March 31, 2015

MEMORANDUM TO: Gregory F. Suber, Chief
Low Level Waste Branch
Division of Decommissioning, Uranium Recovery, and Waste Programs
Office of Nuclear Material Safety and Safeguards

THRU: Christepher A. McKenney, Chief **/RA by K Pinkston for/**
Performance Assessment Branch
Division of Decommissioning, Uranium Recovery, and Waste Programs
Office of Nuclear Material Safety and Safeguards

FROM: Cynthia S. Barr, Sr. Systems Performance Analyst **/RA/**
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Division of Decommissioning, Uranium Recovery, and Waste Programs
Office of Nuclear Material Safety and Safeguards

SUBJECT: TECHNICAL REVIEW OF ENVIRONMENTAL MONITORING AND SITE-SPECIFIC DISTRIBUTION COEFFICIENT REPORTS

The U.S. Nuclear Regulatory Commission (NRC) staff has performed technical reviews of environmental monitoring and site-specific distribution coefficient reports prepared by the U.S. Department of Energy (DOE) to support F-Area Tank Farm Facility (FTF) closure at Savannah River Site. This technical review report is related to Monitoring Factor 4.1, "Natural Attenuation of Pu," and Monitoring Factor 4.3, "Environmental Monitoring," listed in NRC staff's FTF Monitoring Plan (Agencywide Documents Access and Management System Accession No. ML12212A192). The NRC staff concludes the following:

1. DOE has performed environmental monitoring at the FTF that provides useful information on the hydrogeological system at FTF. This information can also be used to better understand contaminant flow and transport and validate DOE Performance Assessment models.

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2. Uncertainty exists in the source of contaminant plumes detected via the FTF monitoring well network. Reducing this uncertainty will be important to better understanding contaminant flow and transport processes operable at the FTF.

3. Progress has been made on development of cement leachate factors used to account for the impact of cement leaching on natural system sorption; however, additional information is needed to support factors for key radionuclides such as Neptunium(Np), Plutonium(Pu), and Uranium(U).

4. Progress has been made on development of site-specific K_d s for Niobium(Nb); however, additional information is needed to support K_d values used in performance assessment calculations.

5. Little progress has been made to address the technical issue associated with the Pu K_d averaging approach used in tank farm performance assessment calculations. DOE should address this technical issue in the future.

Many of the technical issues listed in this technical review report are listed in the FTF Monitoring Plan (ML12212A192) and will not be repeated here. Unique technical issues not discussed in the FTF Monitoring Plan that are listed as follow-up actions include the following:

1. The NRC staff will continue to monitor the ability of the tank farm monitoring well network to detect releases from the tank farm facilities following closure. DOE could evaluate the monitoring well network by performing an analysis of the centerline of plumes emanating from tank sources should releases occur in the future, and provide input on optimal well locations to ensure that future releases from the tank farm facility would be detected.

2. The NRC staff will continue to evaluate the source of elevated Technetium(Tc)-99 levels in well FTF 28. It is not clear that releases from the F-Area Inactive Process Sewer Line could migrate vertically to the lower zone of the Upper Three Runs Aquifer in such a short distance from the source. This evaluation is important to ensure that the hydrogeological system at FTF is well understood and that releases from the tanks could be detected by the monitoring well network. DOE could provide additional support for the source of contamination detected at well FTF 28 by performing particle tracking to better understand contaminant plume trajectories. DOE could also perform a more formal statistical analysis of FTF, and Western Groundwater Operable Unit well data to correlate contaminant concentrations associated with various sources.

3. The NRC staff will continue to monitor the K_d averaging approach used to simulate Pu transport in the natural system at FTF. DOE could address the issue by modeling explicitly more mobile and less mobile forms of Pu in future performance assessment calculations.

4. The NRC staff will continue to monitor support for cement leachate factors developed for Pu (and other constituents). DOE could provide support for cement leachate factors by performing site specific analyses.

5. The NRC staff will continue to monitor the basis for selection of the Nb distribution coefficient or K_d value of 160 L/kg used in the Tanks 5 and 6 Special Analysis. DOE could address the technical issues by verifying the batch experiments did not exceed solubility limits and are representative of conditions at FTF (e.g., plot solid phase versus aqueous phase concentration or K_d versus concentration; evaluate K_d for FTF aquifer soils); or perform additional experiments to verify the Nb K_d.

Docket No.: PROJ0734

Enclosure:
Technical Review of DOE Environmental
Monitoring Reports for Tank Farms

5. The NRC staff will continue to monitor the basis for selection of the Nb distribution coefficient or K_d value of 160 L/kg used in the Tanks 5 and 6 Special Analysis. DOE could address the technical issues by verifying the batch experiments did not exceed solubility limits and are representative of conditions at FTF (e.g., plot solid phase versus aqueous phase concentration or K_d versus concentration; evaluate K_d for FTF aquifer soils); or perform additional experiments to verify the Nb K_d.

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TECHNICAL REVIEW OF ENVIRONMENTAL MONITORING REPORTS PREPARED BY DOE FOR TANK FARMS

Date: March 2015

Reviewers: Cynthia S Barr, U.S. Nuclear Regulatory Commission
Mark Fuhrmann, U.S. Nuclear Regulatory Commission
George Alexander, U.S. Nuclear Regulatory Commission
David Pickett, Center for Nuclear Waste Regulatory Analyses

Summary of Review Documents

Review of Tank Farm Environmental Monitoring Reports (Monitoring Factor 4.3 "Environmental Monitoring" (ML12212A192))

The Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) approved a new Sampling and Analysis Plan (SAP) for F-Area Tank Farm (FTF) in December 2012 (SRNS-RP-2012-00287, Rev. 1). In 2013, Savannah River Site (SRS) performed sampling according to the Sampling and Analysis Plans for the FTF (SRNS-RP-2014-00226, Rev. 0). SRS collected samples during the first and third quarters from 13[1] wells at the FTF. Also of note, DOE measured a rainfall value of 71.4 inches in 2013, which is significantly higher than the 30-year average value of 47.2 inches/yr. In fact, the 2013 precipitation rate was the greatest amount of annual rainfall recorded at SRS over the past 30 years. At the time of preparation of the 2013 tank farm groundwater monitoring report, although the water levels had risen due to the higher than average 2013 rainfall amounts, the water levels were still stated to be lower than the long-term average.

In addition to the monitoring well network at the FTF, DOE also monitors groundwater quality in the Western Groundwater Operable Unit (ERD-EN-2005-0127). Elevated concentrations of non-volatile beta, Iodine-129, Strontium-90, and Tritium have been measured in what is referred to as the "South Plume" in the Western Groundwater Operable Unit down-gradient of the FTF (ERD-EN-2005-0127 [2014]).

Review of Distribution Coefficient Reports (Monitoring Factor 4.1 "Natural Attenuation of Plutonium" (ML12212A192))

A data set of 64 K_d values for Pu was assembled from literature values from batch determinations of samples of Savannah River site sediment (Almond et al., 2012). These data were taken under varying conditions of pH, oxidation state of the tracer and contact times (1, 6, or 33 days). K_d values ranged from 107 to 50,000 mL/g. A number of statistical distribution models were evaluated with three goodness-of-fit metrics for the entire data set. The data were also segregated into several groups; pH > 7, pH ≤ 7, and a combination of pH and sediment texture.

[1] One FTF well was dry--background well FBG001D.

Conclusions of this statistical analysis are:

1. pH 4.6 to 10.47 sediment Pu K_d values ranged from 100 to 50,000 mL/g (mean K_d = 8,559 ± 10,823 mL/g; to simulate a plume moving through all pH conditions),
2. pH 4.6 to 7.0 sediment Pu K_d values ranged from 100 to 33,000 mL/g (mean = 6,047 ± 6,971 mL/g ; to simulate a plume moving through far-field conditions),
3. pH 7.01 to 10.47 sediment Pu K_d values ranged from 210 to 50,000 mL/g (mean = 12,851± 14,525 mL/g; to simulate a plume moving through a basic cementitious plume conditions), and
4. the Weibull distribution was recommended for each of the Pu sediment distributions.

Batch sorption tests were also performed to calculate K_d values for Niobium(Nb) and Selenium(Se) to SRS soils underlying the Saltstone Disposal Facility, and to study the sorption behavior of Radium(Ra) to reducing and non-reducing cementitious materials (SREL Doc. R-13-0005, Rev. 1). All batch sorption tests considered both oxic and anoxic conditions to evaluate the sensitivity of experimentally derived K_d to redox state. Four different groundwater chemistries were considered: portlandite, saltstone leachate solution, calcite, artificial groundwater reflecting different stages of cement degradation and associated changes to key parameters most notably pH. The focus of this technical review is on the Nb distribution coefficient that is important to Tanks 5 and 6 closure (ML13273A299). The results of this study calculate K_ds for Nb >1200 L/kg for all chemical conditions.

<u>NRC Evaluation</u>

Review of FTF Environmental Monitoring Reports (Monitoring Factor 4.3 "Environmental Monitoring" (ML12212A192))

During 2013, SRS collected samples during the first and third quarters from 13[2] wells at the FTF (see Figure 1a). Constituents analyzed include gross alpha, nonvolatile beta, tritium, nitrate-nitrite, cadmium, chromium, manganese, sodium, and Technetium(Tc)-99. These constituents were selected based on historical monitoring and an evaluation of the most prevalent radionuclides expected during operations, waste removal, and tank closure activities. Radionuclide-specific analyses are performed if sample analysis results exceed trigger levels of 15 pCi/L gross alpha, or 50 pCi/L nonvolatile beta. In 2013, the nonvolatile beta trigger level was exceeded at a well screened in the lower aquifer zone of the Upper Three Runs Aquifer (UTRA), well FTF 28. Because well FTF 28 exceeded the screening trigger level, several other constituents were analyzed. Radium-226, Iodine-129, and Tc-99 were detected in the radionuclide-specific analyses. Consistent with measurements in previous years, Tc-99 was measured at values above 1000 pCi/L in well FTF 28 (see Figure 9 in SRNS-RP-2014-00226). Previously, Tank 8[3] was implicated as a possible source of the non-volatile beta/Tc-99 measurements at well FTF-28 (SRNS-RP-2012-00022, Rev. 1). However, currently SRS scientists attribute the radioactivity measured at well FTF 28 to releases from the F-Area Inactive Process Sewer Line (FIPSL). The FIPSL is a vitrified clay pipe used to transfer acidic, low-level radioactive wastewater from the separations facilities to the F-Area seepage basins to the southwest of the FTF. A section of the FIPSL collapsed just south of well FTF 28 as shown

[2] One FTF well was dry—background well FBG 1D.
[3] In 1961, Tank 8 waste was released to the environment due to a tank over-fill event and suspected leakage through the fill line encasement (DPSU 75-11-8, DPSU 76-11-8, DPST-86-00511).

in Figure 2a. The FIPSL is associated with a non-volatile beta plume that extends from FTF 28 to monitoring wells located to the southwest of FTF-28 in the Western Groundwater Operable Unit (Figure 2b).

Near the collapsed section of the FIPSL, elevated non-volatile beta has been measured at wells FSL 5D (see Figure 2b), as well as FTF 28. However, FSL 5D is located in the upper aquifer zone of the Upper Three Runs Aquifer (UTRA) and is screened at an elevation of 204-224 ft, while FTF 28 is screened in the lower aquifer zone of the UTRA at an elevation of 151-161 ft (43 ft lower in the UTRA). Additionally, FTF 28 is also located slightly up-gradient and north of the collapsed FIPSL section. Although wastewater released from the FIPSL could have migrated towards FTF 28 in the vadose zone, it is more difficult to explain the vertical migration of the radioactivity to the lower aquifer zone of the UTRA where FTF 28 is screened in such a short lateral distance from the source. Elevated non-volatile beta has also been measured at FGW 12C, a well also screened in the lower zone of the UTRA at and elevation 154-164; however, this well is located approximately 700 m down-gradient of the FIPSL, a significant distance away from the source.

During the March 27-28, 2013, onsite observation NRC staff inquired about the source of elevated non-volatile beta and Tc-99 at FTF 28 (ML13113A322). DOE contractors indicated that the source of the FTF 28 non-volatile beta and Tc-99 was now thought to be the FIPSL, rather than Tank 8 as originally suspected. NRC staff inquired about the vertical extent of the plume that lies directly underneath the process sewer lines. DOE contractors explained that a residual hydrogen ion plume was also present that is similarly, vertically extensive in the UTRA further supporting the hypothesis that elevated non-volatile beta and Tc-99 at FTF was sourced by the FIPSL. SRNS-RP-2014-00226 also indicates that pH is depressed in FTF 28 (pH values between 4.5 and 5 in 2013) compared to other wells screened in the lower zone of the UTRA (see text on page 9 and Figure 10). However, SRNS-RP-2014-00226 also indicates that FTF 9R is likely impacted by the FIPSL with low pH increasing the solubility of manganese, while the pH measurements in FTF 9R were actually not low at all compared to background levels (5.9 and 6.3 in 2013). Given the small data set, and what appears to be a weak correlation between pH and constituent concentrations that have been attributed to the FIPSL, the arguments presented are not conclusive. Explanations for the vertical extent of the plume include the following: (1) the lower zone of the UTRA was contaminated during FTF 28 well construction, or (2) Tc-99 present in FTF 28 is impacted by another F-Area source (other than the FIPSL).

In an effort to evaluate the efficacy of the FTF monitoring well network for detecting future releases of radioactivity from the tank farm, NRC staff analyzed DOE's FTF Performance Assessment (SRS-REG-2007-00002, Rev. 1) calculations (e.g., Figure 3) and ran DOE's saturated zone PORFLOW models. NRC staff matched features with known coordinates on (1) a map that utilized the Universal Transverse Mercator (UTM) coordinate system to (2) the maps illustrated on Figures 5.2-2 and 5.2-5 in SRS-REG-2007-00002, Rev. 1, that depict the FTF local model grid, which is not in the UTM coordinate system. This was necessary because only UTM coordinates were available for FTF wells (see SRNS-RP-2014-00226, Table 1), and the UTM coordinates had to be translated to FTF grid cells. Next, FTF PORFLOW model simulations of Tc-99 releases from various FTF sources were executed, and concentrations were extracted from the model from the water table surface, vertically downward to the bottom of the model domain at each FTF well location. Tc-99 was chosen for the simulations because it is fairly mobile and long-lived (i.e., acts like a conservative tracer that would produce a fully developed plume in shorter simulation periods). The statistical analysis of concentrations in the

UTRA at the FTF well locations was reviewed to determine the optimal well screen depth and elevation.

Based on NRC staff's evaluation, NRC staff thinks that the monitoring well network could be enhanced to help ensure releases from the FTF facility are detected. Table 1 lists each FTF well and provides an assessment of the tank or set of tanks that each FTF well is best aligned with based on Figure 3 stream traces, and also evaluates, based on the PORFLOW model simulations described above, whether the well is screened at an appropriate depth in the aquifer to best detect releases from those tanks. While the PORFLOW calculations reflect modeling results and may not reflect reality, it is not clear to NRC staff how DOE contractors selected the monitoring well locations at FTF, as they do not always appear to be screened at the most appropriate depth based on FTF Performance Assessment (PORFLOW) modeling results. NRC staff suggests that when the monitoring well network is evaluated in the future, DOE contractors perform an evaluation using the FTF Performance Assessment (PORFLOW) model and provide input on the horizontal and vertical distribution of wells in the FTF monitoring network to DOE subcontractors responsible for well construction, maintenance, and monitoring. This effort should be focused on identifying well locations that would maximize the ability to detect FTF releases and minimize false negative monitoring well results. Adequate groundwater monitoring data could help validate Performance Assessment Models, as well as provide direct evidence that the tank farm facilities are operating as intended. NRC staff will continue to monitor the basis for and adequacy of the FTF monitoring well network and field and chemical data collected, as tank farm closure progresses.

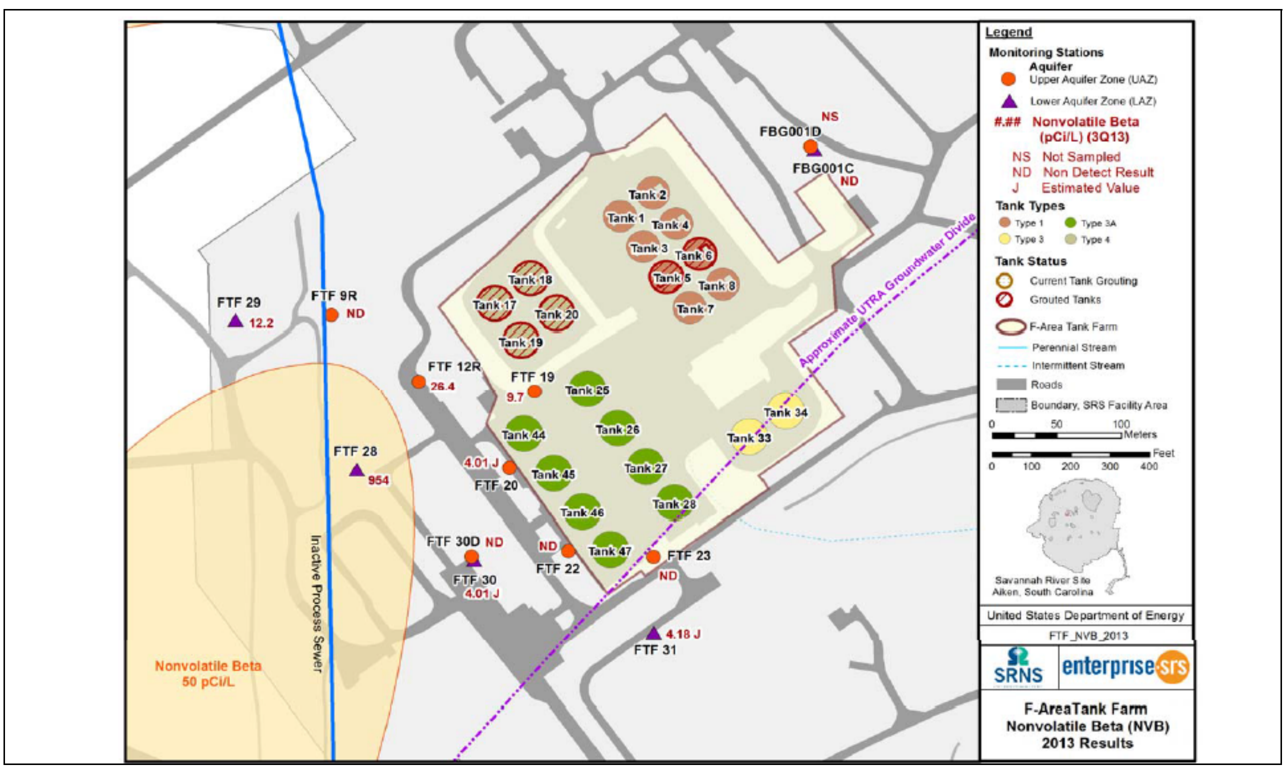

Figure 1: FTF Monitoring Well Network. Adapted from Figure 4 in SRNS-RP-2014-00226.

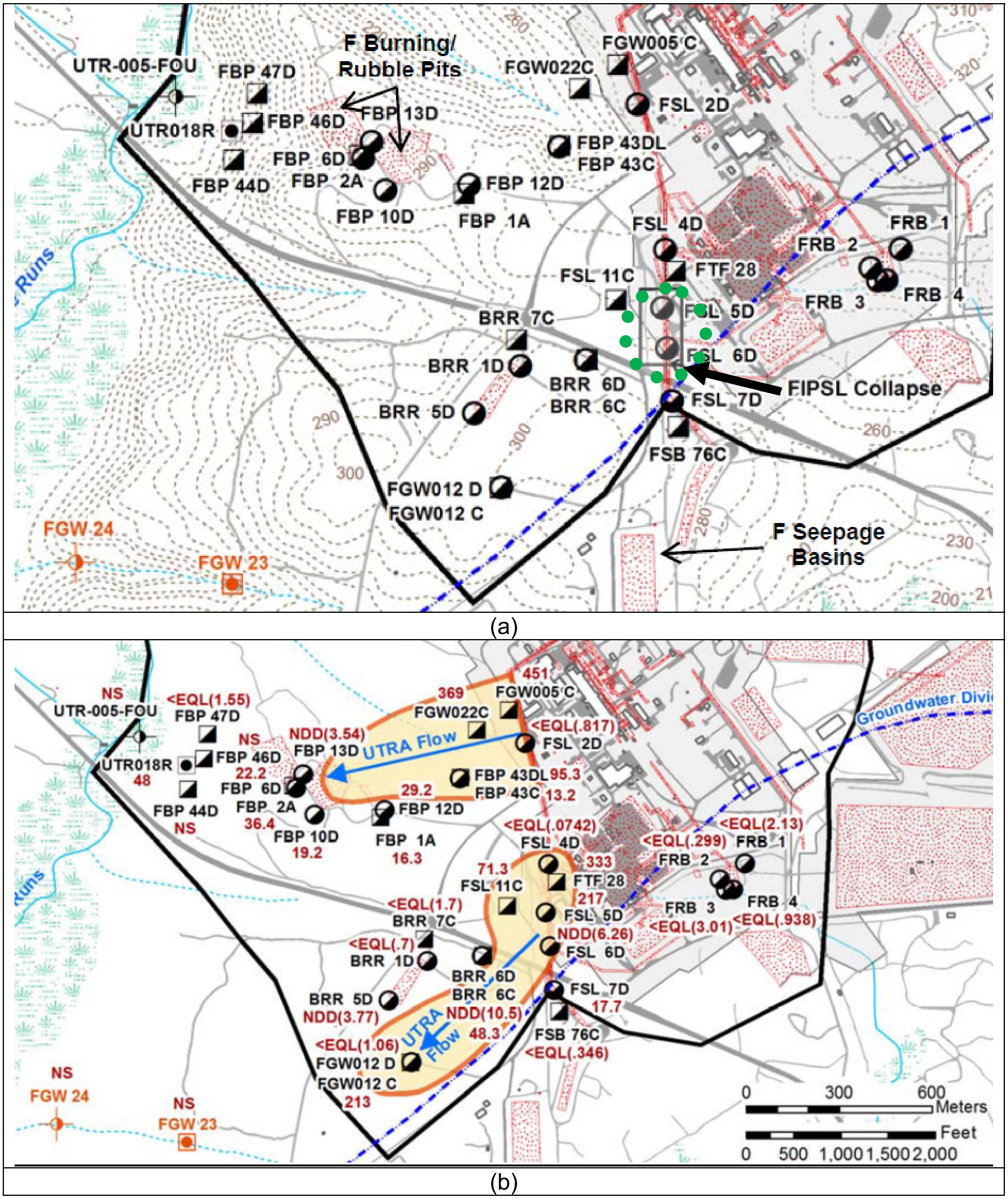

Figure 2: Western Groundwater Operable Unit Monitoring Well Network and Collapsed Section of F-Area Inactive Process Sewer Line (a) and Non-Volatile Beta Plume (b). Adapted from Figure A-2 and A-5 in ERD-EN-2005-0127 (2014).

FTF Well	Screen Interval	Western Sources	Eastern Sources	Assessment of Well Location and Screen Depth
FTF 9R	203-212	--	Tanks 1 and 2	Screen depth high for eastern sources.
FTF 12R	195-205	Tanks 19 and 20	Tanks 3 and 4	Screen depth okay for western sources. Screen depth high for eastern sources.
FTF 19	198-228	Tank 44	Tanks 5 and 6	Not aligned well, but screen depth okay for western sources. Screen depth high for eastern sources.
FTF 20	198-228	Tanks 25 and 44	Tanks 7 and 8	Screen depth little high but okay for western sources. Screen depth high for eastern sources.
FTF 22	212-242	Tanks 27 and 46	--	Screen depth high for western sources.
FTF 23	201-231	Tank 47	Tanks 33 and 34	Screen depth okay but a little high for western sources. Screen depth okay but a little high for eastern sources.
FTF 28	151-161	--	Tanks 5 and 6	Screen depth high for eastern sources.
FTF 29	157-177	--	Tank 1 and 2	Screen depth high for eastern sources.
FTF 30	183-193	Tanks 26 and 45	--	Screen depth little low for western sources.
FTF 30D	213-223	Tanks 26 and 45	--	Screen depth high for western sources.
FTF 31	186-196[4]	--	Tanks 33 and 34	Screen depth okay for eastern sources.

Table 1: Assessment of FTF Monitoring Well Network Based on Figure 3 and PORFLOW Model Simulations.

[4] Note that SRNS-RP-2014-00226 indicates that the screen depth for FTF 31 is 76-106 ft. This is different than the screen depth reported in a data report with FTF well construction details provided as a follow-up action item from the September 26-27, 2012, Onsite Observation (ML12299A188) of 96-106 ft.

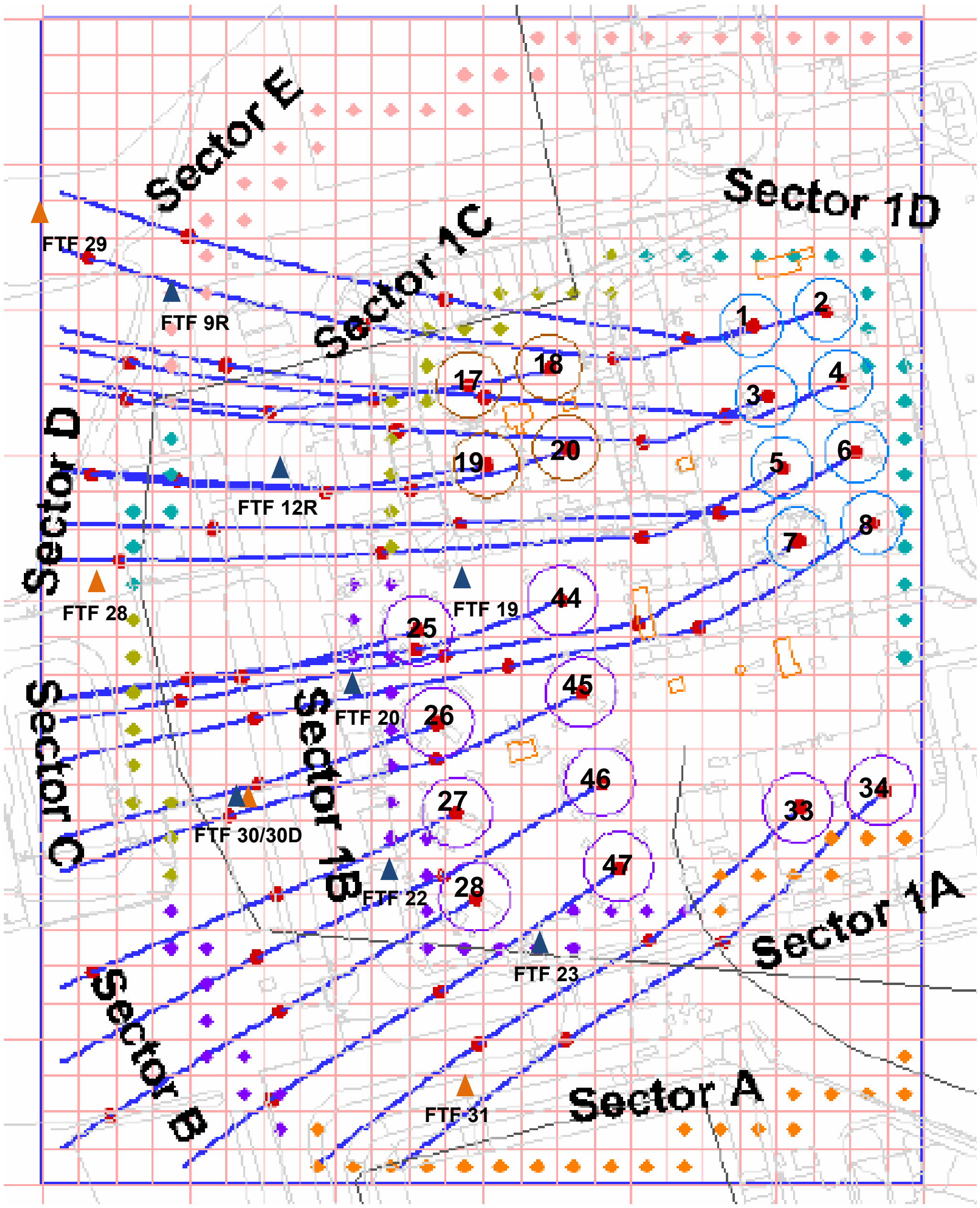

Figure 3: Stream Traces from FTF Tanks, FTF Local Model Grid, and FTF Well Locations Assigned to Model Cells. Adapted from Figure 5.2-5, SRS-REG-2007-00002, Rev. 1.

Review of Distribution Coefficient Reports (Monitoring Factor 4.1 "Natural Attenuation of Plutonium" (ML12212A192))

DOE performed a statistical analysis of 64 K_d values (SRNL-STI-2011-00672) taken from many areas and materials around the Savannah River Site, in an attempt to re-examine K_d from a site-wide perspective. In this report, chemistry is considered only in a very simple manner (i.e. pH binned as greater or less than 7) and Plutonium(Pu) redox state was not considered. As a result NRC staff considers this statistical analysis inappropriate.

This same report suggests that a Pu K_d value of 650 mL/g be used for sandy sediment because 1) information from a modeling analysis (Demirkanli, 2007) of long-term lysimeter studies (Kaplan et al., 2006) indicate that the K_d should be 1800 mL/g and that 2) the statistical analysis showed that the 290 ml/g value is in the lower quantiles. The sediment in the lysimeter appears to have had more clay in it than typically found at the FTF location and so the 1800 value was lowered to 650 ml/g. This value in turn was increased for the "near field" of the tanks using a factor of two recommended in SRNL–STI–2009–00473, Rev. 0, to account for greater adsorption due to elevated pH resulting from grout leaching. The use of a factor to adjust K_d for effects of higher pH due to grout is an arbitrary adjustment that will vary with pH, time, and aqueous speciation. It also depends on the scenario by which water intrudes into the tanks, with some conceptual models not involving water that has been conditioned by grout. While leachate that is influenced by cement chemistry will have an impact in the near-field, NRC staff finds the approach of arbitrarily assigning a factor to increase adsorption to be inappropriate.

As expressed further in the HTF Technical Evaluation Report (ML14094A496), NRC staff has technical issues associated with the same cement leachate factors applied in the HTF Performance Assessment (Table 4.2-25; SRR-CWDA-2010-00128, Rev. 1). The cement leachate factors are used to account for the effect of high pH leachate on the ability of natural soils to sorb key radionuclides also present in the leachate. The cement leachate factors used in the HTF Performance Assessment are based on information provided in SRNL-STI-2009-00473, Rev. 0, and Hanford site data. As stated in the HTF Technical Evaluation Report, because the Hanford site geological and geochemical environment contrasts sharply with SRS, using Hanford site data to calculate the factors for SRS is not justified without an element-by-element analysis of the chemical processes affecting sorption. Element-specific considerations were applied to some but not all key radionuclides when deriving cement leachate factors. With respect to uranium(U) and neptunium, DOE uses cement leachate factors for sand greater than 1, and DOE selected a value of 0.9 for Pu, which is higher than the value of 0.25 used in the Hanford study. Selection of the Pu and U cement leachate factors are based on solubility arguments. However, sorption describes a different mechanism limiting aqueous phase concentrations and if limited by solubility, experiments used to study sorption may over-estimate calculated K_d values. As stated in the HTF Technical Evaluation Report, the sorption behavior of actinides at high pH in the unsaturated zone may be strongly dependent on the presence of carbonate species. Sorption may decrease in the presence of elevated pH, if high carbonate concentrations exist in the natural environment. Therefore, additional information is needed to support the cement leachate factors applied for key radionuclides such as Pu.

With regard to Pu K_d averaging approach applied by DOE in its performance assessment models for the SRS tank farms, NRC staff continues to find the approach inadequate as it potentially overestimates travel time for the more mobile fraction of Pu and thus early dose from Pu. Long-term lysimeter experiments conducted at SRS and other work referenced in Kaplan (2006) show that although most Pu is in the (IV) state, there is a small component that at times is in a much more mobile form. In fact, most Pu that is in solution (albeit a very small concentration) is in the Pu (V) form. Even PuO_2 (s) which had been considered a stable form of Pu(IV) has been shown to oxidize in the presence of water forming a substantial fraction (27%) of Pu(VI) (Haschke et al., 2000). In SRS sediment it is thought that Pu cycles repeatedly through the Pu(IV) and Pu(V) oxidation states in response to wet/dry cycles (WSRC–MS–2003–00889). SRNL–STI–2009–00473 lists the 'best" K_d value for sandy soil for Pu (V/VI) as 16 mL/g, while for Pu (III/IV) the "best" value is 300 mL/g. The use of an average K_d value for different oxidation states is not appropriate, even if the values are weighted for proportions of different redox states. The more mobile fraction of Pu should be modeled explicitly in the performance assessment models that will result in the more mobile fraction arriving at the compliance point earlier in time, possibly during the compliance period, and the concentration and dose from the more mobile fraction and less mobile fraction used to assess compliance with the 10 CFR Part 61, Subpart C, performance objectives.

Batch sorption tests were performed to study the sorption behavior of Nb and Se to SRS soils underlying the saltstone disposal facility as well as to study the sorption behavior of Ra to reducing and non-reducing cementitious materials (SREL Doc. R-13-0005, Rev. 1). All of the sorption tests considered oxic and anoxic conditions, as well as four different groundwater chemistries reflecting different stages of cementitious material degradation (and associated pH changes). Although soils underlying the saltstone disposal facility may not be representative of water table aquifer sediments underlying the tank farm facilities, the results of this study are being leveraged to help provide support for the Nb distribution coefficient selected for use in the Tanks 5 and 6 Special Analysis (SRR-CWDA-2012-00106, Rev. 1). As indicated in the Technical Review Report for the Tanks 5 and 6 Special Analysis (ML13273A299), additional support for the Nb distribution coefficient of 160 L/kg was needed given the risk-significance of the parameter and recommendation of SRNL–STI–2009–00473 for the distribution coefficient of 0 L/kg based on the expectation that Nb would exist as an anion in the natural environment at SRS. In fact, SREL Doc. R-13-0005, Rev. 1 also indicates that Nb exists as various ionic species at pH values above neutrality based on a literature review. While the study provides support for Nb K_d s greater than 1200 L/kg for all chemical conditions, several technical issues should be addressed to support the distribution coefficient values including the following:

1. The soils used in the study are representative of soils underlying the SDF and may not be representative of aquifer sediments underlying the tank farms. In general, the soils used in the study have a higher clay content and greater sorption capacity compared to aquifer sediments underlying FTF.
2. Solubility limits may have been exceeded in the experiments. If solubility limits were exceeded, then the results of the experiments may over-estimate K_d.
3. The report indicates that cement leachate factors should be greater than 1 based on the results of the study; however, the study provides insufficient information to conclude that high pH, cement leachate emanating from the tanks would lead to higher sorption coefficients for SRS soils compared to non-cement-impacted leachate (i.e., all K_d s were stated to be >1200 L/kg so there is no basis to conclude which K_ds would be higher). In fact, the text of SREL Doc. R-13-0005, Rev. 1 (page 12) indicates that Nb would exist as an anionic species for higher pH values suggesting that the K_d might decrease with increasing pH characteristic of cement leachate impacted ground waters.

As stated above, the focus of this review is on the Nb distribution coefficient. Other technical issues such as the use of H_2 gas in the experiments that may provide additional reducing capacity beyond what might be achieved in the field, and the targeted Eh and pH for the various pore waters (e.g., relatively low pH achieved for calcite representative pore water) should also be addressed if the results of the study will be relied on in the performance assessment calculations.

Teleconference or Meeting

None.

Follow-up Actions

Most of the technical issues listed in this technical review report are listed in the FTF Monitoring Plan (ML12212A192) and will not be repeated. Unique technical issues not discussed in the FTF Monitoring Plan include the following:

1. The NRC staff will continue to monitor the ability of the tank farm monitoring well network to detect releases from the tank farm facilities following closure. DOE could evaluate the monitoring well network by performing an analysis of the centerline of plumes emanating from tank sources should releases occur in the future, and provide input on optimal well locations to ensure that future releases from the tank farm facility would be detected.

2. The NRC staff will continue to evaluate the source of elevated Tc-99 levels in well FTF 28. It is not clear that releases from the F-Area Inactive Process Sewer Line could migrate vertically to the lower zone of the Upper Three Runs Aquifer in such a short distance from the source. This evaluation is important to ensure that the hydrogeological system at FTF is well understood and that releases from the tanks could be detected by the monitoring well network. DOE could provide additional support for the source of contamination detected at well FTF 28 by performing particle tracking to better understand contaminant plume trajectories. DOE could also perform a more formal statistical analysis of FTF, and Western Groundwater Operable Unit well data to correlate contaminant concentrations associated with various sources.

3. The NRC staff will continue to monitor the K_d averaging approach used to simulate Pu transport in the natural system at FTF. DOE could address the issue by modeling explicitly more mobile and less mobile forms of Pu in future performance assessment calculations.

4. The NRC staff will continue to monitor support for cement leachate factors developed for Pu (and other constituents). DOE could provide support for cement leachate factors by performing site specific analyses.

5. NRC staff will continue to monitor the basis for selection of the Nb distribution coefficient or K_d value of 160 L/kg used in the Tanks 5 and 6 Special Analysis. DOE could address the technical issues by verifying the batch experiments did not exceed solubility limits and are representative of conditions at FTF (e.g., plot solid phase versus aqueous phase concentration or K_d versus concentration; evaluate K_d for FTF aquifer soils); or perform additional experiments to verify the Nb K_d.

Open Issues

None.

Conclusions

The NRC staff has performed technical reviews of environmental monitoring and site-specific distribution coefficient reports prepared by the DOE to support FTF closure at Savannah River Site. This technical review memorandum is related to Monitoring Factor 4.1, “Natural Attenuation of Pu”, and Monitoring Factor 4.3, “Environmental Monitoring” listed in NRC staff’s FTF Monitoring Plan (ML12212A192). The NRC staff concludes the following:

1. DOE has performed environmental monitoring at the FTF that provides useful information on the hydrogeological system at FTF. This information can also be used to better understand contaminant flow and transport and validate DOE Performance Assessment models.

2. Uncertainty exists in the source of contaminant plumes detected via the FTF monitoring well network. Reducing this uncertainty will be important to better understanding contaminant flow and transport processes operable at the FTF.

3. Progress has been made on development of cement leachate factors used to account for the impact of cement leaching on natural system sorption; however, additional information is needed to support factors for key radionuclides such as Np, Pu, and U.

4. Progress has been made on development of site-specific K_d s for Nb; however, additional information is needed to support K_d values used in performance assessment calculations.

5. Little progress has been made to address the technical issue associated with the Pu K_d averaging approach used in tank farm performance assessment calculations. DOE should address this technical issue in the future.

Many of the technical issues listed in this technical review report are listed in the FTF Monitoring Plan (ML12212A192) and will not be repeated here. Unique technical issues not discussed in the FTF Monitoring Plan that are listed as follow-up actions include the following:

1. The NRC staff will continue to monitor the ability of the tank farm monitoring well network to detect releases from the tank farm facilities following closure. DOE could evaluate the monitoring well network by performing an analysis of the centerline of plumes emanating from tank sources should releases occur in the future, and provide input on optimal well locations to ensure that future releases from the tank farm facility would be detected.

2. The NRC staff will continue to evaluate the source of elevated Tc-99 levels in well FTF 28. It is not clear that releases from the F-Area Inactive Process Sewer Line could migrate vertically to the lower zone of the Upper Three Runs Aquifer in such a short distance from the source. This evaluation is important to ensure that the hydrogeological system at FTF is well understood and that releases from the tanks could be detected by the monitoring well network. DOE could provide additional support for the source of contamination detected at well FTF 28 by performing particle tracking to better understand contaminant plume trajectories. DOE could also perform a more formal statistical analysis of FTF, and Western Groundwater Operable Unit well data to correlate contaminant concentrations associated with various sources.

3. The NRC staff will continue to monitor the K_d averaging approach used to simulate Pu transport in the natural system at FTF. DOE could address the issue by modeling explicitly more mobile and less mobile forms of Pu in future performance assessment calculations.

4. The NRC staff will continue to monitor support for cement leachate factors developed for Pu (and other constituents). DOE could provide support for cement leachate factors by performing site specific analyses.

5. NRC staff will continue to monitor the basis for selection of the Nb distribution coefficient or K_d value of 160 L/kg used in the Tanks 5 and 6 Special Analysis. DOE could address the technical issues by verifying the batch experiments did not exceed solubility limits and are representative of conditions at FTF (e.g., plot solid phase versus aqueous phase concentration or K_d versus concentration; evaluate K_d for FTF aquifer soils); or perform additional experiments to verify the Nb K_d.

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