October 4, 2013

MEMORANDUM TO: Gregory Suber, Chief
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Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
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THRU: Christepher McKenney, Chief **/RA/**
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SUBJECT: TECHNICAL REVIEW OF TANKS 5 AND 6 SPECIAL ANALYSIS AT F-TANK FARM FACILITY, SAVANNAH RIVER SITE (PROJECT NO. PROJ0734)

The U.S. Nuclear Regulatory Commission (NRC) staff has performed a technical review of the Tanks 5 and 6 Special Analysis prepared by the U.S. Department of Energy (DOE) that provides updated performance assessment results using final inventory estimates following waste retrieval from Tank 5 and Tank 6 located at the F-Tank Farm at the Savannah River Site in South Carolina. This technical review report supports Monitoring Factor 1.1, "Final Inventory and Risk Estimates", as detailed in the NRC staff's plan for monitoring the F-Tank Farm (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12212A192).

As a result of the review of several DOE documents that support the Tanks 5 and 6 Special Analysis, a follow-up teleconference held with DOE on May 8, 2013, and discussions with DOE during the August 27-28, 2013, onsite observation visit, the NRC staff concludes that the Tanks 5 and 6 Special Analysis presents useful information on the potential risks associated with cleaned Tank 5 and Tank 6, as well as the larger F-Tank Farm. The NRC staff also concludes

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that additional information related to the Niobium distribution coefficient, or K_d, is needed to have reasonable assurance that DOE disposal actions at the F-Tank Farm will meet the performance objectives in 10 CFR Part 61, Subpart C. Finally, technical concerns identified in the NRC staff's review of the Tanks 18 and 19 Special Analysis (ML13100A230) are also applicable to the Tanks 5 and 6 Special Analysis and are not repeated in this Report. As detailed in the Tanks 18 and 19 Special Analysis Technical Review Report, the monitoring plan for F-Tank Farm (ML12212A192) provides a path forward for DOE to address all of the technical concerns discussed in that Report.

Enclosure: Technical Review of Special Analysis for Tanks 5 and 6 at F-Tank Farm that additional information related to the Niobium distribution coefficient, or K_d, is needed to have reasonable assurance that DOE disposal actions at the F-Tank Farm will meet the performance objectives in 10 CFR Part 61, Subpart C. Finally, technical concerns identified in the NRC staff's review of the Tanks 18 and 19 Special Analysis (ML13100A230) are also applicable to the Tanks 5 and 6 Special Analysis, and are not repeated in this Report. As detailed in the Tanks 18 and 19 Special Analysis Technical Review Report, the monitoring plan for F-Tank Farm (ML12212A192) provides a path forward for DOE to address all of the technical concerns discussed in that Report.

Enclosure: Technical Review of Special Analysis for Tanks 5 and 6 at F-Tank Farm

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Technical Review of Special Analysis for Tanks 5 and 6

Date: September 27, 2013

Reviewers:

Cynthia Barr, Senior Systems Performance Analyst, U.S. Nuclear Regulatory Commission

Primary Documents:

SRR-CWDA-2012-00106, Revision 1, “Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site”, Savannah River Remediation LLC, Closure and Waste Disposal Authority, Aiken, South Carolina, January 2013.

SRR-CWDA-2009-00045, Revision 2, “F-Tank Farm Waste Tank Closure Inventory for Use In Performance Assessment Modeling”, Savannah River Remediation, LLC, Closure and Waste Disposal Authority, Aiken, South Carolina, October 2012.

Summaries of Technical Reports:

SRR-CWDA-2012-00106, Revision 1, “Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site”, January 2013

The Tanks 5 and 6 Special Analysis updates dose estimates for the F-Tank Farm using the latest information available on F-Tank Farm inventories (i.e., final, estimated inventories for Type I Tank 5 and Tank 6, Type IV Tanks 17-20, and updated projected inventories for other F-Area Tanks). The Tanks 5 and 6 Special Analysis also includes sensitivity analysis results that consider updated waste release assumptions obtained from geochemical modeling performed following issuance of the F-Tank Farm Performance Assessment (SRS-REG-2007-00002, Revision 1). The Tanks 5 and 6 Special Analysis represents an incremental improvement over the Tanks 18 and 19 Special Analysis (SRR-CWDA-2010-00124, Revision 0). The Tanks 18 and 19 Special Analysis included the best available information at the time of preparation of that Special Analysis including updated inventories for Tanks 18 and 19, and updated Plutonium (Pu) solubility parameters. The results of the Tanks 5 and 6 Special Analysis indicate that the peak total effective dose equivalent for a member of the public is less than 0.25 mSv/yr (25 mrem/yr) considering a 10,000 year compliance period. The results also indicate that the peak dose is less than 0.25 mSv/yr (25 mrem/yr) for a composite sensitivity study (described as using more probable and defensible inputs) for a longer assessment period of 100,000 years.

The Tanks 5 and 6 Special Analysis results indicate that the relatively high overall peak dose[1] of 6 mSv/yr (600 mrem/yr) associated with Technetium(Tc)-99 presented in the F-Tank Farm Performance Assessment, Revision 1, is no longer a concern. Lower Tc-99 inventory estimates based on final sampling and analysis, and residual volume data for Tank 5 and Tank 6, following waste retrieval operations, led to a lower dose prediction for the F-Tank Farm in the

Enclosure

[1] The overall peak dose occurred beyond the 10,000 year performance period at around 26,000 years.

Tanks 5 and 6 Special Analysis as compared to the F-Tank Farm Performance Assessment, Revision 1. DOE also indicated that concerns related to Pu-239 peak dose of around 5 mSv/yr (500 mrem/yr) in the Tanks 18 and 19 Special Analysis using updated inventories for Tanks 18 and 19 and reference case[2] modeling assumptions were addressed through a sensitivity study (SRR-CWDA-2010-00124, Revision 0). However, as indicated in the NRC staff's Technical Review Reports on (i) the Tanks 18 and 19 Special Analysis (ML13100A230) and (ii) waste release documentation (ML12272A082), NRC continues to have technical concerns related to Tank 18 and Pu-239 dose projections. These technical concerns will not be repeated in this Report.

An unexpected, high inventory for Zirconium(Zr)-93 calculated from final sampling and analysis data and final volume estimates led to an unexpected, high peak dose from Niobium(Nb)-93m, daughter product of Zr-93, in the Tanks 5 and 6 Special Analysis using reference case assumptions. Due to the increased risk-significance of Nb-93m, the distribution coefficient that affects the predicted mobility of Nb-93m was revised by DOE in a composite sensitivity study presented in the Tanks 5 and 6 Special Analysis.

In addition to updates to the Tank 5 and Tank 6 inventories, adjustments were also made to projected inventories for other tanks (see Table 6.1-1 in the Tanks 5 and 6 Special Analysis, SRR-CWDA-2012-00106, Revision 1). The F-Tank Farm Closure Inventory (SRR-CWDA-2009-00045, Revision 2) contains supporting information on the updated inventories. During the May 8, 2013, teleconference, NRC staff asked DOE to clarify the adjustments to projected inventories reported in Table 6.1-1 and discussed in SRR-CWDA-2009-00045. A written response was provided by DOE during the August 27-28, 2013, onsite observation visit (SRR-CWDA-2013-00103, Revision 0). This written response provided the step-by-step methodology for inventory adjustments and example adjustments made for Technetium(Tc)-99 and Iodine(I)-129.

Results of screening for "sensitivity run" radionuclides (i.e., radionuclides that are explicitly modeled for the purpose of calculating seepline concentrations) are provided in Table 6.3-1 of the Tanks 5 and 6 Special Analysis. The decision criteria used in screening is a dose greater than 0.1 mrem/yr (1E-03 mSv/yr) at the 100 m boundary. Parent radionuclides of risk-significant radionuclides are also included. The resulting list of sensitivity run radionuclides includes: Amercium(Am)-241, Am-243, Carbon-14, Chlorine(Cl)-36, Curium(Cm)-244, Cesium-135, I-129, Nb-93m, Nb-94, Neptunium-237, Protactinium-231, Pu-238, Pu-239, Pu-240, Pu-241, Radium-226, Tc-99, Thorium(Th)-230, Uranium(U)-234, U-235, U-238, and Zr-93. This list is different from the F-Tank Farm Performance Assessment, Revision 1, sensitivity run radionuclide list, in that it does not include Th-229 and U-233 and it does include Cl-36, Nb-93m, Nb-94, Pu-241, U-238, and Zr-93.

The peak 100 m Sector E dose of almost 600 mrem/yr (6 mSv/yr) (see Figure 1) is higher than the F-Tank Farm Performance Assessment, Revision 1, and Tanks 18 and 19 Special Analysis peak doses, due to the contribution of Nb-93m dose from Type I Tanks to the overall peak dose (see Figure 2). The Pu-239 dose that represents the majority of the overall peak dose is associated with Tank 18. Although the peak dose is associated with Sector E, Tank 5 and Tank 6 contribute most to the Sector D contributions. Figures 3 and 4 below show the contributions

[2] Reference case refers to Case A in the DOE F-Tank Farm Performance Assessment, Revision 1.

of Tank 5 and Tank 6, respectively, to the overall dose in Sector D. The peak dose in Sector D that occurs around 40,000 years is associated with Pu-239 from Tank 18. The most significant contributions from Tank 5 and Tank 6 to the Sector D dose occur later in time, between 50,000 and 60,000 years, and are attributable to Nb-93m and Pu-239 (see Figures 5 and 6).

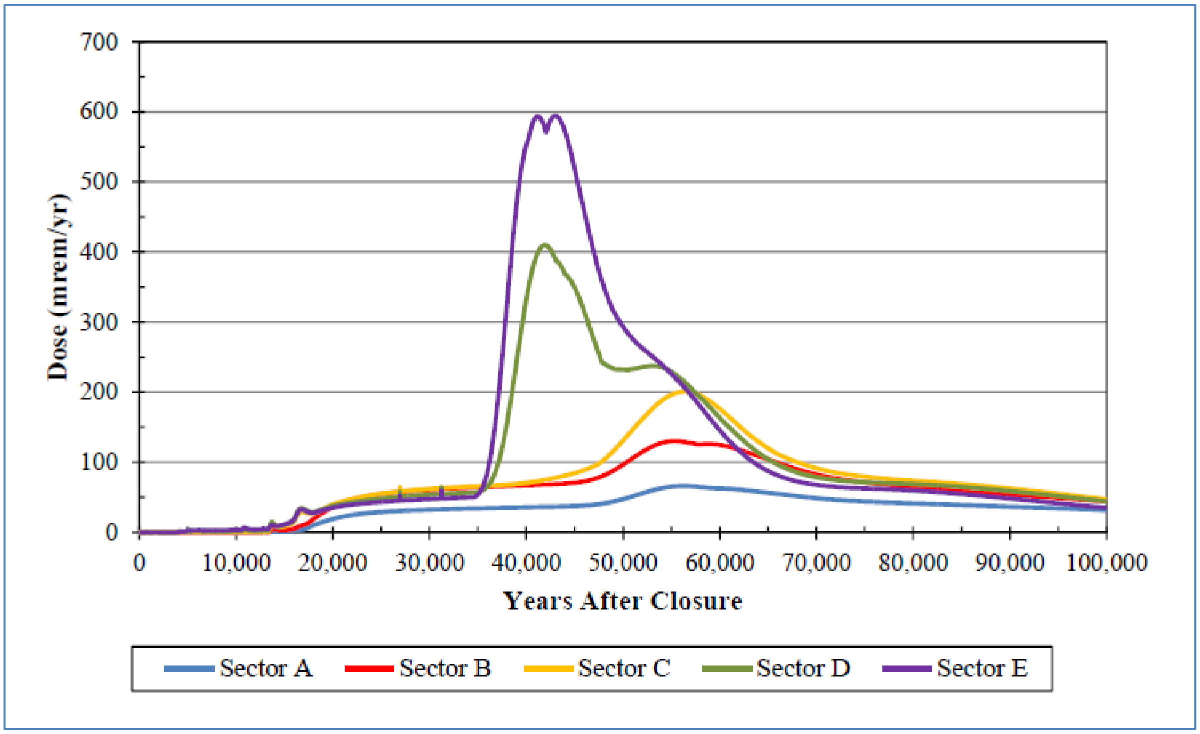

Figure 1. 100 m Sector Doses Over 100,000 Year Simulation Period Using Reference Case Parameters. Image Credit: SRR-CWDA-2012-00106, Revision 1, Figure 6.3-5.

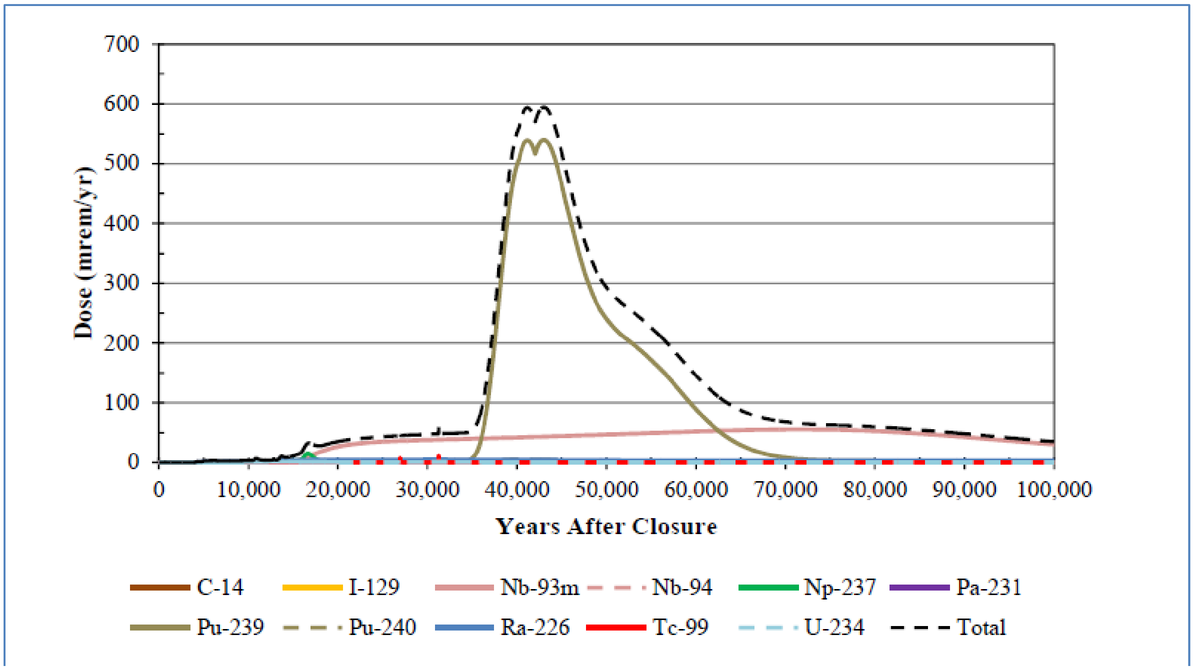

Figure 2. Individual Radionuclide Contributions to the 100 m Sector E Dose Over a 100,000 Year Simulation Period Using Reference Case Parameters. Image Credit: SRR-CWDA-2012-00106, Revision 1, Figure 6.3-9.

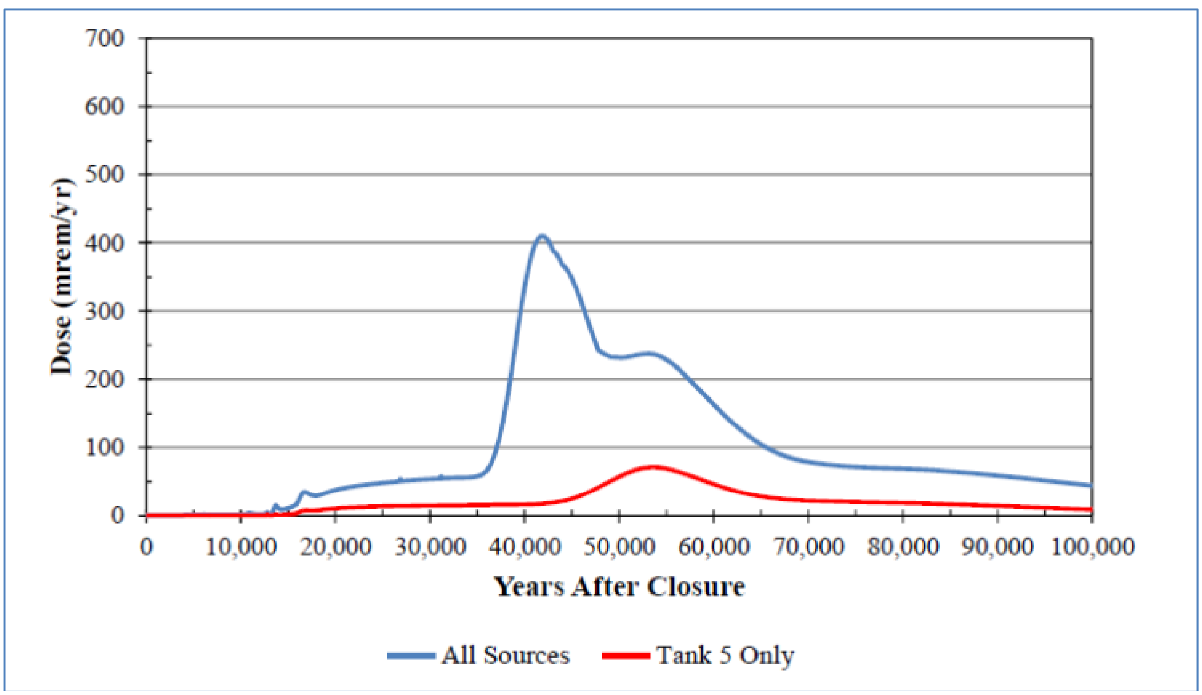

Figure 3. All Tank and Tank 5 Only Sector D (100 m) Dose Over a 100,000 Year Simulation Period Using Reference Case Parameters. Image Credit: SRR-CWDA-2012-00106, Revision 1, Figure 6.3-12.

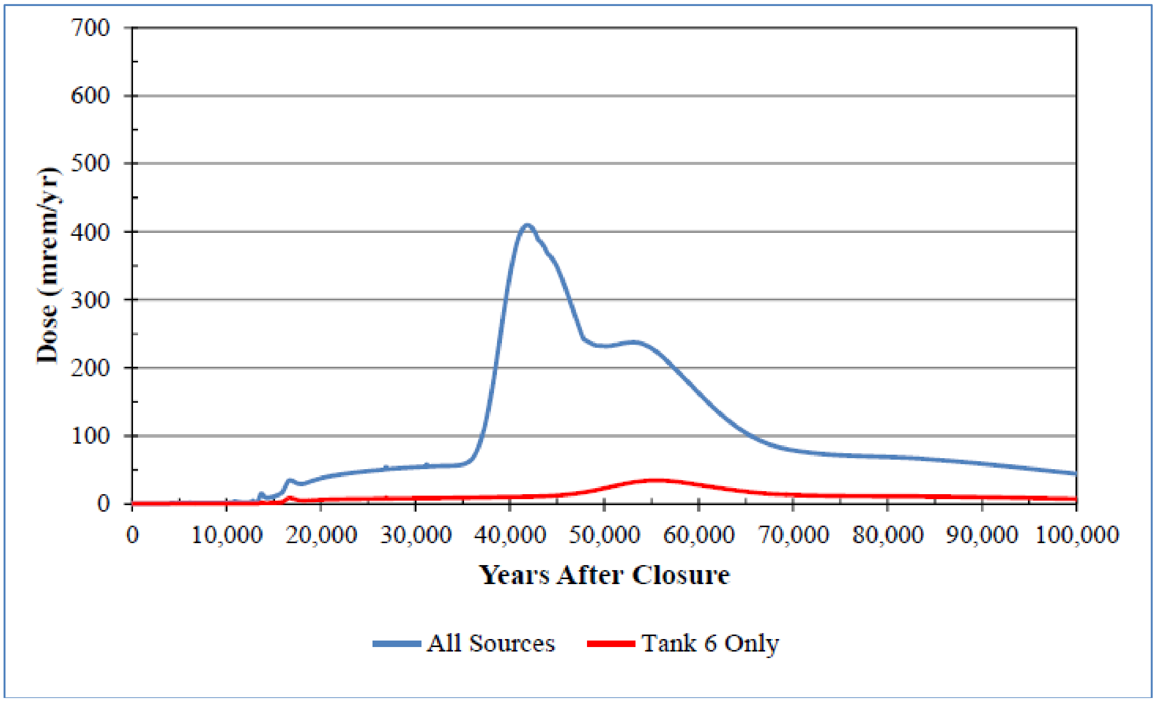

Figure 4. All Tank and Tank 6 Only Sector D (100 m) Dose Over a 100,000 Year Simulation Period Using Reference Case Parameters. Image Credit: SRR-CWDA-2012-00106, Revision 1, Figure 6.3-14.

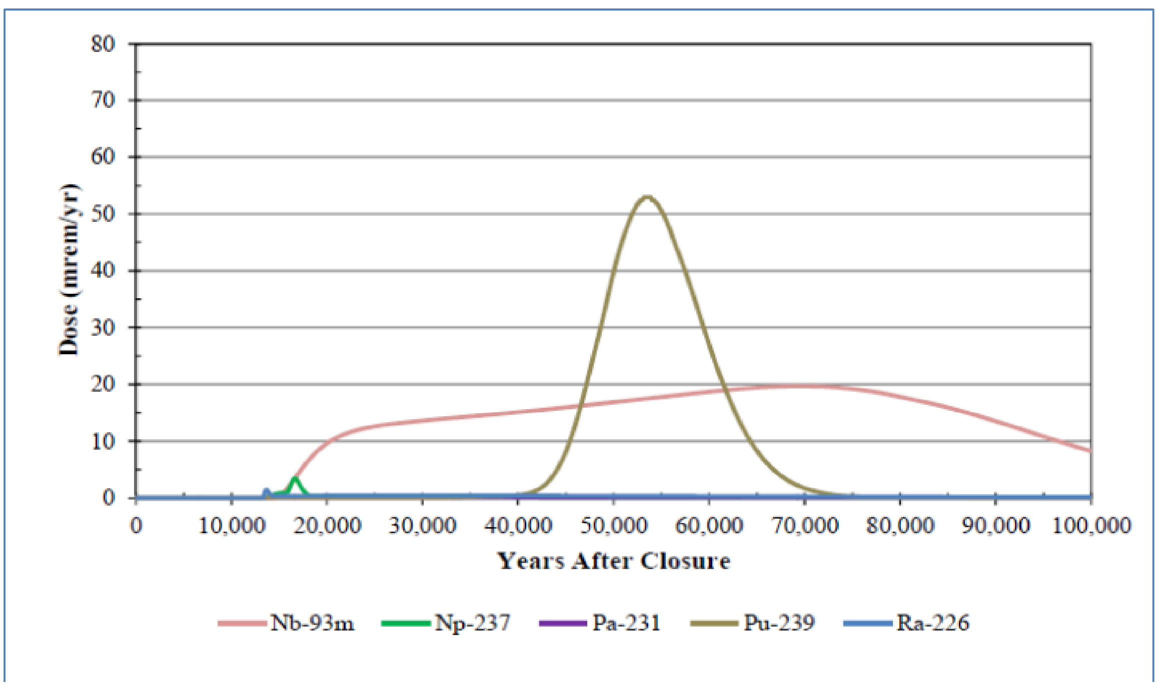

Figure 5. Individual Radionuclide Contributions to Tank 5, Sector D (100 m) Dose Over a 100,000 Year Simulation Period Using Reference Case Parameters. Image Credit: SRR-CWDA-2012-00106, Revision 1, Figure 6.3-30.

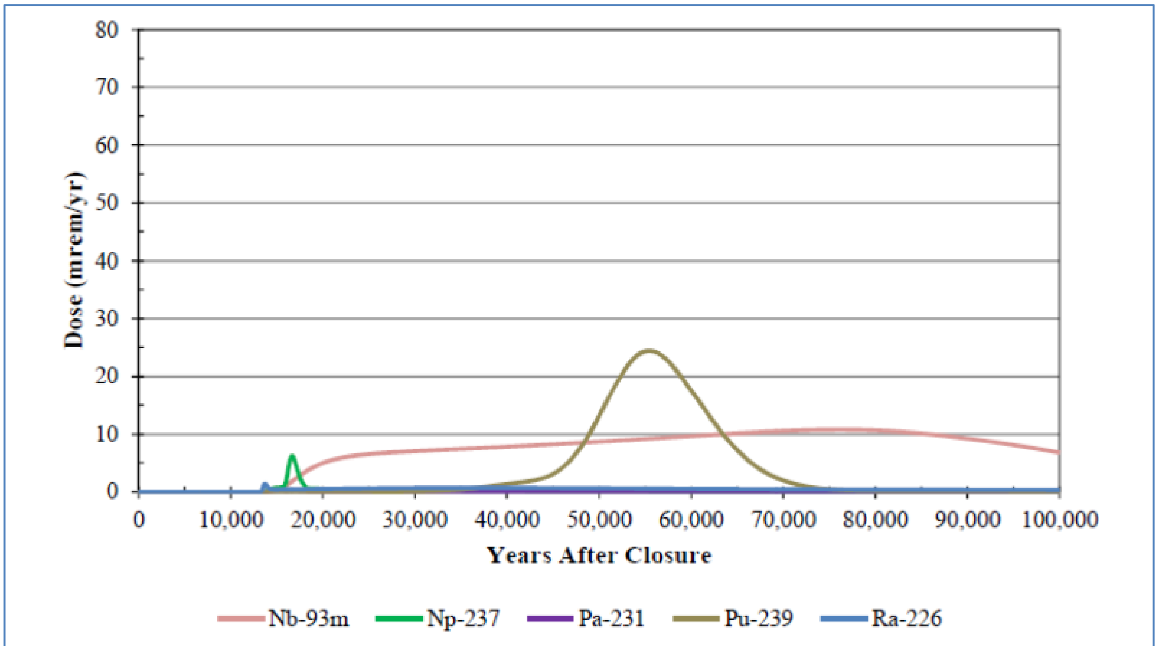

Figure 6. Individual Radionuclide Contributions to Tank 6, Sector D (100 m) Dose Over a 100,000 Year Simulation Period Using Reference Case Parameters. Image Credit: SRR-CWDA-2012-00106, Revision 1, Figure 6.3-31.

DOE performed what it described as a composite sensitivity study that includes (i) the final inventories for Tanks 5, 6, 17, 18, 19, and 20, and (ii) changes to other key waste release (i.e., solubility), and sand distribution coefficient (K_d) values for Pu-239, and Nb-93m that are expected to be more "probable" and "defensible." The results of the composite sensitivity study show a dose less than 25 mrem/yr (0.25 mSv/yr) for a 100,000 year simulation period peaking at around 20 mrem/yr (0.20 mSv/yr) at around 17,000 years.

Updated geochemical modeling (see SRNL-STI-2012-00404) performed since the F-Tank Farm Performance Assessment, Revision 1, and the Tanks 18 and 19 Special Analysis was used to update solubility parameters in the composite sensitivity study. Cement impacted leachate vadose zone K_ds were also developed and used in the model. Nb-93m K_d was changed from 0 L/kg (recommended by Kaplan in WSRC-TR-2006-00004, Revision 0) to 160 L/kg in the composite sensitivity study recommended by Prikryl and Pickett (2007). Kaplan recommended a K_d of 0 L/kg based on the expectation that Nb would be present as an anion in Savannah River Site environment and due to the low sorption potential of anions.

An updated GoldSim model was also developed to support the Tanks 5 and 6 Special Analysis (see SRR-CWDA-2012-00119, Revision 1). Projected doses from the updated probabilistic model are significantly higher than the results from previous analyses (see Table 1). DOE attributes higher reference case doses within 10,000 years to earlier Pu release and higher 95th percentile peak dose to a higher Zr-93 inventory.

A second probabilistic model was constructed that uses refined solubilities and K_ds (composite analysis) that result in lower projected doses. In the composite analysis, the peak of the mean dose within 10,000 years is 2.5 mrem/yr (0.025 mSv/yr) and the 95th percentile dose is 11 mrem/yr (0.11 mSv/yr). The peak dose projection within 100,000 years is 28 mrem/yr (0.28 mSv/yr) and the 95th percentile peak dose projection is 91 mrem/yr (0.91 mSv/yr). Table 2 presents deterministic and probabilistic modeling results for the composite analysis.

Table 1 Comparison of GoldSim Version 2.4 Probabilistic Modeling Results Reported in the F-Tank Farm Performance Assessment (SRS-REG-2007-00002, Revision 1) With Similar Goldsim Version 3.0 Results Reported in the Tanks 5 and 6 Special Analysis (SRR-CWDA-2012-00106, Revision 1)

F-Tank Farm Performance Assessment, Revision 1		***Tanks 5 and 6 Special Analysis***	
Peak Dose	**Time of Peak Dose**	**Peak Dose**	**Time of Peak Dose**
Within 10,000 Years			
10 mrem/yr (0.1 mSv/yr)	10,000 yrs	106 mrem/yr (1 mSv/yr)	10,000 yrs
Within 100,000 Years			
350 mrem/yr (3.5 mSv/yr)	38,000 yrs	550 mrem/yr (5.5 mSv/yr)	35,000 yrs

Table 2 Composite Analysis Results From Tanks 5 and 6 Special Analysis (SRR-CWDA-2012-00106, Revision 1)

Deterministic		***Probabilistic***	
Peak Dose	**Time of Peak Dose**	**Peak Dose**	**Time of Peak Dose**
Within 10,000 Years			
2.5 mrem/yr (0.025 mSv/yr)	~6,500 yrs	2.5 mrem/yr (0.025 mSv/yr)	~6,500 yrs
Within 100,000 Years			
20 mrem/yr (0.20 mSv/yr)	~17,000 yrs	28 mrem/yr (0.28 mSv/yr)	~40,000 yrs

SRR-CWDA-2009-00045, Revision 2, “F-Tank Farm Waste Tank Closure Inventory for Use In Performance Assessment Modeling,” October 2012

The F-Tank Farm Waste Tank Closure Inventory report (SRR-CWDA-2009-00045, Revision 2) provides updated inventory information using what DOE describes as “actual” inventories from Tanks 5, 6, 18, and 19. This document also provides information regarding inventory multipliers used in the Special Analysis to account for uncertainty in projected inventories. Details regarding development of the Tank 5 and Tank 6 inventory multipliers are provided in SRR-CWDA-2012-00027, Revision 1, and SRR-CWDA-2012-00075, Revision 0.

The F-Tank Farm Waste Tank Closure Inventory report indicates that of the 64 radionuclides remaining following screening[3], four additional radionuclides (Californium(Cf)-251, Cf-252, Ra-

[3] The screening process is outlined in the F-Tank Farm Performance Assessment, Revision 1 (SRS-REG-2007-00002, Revision 1).

228, and Th-232) were eliminated from characterization because there is no history of their presence in the F-Tank Farm. While Cf-251, Cf-252, Ra-228, and Th-232 are not expected to be initially present in FTF tanks, NRC notes that Cf-251 was not screened out in the H-Tank Farm Performance Assessment and Thorium fuel reprocessing occurred at H-Tank Farm (SRR-CWDA-2011-00054). Six radionuclides were added to the list to be characterized (Cl-36, Potassium-40, Nb-93m, Palladium(Pd)-107, Platinum(Pt)-193, and Zr-93). These radionuclides were included based on their theoretical occurrence from SRS production activities, and considering their potential risk-significance[4].

The F-Tank Farm Waste Tank Closure Inventory report, indicates that a review was conducted to determine if inventories for FTF tanks needed to be updated, citing SRR-LWE-2011-00201[5]. Upon review, DOE decided to update the closure inventory estimates. Adjustments were made to Pu-238, Pu-239, Pu-240, and Pu-241 concentrations in Tanks 7 and 8; Am-241 concentrations were adjusted in all the Type IIIA Tanks; and I-129 concentrations were adjusted in Type III Tanks. Table 3 provides a listing of the “old” and “new” inventories for these radionuclides.

Table 3 Inventory Adjustments

Tank	Radionuclide	Old Inventory (Ci)	New (Ci)
Tank 7 and 8	Pu-238 Pu-239 Pu-240 Pu-241	140 32 72 32	2600 52 26 500
Type III	I-129	1E-03 1E-03	3.2E-05 (Tank 33) 1.7E-04 (Tank 34)
Type IIIA	Am-241	1 Ci	5.7

To evaluate inventory uncertainty, DOE uses an inventory multiplier to vary individual radionuclide inventories for each tank in the probabilistic analysis. A uniform distribution with a maximum multiplier of 1 is used for radionuclides that are not detected and whose inventory is reported at the analytical detection limit. A uniform distribution with a maximum multiplier of 10 is used for other radionuclides. A minimum multiplier of 0.01 is used for all radionuclides. This approach is similar to the approach used in previous analyses including the F-Tank Farm Performance Assessment (SRS-REG-2007-00002, Revision 1).

<u>NRC Staff Evaluation</u>:

With exceptions indicated below, the NRC staff considers the Tanks 5 and 6 Special Analysis to be a well-documented assessment of the potential risk associated with residual waste expected to remain in Tank 5 and Tank 6 at the time of F-Tank Farm closure, as well as the overall risk posed by remaining waste in the F-Tank Farm. The NRC staff finds especially useful documentation of the evolution of risk estimates presenting results for (i) simulations that use updated inventories for cleaned tanks but that otherwise use parameters that are consistent with the reference case (SRS-REG-2007-00002, Revision 1), and (ii) simulations that use updated

[4] An early version of the F-Tank Farm GoldSim model was used to perform screening.
[5] Waste Characterization System data for sludge, salt, and liquid waste are presented in SRR-LWE-2011-00201 and are presumably used to evaluate the need for updated inventory estimates.

inventories for cleaned tanks, as well as other updated parameters (e.g., solubility values for key radionuclides) that are considered by DOE to be the best available information at the time of preparation of the Tanks 5 and 6 Special Analysis. The presentation of a series of results in the Tanks 5 and 6 Special Analysis allowed NRC staff to understand the impact of incremental improvements in the analysis that would be difficult to discern if only one set of results were presented with no information on the sensitivity of the results to these changes.

Inventory Used in the Special Analysis

The inventories used in the Tanks 5 and 6 Special Analysis are a vast improvement to the projected inventories used previously. Nonetheless, post-waste retrieval inventories should still be considered estimates because radionuclide concentrations and waste volumes remaining in the tanks after waste retrieval operations are uncertain. Given the final inventories of cleaned tanks are uncertain, it is not clear to the NRC staff that inventory uncertainty is properly managed for cleaned tanks in deterministic analyses (e.g., the reference case volume is expected to have a significant amount of uncertainty associated with it, yet "best estimates" of volume are used to determine the residual waste inventory). Potential issues with sample representativeness and calculation of the 95th percent upper confidence level of the mean may lead to underestimates of residual waste concentrations in cleaned tanks. In the future, DOE should consider whether it has appropriately managed volume and sampling and analysis uncertainty in the reference case relied on to demonstrate compliance with the performance objectives. The NRC staff evaluates development of the Tank 5 and Tank 6 inventory, including residual waste sampling and analysis and volume estimates, in a separate Technical Review Report (ML13085A291). For Tank 5 and Tank 6, the impact of inventory uncertainty is expected to be modest compared to other technical uncertainties.

Regarding the inventory projections for tanks that have yet to be cleaned, the NRC staff has concerns with the use of a minimum inventory multiplier of 0.01, while the maximum inventory multiplier is 1 (for radionuclides that are below detection limits) or 10 (for detected radionuclides). DOE adjusted inventories for Type I and IIIA Tanks by a factor of 10 to account for inventory uncertainty. This adjustment appears warranted because the assumed residual volume of one-sixteenth of an inch (~0.16 cm), which equates to approximately 170 gallons (650 L) in Type I Tanks, appears to be overly optimistic[6] considering the volume of residual waste estimated to remain in recently cleaned tanks (Tanks 5, 6, 18, and 19). Cleaned tank volumes range from 1900 gallons (7,900 L) in Tank 5 to 4000 gallons (15,100 L) in Tank 18. NRC would also note that although projected Type I Tank concentrations were assumed to be the same as the final Tank 6 Tc-99 concentration, the projected residual volume in Type I Tanks was assumed to be 1700 gallons, a value lower than the final residual volume estimates for Tank 5 and Tank 6 of 1900 and 3000 gallons (7200 L and 11,000 L), respectively. DOE also uses the maximum concentration of any tank for all tanks of the same type (i.e., Type I, III, or IIIA) when projecting inventories. However, for tanks undergoing chemical cleaning NRC expects that some radionuclide concentrations will be under-estimated while other radionuclide concentrations will be over-estimated due to preferential removal of radionuclides during chemical cleaning. NRC staff indicated in its comments to South Carolina Department of Health and Environmental Control on the Tanks 5 and 6 Closure Module that it thought DOE could

[6] Estimates of waste remaining in recently cleaned tanks are more than a factor of 10 higher than estimates for tanks that have yet to be cleaned.

improve its evaluation of the effectiveness of chemical cleaning on key radionuclide removal by obtaining better baseline information (see ML13081A048 and ML13081A051). NRC also encourages DOE to continue to refine its inventory estimates and parameter distributions over time as additional information is collected.

The NRC staff is also concerned with the gross underestimation of the Zr-93 inventory in Tank 5 and Tank 6 (i.e., the estimate for Zr-93 was approximately a factor of 10,000 times lower than projections made prior to sample and analysis). In fact, several radionuclides were more than a factor of 10 lower than the projected inventory for Tanks 5 and 6 (e.g., Am-243, Cl-36, Ni-59, Ni-63, Pd-107, Ra-226, Sn-126, Th-230, and Zr-93), and approximately 40 percent of the radionuclide inventories were underestimated. While some radionuclides have a greater risk potential than others, based on the fraction of radionuclide inventories that were under-estimated, it does not appear that the radionuclide inventories are biased high, which is contrary to the selection of inventory multipliers that range from 0.01 to 10 (i.e., the inventory range is a factor of 100 less, but only a factor 10 higher than the reference case inventory). Certain key radionuclide inventories (e.g., Tc-99) were grossly overestimated in Tank 5 and Tank 6. These results (both gross over- and gross under-estimates) underscore the importance of adequately characterizing the residual waste and suggest that the dose projections are relatively uncertain based on inventory alone. The NRC staff is also concerned that potential key radionuclides are screened out based on poor inventory data. When the NRC staff questioned DOE regarding the cause for the gross underestimation of the Zr-93 inventory, DOE indicated that after further investigation, it was unable to explain the high inventory of Zr-93 in Tank 5 and Tank 6, although DOE is confident in its process that risk-significant inventories of radionuclides will be identified. However, the inability of DOE to determine the cause of the gross underestimation of the Zr-93 inventory in Tank 5 and Tank 6 does not elicit NRC staff confidence in the process used to identify potential dose contributors in Tank Farm waste.

In response to an NRC inquiry regarding waste streams for F- and H-Tank Farm, DOE provided a report (SRNL-STI-2012-00479, Revision 0) entitled, “Chemical Differences Between Sludge Solids at the F and H Area Tank Farms” that provides general information about F- and H-Canyon processing activities and expected differences in F- and H-Tank Farm wastes. For example, because H-Canyon processed different fuel and targets compared to F-Canyon (e.g., H-Canyon processed enriched uranium, Np targets for Pu-238 production, and Thorex campaigns to produce U-233), the inventory of U-233, U-234, U-235, U-236, Pu-238, Pu-242, Cm-244, and Cm-245 is expected to be higher. Because of the higher concentrations of Pu-238 in HTF, the long-term concentrations of Th-230 and Ra-226 (from Pu-238 decay) are also expected to be higher in HTF. In contrast, F-Canyon operations and F-Tank Farm waste were consistent with the processing of weapons grade Pu, with lower Pu-240 to Pu-239 ratios. While the information in SRNL-STI-2012-00479, Revision 0, was interesting and informative, it did not shed light on the significant underestimation of radionuclide inventories in Tank 5 and Tank 6 for radionuclides, such as Zr-93. NRC staff will continue to evaluate whether all potentially risk-significant radionuclides have been identified.

NRC staff will continue to monitor DOE’s parameterization of final radionuclide inventories in special analyses under Monitoring Factor 1.1, “Final Inventory and Risk Estimates” listed in NRC staff’s plan for monitoring F-Tank Farm (ML12212A192). NRC will also continue to monitor DOE’s basis for concluding that all potentially risk-significant radionuclides have been identified and are targeted for analysis under Monitoring Factor 1.2, “Residual Waste Sampling.”

In the future, NRC expects DOE to address the following technical concerns that are not specifically discussed in NRC staff's monitoring plan:

- In future special analyses, DOE should evaluate whether it has appropriately managed inventory uncertainty for cleaned tanks in its deterministic (reference case) analysis.

- DOE should provide a stronger technical basis for the projected inventory multipliers used in the probabilistic analysis. Because the probabilistic analysis is not strictly relied on, but rather, informs the demonstration of compliance of F-Tank Farm with the performance objectives in 10 CFR Part 61, Subpart C, this technical concern can be addressed as a longer-term activity under Monitoring Factor 6.2 "Model and Parameter Support" in the NRC staff's plan for monitoring F-Tank Farm (ML12212A192).

Waste Release and Sorption Parameters

With regard to Pu solubility values used in the composite analysis, the NRC staff thinks that additional information is needed to support composite analysis assumptions regarding Pu solubility. The NRC staff evaluated updated geochemical modeling, including chemical transition times and Pu solubility values, in a separate Technical Review Report (ML12272A082). The inventory of Pu-239 in Tank 18 alone is sufficient to exceed 25 mrem/yr (0.25 mSv/yr) over longer periods of performance, if higher calculated solubilities are assumed. Furthermore, the Pu-239 projected inventories for Tank 5 and Tank 6 were underestimated. Tanks 5 and 6 Special Analysis simulations show that Pu-239 can also exceed 25 mrem/yr (0.25 mS/yr) for longer periods of performance (SRR-CWDA-2012-00106, Revision 1). NRC discusses technical concerns associated with the projected timing of peak dose in the Tanks 18 and 19 Special Analysis Technical Review Report (ML13100A230). The NRC staff concluded, consistent with the monitoring plan for F-Tank Farm (ML12212A192) that additional information is needed to better understand Pu solubility and mobility in the natural environment. NRC staff will separately evaluate the updated solubility values used in the Tank 5 and Tank 6 composite, probabilistic analysis, and related parameter distributions for a wider range of key radionuclides in the upcoming H-Tank Farm Technical Evaluation Report[7]. It is NRC staff's understanding that the same solubility values used in the Tanks 5 and 6 Special Analysis were also used in the H-Tank Farm Performance Assessment. The H-Tank Farm Technical Evaluation Report will also include results of NRC staff's review of the GoldSim probabilistic model. The probabilistic model developed for the H-Tank Farm Performance Assessment has similar attributes to the GoldSim Version 3 model used to support the Tanks 5 and 6 Special Analysis.

Regarding the Nb-93m K_d selected for the composite analysis, given the risk-significance of the mobility of Nb-93m (daughter product of Zr-93) in the natural environment, NRC staff thinks that additional site-specific information on Nb-93m K_d is needed to provide reasonable assurance that the 10 CFR Part 61, Subpart C, performance objectives can be met. Simulations run with a bounding distribution coefficient of 0 L/kg indicate that Nb-93m may contribute significantly to the overall peak dose and challenge the ability of DOE disposal actions at the F-Tank Farm to meet the 10 CFR 61.41 (and 10 CFR 61.42) performance objective(s). While DOE predicts the peak dose from Nb-93m will not occur until after the 10,000 year compliance period, the NRC staff has concerns with reference case assumptions regarding steel liner failure times that

[7] NRC plans to issue the H-Tank Farm Technical Evaluation Report in Calendar Year 2014.

cause the Nb-93m doses to occur beyond the 10,000 year compliance period. Additionally, in WSRC-TR-2006-00004, Revision 0, Kaplan recommended a value of 0 L/kg for Nb-93m based on the expectation that Nb would behave as an anion in Savannah River Site environments. Therefore, lacking additional site-specific data, it is not clear that the value of 160 L/kg that was selected by DOE in the composite analysis is fully supported. During the March 27-28, 2013, onsite observation visit, DOE indicated that it was currently performing a site-specific sorption study that included Nb K_d for the saltstone disposal facility. This information can be used to inform the selection of this parameter value in the Tanks 5 and 6 Special Analysis. Regarding updates to vadose zone K_ds to reflect cement leachate impacts, NRC plans to review the vadose zone K_ds selected for use in the composite study (presented in Table 6.3-12) of the Tanks 5 and 6 Special Analysis in a separate technical review report or in the H-Tank Farm Technical Evaluation Report.

NRC staff will continue to monitor DOE's selection of waste release parameters under Monitoring Factor 2.1 "Waste Release" and Monitoring Factor 2.2 "Chemical Transition Times" in NRC staff's monitoring plan for F-Tank Farm (ML12212A192). NRC also expects DOE to address the following technical concerns listed in this Technical Review Report that are not specifically discussed in the monitoring plan:

- DOE should provide a stronger technical basis for the assumed Nb distribution coefficient (or K_d) based on site-specific data.

Teleconference or Meeting:

NRC staff held a follow-up teleconference with DOE related to the Tanks 5 and 6 Special Analysis on May 8, 2013 (see summary of teleconference at ML13133A125). NRC provided DOE a list of questions in advance of the teleconference related to the gross underestimation of the Zr-93 inventory in Tank 5 and Tank 6 and the inventory adjustments made in the Tanks 5 and 6 Special Analysis. Although DOE investigated the high Zr-93 inventory in Tank 5 and Tank 6, DOE indicated that it was not able to identify a cause for the significant underestimation of the inventory of the key radionuclide. NRC staff questioned how DOE has confidence that no other potentially risk-significant radionuclide was present in the tanks that was not analyzed due to incomplete knowledge about F-Tank Farm waste streams. DOE indicated that it errs on the side of conservatism when identifying the list of radionuclides to be analyzed and that it was confident that all risk-significant radionuclides have been identified. NRC staff requested additional information on F- and H-Canyon waste processing that included information on the Tank Farm waste streams. In response to NRC's inquiry, DOE provided SRNL-STI-2012-00479, Revision 0, "Chemical Differences Between Sludge Solids at the F- and H-Area Tank Farms". The NRC staff also requested clarification regarding the inventory adjustments that were made to F-Tank Farm Tanks in the Tanks 5 and 6 Special Analysis. DOE indicated that it updated projected inventories based on Tank 5 and Tank 6 cleaning effectiveness and updates to key radionuclide concentrations in the Waste Characterization System. DOE indicated that it would provide additional information on the inventory adjustments and the process used to make these adjustments in a written response back to the NRC.[8] In response to NRC staff

[8] During the August 27-28, 2013, onsite observation visit, DOE provided additional information to clarify the basis for inventory adjustments (see SRR-CWDA-2013-00103). NRC has no further questions related to the inventory adjustments at this time.

inquiry, DOE also indicated that although additional information was available to update baseline inventories for key radionuclides it decided not to update inventory multipliers. At some point in time, NRC staff and DOE agree that sufficient information would be available to refine inventory distributions.

Follow-up Actions:

The NRC staff will continue to monitor the approach DOE takes to manage inventory uncertainty in its reference case in future special analyses under Monitoring Factor 1.1, "Final Inventory and Risk Estimates" listed in NRC staff's plan for monitoring F-Tank Farm (ML12212A192). Specific technical concerns related to sampling and analysis and volume estimates are listed in a separate, but related Technical Review Report on final inventory development (ML13085A291).

The NRC staff will evaluate DOE's progress on development of inventory multiplier distributions under Monitoring Factor 6.2, "Model and Parameter Support" as a long-term performance assessment maintenance activity listed in NRC staff's plan for monitoring F-Tank Farm (ML12212A192).

The NRC staff will review and evaluate DOE results of site-specific distribution coefficient or K_d studies that includes information on Nb K_d. If the K_d for Nb is lower than assumed in the Tanks 5 and 6 Special Analysis composite analysis (i.e., 160 L/kg), then NRC staff will evaluate the impact of lower K_d on the dose projections. This activity is considered to be of moderate to high risk significance based on its importance to the NRC staff's conclusions regarding the ability of DOE disposal actions at the F-Tank Farm to meet the performance objectives in 10 CFR Part 61, Subpart C.

Open Issues:

There are no Open Issues.

Conclusions:

As a result of the review of several DOE documents that support the Tanks 5 and 6 Special Analysis, a follow-up teleconference held with DOE on May 8, 2013, and discussions with DOE staff during the August 27-28, 2013, onsite observation visit, NRC staff concludes that the Tanks 5 and 6 Special Analysis presents useful information on the potential risks associated with cleaned Tank 5 and Tank 6, as well as the larger F-Tank Farm. The NRC staff also concludes that additional information related to the Nb distribution coefficient, or K_d, is needed to have reasonable assurance that DOE disposal actions taken at the F-Tank Farm will meet the performance objectives in 10 CFR Part 61, Subpart C. Finally, technical concerns identified in NRC staff's review of the Tanks 18 and 19 Special Analysis (ML13100A230) are also applicable to the Tanks 5 and 6 Special Analysis and are not repeated in this report. As detailed in the Tanks 18 and 19 Special Analysis technical review report (ML13100A230), the monitoring plan for F-Tank Farm (ML12212A192) provides a path forward for DOE to address all of the technical concerns discussed in that Report.

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