Contract No:

This document was prepared in conjunction with work accomplished under Contract No. 89303321CEM000080 with the U.S. Department of Energy (DOE) Office of Environmental Management (EM).

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Characterization of Infrequent Samples from the Concentration, Storage, and Transfer Facility: Leak Detection Box (LDB) Drain Cell Sample: May 15, 2023, Sample

E. J. Peck

July 2023

SRNL-STI-2023-00252

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Printed in the United States of America

Prepared for
U.S. Department of Energy

SRNL-STI-2023-00252
Revision 0

Keywords: *Tank Farm*

Retention: *Permanent*

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Savannah River National Laboratory is operated by Battelle Savannah River Alliance for the U.S. Department of Energy under Contract No. 89303321CEM000080.

ACKNOWLEDGEMENTS

The author acknowledges assistance in the completion of sample transfers and handling tasks by S. McCollum and the completion of sample analyses tasks by David DiPrete, Sonia Dyer, and the nuclear measurements team.

EXECUTIVE SUMMARY

Savannah River Mission Completion Engineering (SRMC-E) requested that the Savannah River National Laboratory (SRNL) analyze the Concentration, Storage, and Transfer Facility (CSTF) samples from the following Tank Farm areas: the sump encasement, catch tank, drain cell, and waste tank annulus. In general, these CSTF samples will be analyzed on an infrequent basis and analyses will include detection for total beta/gamma activities, total alpha activity, free hydroxide, and pH measurements. SRMC-E corresponded with SRNL to obtain the final results through memo SRNL-L3120-2023-00013.

This report presents characterization results for the leak detection box (LDB) May 15, 2023, drain cell sample. The sample was clear and colorless with no visible particulates. The results are measurements for total gamma, total alpha, total beta, free hydroxide, pH, and density.

These analyses were performed in triplicate. A summary of the average analytical results for the LDB sample includes the following.

The measured pH for the LDB May 15, 2023 “as-received” drain cell sample range was 6.60-6.89, and the free hydroxide concentration as expected, based upon the pH, was <0.02 M. The average measured density of the “as-received” drain cell sample determined at 22 ºC was 1.022 ± 0.001 g/mL. The average measured total alpha activity for the LDB May 15, 2023, sample was 3.04E+02 ± 1.13E+01. This value is less than 4.83E+03 dpm/mL, which is the procedural limit for non-waste determination.

The total empirical activity of the beta and gamma emitting (represented by the sum of total beta and $Ba\text{-}137^{m}$ activities) averaged to 1.83E+04 ± 1.07E+03 dpm/mL. This value is less than 8.69E+05 dpm/mL, which is the procedural limit for non-waste determination.

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CSTF	Concentration, Storage and Transfer Facility
LDB	Leak Detection Box
LSC	Liquid Scintillation Counting
ND	Not Detected
PMP	Polymethyl pentene
SRNL	Savannah River National Laboratory
SRMC-E	Savannah River Mission Completion-Engineering
TTQAP	Task Technical and Quality Assurance Plan
TTR	Technical Task Request

1.0 Introduction

On occasion, Savannah River Mission Completion Engineering (SRMC-E) will request Savannah River National Laboratory (SRNL) to perform analysis on Concentration, Storage, and Transfer Facility (CSTF) samples originating from the sump encasement, catch tank, drain cell, or waste tank annulus per the Technical Task Request (TTR) or email. In May 2023, SRMC-E sent SRNL a sample identified as LDB from a leak detection box. Following the specified TTR, Task Technical and Quality Assurance Plan (TTQAP), and updated request by SRMC-E through email, SRNL tested the sample for Total Alpha and Total Beta by liquid scintillation counting (LSC), Cs-137 by Gamma scan, free hydroxide, and pH.[1,2] SRMC-E corresponded with SRNL to obtain the final results through memo SRNL-L3120-2023-00013.[3]

2.0 Experimental Procedure

The leak detection box (LDB) drain cell sample was received on May 15, 2023, at SRNL. As the "as-received" sample radiation dose rate was Not Detected (ND) mrem/hr for extremity, skin, and whole body, the labeled container, LDB Drain Cell, was moved to a radiological hood for inspection. 80 mL of sample was received from the stainless-steel receipt vessel and was transferred into a clear polymethyl pentene (PMP) beaker for visual inspection. Figure 2-1 shows a photograph of the LDB drain cell sample in the PMP beaker.

The visual appearance of the sample was clear, colorless, and with no visible particulates. The sample was therefore not filtered. Aliquots of the sample were transferred directly into shielded bottles. These samples were then submitted for analyses in triplicate preparation for free hydroxide, pH, Cs-137, total alpha and total beta.

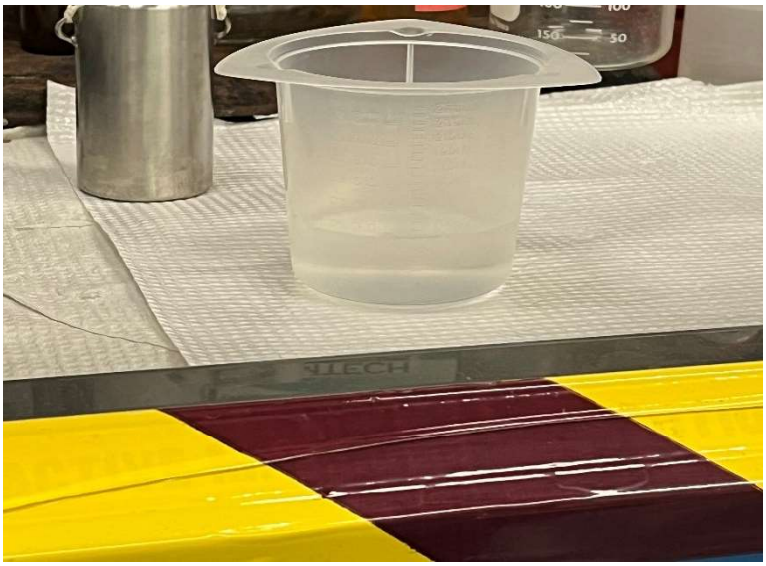

Figure 2-1. Photograph of the LDB Drain Cell Sample in a PMP beaker.

The density of the "as-received" LDB sample was performed in triplicates, in a radiological laboratory hood of around 22°C. 2.0 mL of the "as-received" LDB samples was measured out into the reference glass test tube and weighed to obtain the weight of the sample. With the weight data received and reference volume measured, the density was calculated.

2.1 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in manual E7 2.60.[4] SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.[5] This review, a design verification done by document review, meets the acceptance criteria to comply with the TTR requesting this work with a functional classification of Safety Class and per guidance in the TTQAP.[1] Data are recorded in the electronic laboratory notebook system as Experiment ID K6349-00614-02.[6]

3.0 Results and Discussion

Separate samples were submitted in triplicate for analysis for free hydroxide, pH, Cs-137, total alpha, and total beta. These results are provided in Table 3-1 and Table 3-2.

The directly measured pH for the LDB May 15, 2023 "as-received" drain cell sample range was 6.60-6.89, and the free hydroxide concentration was <0.02 M. The average measured density of the "as-received" drain cell sample determined at 22 ºC was 1.022 ± 0.001 g/mL. The average measured total alpha activity for the LDB May 15, 2023, sample was 3.04E+02 ± 1.13E+01 dpm/mL. This value is less than 4.83E+03 dpm/mL, which is the procedural limit for non-waste determination.[7]

Total gamma, beta and alpha were measured through radiochemical analysis by liquid scintillation counting (LSC) and Gamma scan. The average measured total beta activity in the LDB May 15, 2023, drain cell sample was 9.91E+03 ± 9.99E+02 dpm/mL.

The average measured cesium-137 activity (dominant beta emitter) in the LDB May 15, 2023, drain cell sample was 8.86E+03 ± 1.20E+02 dpm/mL. The corresponding Ba-137^{m} (dominant gamma emitter) activity, calculated as 94.6% of the Cs-137 values, was 8.38E+03 ± 1.14E+02 dpm/mL.

The total empirical activity of the beta and gamma emitting (represented by the sum of total beta and Ba-137^{m} activities) averaged to 1.83E+04 ± 1.07E+03 dpm/mL. This value is less than 8.69E+05 dpm/mL, which is the procedural limit for non-waste determination.[7]

Analytical Results:

Table 3-1. Results for the May 15, 2023, LDB Drain Cell Sample: Total Alpha, Total Beta, Cs-137, and Ba-137^m.

Replicate	Total Alpha (dpm/mL)	Total Beta (dpm/mL)	Cs-137 (dpm/mL)	Ba-137^m (dpm/mL)**	Sum of Total Beta and Ba-137^m (dpm/mL)
1	2.97E+02	1.08E+04	8.86E+03	8.38E+03	1.92E+04
2	2.98E+02	1.01E+04	8.98E+03	8.50E+03	1.86E+04
3	3.17E+02	8.83E+03	8.74E+03	8.27E+03	1.71E+04
Average	3.04E+02 ± 1.13E+01	9.91E+03 ± 9.99E+02	8.86E+03 ± 1.20E+02	8.38E+03 ± 1.14E+02	1.83E+04 ± 1.07E+03
% RSD	3.71	10.08	1.35	1.35	5.87
One Sigma % Uncertainty*	33.8-36.5	15.0	5.00	5.00	15.8

*All One Sigma % Uncertainty values are as reported with the analytical methods. **Ba-137^m activity is calculated as 94.6% of the Cs-137 activity.

Table 3-2. Results for the May 15, 2023, LDB Drain Cell Sample: pH, Free Hydroxide, and Density.

Replicate	pH	Free Hydroxide (M)	Density (g/mL)
1	6.60	<0.02	1.023
2	6.89	<0.02	1.021
3	6.88	<0.02	1.022
Average*	6.60-6.89	<0.02	1.022 ± 0.001
% RSD	N/A	N/A	0.075
One Sigma % Uncertainty**	10	10	1.47

*The pH is reported in a range and not an average value because it is a logarithmic term. **All One Sigma % Uncertainty values are as reported with the analytical methods.

4.0 Conclusions

The LDB drain cell sample characterization indicated low to moderate gamma and beta activity in the sample. The pH range was 6.60-6.89, and the free hydroxide was <0.02 M. Total alpha (3.04E+02 dpm/mL) and total beta/gamma activities (1.83E+04 dpm/mL) are less than the respective values of 4.83E+03 dpm/mL and 8.69E+05 dpm/mL for non-waste determination.

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Distribution:

Cj.bannochie@srnl.doe.gov
William.bates@srnl.doe.gov
marion.cofer@srnl.doe.gov
alex.cozzi@srnl.doe.gov
connie.herman@srnl.doe.gov
brady.lee@srnl.doe.gov
Joseph.Manna@srnl.doe.gov
Gregg.Morgan@srnl.doe.gov
frank.pennebaker@srnl.doe.gov
William.Ramsey@srnl.doe.gov
eric.skidmore@srnl.doe.gov
michael.stone@srnl.doe.gov
Boyd.Wiedenman@srnl.doe.gov
bill.clark@srs.gov
lawrence.oji@srnl.doe.gov
john.dekarske@srnl.doe.gov
elizabeth.peck@srnl.doe.gov
jeffrey.crenshaw@srs.gov
james.folk@srs.gov
Curtis.Gardner@srs.gov
timothy.littleton@srs.gov
Anna.Murphy@srs.gov
tony.polk@srs.gov
Anthony.Robinson@srs.gov
mark-a.smith@srs.gov
thomas.temple@srs.gov
celia.aponte@srs.gov
timothy.baughman@srs.gov
phillip.norris@srs.gov
Azadeh.Samadi-Dezfouli@srs.gov
Vijay.Jain@srs.gov
Bruce.wiersma@srnl.doe.gov
Keisha.martin@srs.gov
Matthew.Hoffman@srs.gov
Collins.Geter@srs.gov
Nilesh.Amin@srs.gov
Brady.Speight@srs.gov
Kevin.O'connor@srs.gov
andrew.marvel@srs.gov
TF-STE@srs.gov

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