to the performance assessment, but the results of the special analysis may be used to determine whether a PA revision is needed." As stated in

the Maintenance Guide, a number of different factors may prompt a special analysis, including “wastes that exceed the concentrations analyzed for performance assessment-significant radionuclides.”

Per the Maintenance Guide, “the purpose of conducting special analyses can be thought of as similar to the process for resolving unreviewed safety questions described in the DOE Order 5480.21, *Unreviewed Safety Questions*. The intent of the process is to provide flexibility in day-to-day operations and to require those issues with a significant impact on the PA’s conclusions, and therefore the projected compliance with performance objectives, to be brought to the proper level for attention.”

Special Analyses supplement the PAs by utilizing new information (e.g., tank specific inventories) to update the PA fate and transport modeling and evaluate the potential impact of new information on PA assumptions. The Special Analyses can include sensitivity and uncertainty analyses specifically targeting new information. The ultimate goal of the Special Analyses is to evaluate the significance of a proposed activity or new data to the inputs, assumptions, results, and conclusions of the PA, potentially through supplements or amendments to the analyses performed in the PAs. Special Analyses are expected to be part of the routine maintenance of the PA.

For example, an FTF Special Analysis was prepared to evaluate the final residual inventories that were to be grouted in-place in two FTF Waste Tanks [11]. The new inventory information was used to update the FTF fate and transport modeling performed as part of the FTF PA. The potential impact of the new inventory information on FTF PA assumptions was also considered, with focus on the impact of the final residual waste data for these two waste tanks on the information presented in the FTF PA. In addition to updating applicable results from the PA, additional sensitivity analyses were also performed as part of this Special Analysis. Information previously provided in the FTF PA that was unaffected by the new residual waste data was not duplicated in this Special Analysis. The Special Analysis results were used to inform decisions regarding waste tank closure documents.

Having the Special Analyses process in place ensures that changes to the PA inputs and assumptions are evaluated and managed in a rigorous and systematic manner.

PA Monitoring Activities

PA Monitoring activities take place periodically to validate PA inputs and to better understand variability around those inputs. Documented PA Monitoring Plans, as applicable, and proceduralized inspections support these activities.

Provided below are examples of specific activities that are performed as part of PA Monitoring:

- Monitoring tank grouting – Tank grout activities associated with the furnishing and delivery of tank closure grout are monitored per the grout specification to ensure PA assumptions and inputs are maintained. Monitoring activities include such things as video monitoring of in-tank grout placement and receipt inspection and testing of delivered grout.
- Tank inspections/walk downs to review configuration management - Visual inspection of the area surrounding select waste tanks was conducted. Inspection was carried out after grout stabilization to identify any deficiencies that might indicate PA assumptions regarding tank performance are not being met (e.g., significant tank top cracking, significant tank top settlement).

- Groundwater monitoring - Historically, groundwater monitoring has been performed in accordance with the current SRS programs that have been conducted inside and around the LWO Facilities since the 1970's. The groundwater monitoring samples results are reported annually and these results are evaluated to see if the results conform to the PA models regarding contaminant release.

Ongoing PA Monitoring ensures that activities associated with PA inputs and assumptions are evaluated and managed in a rigorous and systematic manner.

Regulator/Stakeholder Interactions and Reviews

Another important element of PA improvement is regulator/stakeholder interactions and reviews. Regulator/stakeholder meetings and document reviews provide feedback on the PAs and identify areas of interest and/or concern. The set of regulators/stakeholders that have reviewed and provided input on the PAs include the South Carolina Department of Health and Environmental Control, United States Environmental Protection Agency, United States Nuclear Regulatory Commission, Citizens Advisory Board, and the general public. Clear, open and frequent communications with the regulators and stakeholders are critical to success. The PA results and approaches need to be presented in a manner that allows for common understanding by all parties.

Provided below are examples of specific activities that are performed as part of regulator/stakeholder interactions and reviews:

- Meetings on PA Technical Scope - PA scoping meetings were held with various regulators/stakeholders to promote collaboration during development of the PAs. For example, prior to submittal of the Draft HTF 3116 Basis Document [12], DOE interacted with the NRC beginning in 2010 in development of the HTF PA. The interactions included extensive discussion (i.e., scoping meetings) between DOE and NRC on the fundamental technical bases, approaches, and key parameter values prior to development of the HTF PA.
- Meetings on the Scope of Review - Meetings were held with regulators/stakeholders to develop, define and document the scope of reviews and consultation. Better understanding of the overall process allowed for exploration of methods to shorten the review and consultation cycles without compromising safety or agency independence.
- Public Information Meetings - Public meetings are held to ensure regulators/stakeholders understand PAs and to facilitate feedback. To support the NRC consultative role, after issuance of the Draft HTF 3116 Basis Document [12], NRC and DOE engaged in a series of technical exchanges and public meetings to clarify the approaches and rationales documented in the Draft HTF 3116 Basis Document and HTF PA. These clarifications were intended to provide NRC staff an improved understanding of the approaches and supporting technical bases developed by DOE. On August 29, 2013, NRC and DOE held a joint public meeting in Aiken, South Carolina to discuss and clarify the intent of the NRC comments and requests for additional information.
- Public Document Reviews – The PA documents are made available to the regulators/stakeholders to better facilitate feedback on the documents. The document feedback is tracked and addressed as part of PA maintenance.

Regulator/stakeholder interactions and reviews ensure that feedback regarding the PA is generated and evaluated to support of PA improvements.

CONCLUSIONS

SRR has multiple initiatives in place working towards not only improving the PAs, but ensuring that improvements can be leveraged across multiple facilities (i.e., HTF, FTF, SDF) as much as possible. The key PA improvement initiatives include 1) PA Maintenance Plans, 2) a UWMQ Program, 3) Special Analyses, 4) PA Monitoring Activities, and 5) Stakeholder Interactions and Reviews. These programs are a necessary part of the PAs evolving over time and provide confidence that decisions based on the PAs remain valid. The programs cover different areas so that PA improvements are addressed over different development stages, from planning (Maintenance Plans) to enhancement (UWMQEs and Special Analyses) to monitoring (PA Monitoring) to feedback (Stakeholder Interactions and Reviews).

REFERENCES

1. SRR-CWDA-2009-00017, *Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site*, Savannah River Site, Aiken, SC, Rev. 0, October 29, 2009.
2. SRS-REG-2007-00002, *Performance Assessment for F-Tank Farm at the Savannah River Site* Savannah River Site, Aiken, SC, Rev. 1, March 31, 2010.
3. SRR-CWDA-2010-00128, *Performance Assessment for the H-Area Tank Farm at the Savannah River Site*, Savannah River Site, Aiken, SC Rev. 1, November 2012.
4. DOE M 435.1-1, Chg. 1, *Radioactive Waste Management Manual*, U.S. Department of Energy, Washington DC, June 19, 2001.
5. DOE O 435.1, Chg. 1, *Radioactive Waste Management*, U.S. Department of Energy, Washington DC, August 28, 2001.
6. WSRC-OS-94-42, *Federal Facility Agreement for the Savannah River Site*, Savannah River Site, Aiken, SC, August 16, 1993.
7. NDAA_3116, *Public Law 108-375, Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Section 3116, Defense Site Acceleration Completion*, October 28, 2004.
8. DOE_11-10-1999, *Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses*, U.S. Department of Energy, Washington DC, November 10, 1999.
9. SRR-CWDA-2013-00049, *Savannah River Site Liquid Waste Facilities Performance Assessment Maintenance Program, FY2013 Implementation Plan*, Savannah River Site, Aiken, SC, Rev. 1, May, 2013.
10. SRNL-STI-2009-00512, *Savannah River Site DOE 435.1 Composite Analysis*, Volumes I and II, Savannah River Site, Aiken, SC, Rev. 0, June 10, 2010.
11. SRR-CWDA-2010-00124, *Tank 18/Tank 19 Special Analysis for the Performance Assessment for the F-Area Tank Farm at the Savannah River Site*, Savannah River Site, Aiken, SC, Rev. 0, February 2012.
12. DOE/SRS-WD-2013-001, *Draft Basis Document for Section 3116 Determination for H-Tank Farm at the Savannah River Site*, Savannah River Site, Aiken SC, Rev. 0, February 6, 2013.