NRC Staff Comments on: "Industrial Wastewater Closure Module for the Liquid Waste Tank 12H H-Area Tank Farm, Savannah River Site," SRR-CWDA-2014-00086, Revision 0, May 2015.

Introduction

NRC staff offers the following public comments on the Tank 12H Closure Module, "Industrial Wastewater Closure Module for the Liquid Waste Tank 12H H-Area Tank Farm, Savannah River Site" (SRR-CWDA-2014-00086, Rev. 0) to the South Carolina Department of Health and Environmental Control (SCDHEC) to provide insight regarding aspects of tank cleaning, waste sampling, and characterization of residual contaminants that will be important to NRC staff in its role of monitoring the U.S. Department of Energy's (DOE) ability to comply with the performance objectives of 10 CFR Part 61, in particular, the As Low As Reasonably Achievable (ALARA) aspect of 10 CFR 61.41.

General Comments

1. In comments on the Tank 5F and 6F Closure Module (ML13081A051)[1], NRC staff stated that DOE should consider analyzing tank waste samples prior to chemical sludge removal to enable a more thorough and accurate analysis of Highly Radioactive Radionuclide (HRR) removal. NRC staff reiterated these comments in its "Technical Evaluation Report for the H-Area Tank Farm Facility, Savannah River Site, South Carolina", hereafter referred to as the H-Area Tank Farm (HTF) Technical Evaluation Report (ML14094A496), recommending that DOE consider obtaining data on HRR inventories to provide effectiveness measurements. While many of the Tank 12H cleaning campaigns occurred prior to the release of the NRC staff comments on the Tanks 5F and 6F Closure Module and NRC staff's issuance of the HTF Technical Evaluation Report, NRC staff continues to encourage DOE to consider obtaining HRR inventories more frequently during removal activities to better understand the effectiveness of cleaning activities.

2. NRC staff recognizes the challenges associated with the waste removal process in light of the complex infrastructure and variable waste characteristics associated with Type I tanks such as Tank 12H. Cleaning campaigns are iterative in nature with subsequent campaigns building on the existing knowledge base and previous lessons learned that are reflected in technology advancements and optimization of operational parameters over time. Previously, NRC staff commented on the Tanks 5F and 6F closure module at the F-Area Tank Farm (FTF). Tanks 5F and 6F, like Tank 12H. are also Type I tanks. It is apparent from NRC staff's review that there were numerous lessons learned from the Tanks 5F and 6F waste removal process that have been incorporated to improve the efficiency and effectiveness of the Tank 12H waste removal process(see discussion in Section 3.7.2.2 of the NRC staff's HTF Technical Evaluation Report [ML14094A496]). Nonetheless, there are additional lessons learned that can be gleaned from the Tank 12H waste removal process that would likely improve the efficiency and effectiveness of future tank cleaning campaigns at the tank farm facilities. For instance, rheological studies of the Tank 12H sludge during the initial mechanical sludge removal phase helped to improve the understanding of Tank 12H sludge characteristics and, after adjusting the mixing strategy, greatly improved the

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[1] The NRC staff's comments on the Tanks 5F and 6F Closure Module are available at Accession No. ML13081A051 in the NRC's Agencywide Document Access and Management System (ADAMS). ADAMS can be found on the internet at http://www.nrc.gov/reading-rm/adams.html

efficiency of mechanical sludge removal. Similarly, DOE has identified improvements to be considered in future oxalic acid cleaning campaigns based on the experience gained cleaning Tank 12H (X-ESR-H-00599).

3. As discussed in NRC staff's HTF Technical Evaluation Report (ML14094A496), DOE should continue to evaluate new and emerging technologies that may improve waste removal efforts in the future.

4. DOE should provide a more comprehensive discussion of the potential risks associated with residual waste remaining in Tank 12H at the time of closure than presented in the Tank 12H Closure Module to better assess whether reasonable effort is made to maintain releases of radioactivity in effluents to the geneal environment ALARA. Several examples of how DOE could improve its discussion of the risks associated with residual Tank 12H waste are provided in the detailed comments.

5. NRC staff will evaluate the arguments presented in the Tank 12H Closure Module and the forthcoming addendum that will include final characterization of the residual waste with respect to the costs and benefits of additional radionuclide removal within the context of the Special Analysis and other documentation to determine the extent to which closure of Tank 12H is consistent with ALARA aspects of 10 CFR 61.41 as discussed in NRC staff's FTF Monitoring Plan (ML12345A322), Monitoring Factor 1.5.[2]

<u>Detailed Comments</u>

1. In the NRC staff's HTF Technical Evaluation Report (ML14094A496), NRC staff recommended that DOE perform tank mapping consistently and as frequently as practical throughout the cleaning process. NRC staff note that DOE performed mapping for Tank 12H during or following each major use of a removal technology[3] including MSR-I[4] and MSR-II[5], CSR-I[6], MSR-III[7], and CSR-II[8]. Although DOE did not perform mapping after each

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[2] The FTF Tank Farm Monitoring Plan (ML12345A322) is currently being updated to include HTF.
[3] Sludge removal was achieved through a series of campaigns using technologies categorized as either mechanical sludge removal (MSR) or chemical sludge removal (CSR). During bulk sludge removal, DOE conducted 10 campaigns of mechanical sludge removal (referred to collectively as MSR-I in the Tank 12H Closure Module). After bulk sludge removal, DOE performed several campaigns to remove the remaining heel of sludge using both mechanical and chemical sludge removal technologies. Specifically, DOE conducted two campaigns of mechanical sludge removal (referred to collectively as MSR-II in the Tank 12H Closure Module) followed by a single campaign of Low Temperature Aluminum Dissolution or LTAD (referred to as CSR-I in the Tank 12H Closure Module), five campaigns of another mechanical sludge removal (referred to collectively as MSR-III in the Tank 12H Closure Module), and three campaigns of bulk oxalic acid cleaning (referred to collectively as CSR-II in the Tank 12H Closure Module).
[4] Sludge mapping was performed after Campaign 4 and again after Campaign 10, the final campaign of MSR-I.
[5] Sludge mapping was performed after Campaign 2, the final campaign of MSR-II.
[6] CSR-I consisted of a single campaign, after which sludge mapping was conducted.
[7] Sludge mapping was performed after Campaign 4 of MSR-III. DOE indicates in the Tank 12H Closure Module that tank inspections after Campaign 5 indicated little or no change in sludge distribution and volume. Therefore, a formal tank mapping was not conducted.
[8] Sludge mapping was performed after Campaign 3, the final campaign of CSR-II.

individual cleaning campaign, more frequent mapping likely would not have greatly improved DOE's understanding of the effectiveness of the removal technologies used in Tank 12H.

2. NRC staff found in the HTF Technical Evaluation Report (ML14094A496) that DOE could still improve the standardization of metrics for determining that the anticipated end states have been reached. It is not clear from the Tank 12H Closure Module that DOE establishes an anticipated end state of what is practical for cleaning of Tank 12H *in toto* or removal goals for many of the major uses of removal technologies, instead relying on judgments regarding the level of diminishing effectiveness that appear *ad hoc* for removal technologies without anticipated removal goals. NRC staff note that DOE documented its anticipated removal goals for CSR-II (Bulk Oxalic Acid Cleaning) in the Tank 12H Bulk Oxalic Acid Cleaning Flowsheet (X-CLC-H-00896). However, the Tank 12H Closure Module provided little documentation of anticipated removal goals for other cleaning technologies. Future tank cleanings could benefit from clear documentation of anticipated end states and removal goals for removal technologies that includes a basis for the end state or removal goal and anticipated risks associated with achieving the end state or removal goal. Future closure modules could then describe whether the anticipated end states and removal goals were achieved and a rationale documenting why the anticipated end states and removal goals that were not actually achieved may not have been practical in reality given tank-specific conditions. A demonstration of this sort would enhance confidence that waste has been removed to the maximum extent practical.

3. Which tanks are expected to have waste similar to waste in Tank 12H (i.e., high aluminum content waste)? SRR-STI-2012-00022 indicates that Tanks 11H and 15H have the same type of waste as Tank 12H and that Low-Temperature Aluminum Dissolution (LTAD) is being planned for the heel removal phases for Tanks 11H and 15H. Does DOE plan to treat Tanks 11H and 15H with LTAD and is DOE considering this technology for other tanks?

4. The purpose and effectiveness of LTAD in waste retrieval operations is not clear to NRC staff (i.e., bulk solids removal, removal of HRRs, or beneficial changes to waste rheology). Page 40 of the Tank 12H Closure Module indicates that 60 percent of the solids volume was reduced but does not indicate the percentage of HRRs removed. It is not clear to NRC staff if data were collected to determine the effectiveness of LTAD on HRR removal from Tank 12H. SRNL-STI-2009-00180, Rev. 0, indicates that 60 percent of the aluminum and 20 percent of the plutonium dissolved following caustic addition during testing. It appears to NRC staff that aluminum and not necessarily HRRs are preferentially removed via LTAD. The message on the benefits of LTAD with respect to removal of HRRs is, therefore, not clear to NRC staff. Page 42 of the Tank 12H Closure Module indicates the potential for beneficial changes in waste rheology with respect to removal of waste; however, it is not clear if follow-up testing was conducted as recommended in SRNL-STI-2009-00180, Rev. 0, which indicates that yield stress of the remaining sludge after washing and decanting may be similar to yield stress before LTAD (i.e., yield stress is simply a function of solids content).

5. The Tank 12H Closure Module does not clearly describe how DOE determined when to cease LTAD. SRNL-STI-2012-00022 provides data of liquid aluminum concentrations in Table II. DOE states that the liquid aluminum concentrations presented in Table II of SRNL-STI-2012-00022, indicate a declining rate of reaction. If one plots the change in

aluminum concentration data from Table II over time, an initial rapid decrease in the rate of change occurs within the first approximately 10 to 20 days, however, thereafter, the data are not as clear whether the rate of change continues to decline over the remaining timeframe covered by data in Table II. Also, it is not clear to NRC staff how DOE determined that 60-percent removal of aluminum was adequate. DOE, in SRNL-STI-2012-00022, states that tests conducted on a 3-L sample demonstrated 60-percent removal of aluminum after 26 days at 60°C (SRNL-STI-2009-00180, Rev. 0), while a large batch test on Tank 12H waste demonstrated approximately 72-percent removal of aluminum over an eight week period at 70 °C (SRR-LWP-2010-00005). Similarly, the Sludge Batch 6 Aluminum Dissolution Flowsheet (SRNL-STI-2008-00389, Rev. 0) identifies other aluminum dissolution demonstrations and states that dissolution can range from 44- to more than 80-percent in four weeks. DOE should improve the Tank 12H Closure Module by clearly explaining the rationale for ceasing LTAD and that 60-percent of aluminum dissolution was adequate.

6. In SRR-CWDA-2013-00125, DOE states that preliminary mapping indicates the residual volume consistent with what was predicted. After Bulk Oxalic Acid Cleaning, DOE estimates that there are < 2,000 gallons remaining and about 50 volume-percent removal was achieved for the chemical removal activity. However, anticipated removal goals from the Tank 12H Bulk Oxalic Acid Cleaning Flowsheet in Chemical Sludge Removal-II were estimated to be between 630 and 1,030 gallons of sludge remaining or about 76 to 86 volume-percent removal (X-CLC-H-00896). Given the apparent differences between the anticipated and reported removal goals for Bulk Oxalic Acid Cleaning, DOE's rationale for stating the anticipated removal goal is consistent with the anticipated removal goal is not clear. Further DOE states that the Tank 12H Bulk Oxalic Acid Cleaning Flowsheet evaluated the potential benefit of additional campaigns, beyond three, but determined that waste removal was expected to be minimal and a potential existed to precipitate oxalates, which would add to the residual volume. It is not clear to NRC staff how DOE arrived at its conclusion regarding a fourth campaign of oxalic acid cleaning.

7. Page 35 of the Tank 12H Closure Module states, "The plan was to replace slurry pumps (SLPs) in Tank 12H with submersible mixing pumps (SMPs), the previously identified technology for heel removal in Tank 12H, in mid-2011." It is not clear to NRC staff why SMPs were selected as the preferred technology over SLPs, and what advantage SMPs have over SLPs for each stage of waste retrieval. SLPs appeared to have been effective at removing residual waste from Tank 12H. DOE could perform an evaluation comparing various sluicing and waste transfer technologies for recently cleaned tanks to support future decisions regarding the selected technologies for different tank and waste types.

8. Several equipment failures are cited in the Tank 12H Closure Module. It is not clear what measures or programs are in place to reduce the likelihood of equipment failures and what contingencies exist to minimize the impacts of these equipment failures; and how the equipment failures impact the success of overall waste retrieval operations for the tank farms. Additional information on mitigative measures in place to address equipment failures would be useful.

9. Page 53 of the Tank 12H Closure Module indicates that the top of cooling coils had accumulated residual waste that would remain at the time of closure. It is not clear to NRC

staff what effort was taken to remove waste from the top of the cooling coils in Tank 12H and how recalcitrant this waste is to additional removal (e.g., Tanks 5F and 6F walls and cooling coils were washed with oxalic acid).

10. Page 46 of the Tank 12H Closure Module discusses newly identified nuclear safety concerns including hydrogen generation and corrosion of tanks during bulk oxalic acid cleaning (BOAC). How will modifications made to BOAC flow sheets, procedures, and equipment impact the efficacy of this treatment technology for the various waste streams and tanks in future cleaning campaigns?

11. Page 80 of SRR-CWDA-2013-00125, Rev. 0, "Proposal to Cease Waste Removal Activities in Tank 12 and Enter Sampling and Analysis Phase," indicates that HTF has more nuclear safety concerns. The documentation could better explain these challenges for HTF (e.g., enhanced corrosion potential).

12. The Tank 12H Closure Module and SRR-CWDA-2013-00125, Rev. 0, "Proposal to Cease Waste Removal Activities in Tank 12 and Enter Sampling and Analysis Phase" do not appear to discuss uncertainty in the conceptual model used to assess impacts from the residual waste. DOE compares results from the Tank 16H Special Analysis Base Case modeling and states on page 72 of the Tank 12H Closure Module that this represents the best estimate or most probable and defensible scenario for modeling. NRC staff documented a number of concerns and questions regarding the modeling done for the HTF Performance Assessment (SRR-CWDA-2010-00128, Rev. 1) in its HTF Technical Evaluation Report (ML14094A496). NRC staff is also currently reviewing the Tank 16H Special Analysis. Given the location of residual waste (i.e., along the primary liner wall near the location beneath the valve house and coatings on cooling coils, it is not clear to NRC staff whether the conceptual model used the base case to support the determination that waste retrieval can cease is the appropriate best estimate or most probable and defensible scenario.

13. The Tank 12H Closure Module and SRR-CWDA-2013-00125, Rev. 0, "Proposal to Cease Waste Removal Activities in Tank 12 and Enter Sampling and Analysis Phase" do not appear to discuss inadvertent intruder doses. For example, page 121 of SRR-CWDA-2013-00125, Rev. 0, indicates that Tank 12H is not a significant contributor to the peak dose in HTF. This conclusion does not appear to be true for the inadvertent intruder. A well near Tank 12H had the highest overall inadvertent intruder doses. The probabilistic analysis indicates an exceedance of the performance objective within the 10,000 year compliance period. Additionally, Figure 7.1-15 in SRR-CWDA-2010-00093, Rev. 1, shows that the inadvertent intruder peak dose for Tank 12H in DOE's PORFLOW and GoldSim models differ primarily with respect to timing and not the magnitude of peak dose. DOE should provide a more complete discussion regarding the risk of residual waste remaining in Tank 12H at the time of closure.

14. It is not clear to NRC staff that DOE adequately considered the effect of uncertainty when assessing impacts from the residual waste remaining after cleaning. For instance, DOE states that conservative estimates of input parameters are used to develop a conservative bound for the estimate of residual waste volume coating the upper portions of the cooling coils. However, little actual data is provided in the calculation (M-CLC-H-03256) of scale

thickness and the extent of scale coverage to support the assumptions that scale thickness averages 3/16" and the extent of scale coverage is bounded by assuming half of the cooling coils above the 140" from the bottom of the tank are coated. DOE should evaluate the effect of uncertainty in both estimated scale thickness and scale coverage to assess whether 400 gallons of residual waste in the coating is conservative.

15. In the Tank 12H Closure Module, DOE describes a rationale for the number of analytes for residual materials characterization. The analytes include all the HRRs identified for the HTF. Further, DOE has indicated that characterization will be conducted in accordance with its *Liquid Waste Tank Residuals Sampling and Analysis Program Plan* (SRR-CWDA-2011-00050, Rev. 2) and *the Liquid Waste Tank Residuals Sampling – Quality Assurance Program Plan* (SRR-CWDA-2011-00117, Rev. 1). As stated in the HTF Technical Evaluation Report (ML14094A496), NRC staff finds DOE's process for determining analytes for characterization acceptable as long as DOE follows its commitment to analyze all HRRs, provides justification if the number of analytes is reduced, and conducts characterization according to a Technical Task Request and Quality Assurance and Quality Control Plan. It appears DOE will meet each of these conditions based on the description provided in the Tank 12H Closure Module.

Clarifying Comments

1. Page 36 of the Tank 12H Closure Module states that sludge slurry from Tank 12H was sent to Tank 7F. It was NRC staff's understanding that HTF waste does not go back through FTF, although FTF waste goes through HTF. Please clarify whether HTF waste cycles back through FTF and which FTF tanks have or are expected to receive HTF waste.

2. Pages 38-39 of the Tank 12H Closure Module states that the method involved adding 50 weight-percent of NaOH (sodium hydroxide) to the processing tank to establish a minimum molar ratio of three moles of free hydroxide to every mole of gibbsite, and a final free hydroxide concentration of 3 mol/L. However, WSRC-STI-2008-00366 and SRR-STI-2012-00022 suggest that boehmite rather than gibbsite dominates the aluminum compounds in the tank. Please clarify whether three moles of free hydroxide to every mole of gibbsite or boehmite was established.

3. With respect to page 74 of the Tank 12H Closure Module, could DOE clarify if the seemingly high dose from I-129 reported here is a result of use of NBS Handbook 69 and ICRP 2 methodology that MCLs are based on? The dose from all radionuclides at 100 m is an order of magnitude less in Figure 5.0-1 so it would be helpful to clarify this apparent discrepancy in the text of the closure module.