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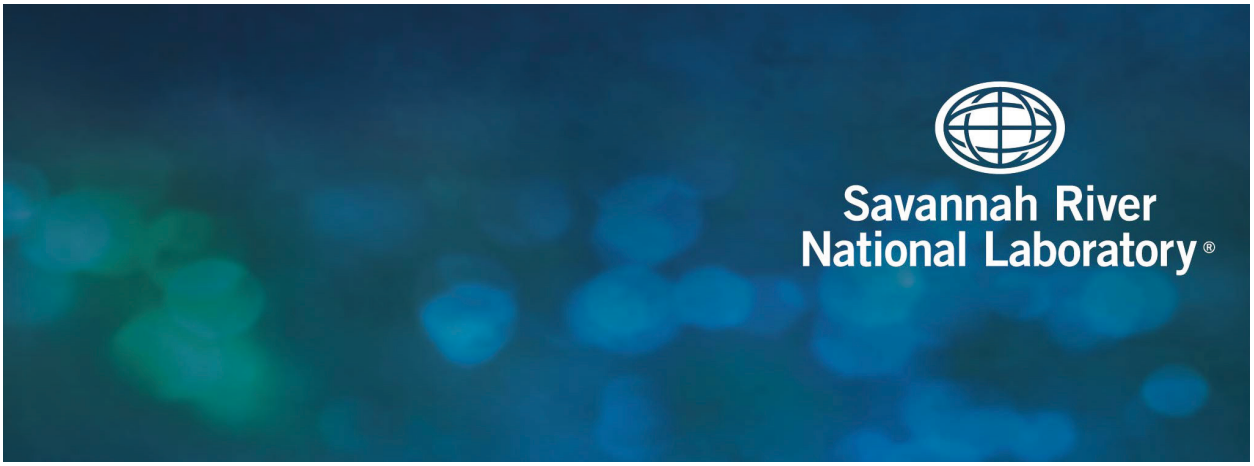

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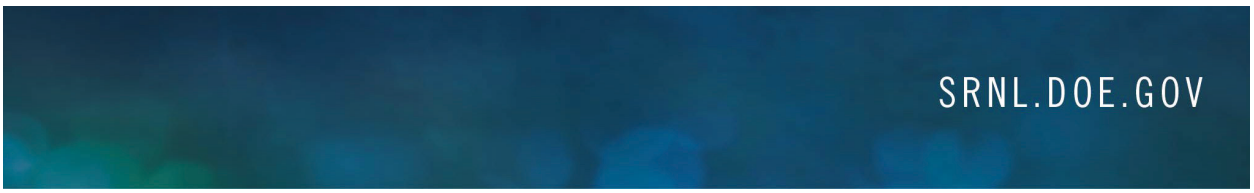
Characterization of Infrequent Samples from the Concentration, Storage, and Transfer Facility: Leak Detection Box (LDB) Drain Cell Sample: August 04, 2022 Sample

J. R. Dekarske

September 2022

SRNL-STI-2022-00403, Revision 0



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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.

This report presents characterization results for the leak detection box (LDB) August 04, 2022 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, and pH.

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

The directly measured pH for the LDB August 04, 2022 "as-received" drain cell sample range was 7.16-7.88, and the free hydroxide concentration was <0.01 M. The total alpha activity for the LDB August 04, 2022 sample is reported as a less than value (MDA) either because of possible spectral interferences or because there is not much alpha activity in the sample. Thus, the total alpha activity averaged <5.17E+02 dpm/mL. This value is less than 4.83E+03 dpm/mL, which is the procedural limit for non-waste determination.[i]

The total beta activity in the LDB August 04, 2022 drain cell sample is above the instrument detection limits and averaged 4.88E+04 dpm/mL. The beta activity of the sample is mostly from Cs-137 which is evidenced by the cesium removed beta activity being two orders of magnitude lower than the total beta activity.

The average measured cesium-137 activity (dominant beta emitter) in the LDB August 04, 2022 drain cell sample is 4.16E+04 dpm/mL, which is slightly lower than the total beta activity. The corresponding Ba-137m (dominant gamma emitter) activity, calculated as 94.6% of the Cs-137 values, is 3.94E+04 dpm/mL.

The total empirical activity of the beta and gamma emitting (represented by the sum of total beta and Ba-137m activities) averaged 8.82E+04 dpm/mL. This value is less than 8.69E+05 dpm/mL, which is the procedural limit for non-waste determination.[i]

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LIST OF ABBREVIATIONS

CSTF	Concentration, Storage and Transfer Facility
LDB	Leak Detection Box
LSC	Liquid Scintillation Counting
MDA	Minimum Detectable Activity
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 August 2022, SRMC-E sent SRNL a sample identified as LDB from a leak detection box. Following the specified TTR[ii], Task Technical and Quality Assurance Plan (TTQAP)[iii], 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.

2.0 Experimental Procedure

The leak detection box (LDB) drain cell sample was received on August 04, 2022 at SRNL. As the "as-received" sample radiation dose rate was Not Detected (ND) mrem/hr extremity and skin and whole body, the container was moved to a radiological hood for inspection. Less than 100 mL of sample was collected from the stainless-steel receipt vessel and was transferred into a clear polymethyl pentene (PMP) bottle for visual inspection.[iv]

The sample appearance was clear and colorless with no visible particulates. The sample was not filtered. Aliquots of the sample were directly transferred into shielded bottles and submitted in triplicate preparations each for total gamma/beta/alpha, free hydroxide, and pH analyses by direct measurement using a pH probe. The remaining sample was stored in a plastic bottle.

2.1 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in manual E7 2.60[v]. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2[vi]. This review, a design verification done by document review, meets the acceptance criteria to comply with the TTR[ii] requesting this work with a functional classification of Safety Class and per guidance in the TTQAP.[iii] Data are recorded in the electronic laboratory notebook system as Experiment ID M0869-00537-12.

3.0 Results and Discussion

A photograph of the LDB drain cell sample is provided in Figure 3-1. Separate samples were submitted in triplicate for analysis by each of the following methods: 1) radiochemical analysis (total gamma, beta, and Cs-removed beta and alpha), 2) free hydroxide, and 3) pH. Results are provided in Table 3-1.

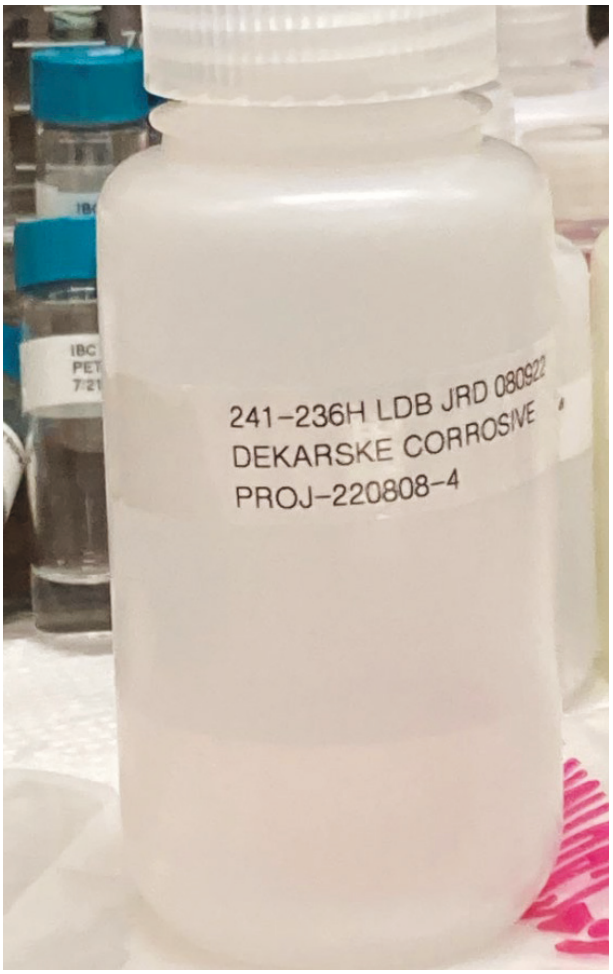

Figure 3-1. Photograph of the LDB drain cell Sample in Plastic Bottle

Table 3-1. Results for August 04, 2022 LDB drain cell sample: Total Alpha, Total Beta, Total Gamma scan, pH, and Free Hydroxide.

Test	Replicate 1	Replicate 2	Replicate 3	Average	%RSD
Total Alpha (dpm/mL) (one sigma %uncertainty)	*<4.74E02 (MDA)	*<5.17E02 (MDA)	*<4.77E02 (MDA)	*<5.17E02 (MDA)	N/A
Cs-Removed Alpha (dpm/mL) (one sigma % uncertainty)	*<1.76E02 (MDA)	*<1.71E02 (MDA)	*<1.76E02 (MDA)	*<1.76E02 (MDA)	N/A
Total Beta (dpm/mL) (one sigma % uncertainty)	4.86E04 (11%)	4.88E04 (11%)	4.89E04 (11%)	4.88E04	0.31
Cs-Removed Beta (dpm/mL) (one sigma % uncertainty)	1.07E03 (25%)	1.55E03 (21%)	1.31E03 (22%)	1.31E03	18.32
Cs-137 (dpm/mL) (one sigma % uncertainty)	4.15E04 (5.00%)	4.18E04 (5.00%)	4.16E04 (5.00%)	4.16E04	0.37
**Ba-137m (dpm/mL)	3.93E04	3.95E04	3.94E04	3.94E04	0.37
**Sum of Total Beta and Ba-137m (dpm/mL)	8.79E04	8.83E04	8.83E04	8.82E04	0.29
pH (one sigma uncertainty)	7.88 (10%)	7.35 (10%)	7.16 (10%)	***Range: 7.16-7.88	N/A
Free Hydroxide (M) (one sigma uncertainty)	<0.01 (10%)	<0.01 (10%)	<0.01 (10%)	<0.01	N/A

*Note: Results were below detectable limit for quantification by method, therefore result is the minimum detectable activity based on sensitivity of the analysis method. Thus, the average value reported is the highest "<" result. All one sigma % uncertainties are as reported with the analytical methods. **Note: Ba-137m activity is calculated as 94.6% of the Cs-137 value. ***Note: pH given as a range as it cannot be averaged as a logarithm.

4.0 Conclusions

The LDB drain cell sample characterization indicated low to moderate gamma and beta activity in the sample and no measurable alpha activity/Cs-removed alpha activity. The pH range was 7.16-7.88, and the free hydroxide was <0.01 M. Total alpha (<5.17E02 dpm/mL) and total beta/gamma activities (8.82E04 dpm/mL) are less than the respective values of 4.83E+03 dpm/ml and 8.69E+05 dpm/mL for non-waste determination.

5.0 References

[i] "Tank Farm Transfer Control Program, Pump Tank Transfer Jet Control Program, and Waste Tank Chemical Cleaning Program", WSRC-TR-2002-00403, Rev. 33, August 2021
[ii] Technical Task Request, "Infrequent CSTF Samples", X-TTR-H-0101, Rev. 1, June 2021.
[iii] L. N. Oji, S. C. Lucatero, "Task Technical and Quality Assurance Plan for the Analysis of Infrequent Samples from the Concentration, Storage, and Transfer Facility", SRNL-RP-2020-00565, Rev.1, July 2021.
[iv] J. R. Dekarske: ELN: M0869-00537-12 (Electronic Notebook (Production)); SRNL, Aiken, SC 29808 (2022).
[v] "Technical Reviews," E7 Manual, Procedure 2.60, Rev. 18, 2019.
[vi] "Savannah River National Laboratory Technical Report Design Check Guidelines", WSRC-IM-2002-00011, Rev.2, 2004.

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