September 1, 2009

MEMORANDUM TO: Gregory Suber, Chief
Low-Level Waste Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

THRU: Christepher McKenney, Chief **/RA/ by K. Pinkston for**
Performance Assessment Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

FROM: David Esh, Sr. Systems Performance Analyst **/RA/**
Performance Assessment Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

SUBJECT: TECHNICAL REVIEW: SOIL CONTAMINATION DATA AND ASSOCIATED ANALYSIS FOR VAULT 4 OF THE SALTSTONE DISPOSAL FACILITY

On January 8, 2009, the U.S. Department of Energy, Savannah River Operations Office, provided reports describing soil sampling and associated analysis for soil contamination in the vicinity of Vault 4 of the saltstone disposal facility for review by the Nuclear Regulatory Commission (NRC) staff pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005. The subject reports are available on NRC's Agencywide Documents Access and Management System (ADAMS) at accession numbers ML090120429, ML090120404, ML090120475, ML090120546, and ML090120539. These reports were reviewed in accordance with monitoring activities described in "U.S. Nuclear Regulatory Commission Plan for Monitoring the U.S. Department of Energy Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005" (ML070730363). The staff's technical review summary is attached for your use.

Docket No.: PROJ0734

Enclosure: Technical Review Summary

September 1, 2009

MEMORANDUM TO: Gregory Suber, Chief
Low-Level Waste Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

THRU: Christepher McKenney, Chief **/RA/ by K. Pinkston for**
Performance Assessment Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

FROM: David Esh, Sr. Systems Performance Analyst **/RA/**
Performance Assessment Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

SUBJECT: TECHNICAL REVIEW: SOIL CONTAMINATION DATA AND ASSOCIATED ANALYSIS FOR VAULT 4 OF THE SALTSTONE DISPOSAL FACILITY

On January 8, 2009, the U.S. Department of Energy, Savannah River Operations Office, provided reports describing soil sampling and associated analysis for soil contamination in the vicinity of Vault 4 of the saltstone disposal facility for review by the Nuclear Regulatory Commission (NRC) staff pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005. The subject reports are available on NRC's Agencywide Documents Access and Management System (ADAMS) at accession numbers ML090120429, ML090120404, ML090120475, ML090120546, and ML090120539. These reports were reviewed in accordance with monitoring activities described in "U.S. Nuclear Regulatory Commission Plan for Monitoring the U.S. Department of Energy Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005" (ML070730363). The staff's technical review summary is attached for your use.

Docket No.: PROJ0734
Enclosure: Technical Review Summary

DISTRIBUTION:
DBrown CGrossman KPinkston LHoward/CNWRA

ML092300572

OFC	DWMEP	DWMEP	DWMEP:BC	DWMEP
NAME	D.Esh	A. Walker-Smith	KPinkston for C.McKenney	D.Esh
DATE	8/25/09	08/27/09	9/25/09	9/1/09

OFFICIAL RECORD COPY

TECHNICAL REVIEW SUMMARY: *SOIL CONTAMINATION DATA AND ASSOCIATED ANALYSIS FOR VAULT 4 OF THE SALTSTONE DISPOSAL FACILITY*

Review Completed: July 2, 2009

Reviewer(s): D. Esh

Document(s): Rosenberger, K. H., *Comparison of Vault 4 Soil Sampling Results to Existing Unreviewed Disposal Question Evaluation*, SRS-REG-2007-00041, SRNS-J2100-2008-00013, Savannah River Nuclear Solutions. December, 2008b. ADAMS Accession # ML090120429

Kubilius, W., *Z-area Vault 4 Phase 2 Soil Sample Analytical Data Report*, ERD-EN-2008-0083, Savannah River Site, December 2008. ADAMS Accession # ML090120404

Rosenberger, K. H., *Unreviewed Disposal Question Evaluation: Evaluation of Liquid Weeping from Saltstone Vault 4 Exterior Walls*, SRS-REG-2007-00041, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina, April 2008a. ADAMS Accession # ML090120475

Kent, E., *Letter to J. Buczek, WSRC, re: Samples received on February 14, 2008*, GEL Laboratories, March, 2008. ADAMS Accession # ML090120546

Kent, E., Letter to J. Buczek, *WSRC, re: Samples received on July 16, 2008*, GEL Laboratories, September, 2008. ADAMS Accession # ML090120539

Evaluation

The reports provide data from sampling and associated analysis of soil contamination that occurred outside of Cell E of Vault 4 at the Saltstone Disposal Facility (SDF). The soil contamination resulted from active weep sites in the exterior vault wall and at the joint between the vault wall and wall floor. The Department of Energy (DOE) collected samples and performed analysis to determine the magnitude and spatial extent of contamination (Kubilius, 2008). DOE concluded that a very large fraction (> 99%) of the contamination was located within 2 feet (0.6 m) of the release points. In addition, the Unreviewed Disposal Question Evaluation (UDQE) evaluation concluded that there was no significant impact to public health and safety due to an assumed release of up to 1000 liters of undiluted salt solution (Rosenberger, 2008a). This review documents the U.S. Nuclear Regulatory Commission (NRC) staff evaluation of the sampling, analysis, and evaluation. As previously noted by NRC staff in the March 2008 onsite observation report (ML081290367), staff agreed that the risk from leakage from the vaults during operations had been appropriately assessed by DOE and that the performance objectives were likely to continue to be met. However, substantial increases in

the expected inventory that has been released or the concentration of that inventory could invalidate that conclusion. Based on current information, the risks are likely limited and public health and safety continues to be protected.

Soil sampling was conducted in two phases, and the second phase had two objectives, 1) to investigate the spatial extent of the most contaminated area sampled by Phase 1 (location ZV4-002 at Cell E) and 2) to obtain I-129 data. Samples were collected at a variety of locations and up to five different depth intervals. Figures 2 and 3 of (Kubilius, 2008) provide illustrations of the sampling locations. The shallowest sample depth comprised the 0 to 3 inch (0 to 8 cm) depth interval. Samples were analyzed for nitrate and a limited suite of radiological constituents, including gross alpha, nonvolatile beta, C-14, Sr-90, Tc-99, Sb-125, I-129, and Cs-137. The sample results for Cs-137 showed the highest concentrations were closest to the walls and at the shallowest sample depths. NRC staff believes the fact that contamination was found a much more significant distance laterally from the walls (> 3 m) compared to depth suggests surface runoff and stormwater flow was the dominant redistribution process.

The vaults contain concrete footers which extend into the soil approximately 0.6 m from the vault walls. Sampling was performed above and adjacent to the footers, but not underneath. During the March 25-26, 2009 monitoring visit, NRC and DOE staff discussed whether the floor and footers of the vaults could have active weep sites. DOE explained that the causes of the discontinuities in the vault walls were not anticipated in the floors, and that the groundwater sampling plan would identify any releases. Therefore direct soil sampling was not necessary. NRC staff noted that the potential for releases through the vault floors could be much higher, as a result of the larger surface area and continual presence of a hydrostatic head, but otherwise agreed with the DOE conclusion. Sample results for nitrate, which is more mobile, showed maximum concentrations in the 12-24 inch (30-60 cm) or 24-48 inch (60-120 cm) depth intervals. DOE experienced problems with the radiological analysis for I-129. Initially, the laboratory contracted to perform the analysis failed to perform a separation of Cs-137, which made the sample results inconclusive. After the error was recognized, the separation was performed but by that time the maximum holding time of 28 days for iodine-129 analysis had been exceeded.

In (Rosenberger, 2008b) DOE evaluated the soil sampling results with respect to the UDQE performed in April 2008 (Rosenberger, 2008a) and determined the previous evaluation bound the observed soil concentrations. The April 2008 UDQE evaluated the impact of the immediate release of 1000 L of concentrated salt solution to the environment. It employed the NCRP-123 screening methodology to evaluate potential impacts to groundwater. The results, combined with the groundwater sampling program, provided the basis for DOE to conclude that further soil sampling to obtain additional radionuclide concentrations was not warranted. As expressed at the March 25-26, 2009 monitoring visit, NRC staff does not agree with this conclusion. In (Rosenberger, 2008b) DOE used a comparison of the ratio of measured Tc-99 to Cs-137 in the salt solution used as feed for saltstone to the ratios observed in the soil samples to argue that further sampling for I-129 is not needed. DOE believed that because the Tc-99 to Cs-137 was reasonably in line with expectations and both Tc-99 and I-129 are relatively non-sorbing that I-129 should also be in a ratio in the soil similar to that in the salt solution.

NRC staff believes that while the elevated iodine-129 measurement could be an anomaly attributable to sample handling and analysis problems encountered in the laboratory, further investigation by DOE is warranted. The staff believes that differential sorption of radioelements in soil can confound the use of contaminant ratios to judge whether a contaminant should be expected in a given soil sample. In addition, the saltstone grout is designed to reduce technetium and result in low concentrations in solution, which would possibly further modify the ratio for Tc-99 to Cs-137 in saltstone bleedwater, as compared to the ratio in salt waste that has not contacted reducing constituents of the grout (i.e., blast furnace slag). The contaminant ratio argument is indirect, whereas the sampling results are direct (but as discussed above are suspect for current I-129 values due to laboratory analysis problems). For this issue, identification of a soil concentration limit and sampling to determine observed values are less than the limit is sufficient for NRC monitoring.

The contaminant ratio argument and (suspect) sample result can be in strong disagreement or can be in relative agreement depending on the inventory estimate that is used. The reported iodine-129 concentration in a phase 2 gravel sample from 3" to 12" (8 to 30 cm) in depth next to Cell E was 69 pCi/g (a 95 percent confidence interval, or uncertainty value, was not reported). The cesium-137 value for the corresponding phase 1 sample from the same depth and location was 11,700 pCi/g. Using these values, staff calculated a concentration ratio of Cs-137 to I-129 of about 170. Based on the Saltstone Performance Objective Demonstration Document (CBU-PIT-2005-00146, Rosenberger et al June 2005), the then current Vault 4 inventory of I-129 was 8.16E-2 Ci and the inventory of Cs-137 was 16.8 Ci, for a concentration ratio of about 200. This value is consistent with the observed soil concentration ratio.

Using expected SDF inventories cited in the salt waste performance assessment, the expected average Cs-137:I-129 ratio in salt waste is about 75,000 (The UDQE implies an Cs-137:I-129 ratio of 10,000,000:1). NRC staff believes that the reasons for the large difference between an expected Cs-137:I-129 ratio of 75,000 and an observed ratio of 170 should be thoroughly understood by DOE. In addition, the difference between the salt waste performance assessment value (75,000) and the UDQE value (10,000,000) should be clearly described.

The use of contaminant ratios assumes that the contaminants are transported in the environment at the same rate (or are equally sorbing). As noted previously, nitrate (and Tc-99 and I-129) has a significantly different affinity for sorption to soil compared to Cs-137. The UDQE used a Kd for Cs-137 of 50 ml/g and a value of 0.0 ml/g for I-129. I-129 has the potential to exceed the > 2.5 mrem screening criteria used in the UDQE if the inventory was significantly different than anticipated (This is one possible explanation of the I-129 soil sample results). Using information from Table 3 of the UDQE (Rosenberger, 2008a), staff estimate that an I-129 release of 0.002 Ci would exceed the 2.5 mrem screening criteria based on the DOE UDQE analysis.

Teleconferences and Meetings

The subject reports were discussed with representatives of the Department of Energy and its contractors on March 25-26, 2009 at the onsite observation conducted at the Savannah River Site. A summary of the discussion is provided in the onsite observation report (ADAMS accession no. ML091320439). The follow-up action as a result of the discussion was:

1) DOE should continue to investigate the source of iodine-129 detected in soil samples.

Open Issues

No open issues were identified as a result of the review, however as indicated above a follow-up action was identified.

Conclusion

The NRC staff has not identified open issues associated with the methods and data reported in this study at this time. However, DOE has a follow-up action in response to staff questions. The staff plans to review any new information developed by DOE as part of this follow-up action.

This study contains data that may be relied upon in future performance assessment (PA) updates in support of the 2005 DOE waste determination for the Saltstone Disposal Facility. The revised saltstone performance assessment is expected to include the observed locations and form of contamination identified during disposal system operation and monitoring. However, until such time as a PA update is completed and reviewed by NRC staff, the staff cannot fully assess the risk significance of the information. For this reason, all monitoring activities identified under Factors 1-3 of the NRC monitoring plan remain open at this time.