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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Increased Fissile Loading Flowsheet Review

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August 2021

SRNL-STI-2021-00156, Revision 0

SRNL.DOE.GOV

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Prepared for
U.S. Department of Energy

SRNL-STI-2021-00156
Revision 0

Keywords: *fissile, radioactive waste*

Retention: *Varies*

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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.

REVIEWS AND APPROVALS

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PREFACE OR ACKNOWLEDGEMENTS

This task was supported by dozens of engineers and researchers from SRNS, SRR and SRNL. Key members of the flowsheet review team included Tara Smith of SRNS and Terri Fellinger of SRR, supported by Leo Thompson and Frank Pennebaker of SRNL as available. The support of all was essential in looking at the various facilities and best understanding the specific radionuclides that might be problematic for each of them.

EXECUTIVE SUMMARY

A request was made by H-Canyon Process Engineering to assess the impact of blending dissolved, neutralized Spent Nuclear Fuel (SNF) with future sludge batches and their impact on downstream processing facilities including the Concentration, Storage and Transfer Facilities (CSTF), the Salt Waste Processing Facility (SWPF), the Defense Waste Processing Facility (DWPF), Saltstone, and the Effluent Treatment Facility (ETF). The purpose of this change is to accelerate the deinventory of SNF which is currently stored in the L-Area Disassembly Basin. The addition of SNF increases the mass of fissiles in each future sludge batch, due to their high enrichment. This high enrichment has the potential to complicate the programs to eliminate criticality events in the downstream processing facilities and will increase the number of canisters produced by DWPF because of the SNF mass increase. A separate report addressed the impacts to glass.

The review and subsequent calculations were based on average predicted compositions of Accelerated Basin Deinventory (ABD) slurry, average compositions for predicted future sludge batches, average past salt batches and average past recycle batches to predict the feeds that will be processed in SWPF, DWPF, Saltstone, the 2H evaporator and ETF. Each of the processes was evaluated for potential issues.

Using these average composition predictions, WAC requirements for the fissiles and other significant radionuclides that are added with the ABD can be met, including Cs-137, Sr-90 and U-235. The addition of ABD material did increase the mass of aluminum and sodium, but this did not increase the concentration of these in the blended sludge due to the Low Temperature Aluminum Dissolution (LTAD) and sludge washing in the CSTF. The ABD stream is also high in nitrate but much of this is removed through washing of the sludge batch. DWPF compensates for higher nitrate not removed by washing by adding more reducing acid, leading to the production of a similar Slurry Mix Evaporator (SME) product. The main impacts are the increase in fissile isotopes, primarily U-235 and the mass of additional U-238 required to reduce the enrichment below 5 wt%. The predicted fissile concentration in glass is 2,010 g/m^3, lower than the planned 2,500 g/m^3 maximum. This provides margin to add additional fissiles to one or more of the future sludge batches. Furthermore, this added uranium does not exceed the uranium concentrations that have been previously evaluated using the DWPF glass models.

It should be noted that this review was based on projected averages and past experience and the data collected from the Waste Characterization System (WCS) database. There are some projected sludge or salt tanks that will be high in some radionuclides which might exceed one of the WAC limits and could limit the amount of ABD material added. In addition, there are a number of process upsets that could cause a product to exceed the WAC limit such as a foamover in the DWPF Chemical Processing Cell (CPC), excessive melter entrainment, decontamination of failed equipment such as steam or cooling coils or foaming in the 2H evaporator. However, the frequency of these process upsets is likely the same as has been seen historically but the severity would be higher due to the higher concentration of fissiles in the added ABD material.

Based on this assessment, it is viable to add ABD material to future sludge batches to deinventory the SNF in L basin provided fissile concentration limit in the glass is raised from 897 g/m^3 to 2,500 g/m^3 Note that typical processing will minimize the impact of process upsets on downstream processing facilities such as Saltstone and ETF. But processing with the additional ABD material might slow down throughput and will extend total processing time compared to operation without the ABD material. Since this review focused on average compositions, the flowsheet reviews that SRR completes for each sludge batch are necessary to ensure the WAC limits can be met for each sludge batch. SRR should begin their planning soon to support receiving ABD in preparation of SB11.

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LIST OF ABBREVIATIONS

ABD	Accelerated Basin Deinventory
AFP	Alpha Finishing Process
ARP	Actinide Removal Process
ASNF	Aluminum Spent Nuclear Fuel
ASP	Alpha Strike Process
CPC	Chemical Processing Cell
CSSX	Caustic-side Solvent Extraction
CSTF	Concentration, Storage and Transfer Facilities
DF	Decontamination Factor
DOE	Department of Energy
DSS	Decontaminated Salt Solution
DWPF	Defense Waste Processing Facility
ETF	Effluent Treatment Facility
HFIR	High Flux Isotope Reactor
HGR	Hydrogen Generation Rate
HLW	High-level Waste
HM	H Modified Plutonium Uranium Extraction
LPPPRT	Low Point Pump Pit Recycle Tank
LTAD	Low Temperature Aluminum Dissolution
LW	Liquid Waste
MCU	Modular Caustic Side Solvent Extraction Unit
MDE	Material Disposition Engineering
MST	Monosodium Titanate
MTR	Materials Test Reactor
NA	Not Applicable
NASNF	Nonaluminum Spent Nuclear Fuel
NGS	Next Generation Solvent
NPDES	National Pollutant Discharge Elimination System
PCCS	Product Composition Control System
PFD	Process Flow Diagram
PRFT	Precipitate Reactor Feed Tank
PUREX	Plutonium Uranium Extraction
RCT	Recycle Collection Tank
RSD	Relative Standard Deviation

SAS	Steam Atomized Scrubber
SB	Sludge Batch
SE	Strip Effluent
SEFT	Strip Effluent Feed Tank
SME	Slurry Mix Evaporator
SNF	Spent Nuclear Fuel
SRAT	Sludge Receipt and Adjustment Tank
SPF	Saltstone Processing Facility
SRE	Sodium Reactor Experiment
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions
SRR	Savannah River Remediation
SRS	Savannah River Site
SS	Sludge Solids
SSRT	Salt Solution Receipt Tank
SWPF	Salt Waste Processing Facility
TCCR	Tank Closure Cesium Removal
TIC	Total Inorganic Carbon
TOC	Total Organic Carbon
TTQAP	Task Technical and Quality Assurance Plan
WAC	Waste Acceptance Criteria
WCHT	Waste Concentrate Hold Tank

1.0 Introduction

This task was requested by Savannah River Nuclear Solutions - Materials Disposition Engineering (SRNS-MDE)[1] to support the accelerated disposition of spent fuel stored in L-Basin via the Accelerated Basin Deinventory (ABD) program. As part of the ABD program, the fissile mass loading (sum of U-233, U-235, Pu-239, and Pu-241) of vitrified high-level waste (HLW) processed at the Defense Waste Processing Facility (DWPF) is to be increased from the current limit of 897 g/m^3 to at least 2,500 g/m^3 to accommodate adding the material into currently planned sludge batches.[2] This flowsheet study looked at the impact of increasing the fissile loading as well as increasing to higher concentrations to enable deinventory of L-basin within the lifetime of sludge processing. It is important to include this fissile material in currently planned sludge batches to minimize the number of canisters that will be produced and stored.

In order to address the potential concerns related to the change to increase fissile mass loading, SRNS-MDE requested that the Savannah River National Laboratory (SRNL) evaluate processing waste through the H-Canyon transfers and Liquid Waste system to identify any processing, flowsheet, safety basis or regulatory concerns due to increased fissile material released to the Liquid Waste system. To simplify this evaluation, the study evaluated the addition of a projected nominal ABD stream[3] combined with the average of future sludge batches ("System Plan Revision 22 Case 2 without ABD material added (draft)") and its impact due to increased fissile loading. The scope of this study is summarized in a Task Technical and Quality Assurance Plan (TTQAP).[4]

The primary objective of this task was to perform a flowsheet review to assess the impact of increasing the fissile material in processing facilities including H-Canyon, CSTF for HLW, DWPF, HLW evaporators, Salt Waste Processing Facility (SWPF), Saltstone, and Effluent Treatment Facility (ETF). Since one of the goals is to better understand the impact of actinide species on processing through the Liquid Waste system, the main focus has been to include a good approximation of uranium added through H-Canyon processing. Other species such as aluminum, chromium, mercury, and other chemical species will be included in the evaluation provided by H-Canyon's estimates, but exact concentrations may change over time depending on specific ABD dissolution and chemical adjustment flowsheets. Note that although the flowsheet review is limited, each future sludge batch will be evaluated more comprehensively by SRR System Planning.

2.0 Flowsheet Study Methodology

In FY21, SRNL teamed with process experts from SRNS H-Canyon and Savannah River Remediation (SRR) to complete an Increased Fissile Loading Flowsheet Review study to determine the impact of increasing the fissile material content on processing streams from H-Canyon to storage of the HLW canisters. Note that this isn't the first time a canyon stream that is not an F-Canyon Plutonium Uranium Extraction (PUREX) slurry or H-Canyon H Modified (HM) PUREX sludge slurry has been added to the CSTF. The following streams have been added to CSTF: Pu and Gd for many of the sludge batches, neutralized Am/Cm and Np-237 was added to Sludge Batch (SB) 3[5], Np was added to SB5[6]. and a large fissile discard of uranium was added to SB9 and SB10 as a result of dissolved and neutralized fuel that was added to SB9 and SB10. [4,7] The addition of SRE is most similar to what is planned for processing the ABD stream except that the U-235 concentration will be increased significantly compared to the previous SRE additions.

The addition of ABD material to the sludge stream has the potential to impact the processing throughout the waste processing facilities as summarized in Figure 2-1.The study was designed to be less comprehensive than the typical review that SRR does to prepare for each new Salt and Sludge batch since the details of batch composition are not completely known at this time. To simplify the review, average compositions for ABD material, sludge and salt batches were used. The focus of the study is on ABD stream elements, isotopes, and compounds.

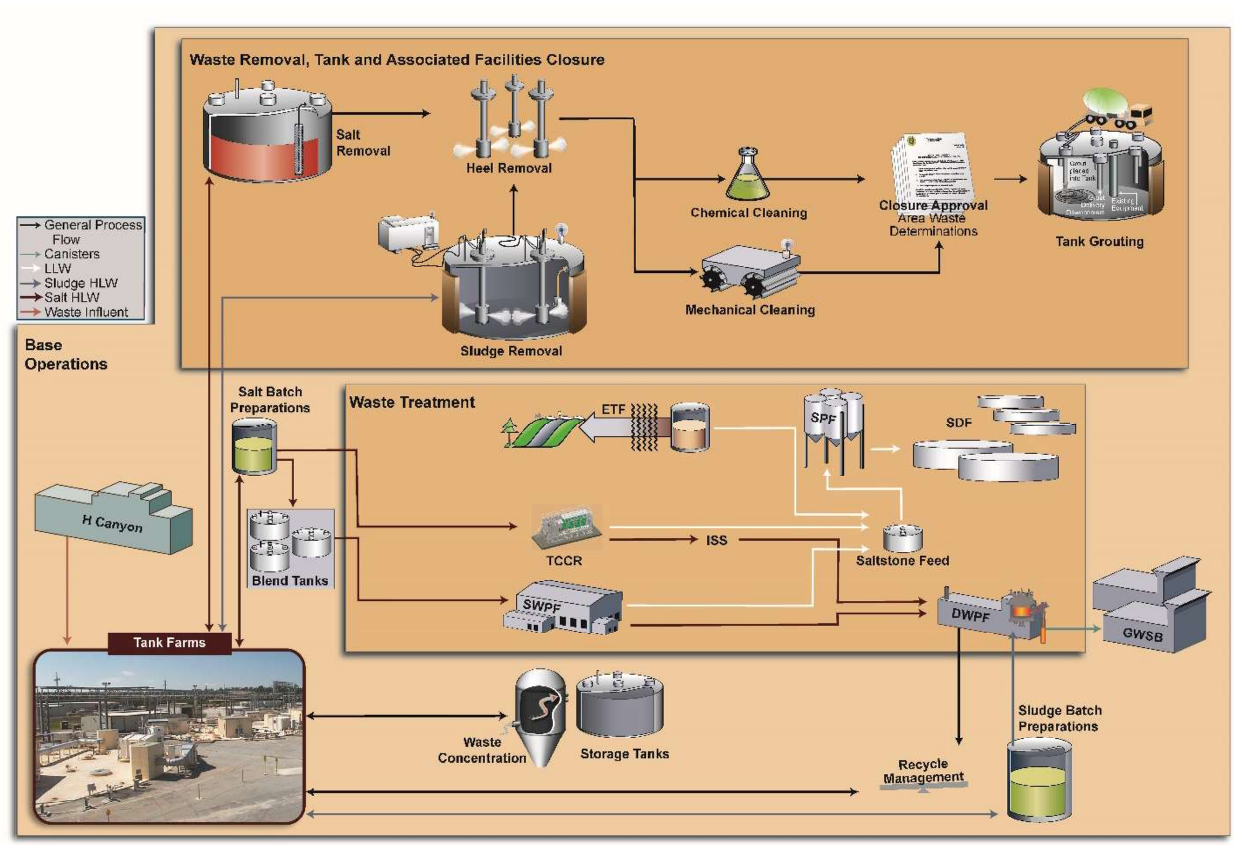

Figure 2-1. SRS Liquid Waste-and Waste Solidification System

This study utilized current H-Canyon and SRR system plan projections, process calculations, and modeling to predict the composition of pertinent waste streams. Each of these waste streams was compared to each downstream facility's WAC to demonstrate that these limits can be satisfied at the higher fissile mass loading level. The flowsheet study was completed in seven stages as discussed in the following subsections.

Stage	Descriptions	Date
Stage 0	**Kickoff meeting**	**March 1, 2021**
Stage 1	**H-Canyon fuel dissolution, neutralization, transfer, and storage**	**March 4, 2021**
Stage 2	**Sludge batch storage, transfer, washing and concentration**	**March 11, 16 2021**
Stage 3	**DWPF**	**March 18, 23 2021**
Stage 4	**Salt batch storage, transfer, and washing**	**March 25, 2021**
Stage 5	**SWPF**	**March 25, 30, 2021**
Stage 6	**Saltstone**	**March 30, 2021**
Stage 7	**DWPF Recycle, HLW Evaporation, Effluent Treatment Facility**	**April 1,6, 8 2021**

In each of these stages, Microsoft Teams meetings were held over a period of six weeks to discuss the compositional changes expected from introducing the ABD stream and the expected processing changes to future processing. SRNS, SRR, and SRNL processing experts participated in these flowsheet review meetings. Section 2 will discuss the key assumptions, documents and spreadsheets that were used in this review along with a simple discussion of processing in this stage, together with a sketch of the processing equipment. Section 3 will discuss the results of this study.

This study looked for key soluble and insoluble components in the ABD slurry. The soluble components will be washed out during sludge preparation. These soluble species would then be added to future salt batches and have the potential to exceed WAC limits. The following soluble components were tracked: sodium, OH^-, aluminate, carbonate, sulfate, phosphate, fluoride, chloride, Cs-137, Sr-90, Tc-99, and I-129. The following insoluble components were tracked: Sr-90, Np-237, U-233, U-234, U-235, U-236, U-238, Pu-239, Pu-241, Al, Ca, Cr, Fe, Gd, and Hg.

It should also be noted that this study used a particular sequence in processing, which is defined as the flowsheet. Deviations from the sequence may produce different results that were not evaluated in this paper. If this sequence changes, modeling or additional testing will be needed to ensure the conclusions of this study are still valid.

2.1 Stage 1: H-Canyon fuel dissolution, neutralization, transfer, and storage

In order to accelerate the deinventory of aluminum clad spent nuclear fuel (SNF), H-Canyon will dissolve the SNF in a 5 - 8.5 M nitric acid solution with added mercury and gadolinium as required to dissolve the aluminum cladding and then neutralize the resulting solution by adding sodium hydroxide. H-Canyon plans to add gadolinium as a neutron poison for U-233 and U-235 in accordance with the revised CSTR and DWPF WAC. For the relatively small amount of Pu-239 and Pu-241 in the ABD waste stream, H-Canyon will add iron or gadolinium as a neutron poison for Pu-239 and Pu-241 to meet the revised CSTF and DWPF WAC requirements. H-Canyon plans on adding depleted uranium as required to meet sludge batch enrichment WAC requirements. Both extra gadolinium and depleted uranium will be added prior to neutralization. Natural uranium may be used if depleted uranium is unavailable. The resulting slurry will be transferred to the sludge preparation tank (Tank 51 or 42).

There are primarily two aluminum fuel types that will be processed: Materials Test Reactor (MTR) fuel and High Flux Isotope Reactor (HFIR) fuel. Other fuels like nonaluminum spent nuclear fuel (NASNF) assemblies are not included in this study. However, evaluation of fissiles is independent of fuel type. Contribution by unique cladding components will be evaluated separately by SRR with SRNL support as needed at a later date. The HFIR fuel is typically processed in the 6.4D dissolver and then transferred to Tank 8.3. The MTR fuel is typically processed in the 6.1D dissolver and transferred to Tank 7.4. However, HFIR and MTR flowsheets exist for performing dissolution in both dissolvers. Typical processing was assumed. Both dissolution streams will be blended in Tank 10.2. Using L Basin averages, as described above, this will produce an approximately constant blend. The ABD blend will be transferred to an isotopic adjustment tank where Gd and depleted uranium will be added and then transferred to a neutralization tank where sodium hydroxide is added to meet the Tank Farm WAC.[8] The resulting slurry will be transferred to Tank 42 or 51 during preparation of the next sludge batch. A schematic summarizing the planned processing is shown in Figure 2-2.

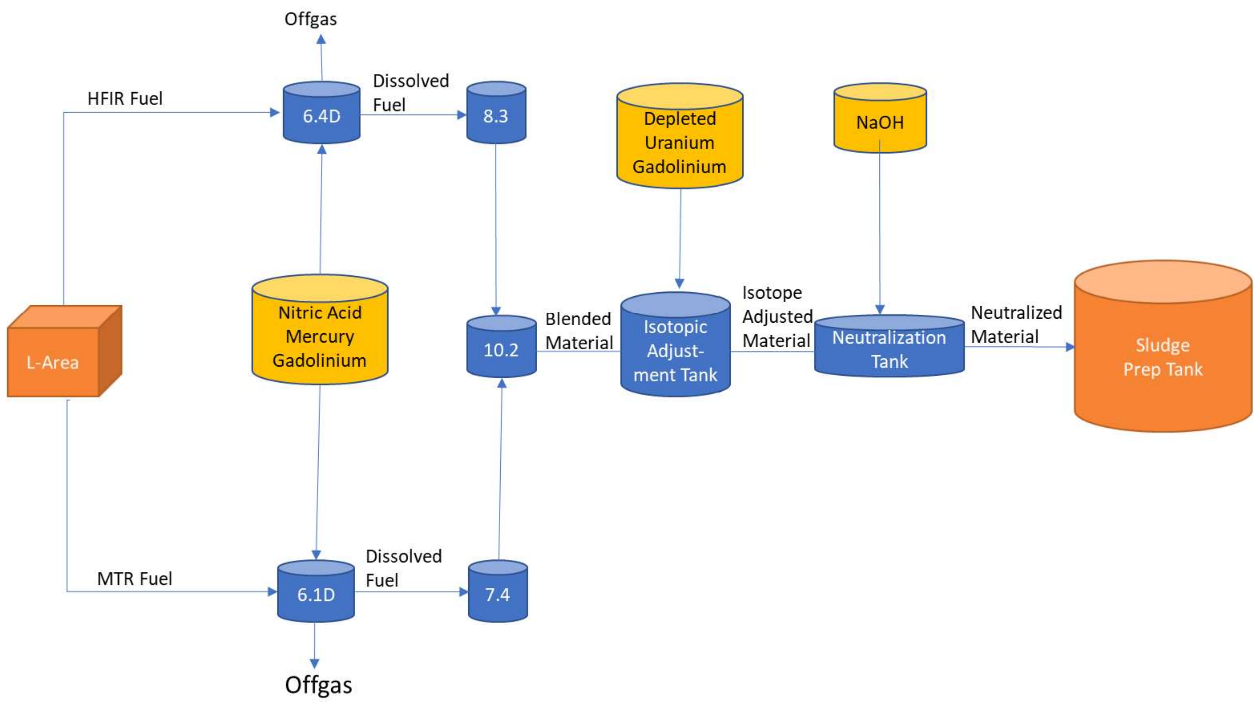

Figure 2-2. Planned Production of ABD Stream for Addition to Future Sludge Batches

The key documents related to ABD material processing are summarized in Table 2-1.

Table 2-1. Key ABD material Processing Documents for This Study

Document Title	Document Number
Process Flow Diagram for Post-Accelerated Basin De-Inventory Initiative Implementation Canyon Processing	SRNS-RP-2021-00062, Rev 0[3]
Inventory of Aluminum Spent Nuclear Fuel Evaluation	SRNS-E1122-2020-00008, Rev 0[9]
Waste Acceptance Criteria for Liquid Waste Transfers to the Tank Farms	X-SD-G-00009, Rev 8[8]
PFD Revision Ten No First Cycle FINAL- All basin case	PFD Revision Ten No First Cycle FINAL- All basin case for DAN.xlsx, 2-18-2021[3]

The composition of the ABD stream is an average of the aluminum clad spent nuclear fuel currently stored in L-Basin, since H-Canyon plans to blend both HFIR, and MTR spent fuels. The predicted average ABD material composition being transferred to Tank 42 or Tank 51 is summarized in Table 2-2. Note that the supplied ABD material composition[3] was limited to sodium, aluminum, potassium, nitrate, hydroxide, mercury, U-233, U-235, Pu-239, Pu-241, Np-237, silicon and water. The measured composition of a sample from H-Canyon of blended dissolved fuel was measured by SRNL during gadolinium poison solubility testing for the downstream impacts of added ABD material[10]. This Tank 10.2 composition was used to add other isotopes and elements. The amount of each that was added was calculated by multiplying the measured Tank 10.2 composition by the ratio of U-235 in the canyon estimate to the U-235 concentration in the Tank 10.2 analysis. The complete composition is summarized in Appendix **A**. This study evaluated the flowsheet impacts of ABD material at average dissolved ASNF and sludge quantities.[9] The basis used by SRR is different than that used in this study.[11]

A brief discussion of some of the ABD species and their impact on downstream processing is included below.

Al, Si, P – These have no isotopic significance. P (as phosphate) expected to be considerably lower given that the source of P from the TBP used in H-Modified PUREX processing will not occur during processing of fuels in the ABD campaign. Si could be higher when silicide-type fuels are processed. Since the bulk of the ABD fuels are Al-clad, the Al released to the tank farm should be comparable to that released from historical H-Canyon operations.

C-14 and I-129 - These radionuclides should be largely lost to the H-canyon off-gas system during fuel dissolution.

Cs-137 – Cs is highly soluble in acidic and alkaline solutions and thus follows the liquid fraction in waste processing. Most of the wastes in the tank farm have been stored in waste tanks for decades and thus have decayed at least one half-life. Some ABD fuels are somewhat younger and, therefore, the ABD materials sent to the tank farm would be somewhat higher in Cs-137.

Ru-106 is a radionuclide with a relative short half-life (371.5 days). A similar argument as with Cs-137 indicates that there could be an increase in Ru-106 activity relative to the aged sludge waste.

Tc-99 is a long-lived beta-emitting radionuclide that is very soluble across the entire pH range as the pertechnetate anion. Given the lack of any removal mechanism, all the Tc-99 should remain in solution and feed forward into salt solution where it has no impact on SWPF and is disposed of in Saltstone. Given the long half-life all the Tc-99 sent to the tank farm prior to ABD is essentially still there. The Tc-99 is a fission product and would be expected to be present in the ABD fuels at similar levels to fuels processed in H-Canyon throughout its operational history.

Lanthanides and Actinides – Lanthanides and actinides have limited solubilities in alkaline solutions, typically in the few parts per million or less. Typically, lanthanides would be almost exclusively in the insoluble solids fraction. The authors do not recall ever seeing an actual measured value for any lanthanide in an actual tank solution sample. On the other hand, U, Np and Pu (but not Am or Cm) are typically measured in salt solution. Actinide solubility in alkaline solutions typically follows the trend Np>U>>Pu>>Am, Cm. Although the processing of the ABD material will send increased quantities of the actinides to the tank farm, the bulk of it will be in the insoluble solids fraction. The low solubilities (i.e., chemistry) of the actinides limits the concentrations in alkaline salt solution. Thus, the concentrations of actinides in alkaline solutions derived from ABD materials would not be expected to be any higher than that from historically processed fuels. Enriched uranium in the ABD materials is a concern. However, controls will be in place to prevent highly enriched uranium being released into the tank farm without isotopic dilution with depleted or natural uranium and neutron poisoning from the addition of Gd.

Hg – ABD flowsheet does use Hg as catalyst for dissolution. This has been used historically and thus not expected to significantly increase Hg when added to H-Area sludge waste.

Table 2-2. Average ABD material Composition

	Slurry	Supernate	Total Dried Solids	Insoluble Solids
Mass, kg	3.88E+06	3.50E+06	1.56E+06	3.75E+05
Volume, gal	7.59E+05	7.20E+05	NA	3.85E+04
Solids, wt %	40.2	33.8	NA	9.67
Density, g/mL	1.35	1.28	NA	2.57
Soluble anions	**Total Mass, kg**	**Anion, mg/L**	**Anion Concentration, mg/L supernate**	**M**
$NaNO_3$	1.04E+06	3.83E+05	4.04E+05	4.51
NaOH	1.38E+05	5.05E+04	5.32E+04	1.26
Radioactive Isotope	**Total Mass, kg**	**Isotope, mg/L**	**Isotope Concentration, mg/L supernate**	**M**
Tc-99	7.27E+01	2.67E+01	2.81E+01	2.70E-04
Cs-137	1.07E+02	3.92E+01	4.13E+01	2.86E-04
Sr-90	3.48E+01	1.28E+01	NA	NA
Np-237	4.02E+01	1.47E+01	NA	NA
U-233	1.83E-01	6.71E-02	NA	NA
U-234	8.99E+01	3.30E+01	NA	NA
U-235	2.91E+03	1.07E+03	NA	NA
U-236	6.30E+02	2.31E+02	NA	NA
U-238	5.55E+04	2.04E+04	NA	NA
Pu-239	3.54E+01	1.30E+01	NA	NA
Pu-241	7.67E+00	2.81E+00	NA	NA
Other ABD material Components	**Total Mass, kg**	**Metal, mg/L**		
Al	1.01E+05	3.53E+04	NA	NA
Ca	2.10E+02	7.31E+01	NA	NA
Cr	1.27E+02	4.44E+01	NA	NA
Gd	1.46E+03	5.07E+02	NA	NA
Hg	8.19E+02	2.85E+02	NA	NA
Na	3.62E+05	1.26E+05	NA	5.77
Si	3.14E+02	1.09E+02	NA	NA

* Limited compounds were provided in the ABD estimate. In order to add additional components (Tc-99, Cs-137, U-233, and U-234), their composition was estimated by multiplying the concentration of each isotope in the Tank 10.2 sample by the ratio of U-235 in the ABD estimate to U-235 in the Tank 10.2 sample.[12]

During H-Canyon processing, the key assumptions in assessing the impact on processing include:

1. The current baseline for ABD processing will not remove uranium or plutonium from the dissolved spent fuel and will use gadolinium (Gd) as a neutron poison (≥0.5 Gd:U-235(eq_{SLU}), where U-235(eq_{SLU})=U-235+1.4*U-233) across the Savannah River Site (SRS) flowsheet. Therefore, Gd should be used as the neutron poison (to simulate the plant process when adding additional fissile uranium to the sludge batch in order to make high fissile glass).
2. As H-Canyon transitions from uranium separations to ABD processing, the uranium concentration in the stream and other non-fissile components will vary. However, it will be assumed that 500 kg

of additional fissile isotopes are added to each sludge batch in the form of neutralized dissolver solution.

3. The fresh-Canyon waste stream will be transferred to Tank 51 or 42 in preparing a sludge batch. Tank 42 won't be available until Sludge Batch 11 or later.
4. The composition of each ABD batch was projected by SRNS-MDE. This was to develop an average stream composition.
5. Depleted uranium will be added to some sludge batches to ensure the U-235(eq_{SLU}) enrichment is ≤5 wt % in DWPF and the U-235(eq_{REC}) enrichment is ≤5.5 wt % in the Recycle Stream, where U-235(eq_{REC}) =U-235+1.4*U-233+2.25*(Pu-239+Pu-241).
6. DOE approves exceeding the 897 g fissile/m^3 glass limit.
7. The composition of the slurry during transfer, storage or processing will not invoke DOE Order 474.2 for Safeguards and security and material control and accountability by managing the transfers to ensure this condition will be met.
8. The liquid waste processing facilities will be active longer due to the added ABD material.
9. The ABD stream will be dissolved aluminum spent nuclear fuel (ASNF) only. Other fuels like nonaluminum spent nuclear fuel (NASNF) assemblies are not included in this study. Therefore, the impact of NASNF cladding is outside the scope of this review.
10. The SNF will be cooled at least seven years to minimize the impact of shorter-lived isotopes such as Ru-106. Short cooled flowsheets are not yet fully developed.
11. Organics should be lower with added ABD material than with typical SRS fuels since no gelatin strike and no tributylphosphate (TBP) solvent extraction operations will be completed in H-canyon (Saltstone is particularly sensitive to the presence of organics).

2.2 Stage 2: Sludge batch storage, transfer, washing and concentration

The neutralized ABD stream will be transferred to the sludge preparation tank (Tank 51 or 42) in a series of transfers. Note that this tank is only available to receive transfers after LTAD is complete so there are windows when transfers will not be accepted by SRR. Figure 2-3 shows a hypothetical process diagram for integration of the ABD stream into the sludge batch feed tank. The configuration used for each sludge batch will be different as Tank 42 and Tank 51 will be used in alternate sludge batches, different tanks will supply sludge to the sludge batch, etc. This figure shows a draft plan for Sludge Batch 13, which is representative of all ABD stream integration into the CSTF flowsheet. Low Temperature Aluminum Dissolution (LTAD) will be needed to minimize the aluminum in most of the sludge batches. After the LTAD is complete, the ABD stream will be added to the backup sludge preparation tank over a period of 18 months. Sludge batch washing will then proceed as before, with the final batch being transferred to Tank 40, the DWPF feed tank. A schematic summarizing the planned processing for Sludge Batch 13 is shown in Figure 2-3.

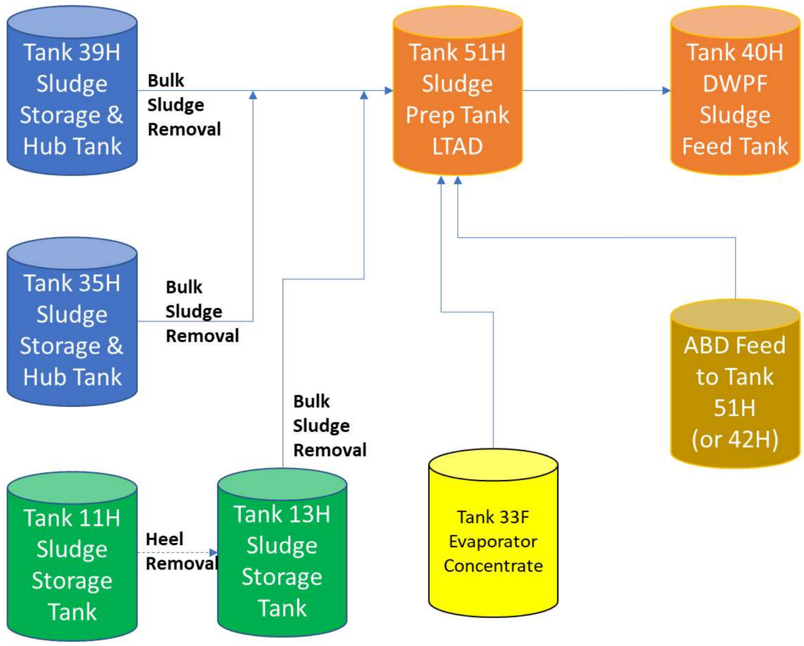

Figure 2-3. Planned Production of Future Sludge Batches with Added ABD material (Example: Sludge Batch 13)

The key points in this processing include: The composition in the waste tanks will be based on the Liquid Waste (LW) System Plan Rev 22 Case 2 without ABD material added (draft) as summarized in Table 2-3.

Table 2-3. Key CSTF Processing Documents for This Study

Document Title	Document or File Number
System Plan R-22 Case 2 -TK51/TK42 Pre-ABD (Draft) Excel Workbook Summarizing Data	**LCP R22 Case 2_Sludge Batch Data Requested by DL_040721.xlsx, 4-7-2021**
Washing Spreadsheet for Sludge Batches 11-20 Excel Workbook	**SB10 to SB19 for SBP 0720_Case 2 with ABD excluded_040621.xlsm, 4-7-2021**[13]
Waste Acceptance Criteria for Raw Salt Solution, Sludge and SWPF Salt Streams Transfers to DWPF	**X-SD-S-00001, Rev 2**[14]

Key analyses of average composition of washed sludge without addition is summarized in Table 2-4. The fourth column, labeled "Ratio of Sludge plus ABD to Sludge only", is a calculation of the ratio of sludge plus ABD to sludge. In cases where an element, isotope our chemical increases significantly, the ratio should be >1. If there is no increase, the ratio is 1. The complete composition is summarized in Appendix B.

Table 2-4. Average Washed Sludge Composition without ABD material

	Slurry	Supernate	Total Dried Solids	Insoluble Solids
Mass, kg	1.40E+07	1.23E+07	2.44E+06	1.68E+06
Volume, gal	3.33E+06	3.14E+06	NA	1.91E+05
Solids, wt %	17.4	6.22	NA	12.0
Density, g/mL	1.113	1.039	NA	2.32
Soluble anions	**Total Mass, kg**	**Anion Concentration, mg/L slurry**	**Anion Concentration, mg/L supernate**	**M**
$NaNO_2$	1.89E+05	1.00E+04	1.06E+04	2.31E-01
$NaNO_3$	3.44E+05	1.99E+04	2.11E+04	3.41E-01
NaOH	1.26E+05	4.27E+03	4.53E+03	2.66E-01
NaCl	3.73E+02	1.80E+01	1.91E+01	5.37E-04
Na_2SO_4	2.41E+04	1.29E+03	1.37E+03	1.43E-02
NaF	5.17E+02	1.86E+01	1.97E+01	1.04E-03
Na_2CO_3	3.69E+04	1.66E+03	1.76E+03	2.93E-02
$NaAlO_2$	2.62E+04	2.08E+03	2.21E+03	2.69E-02
$Na_2C_2O_4$	8.18E+03	4.27E+02	4.53E+02	5.14E-03
Na_3PO_4	2.08E+03	9.56E+01	1.01E+02	1.07E-03
KNO_3	2.66E+03	1.29E+02	1.37E+02	2.21E-03
Radioactive Isotope	**Total Mass, kg**	**Isotope Concentration, mg/L**	**Ratio of Sludge plus ABD to Sludge only**	
Sr-90	7.25E+04	5.75E+03	NA	NA
Cs-137	2.44E+01	1.93E+00	2.05E+00	1.41E-05
Th-232	5.82E+03	4.62E+02	NA	NA
Np-237	5.99E+01	4.76E+00	NA	NA
U-233	1.09E+00	8.65E-02	NA	NA
U-234	5.46E+00	4.34E-01	NA	NA
U-235	6.05E+02	4.81E+01	NA	NA
U-236	9.76E+01	7.75E+00	NA	NA
U-238	1.30E+05	1.03E+04	NA	NA
Pu-239	6.12E+02	4.86E+01	NA	NA
Pu-240	7.19E+04	5.71E+03	NA	NA
Pu241	4.85E+00	3.85E-01	NA	NA
Am-242m	9.08E-03	7.21E-04	NA	NA
Cm-244	2.60E+00	2.07E-01	NA	NA
Other ABD Components	**Total Mass, kg**	**Metal Concentration, mg/L slurry**	**Metal Concentration, mg/L supernate**	**M**
Al	**1.37E+05**	1.09E+04	NA	NA
Ca	3.66E+04	2.91E+03	NA	NA
Cr	4.10E+03	3.26E+02	NA	NA
Cs	2.44E+01	1.93E+00	NA	NA
Fe	3.76E+05	2.99E+04	NA	NA
Gd	3.43E+02	2.73E+01	NA	NA
Hg	6.19E+04	4.92E+03	NA	NA

2.3 Stage 4: Salt batch storage, transfer, and washing

About 90% of the volume in the CSTF or about 32 million gallons is saltcake and concentrated supernate. Before processing in SWPF, the saltcake needs to be dissolved and the concentrated supernate is diluted to 6.4 M Na producing 3X the volume (~96 million gallons). These salt solutions are prepared by blending evaporator concentrate, LTAD supernate, dissolved saltcake, diluted supernate and DWPF recycle.

Figure 2-4 shows a simplified process diagram for Salt Batch Preparation. Key documents for Salt Batch Salt Batch preparation are summarized in Table 2-5.

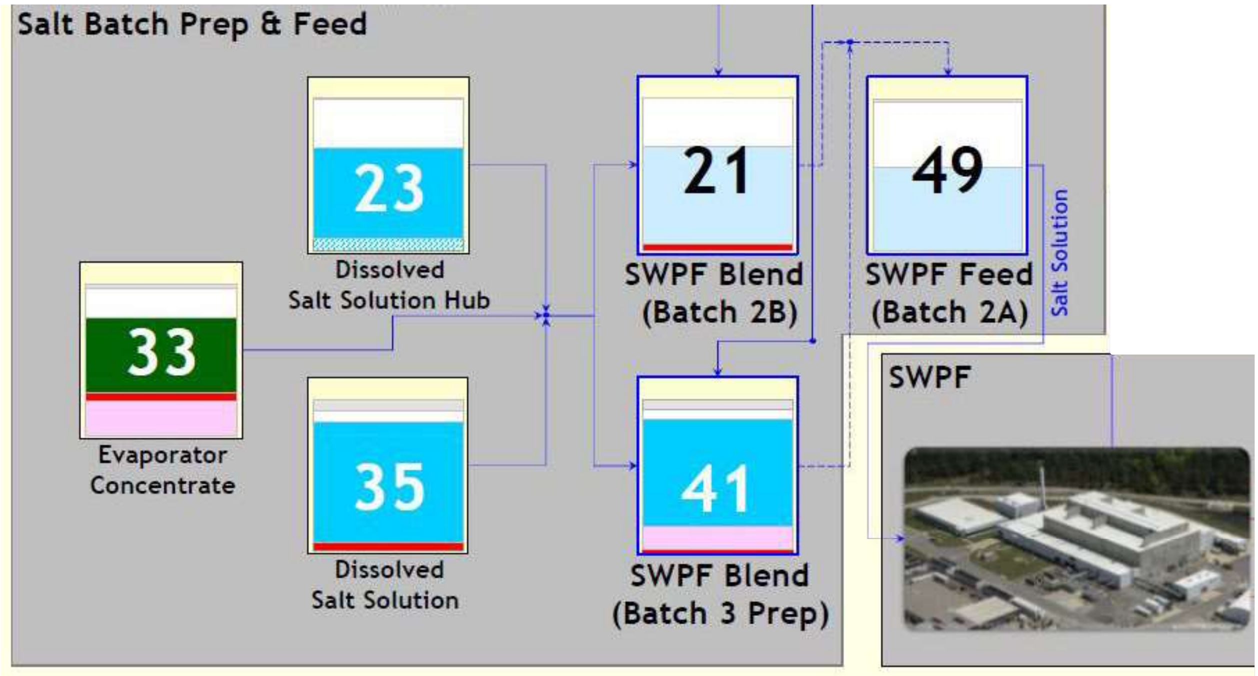

Figure 2-4. Salt Batch Processing Schematic

The key points in this processing include:

1. The composition of anions and minor cation species in these salt batches have a large variability from batch to batch (many of the constituents have a relative standard deviation of more than 100%). Although the composition of future salt batches and their variability is unknown, the average of all the salt batches was used as the best estimate of the composition of future salt batches.

Table 2-5. Key Salt Processing Documents for This Study

Document Title	Document Number
Salt Batch Constituents	Salt Batch Constituents.xlsx 3-21-21[13]
Salt Waste Processing Facility Feed Waste Acceptance Criteria	X-ESR-J-00001, Rev 6[15]
eWAC (eWAC Evaluation Calculator)	http://pceweb.srs.gov/eWac/EvaluationCalculator
Waste Acceptance Criteria for Transfers to the Z-Area Saltstone Production Facility During Salt Disposition Integration (SDI)	X-SD-Z-00004, Revision: 4[16]

The System Planning group of SRR has maintained a spreadsheet with data from all salt batches prepared for both Actinide Removal Process (ARP)/Modular Caustic Side Solvent Extraction Unit (MCU) and SWPF.[17] Key analyses of average Salt Batch composition are summarized in Table 2-6. The complete composition is summarized in Appendix **C**. Although SRR will try to blend each salt batch to be similar, there has been significant variability in the eleven salt batches produced for ARP and MCU and the three batches that have been produced for SWPF so far. So, although the average is the best estimate of the composition for future batches the variability from batch to batch will be significant. This batch-to-batch variability is expected to have more impact on the salt batch composition than a small increase in fissiles that will come from the ABD stream since the fissiles are largely insoluble at a 2 M free hydroxide concentration.

Table 2-6. Average Salt Batch Composition Based on ARP/MCU batches 1-11 & SWPF batches 1-3

Element	Result	Percent Relative Standard Deviation (RSD)	Units
Al	6.08E+03	25%	mg/L
Fe	1.78E+02	276%	mg/L
Gd	0.00E+00	NA	NA
Hg	6.50E+01	69%	mg/L
K	4.45E+02	30%	mg/L
Mn	1.22E+00	116%	mg/L
Na	6.15E+00	7%	M
S	2.82E+03	32%	mg/L
Si	3.59E+01	59%	mg/L
U	4.01E+02	NA	mg/L
Anion	**Result**	**%RSD**	**Units**
$C_2O_4^{2}$	3.52E+02	27%	mg/L
Total Inorganic Carbon (TIC or CO_3^{2-})	4.66E+03	96%	mg/L
Total Organic Carbon (TOC)	2.47E+02	29%	mg/L
$CHOO^-$	5.48E+02	90%	mg/L
Free OH^-	2.21E+00	27%	M
NO_2^-	3.09E+04	28%	mg/L
NO_3^-	1.33E+05	25%	mg/L
PO_4^{3-}	5.22E+02	42%	mg/L
SO_4^{2-}	7.11E+03	42%	mg/L
Radioisotope	**Result**	**RSD**	**Units**
Sr-90	3.01E+05	44%	pCi/mL
Tc-99	4.16E+04	46%	pCi/mL
Cs-137	1.04E+08	72%	pCi/mL
U-233	8.94E+01	136%	pCi/mL
U-235	3.91E-01	36%	pCi/mL
U-238	5.19E+00	50%	pCi/mL
Np-237	7.56E+00	73%	pCi/mL
Pu-239	8.99E+02	39%	pCi/mL
Pu-241	3.12E+04	194%	pCi/mL
Other	**Result**	% RSD	**Units**
Density	1.28	2%	g/mL
Insoluble Solids	<1	NA	wt %

The key points in this processing includes:

1. Processing calculations based on assuming 9 million gallons per year of salt processing[18] will be processed through the Salt Waste Processing Facility (SWPF) using the Next Generation Solvent (NGS) flowsheet.

2. The Salt Batch feed to SWPF will target a sodium molarity of 6.4 M and must meet the WAC requirements for SWPF and Saltstone (after being diluted by 15% as the result of SWPF processing and accounting for removal of Cs, Sr and actinides).

2.4 Stage 5: SWPF processing

About 90% of the volume in the CSTF consists of solutions that will be processed through SWPF. In addition, most of the dissolved salts in the ABD solution sent to the CSTF will eventually be sent to SWPF. The dilution of the Salt batches to 6.4 M Na will increase the total volume needing processing through SWPF to approximately 100 million gallons. Waste processing at SWPF occurs in three basic operations: Alpha Strike Process (ASP), Caustic-side Solvent Extraction (CSSX), and Alpha Finishing Process (AFP). Salt waste is initially received and processed in the ASP. The ASP separates strontium (Sr)/actinides from the waste feed by monosodium titanate (MST) adsorption and filtration. The CSSX process follows the ASP and is used to remove cesium (Cs) from the ASP filtrate by solvent extraction. The Alpha Finishing Process (AFP) includes an optional process step used for additional Sr/actinide removal downstream of the CSSX process using the same MST adsorption and filtration as the ASP. The CSSX process will produce a Cs-137 rich strip effluent stream that will be fed to the SRAT. The ASP or AFP will produce an MST/SS stream that will be fed to the SRAT.

The decontaminated salt solution (DSS), a 5.6M Na solution and the bulk of the volume will be fed to the Saltstone Processing Facility (SPF) and incorporated into grout. Figure 2-5 shows a simplified process diagram for SWPF.

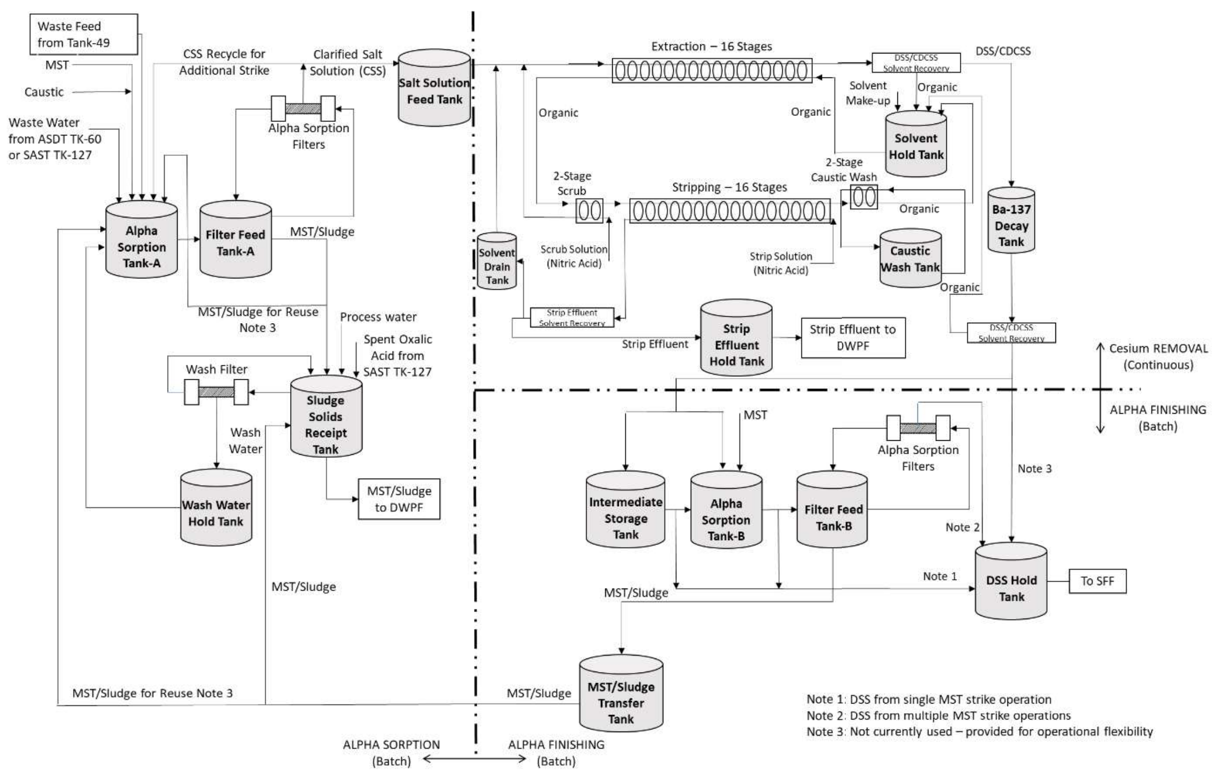

Figure 2-5. SWPF Processing Schematic

Key documents for SWPF Processing are summarized in Table 2-7.

The key points in this processing include:

1. SWPF will be using the Next Generation Solvent (NGS) flowsheet. This means the strip acid will be boric acid, not nitric acid as is used with the original flowsheet.
2. The feed to SWPF is the Salt Batch prepared and transferred to Tank 49. The Salt Batch will target a sodium molarity of 6.4 M and must meet the WAC requirements for SWPF and Saltstone
3. There are three products of SWPF:
    a. Decontaminated Salt Solution that is transferred to Tank 50 (after being diluted by 15% as the result of SWPF processing and accounting for removal of Cs, Sr, and actinides).
    b. Strip Effluent (SE) that is fed into the DWPF SRAT through the Strip Effluent Feed Tank (SEFT)
    c. Monosodium Titanate (MST)/Sludge Solids (/SS) that is fed into the DWPF SRAT through the Precipitate Reactor Feed Tank (PRFT)

Table 2-7. Key SWPF Processing Documents for This Study

Document Title	Document Number
Salt Batch Constituents (System Planning Compilation)	**Salt Batch Constituents.xlsx 3-23-21[13]**
eWAC Evaluation Calculator	**http://pceweb.srs.gov/eWac/EvaluationCalculator**
Salt Waste Processing Facility Feed Waste Acceptance Criteria	**X-SD-J-00001, Rev 6[15]**
Waste Acceptance Criteria for Transfers to the Z-Area Saltstone Production Facility During Salt Disposition Integration (SDI)	**X-SD-Z-00004, Revision: 4[16]**

2.5 Stage 6: Saltstone processing

The SWPF DSS is stored in Tank 50 and fed to the Salt Solution Receipt Tanks (SSRTs) in the SPF. The DSS is mixed with concrete (may be eliminated in some Saltstone blends), fly ash and/or slag and. the resulting slurry is pumped into a vault and for permanent storage.

There are additional feeds to Tank 50 in addition to the DSS. These include the DSS from Tank Closure Cesium Removal (TCCR), SRNL Analytical returns, and leaks in H-Canyon basins (about half rainwater). Present processing in Saltstone includes the addition of slag, fly ash, and/or cement but does not include set retardant or antifoam.

Key documents for Saltstone Processing are summarized in Table 2-8.

Table 2-8. Key Saltstone Processing Documents for This Study

Document Title	Document Number
Salt Batch Constituents	Salt Batch Constituents.xlsx 3-21-2112[13]
eWAC Evaluation Calculator	http://pceweb.srs.gov/eWac/EvaluationCalculator
Waste Acceptance Criteria for Raw Salt Solution, Sludge and SWPF Salt Streams Transfers to DWPF	X-SD-S-00001, Rev 2[14]
Waste Acceptance Criteria for Transfers to the Z-Area Saltstone Production Facility During Salt Disposition Integration (SDI)	X-SD-Z-00004, Revision: 4[16]

Figure 2-6 shows a process diagram for Saltstone.

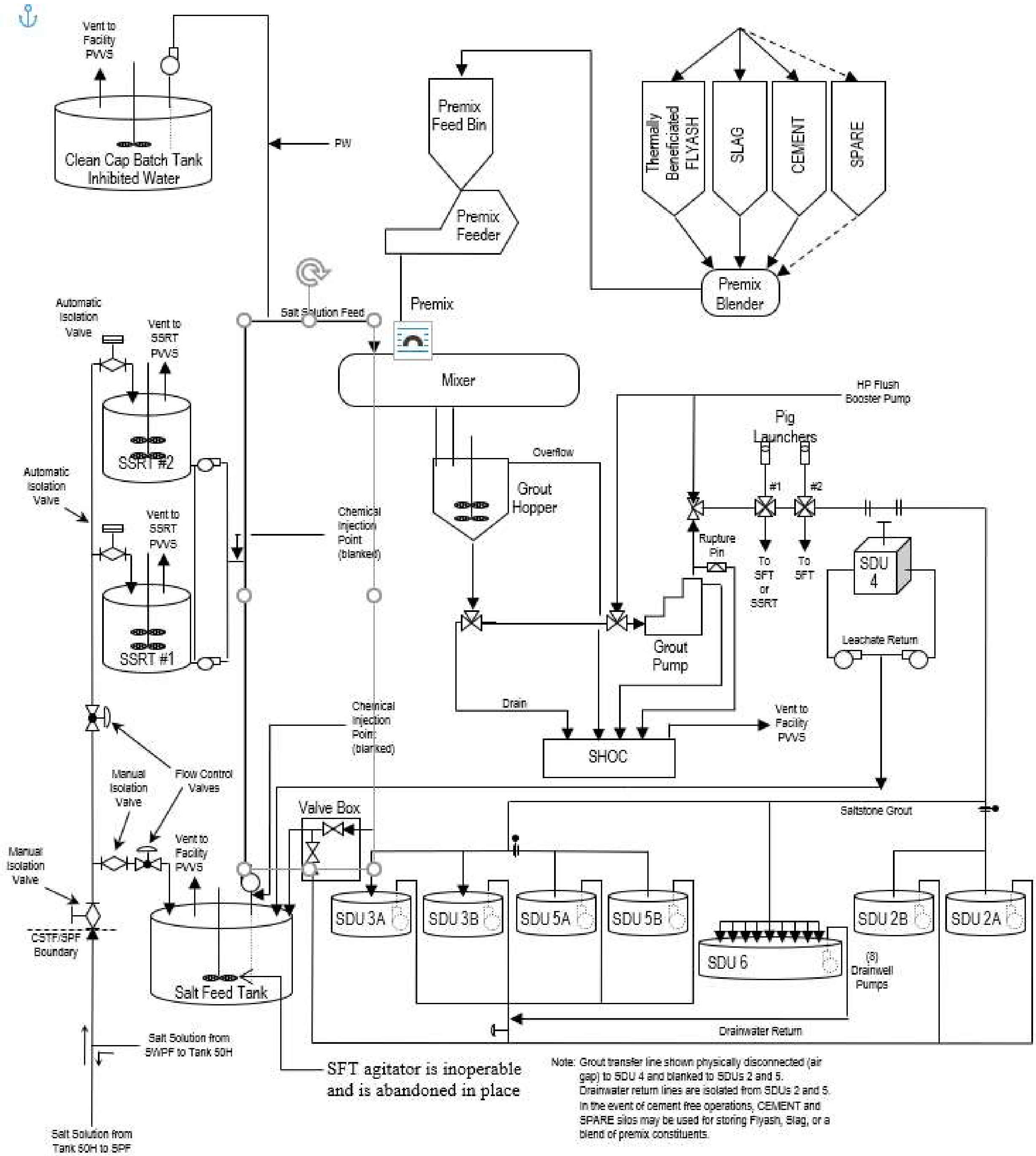

Figure 2-6. Saltstone Processing Schematic

The key point in this processing include:
The best estimates for future salt batches are predicted from past salt batches (Salt Batch Constituents.xlsx 3-21-2112) after processing through SWPF

2.6 Stage 3: DWPF sludge processing

Three feed streams are fed to the Sludge Receipt and Adjustment Tank (SRAT), namely sludge from Tank 40, strip effluent from SWPF, and monosodium titanate (MST)/Sludge Solids (SS) from SWPF. These three streams are processed through the Chemical Processing Cell (CPC) and melter to produce glass, which is poured into stainless steel canisters, and a recycle stream that is returned to Tank 22.

Figure 2-7 shows a simplified process diagram for DWPF processing. This assessment assumes that the nitric-glycolic flowsheet[19] is used along with a new antifoam[20] to effectively prevent foam overs from the CPC. Key documents for DWPF processing are summarized in Table 2-9.

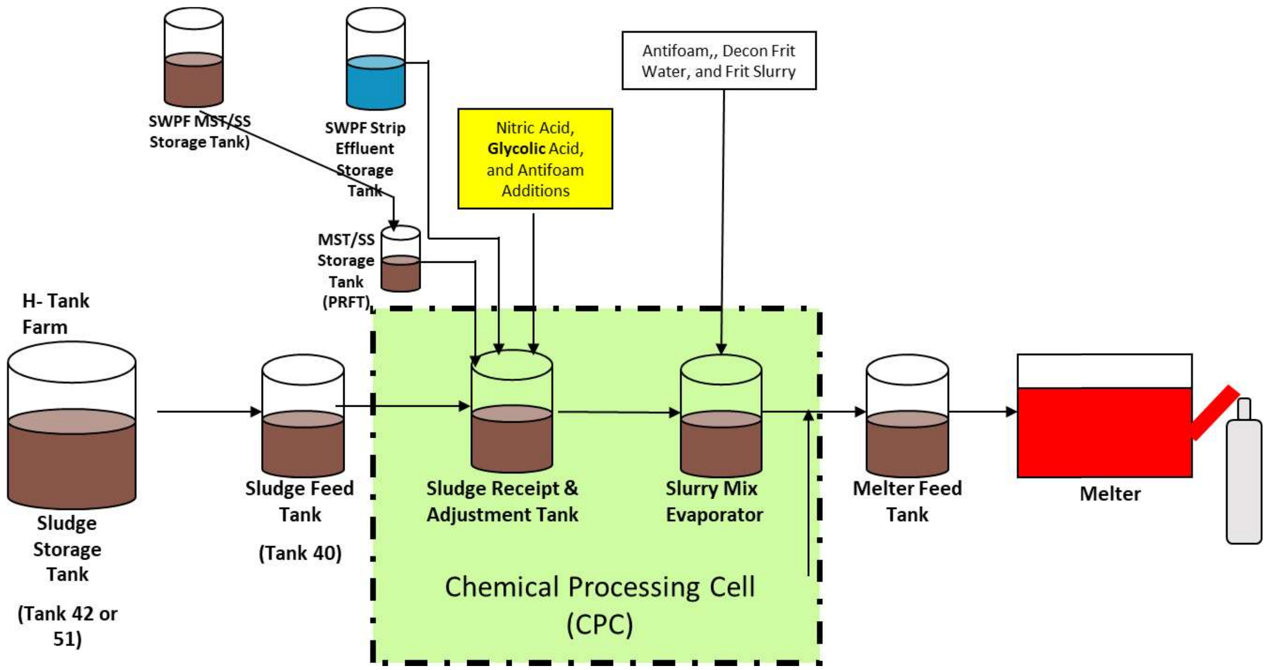

Figure 2-7. DWPF Processing Schematic

Table 2-9. Key DWPF Processing Documents for This Study

Document Title	Document Number
Sludge Batch 9 Simulant Runs Using the Nitric-Glycolic Acid Flowsheet	SRNL-STI-2016-00319, Revision 0[19]
Antifoam Development for Eliminating Flammability Hazards and Decreasing Cycle Time in the Defense Waste Processing Facility	SRNL-STI-2019-00677, Revision 3[20]
Waste Acceptance Criteria for Liquid Waste Transfers to the Tank Farms	X-SD-G-00009, Rev 8[8]

The key points in this processing includes:

1. The sludge composition for future batches was provided by SRR Planning without ABD (LW System Plan Rev 22 Case 2 without ABD material added (draft)) so the ABD stream could be estimated and added separately. The combined washed slurry is estimated in section 3.2.
2. Processing calculations for SEFT and PRFT should be based on assuming 9 million gallons per year of salt processing in the SWPF using the NGS flowsheet strip effluent based on an average of past and current salt batch compositions. The PRFT and SEFT compositions are estimated in Section 3.4.
3. The DWPF Chemical Processing Cell (CPC) will process using the nitric-glycolic flowsheet (includes permanganate destruction of glycolate if recycle is not diverted) with and without recycle

diversion. The current strategy for recycle diversion includes sending the bottoms from proposed recycle evaporator to a salt tank, the proposed recycle evaporator condensate to ETF, and the filtered solids to an HLW sludge tank.

4. The sludge or SWPF processing volumes will be decreased if the SWPF volume of 9 million gallons per year and the sludge processing volumes cannot both be achieved as assumed in LW System Plan Rev 22 Case 2 without ABD material added (draft).

2.7 Stage 7: Recycle, High Level Waste Evaporators, and Effluent Treatment Facility Processing

DWPF recycle is currently transferred from the Recycle Collection Tank (RCT) through the Low Point Pump Pit Recycle Tank (LPPPRT) to Tank 22 and is the largest influent stream received by the CSTF. The disposition of the recycle stream is handled through evaporation in the 2H Evaporator System and through the beneficial reuse of the low sodium molarity (less than 1.0 molar sodium) recycle stream. The DWPF recycle rate during SWPF processing will be approximately 3.2 Mgal/yr because of extra water in the strip effluent stream and MST slurry and because the higher Cs-137 concentrations will require the operation of two Steam Atomized Scrubber (SAS) stages in the DWPF melter offgas system. DWPF recycle is evaporated in the 2H Evaporator System due to chemical incompatibility with other waste streams. It may, however, be beneficially reused for salt solution molarity adjustment, salt dissolution, heel removal, etc. Beneficial reuse minimizes the utilization of the 2H Evaporator. A schematic showing the DWPF Recycle stream, subsequent 2H Recycle Evaporation and ETF Processing of the 2H overheads is summarized in Figure 2-8. Details concerning the 2H evaporator are shown in Figure 2-9 and Figure 2-10.

The addition of the ABD material should not send liquid that would be any higher in the actinides than that seen historically. The only radionuclides that are increased in the release to the tank farm are uranium, plutonium, and neptunium (i.e., alpha-emitters that normally would be removed by canyon processing). These actinides would be higher in the sludge feed to DWPF and thus higher in the RCT due to CPC foamovers and melter entrainment. The alkaline conditions limit the soluble fraction of these to their respective solubilities which is no different than that for typical canyon waste. The RCT material then processes through the evaporator (note: the insoluble solids could have higher actinide concentrations than typical sludge waste). However, the concentrations of the actinides in the liquid fraction would be no higher due to the chemistry. (i.e., solubilities of the actinides limited by high hydroxide concentrations in the liquid fraction). The overheads from the evaporator would have similar DF values for the various radionuclides as that observed historically with canyon waste. Consequently, the condensed overheads from the evaporator that form the feed to the ETF should be no higher in the respective radionuclides than that seen historically.

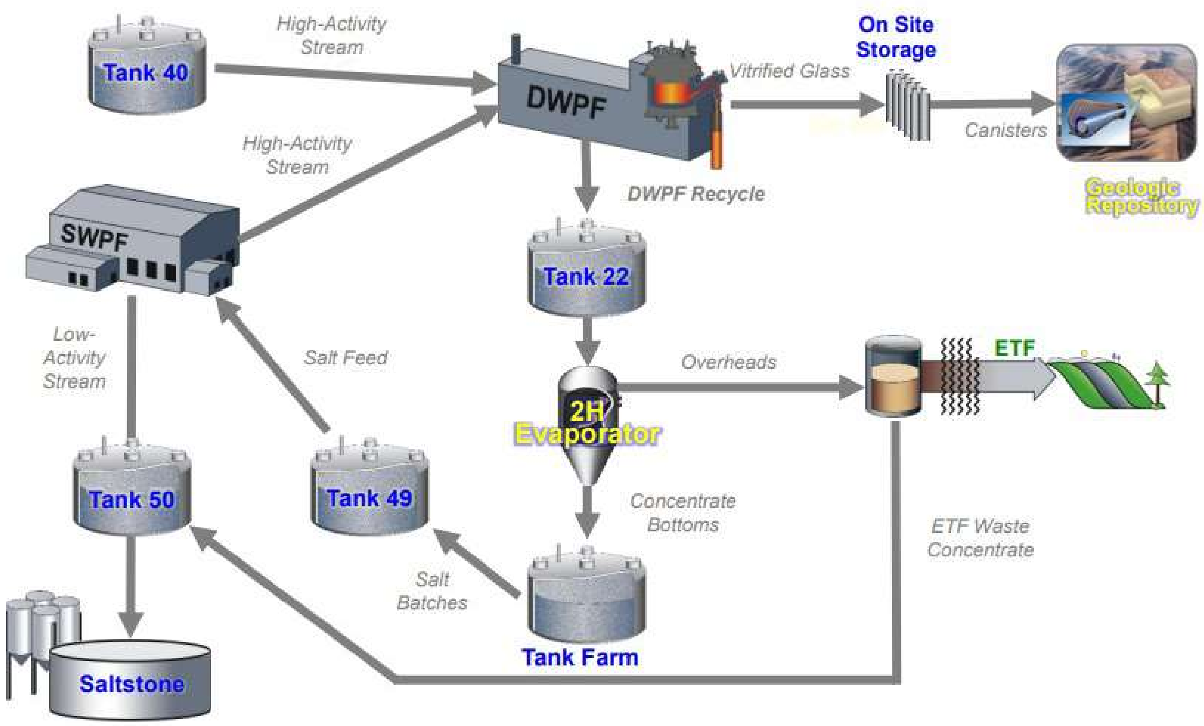

Figure 2-8. Schematic of Recycle, 2H Evaporation and ETF Processing

The primary influents into the CSTF are DWPF recycle and H-Canyon waste receipts. In addition, sludge batch preparation produces a large internal stream of spent washwater. To continue to maintain space in the CSTF to support these missions, these streams must be concentrated. There are two evaporators in H-Area. DWPF recycle has a high concentration of silica due to the vitrification process. When this stream is mixed with high aluminum streams from PUREX and HM canyon processing, there is a potential for forming sodium aluminosilicate solids that can accumulate in the evaporator and plug transfer lines.

Experience has shown that sodium aluminosilicate can co-precipitate sodium diuranate in the evaporator, causing a potential criticality concern. To prevent the potential for criticality, a feed qualification program is in place to minimize the formation of a sodium aluminosilicate scale in the 3H Evaporator and to prevent accumulation of enriched uranium in the 2H Evaporator. It is assumed that scale may accumulate in the 2H Evaporator, but uranium enrichments and masses will be well below criticality concerns. The 2H Evaporator System is used to evaporate DWPF recycle. The 3H Evaporator is used to process streams that will not produce scale, i.e., canyon wastes, and sludge batch decants. The evaporator system feed and concentrate receipt tanks configuration is:

3H: Feed – Tank 32; Receipt – Tanks 30 and Tank 37

2H: Feed – Tank 43; Receipt – Tank 38.

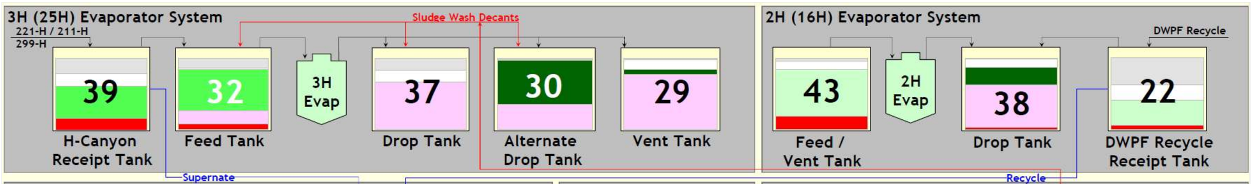

Figure 2-9. Waste Tanks Supporting 2H and 3H High Level Waste Evaporators

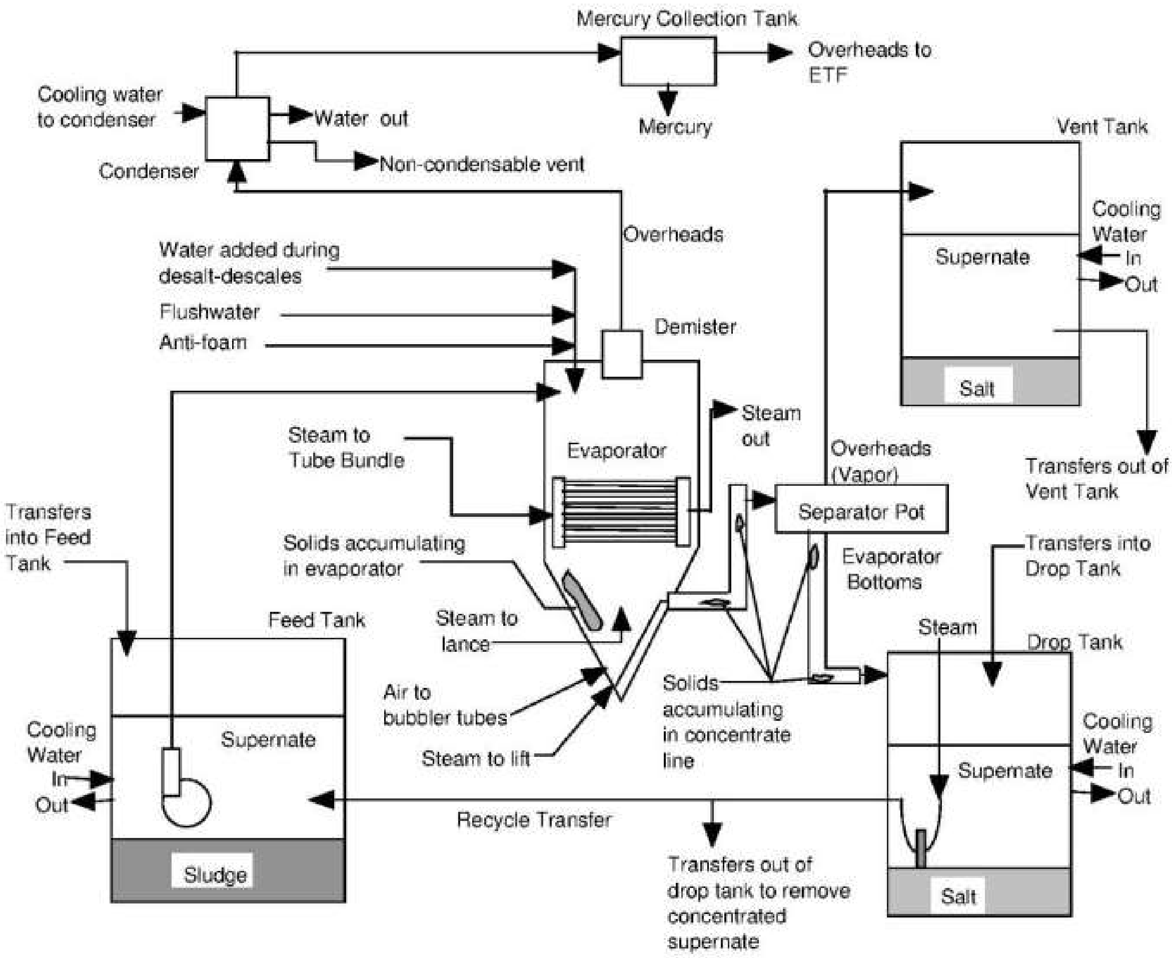

Figure 2-10. Schematic of 2H and 3H High Level Waste Evaporators

The Effluent Treatment Facility (ETF), located in H-Area, collects, and treats process wastewater that may be contaminated with small quantities of radionuclides and process chemicals. The primary sources of wastewater include the 2H and 3H Evaporator overheads and H-Canyon. The wastewater is processed through the treatment plant and pumped to Upper Three Runs Creek for discharge at a National Pollutant Discharge Elimination System (NPDES)-permitted outfall. Tank 50 receives ETF residual waste for storage prior to treatment at Saltstone. A 35-kgal Waste Concentrate Hold Tank (WCHT) provides storage capacity at ETF to minimize transfer impacts directly to Tank 50 or SPF during SWPF operations. A schematic of the ETF is summarized in Figure 2-11.

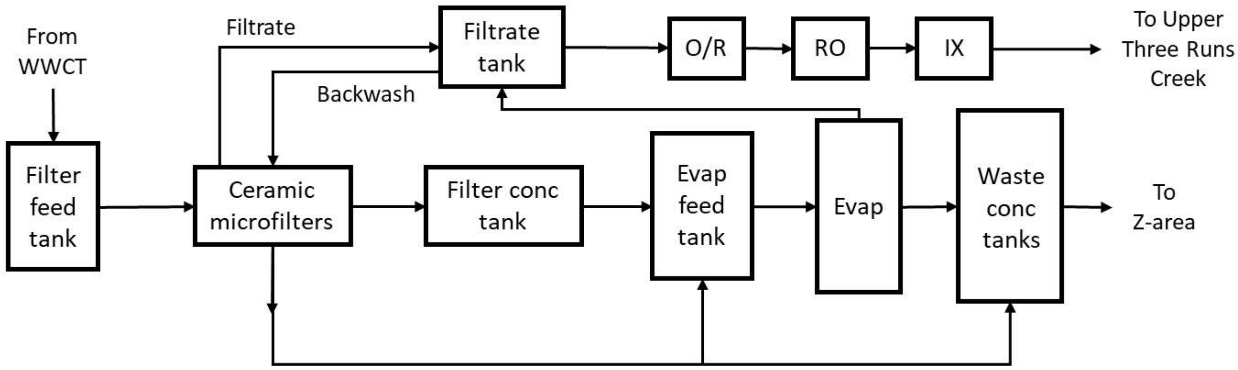

Figure 2-11. ETF Processing Schematic

Key documents for Recycle, HLW Evaporator and ETF are summarized in Table 2-10

Note that the 3H evaporator does not typically evaporate DWPF recycle. As a result, it is highly unlikely that the 3H evaporator would be impacted by the extra fissile that will be added to future sludge batches. As a result, the 3H evaporator will not be evaluated as part of this study.

The best estimate of the future recycle stream is the previous analyses of RCT samples by the DWPF laboratory. These results were summarized by DWPF for SRNL.[21] Other estimates of the RCT composition have been made by the Recycle Diversion Team, included the expected entrainment of SRAT, SME melter feed, and glass into the recycle stream.[22] Expected changes due to the identification of a new antifoam and the deployment of the nitric-glycolic acid flowsheet will be discussed in Section 3.6.

Table 2-10. Key Recycle, HLW Evaporator and ETF Documents for This Study

Document Title	Document Number
DWPF Recycle Diversion Process Flow Diagram Inputs and Assumptions	X-ESR-S-00418, Revision A[22]
Waste Laboratory Services -Laboratory Information Management System (WLS LIMS) Data Generated to Scope Hydrogen Generation Rate (HGR) Experiments	X-ESR-S-00365, Revision 0[21]
F/H Effluent Treatment Project Waste Acceptance Criteria	X-SB-H-00009, Revision 7[23]
Waste Acceptance Criteria for Transfers to the Z-Area Saltstone Production Facility During Salt Disposition Integration (SDI)	X-SD-Z-00004, Revision: 4[16]
DWPF RCT Analytical Results 2003-2021	RCT.xlsx[13]

Key analyses of average Recycle, HLW Evaporator, and ETF are summarized in Table 2-11. The RCT data was calculated to be an average of historical data as measured by the DWPF Laboratory. The 2H bottoms composition was estimated to be a 15X evaporation of the average RCT composition. The ETF feed composition was calculated to be the overheads from the 2H evaporator with added volatile species (name) plus 0.1% entrainment from the 2H evaporator. Note that the ETF feed is usually diluted with other sources such as rainwater.

Table 2-11. Average Historical Recycle Composition

Analysis	Result	% Relative Standard Deviation (RSD)
Base Equiv M	2.53E-01	25.3%
NH3, mg/L	1.71E+01	137%
Formate, mg/L	1.30E+03	77.3%
Nitrate, mg/L	8.30E+03	161%
Nitrite, mg/L	1.30E+04	115%
Cl,	5.24E+02	103%
TOC, mg/L	2.10E+02	87.2%
TIC, mg/L	2.00E+02	84.9%
Density, g/mL	1.01E+00	2.52%
Fe, mg/L	2.34E+02	144%
Li, mg/L	4.35E+01	144%
Si, mg/L	9.55E+01	132%
Al, mg/L	2.08E+02	105%
Beta, bq/g	2.01E+07	45%
Alpha, bq/g	1.01E+11	469%
Cs-137, bq/g	4.80E+05	174%
Am-241, bq/g	3.67E+04	119%
Co-60, bq/g	1.93E+04	410%
Eu-154, bq/g	1.28E+05	163%
Ru-106, bq/g	6.12E+04	179%

The key points in this processing includes:

1. The RCT data was calculated to be an average of historical data as measured by the DWPF Laboratory.
2. Fissile isotopes were added to the DWPF recycle assuming 39 gallons of entrained SRAT product.[22]
3. Frit was added to the DWPF recycle assuming the addition of 41 lbs of frit due to melter entrainment.[22]
4. The 2H bottoms composition was estimated to be a 15X evaporation of the average RCT composition.
5. The ETF feed composition was calculated to be the overheads from the 2H evaporator with added volatile species (name) plus 0.1% entrainment from the 2H evaporator.
6. The nitric-glycolic acid flowsheet will not only lower the formate concentration in the DWPF recycle but will also add glycolate. To ensure the additional glycolate does not lead to higher hydrogen generation in the 2H evaporator, sodium permanganate will be added to the RCT to destroy the glycolate. The addition of sodium permanganate will increase the mass of MnO in Tank 22 but isn't expected to impact the processing in the 2H evaporator or ETF.

2.8 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in manual E7 2.60. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2.

3.0 Results and Discussion

The addition of ABD material will mainly impact the composition of the sludge fed to DWPF. It will have a minimal impact on the concentration of fissile material in the salt batch processing, SWPF processing, Saltstone Processing, Recycle Processing, HLW evaporation, and ETF processing. This is because the fissiles are very insoluble at the process conditions in these facilities, predominantly retained in the concentrate during evaporation, and are not significantly volatile during vitrification. The most likely source of increased fissile materials in the salt streams would be either the formation of small particles of U-235 that don't separate by gravity in the sludge prep tank or process upsets such as a foamover or excessive entrainment in the melter. The addition of ABD material increases the mass of the following components during sludge blending and sludge preparation:

Insoluble species

- Mercury is added to accelerate the dissolving of the aluminum cladding. The Mercury from ABD material is < 1.3% of the total Hg in the average batch. This does impact DWPF processing as it will increase the total boiling time needed to strip the Hg.
- Uranium, mainly U-233, U-235, and U-238, will increase due to the addition of the ABD stream. U-233 and U-235 are the result of the fuel dissolution and to a lesser extent U-238. Most of the U-238 present will be added to ensure the U-235 enrichment is ≤5% for processing in DWPF. This projected addition of uranium will lead to an increase in DWPF canisters due to the added ABD mass that will be incorporated into future glass canisters.
- Gadolinium is added to ensure there will not be a criticality scenario by acting as a neutron poison of the fissile U-233 and U-235. The planning assumption of 0.5 g Gd per g of U-235 may change due to SRNL studies that are underway and nuclear criticality safety evaluation. However, this is a much lower amount of mass and volume needed to poison the U-235 than the 70 g Mn per g of U-235 that was used for SB10.
- During LTAD and sludge washing, most of the aluminum from dissolution of the aluminum clad fuel is soluble and will be removed in decants from the sludge batch. The Aluminum from ABD material is 4.7% of the total aluminum in the average blended sludge.

Note that the soluble species will primarily be washed out of the sludge batches. Therefore, these species will be included in the assessment since they will eventually be part of future Saltstone batches after processing through SWPF.

Soluble Species

- Aluminum, although primarily insoluble in washed sludge (with or without ABD), will be intentionally removed through the LTAD process, if performed, since aluminum can be resolubilized at high free hydroxide concentrations. Most of the aluminum will be removed from the sludge preparation tank through decants if LTAD is performed. Although ABD material will add aluminum to each sludge batch, it is a small fraction of the aluminum that is present in the final sludge batch based on assumptions that LTAD will typically be performed.
- The ~1M nitric acid solution (~7.5 M nitrate) exiting the H-Canyon dissolver will be neutralized with sodium hydroxide to form sodium nitrate. An excess of NaOH is added to target 1.2 M free hydroxide.
- The sodium nitrate concentration of the ABD stream added to the sludge batch will be ~4.5M. This is consistent with historical processing. Most of the nitrate will be removed during sludge processing so the nitrate isn't significantly higher than a sludge batch without ABD material. In addition, DWPF will adjust the acid mix by adding more glycolic acid and less nitric acid during the processing so the melter feed will have approximately the same glycolate and nitrate concentration with and without ABD material.
- Typically, sodium sulfate is present in the sludge due to the addition of ferrous sulfamate in H-Canyon processing of SRS SNF. There is no expected sulfate in ABD processing as ferrous sulfamate will not be added during ABD processing.
- Sodium nitrite will be added to the sludge tanks as needed to ensure the corrosion controls are met. No nitrite is added in H-Canyon.

- Soluble Fission products, namely I-131, Tc-99, and Cs-137 are tracked as these are the most likely to exceed Saltstone and ETF WAC limits.
- Neither Cl or F is added during the H-Canyon dissolution of aluminum clad fuel due to procurement specifications, so neither will impact the corrosivity during sludge or salt processing.

3.1 Stage 1: H-Canyon fuel dissolution, neutralization, transfer, and storage

H-Canyon will prepare waste suitable for the CSTF and DWPF WAC. The primary impact of the increased fissile loading is the increased U-235 in the dissolved fuel. To meet the DWPF WAC, H-Canyon will add depleted uranium to produce an enrichment that is ≤ 5 wt%. Gd will also be added to poison the fissile U-235 and U-233. Sodium hydroxide will be added to neutralize the nitric acid and meet the caustic corrosion limits. The addition of sodium hydroxide precipitates most of the metallic elements including the fissiles. The resulting slurry will be transferred to the sludge preparation tank, Tank 42, or Tank 51, where it will undergo LTAD and washing.

For this paper study only, the H-Canyon slurry was washed separately and combined with the washed Tank 42 or 51 slurry to produce feed for DWPF. Since sludge batches SB11-17 will utilize LTAD for minimizing the aluminum in the slurry, LTAD will be utilized for the ABD stream also, targeting the removal of 93% of the aluminum, the average removal for SB11-17. The H-Canyon neutralized slurry will be washed to 0.8 to 1.0 M Na (same as the Tank 42 or 51 slurry) as 0.2 M sodium nitrite is needed for corrosion control.[24] Decanting will be used to increase the insoluble solids concentration to 9.1 wt% and the total solids concentration to 17 wt %. The composition of the washed canyon slurry is summarized in Table 3-1. Full composition is included in Appendix **A**.

Important notes:

1. The fraction of aluminum that will be removed from the sludge batch will depend on the timing of the ABD material addition. If all the ABD material is added prior to LTAD, it is likely that a higher fraction of aluminum will be removed during LTAD. The aluminum in the ABD sludge is freshly precipitated so it is less likely to be present as boehmite, a form of aluminum that is much more difficult to dissolve in LTAD. Freshly precipitated aluminum in sludges transforms into boehmite upon aging at elevated temperatures. A higher fraction of aluminum removal will increase the fissile concentration in the sludge batch so resulting fissile concentration is conservative for this study.
2. The freshly precipitated ABD supernate stream, because of the high free hydroxide concentration of the slurry (1.2 M), will absorb CO_2 from air ($2\ NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$). This is a mass transfer limited reaction. The result is that the composition calculation from Table 3-1 will have slightly more NaOH and slightly less Na_2CO_3. This doesn't impact DWPF processing because it takes the same two mols of acid to neutralize the two mols of NaOH as it takes to destroy a mol of Na_2CO_3. So, it doesn't change the composition of the SRAT or SME product. The sludge in the tank farm has undergone this process for decades so the TIC is significantly higher. Fresh $NaOH/NaNO_2$ is added as needed in the sludge tanks to maintain corrosion control.

Table 3-1. Average Washed ABD material Composition

	Slurry	Supernate	Total Solids	Insoluble Solids
Mass, kg	1,720,000	1,550,000	258,000	170,000
Volume, gal	388,000	369,000	NA	19,000
Solids, wt %	15.0	5.70	NA	9.88
Density, g/mL	1.17	1.11	NA	2.36
Soluble anions	**Total Mass, kg**	**Anion Concentration, mg/L Slurry**	**Anion Concentration, mg/L supernate**	**M**
$NaNO_2$	1.93E+04	1.31E+04	1.38E+04	0.200
$NaNO_3$	8.39E+04	5.71E+04	6.01E+04	0.707
NaOH	5.20E+03	3.54E+03	3.72E+03	0.093
Radioactive Isotope	**Total Mass, kg**	**Isotope Concentration, mg/L**	**Isotope Concentration, mg/L supernate**	**M**
Tc-99	5.43E+00	3.89E+00	NA	NA
Cs-137	7.99E+00	5.72E+00	NA	NA
Sr-90	3.48E+01	2.49E+01	NA	NA
Np-237	4.02E+01	2.88E+01	NA	NA
U-233	1.83E-01	1.31E-01	NA	NA
U-234	0.00E+00	0.00E+00	NA	NA
U-235	2.91E+03	2.09E+03	NA	NA
U-236	6.30E+02	4.51E+02	NA	NA
U-238	5.55E+04	3.97E+04	NA	NA
Pu-239	3.54E+01	2.53E+01	NA	NA
Pu241	7.67E+00	5.49E+00	NA	NA
Other ABD Components	**Total Mass, kg**	**Metal Concentration, mg/L**	**Metal Concentration, mg/L supernate**	**M**
Al	3.04E+04	2.07E+04	NA	NA
Ca	2.10E+02	1.43E+02	NA	NA
Cr	9.52E+00	6.48E+00	NA	NA
Fe	0.00E+00	0.00E+00	NA	NA
Gd	1.46E+03	9.92E+02	NA	NA
Hg	8.19E+02	5.57E+02	NA	NA
Na	3.21E+04	2.19E+04	NA	1.00
Si	3.14E+02	2.14E+02	NA	NA

Flowsheet assessment: The ABD stream as defined in this report will add sodium hydroxide, sodium nitrate, aluminum, mercury, and Gd along with actinides to future sludge batches. Much of the aluminum will be washed out during LTAD, washing, and decanting in preparation of sludge batches. Based on the projected composition of the ABD stream, the Cl, F, NO_3, and SO_4 were all below WAC limits for corrosive species. The nitrite, nitrate and free hydroxide concentrations will be controlled to maintain corrosion control. H-Canyon will add U-238 to ensure enrichment is ≤5 wt %. Because small batches will be made in H-Canyon and transferred to the sludge prep tank, the Tank Farm WAC requirements should be easily met. One exception to the WAC is that H-Canyon will add Gd instead of Mn to ensure criticality protection for U-233 and U-235.

3.2 Stage 2: Sludge batch storage, transfer, washing and concentration

The washed ABD material sludge composition (Table 3-1) was combined with the washed DWPF sludge composition from Table 2-2. The resulting composition is summarized in Table 3-2 and the complete composition is included in Appendix **B**.

Table 3-2. Average DWPF Sludge Composition with ABD material

	Slurry	Supernate	Total Solids	Insoluble Solids	
Mass, kg	1.57E+07	1.39E+07	2.70E+06	1.85E+06	
Volume, gal	3.72E+06	3.51E+06	NA	2.11E+05	
Solids, wt %	17.2	6.16	NA	11.7	
Density, g/mL	1.119	1.047	NA	2.32	
Soluble anions	**Total Mass, kg**	**Anion Concentration, mg/L**	**Increase from ABD Addition**	**WAC, mg/L**	**Meets WAC?**
$NaNO_2$	2.08E+05	1.05E+04	1.10	NA	NA
$NaNO_3$	4.27E+05	2.35E+04	1.24	NA	NA
NaOH	1.32E+05	9.92E+03	1.04	NA	NA
NaCl	3.73E+02	1.70E+01	1.00	≤8.00E+02	Yes
Na_2SO_4	2.41E+04	1.23E+03	1.00	≤4.20E+03	Yes
NaF	5.17E+02	1.76E+01	1.00	NA	NA
Na_2CO_3	3.69E+04	1.57E+03	1.00	NA	NA
$NaAlO_2$	2.62E+04	1.42E+03	1.00	NA	NA
$Na2C_2O_4$	8.18E+03	4.05E+02	1.00	NA	NA
$Na3PO_4$	2.08E+03	9.08E+01	1.00	NA	NA
KNO_3	2.66E+03	1.23E+02	1.00	NA	NA
Radioactive Isotope	**Total Mass, kg**	**Isotope Concentration, PCi/mL**	**Increase from ABD Addition**	**WAC, pCi/mL**	**Meets WAC?**
Cs-137	1.34E+02	7.70E+05	5.01	≤7.56E+08	Yes
Sr-90	3.02E+02	2.80E+06	1.13	≤4.68E+08	Yes
Np-237	1.04E+02	4.91E+00	1.63	NA	NA
U-233	1.27E+00	8.18E-01	1.17	NA	NA
U-234	9.53E+01	3.92E+01	17.5	NA	NA
U-235	3.52E+03	5.13E-01	5.81	NA	NA
U-236	7.27E+02	3.13E+00	7.46	NA	NA
U-238	1.85E+05	4.17E+00	1.43	NA	NA
Pu-239	6.48E+02	2.66E+03	1.06	≤2.99E+06	Yes
Pu-240	7.19E+04	1.10E+06	1.00	NA	NA
Am-242m	9.08E-03	6.02E+00	1.00	NA	NA
Cm-244	2.60E+00	1.40E+04	1.00	NA	NA
Cm-245	1.28E-01	1.44E+00	1.00	NA	NA
Enrichment	NA	1.86%	4.00	≤5	Yes
U-235(eq_{SLU}) Enrichment	NA	1.86%	4.00	≤5	Yes
Other ABD Components	**Total Mass, kg**	**Metal Concentration, mg/L**	**Increase from ABD Addition**	**WAC, mg/L**	**Meets WAC?**
Al	1.51E+05	1.08E+04	1.10	NA	NA
Ca	3.46E+04	2.46E+03	0.94	NA	NA
Cr	4.11E+03	2.92E+02	1.00	NA	NA
Cs	3.23E+01	2.30E+00	1.33	NA	NA
Fe	3.76E+05	2.67E+04	1.00	NA	NA
Gd	1.80E+03	1.28E+02	5.24	NA	NA
Hg	6.28E+04	4.46E+03	1.01	≤2.10E+04	Yes

The addition of the ABD stream to the future sludge batches had the following impacts on the final prepared batch slurry composition projection.

a. The total fissile mass (U-233, U-235, Pu-239, Pu-241) increases by a factor of 3.4
b. The U-238 concentration increases as needed to decrease the enrichment to ≤5% in the ABD stream. U-238 is the largest insoluble mass in the ABD slurry after LTAD.
c. Although the ABD stream is very high in aluminum, an estimated 93% of the aluminum is removed through LTAD, washing, and decanting in preparing the sludge batch. The final insoluble mass of the aluminum is lower than the U after LTAD.
d. Gd is added to poison the U-233 and U-235, increasing the Gd concentration by a factor of 18.
e. Fe might be needed to ensure the mass ratio of Fe:Pu-239eq≥64. Because Pu is low ABD, no iron will need to be added as adequate Fe is present in the planned sludge batches.
f. The nitrate concentration in the ABD stream is very high. Even after LTAD and repeated washing and decanting, the nitrate added from the ABD slurry increases the nitrate mass by a factor of 3.9. The neutralization of the nitric acid with sodium hydroxide increases the free sodium hydroxide mass by a factor of 2.1.
g. A few other lower concentration elements and isotopes have been added to the tables including Cs-137, Np-237, Tc-99, Sr-90, Ca, and Cr. These additions were based on the small but significant masses of these elements and isotopes as identified in a Tank 10.2 sample (similar dissolution, used in the recent shielded cells Gd study and high fissile glass study). For these elements or isotopes, the concentration was estimated by multiplying the analytical result times the ratio of U-235 in the Tank 10.2 sample and the H-Canyon estimate used to predict the ABD material composition.

The addition of the ABD slurry to the SB11-17 sludge batches has a significant impact on the fissile mass, particularly the mass of U-233, U-235, Pu-239 and Pu-241. Consequently, the masses increase by factors of 1.2, 5.8, 1.1 and 2.6 for U-233, U-235, Pu-239 and Pu-241. This is expected to have a minimal impact on the fissile concentration of the salt solutions as the U and Pu are both very insoluble at the high free hydroxide conditions in the CSTF.

Note for this paper study only, the slurry and ABD streams were washed independently. Enough U-238 was added to the ABD stream to target 5% enrichment. Once combined with the sludge stream, the average enrichment is 1.86%. In practice, the canyon can add less U-238 by taking credit for the low enrichment of the sludge batches, which can cut the U-238 mass to about a third as long as CSTF poison controls are met prior to sludge batch blending. This would minimize the can production from the ABD stream, since U-238 is the biggest mass of insoluble solids in the ABD slurry after LTAD. The total U increased by a factor of 1.47 due to the ABD material addition, although this could be decreased to a factor of 1.17 if the credit could be taken for the low enrichment in the sludge batches without added ABD material.

There is very little Gd in future sludge streams without added ABD material. The Gd concentration will increase by a factor of 18 to poison the fissile uranium from the ABD slurry. This is less detrimental than adding Mn as a poison as the Gd mass demand is much lower than that of Mn to poison the same fissile loading.

Flowsheet assessment: The combined sludge and ABD stream has a higher mass of sodium hydroxide, sodium nitrate, aluminum, mercury, and gadolinium along with actinides because of the ABD stream. The aluminum and mercury concentrations are lower in the ABD stream than the sludge so they will not impact sludge processing. The nitrate concentration is higher with added ABD material but the acid blend mix in the DWPF SRAT will result in approximately the same SME product nitrate concentration since more glycolic acid and less nitric acid will be added in the SRAT. Each batch in the CPC and melter will produce about the same amount of NO_x with and without ABD. However, since there will be more batches due to ABD, the NO_x emissions over the life of the facility will increase slightly. Since H-Canyon will add more

U-238 to the ABD stream, the enrichment will be <5 wt%. The WAC requirements for DWPF will be met with the appropriate blending of sludge and ABD material.

3.3 Stage 4: Salt batch storage, transfer, and washing

Previous salt batch estimates were provided by SRR and included in Table 2-6. It is assumed that the best estimate of the future salt batches is the average composition of the previous salt batches. This is the key input to the processing in SWPF, Saltstone, and DWPF. Note that almost all elements, anions and radioisotopes are soluble in the blended salt solution with <1.2 g/L of insoluble solids.

Flowsheet assessment: Each salt batch will consist of a blend from ABD supernate, Interstitial salt dissolution, Evaporator bottoms, and LTAD leachate. The result is that they can blend these feeds to make a salt batch that will meet SWPF and Saltstone WAC requirements. The fissile isotopes from ABD material are very insoluble in these high molarity salt solutions so they have little chance to impact the fissile concentration WAC. The one exception is Al, which is about 90% of the WAC limit. Most of the aluminum from the ABD dissolved fuel will be added to a future salt batch. However, the proper blending of the Salt Batch is expected to remain below this limit. The results are summarized in Table 3-3.

Table 3-3. Average Salt Batch Composition with ABD material

Element	Result	SWPF WAC	Units	Meets WAC?
Al	6.08E+03	≤6.74E+03	mg/L	Yes
Hg	6.50E+01	≤3.25E+02	mg/L	Yes
K	4.45E+02	≤2.24E+03	mg/L	Yes
Na	6.15E+00	>5.6 [Na] > 7.0	M	Yes
Si	3.59E+01	≤8.42E+02	mg/L	Yes
Anion	**Result**	**SWPF WAC**	**Units**	**Meets WAC?**
$C_2O_4^{2-}$	3.52E+02	≤2.72E+04	mg/L	Yes
TIC $(CO_3)^{2-}$	4.66E+03	≤2.40E+04	mg/L	Yes
TOC	2.47E+02	≤4.50E+03	mg/L	Yes
$CHOO^-$	5.48E+02	≤4.50E+03	mg/L	Yes
Free OH^-	2.21E+00	≥2E+00	M	Yes
NO_2^-	3.09E+04	NA	mg/L	NA
NO_3^-	1.33E+05	NA	mg/L	NA
No_{eff}	5.50E+00	≥1	M	Yes
PO_4^{3-}	5.22E+02	≤3.14E+04	mg/L	Yes
SO_4^{2-}	7.11E+03	≤5.69E+04	mg/L	Yes
Radioisotope	**Result**	**SWPF WAC**	**Units**	**Meets WAC?**
Sr-90	1.14E-03	≤5.21 E-03	Ci/gallon	Yes
Cs-137	4.51E-01	≤2E00	pCi/mL	Yes
U-233	8.94E+01	≤1.68+E04	pCi/mL	Yes
U-235	3.91E-01	≤1.68E+02	pCi/mL	Yes
Total U	1.55E+01	≤2.5E+01	mg/L	Yes
Pu-241	3.12E+04	≤5.07E+06	pCi/mL	Yes
Total Pu	5.81E-02	≤2.50E+00	mg/L	Yes
U-235 Enrichment	1.15E+00	≤8.00E+00	%	Yes

3.4 <u>Stage 5: SWPF processing</u>

It is assumed in this study that nine million gallons of Salt Solution is processed through SWPF annually. SWPF produces three products, the DSS that is fed to Saltstone, along with the strip effluent and MST/SS streams that are fed to DWPF. SWPF is designed to remove Cs-137, Sr-90, and actinides (primarily U and Pu isotopes). The DSS composition was estimated by removing components based on their Decontamination Factor (DF) by adding 0.4 g/L MST and filtering and removing Cs-137 using the solvent extraction. It is also assumed that the salt solution is diluted by 15% during SWPF processing, producing 10.4 million gallons of DSS annually. The composition of the DSS is summarized in Table 3-4

The second product of SWPF is a simple aqueous solution with Cs-137. This strip effluent is fed to the SRAT. If SWPF processes 9 million gallons of salt feed, they will produce approximately 750,000 gallons of strip effluent. In this study it is assumed the DF for Cs is 40,000. Based on this, the strip effluent will be 1.43E9 pCi/mL of Cs-137 (5.41 Ci/gal). This is about one-third of the 16.5 Ci/gallon limit for strip effluent feed in DWPF. It will also contain 0.01 M boric acid solution and up to 87 mg/L solvent entrainment. The average strip effluent meets the WAC requirements for DWPF.

The third product of SWPF is the MST/SS stream that is fed to the SRAT. This is a slurry that if SWPF processes 9 million gallons of salt feed, they will produce approximately 125,000 gallons of MST/SS. Note that the DF is 20 for Sr, 2.4 for Np, 1.35 for U and 5.5 for Pu so any salt batches with fine sludge solids may challenge the Saltstone WAC for these radionuclides. However, ARP was able to use only filtration, without the MST addition in processing from November 2015 to shutdown of ARP, as the salt feed met the Saltstone WAC prior to processing. It is possible that some of the future batches will be processed in SWPF without MST but there are also some future batches that may require a second MST strike to meet the Saltstone WAC. The composition of the SWPF MST/SS stream assuming a single strike and the combined sludge and MST/SS stream composition is summarized in Table 3-5. The complete composition is summarized in Appendix C

Table 3-4. Average SWPF DSS Product (Saltstone Feed)

Element	Result	WAC	Units	Meets?
Al	5.29E+03	≤1.19E+04	mg/L	Yes
Fe	1.51E+02	≤6.60E+03	mg/L	Yes
Gd	0.00E+00	NA	NA	NA
Hg	5.52E+01	≤3.25E+02	mg/L	Yes
K	3.78E+02	≤4.69E+03	mg/L	Yes
Mn	1.04E+00	≤9.90E+02	mg/L	Yes
Na	5.22	2.5 M ≤ [Na+] ≤ 7.0 M	M	Yes
S	2.45E+03	NA	mg/L	NA
Si	3.12E-01	≤1.07E+04	mg/L	Yes
U	9.99E+00	NA	mg/L	NA
Anion	**Result**	**WAC**	**Units**	**Meets?**
$C_2O_4^{2-}$	3.06E+02	≤2.72E+04	mg/L	Yes
TIC $(CO_3)^{2-}$	4.05E+03	≤2.40E+04	mg/L	Yes
TOC	2.15E+02	≤4.50E+03	mg/L	Yes
$CHOO^-$	4.77E+02	≤6.38E+03	mg/L	Yes
Free OH^-	1.92E+00	≤4.60E+00	M	Yes
NO_2^-	2.69E+04	≤8.28E+04	mg/L	Yes
NO_3^-	1.16E+05	≤2.91E+05	mg/L	Yes
PO_4^{3-}	4.54E+02	≤9.50E+03	mg/L	Yes
SO_4^{2-}	6.18E+03	≤3.46E+04	mg/L	Yes
Radioisotope	**Result**	**WAC**	**Units**	**Meets?**
Sr-90	4.95E-05	≤9.92E-03	Ci/gallon	Yes
Tc-99	3.62E+04	≤2.11E+03	pCi/mL	Yes
Cs-137	2.59E+03	≤3.96E+06	pCi/mL	Yes
U-233	5.76E+01	≤1.25E+04	pCi/mL	Yes
U-235	2.52E-01	≤1.13E+02	pCi/mL	Yes
U-238	3.34E+00	≤3.12E+01	pCi/mL	Yes
Np-237	2.74E+00	≤1.00E+04	pCi/mL	Yes
Pu-239	1.42E+02	≤6.67E+04	pCi/mL	Yes
Pu-241	4.94E+03	≤4.94E+03	pCi/mL	Yes
Other	**Result**	**WAC**	**Units**	**Meets?**
Density	1.23	NA	g/mL	NA
Insoluble Solids	≤1.00E+00	≤1.50E+01	wt %	Yes

Table 3-5. Average SWPF MST/SS Product (DWPF Feed)

Element	Result	DWPF WAC	Units	Meets WAC?
Al	7.59E+02	NA	mg/L	NA
Fe	1.51E+02	NA	mg/L	NA
Gd	0.00E+00	NA	mg/L	NA
Hg	5.52E+01	NA	mg/L	NA
K	5.43E+01	NA	mg/L	NA
Mn	1.04E+00	NA	mg/L	NA
Na	7.50E-01	NA	mg/L	NA
S	3.52E+02	NA	mg/L	NA
Si	3.12E-01	NA	mg/L	NA
Ti	1.38E+04	NA	mg/L	NA
U	9.99E+00	NA	mg/L	NA
Anion	**Result**	**DWPF WAC**	**Units**	**Meets WAC?**
$C_2O_4^{2-}$	4.39E+01	NA	mg/L	NA
TIC $(CO_3)^{2-}$	5.82E+02	NA	mg/L	NA
TOC	3.08E+01	NA	mg/L	NA
$CHOO^-$	6.84E+01	NA	mg/L	NA
Free OH^-	2.76E-01	NA	M	NA
NO_2^-	3.86E+03	NA	mg/L	NA
NO_3^-	1.66E+04	NA	mg/L	NA
PO_4^{3-}	6.51E+01	NA	mg/L	NA
SO_4^{2-}	8.88E+02	NA	mg/L	NA
pH	1.34E+01	>7	pH	Yes
Radioisotope	**Result**	**DWPF WAC**	**Units**	**Meets WAC?**
Co-60	1.04E+01	1.98E+04	pCi/mL	Yes
Sr-90	4.95E-05	NA	pCi/mL	NA
Tc-99	5.19E+03	NA	pCi/mL	NA
Cs-137	1.49E+07	NA	pCi/mL	NA
U-233	5.76E+01	NA	pCi/mL	NA
U-235	2.52E-01	NA	pCi/mL	NA
U-238	3.34E+00	NA	pCi/mL	NA
Np-237	2.74E+00	NA	pCi/mL	NA
Pu-239	2.04E+01	NA	pCi/mL	NA
Pu-241	7.09E+02	NA	pCi/mL	NA
U-235 Enrichment	1.15E+00	≤8.00E+00	%	Yes
Other	**Result**	**DWPF WAC**	**Units**	**Meets WAC?**
Density	1.03E+00	NA	g/mL	NA

Flowsheet Assessment: The addition of ABD material has minimal impact on the salt processing. Soluble isotopes in the ABD material, such as I-129 and Tc-99, would be removed during sludge washing and eventually sent to SWPF. These species will not be removed in SWPF, so the amounts in the ABD stream were evaluated versus Saltstone WAC limits. The iodine isotopes were below detection limits in the ABD material and are not expected to impact the Saltstone WAC limit. The calculated concentration of Tc-99 in DSS and allowing for variance due to the RSD resulted in the Tc-99 concentration with ABD material being well below the Saltstone WAC limit.

3.5 Stage 6: Saltstone processing

The Salt Batch is blended so that calculational models indicate that the resulting DSS from SWPF process would be expected to meet the Saltstone WAC. The most likely component of the ABD material to exceed the Saltstone WAC is a soluble radionuclide like Tc-99. Cs-137 is present in the Salt Batch at a much higher concentration than Tc-99, but because of the predicted DF of 40,000 in SWPF, only a small fraction of the Cs-137 is present in the Saltstone feed.

Flowsheet Assessment: The addition of ABD material has minimal impact on the Saltstone processing. Soluble isotopes in the ABD material, such as I-129 and Tc-99, would be removed during sludge washing and eventually sent to SWPF. These species will not be removed in SWPF, so the amounts in the ABD stream were evaluated versus Saltstone WAC limits. The iodine isotopes were below detection limits in the ABD material and are not expected to impact the Saltstone WAC limit. The calculated concentration of Tc-99 in DSS was far below the WAC limit.

3.6 Stage 3: DWPF sludge processing

DWPF processes three radioactive streams: sludge, MST/SS and SEFT. The average sludge is summarized in Table 3-2. The average MST/SS is summarized in Table 3-5. The predicted SEFT is summarized in Section 3.4. These streams are combined in the SRAT, combined with frit in the SME, transferred to the MFT, and fed to the melter. The product of the melter is a borosilicate glass wasteform that is poured into a ten-foot-tall, two-foot diameter stainless steel canister for permanent disposal.

DWPF will utilize the nitric-glycolic acid flowsheet[19] in future processing. An acid calculation spreadsheet was developed by SRNL for estimating the nitric and glycolic acid volumes needed for processing in the SRAT to target a glass REDOX. This acid calculation spreadsheet was used to predict the SRAT and SME product composition in this study. Key parameters needed to complete this calculation included:

- Koopman Acid Stoichiometry: 100%
- REDOX target: 0.1 $\frac{Fe^{2+}}{\sum Fe}$
- Waste loading in glass: 36 wt %

The nitric-glycolic acid flowsheet combined with a new antifoam[20] are expected to reduce foamovers in the SRAT and SME. However, the DWPF melter is expected to have approximately 1% carryover caused by entrainment from the argon bubblers. So the projections by the Recycle Diversion Task Force of 39 gallons of SRAT product carryover and 0.7 gallons of frit[22] were used in this study to be conservative.

The predicted fissile loading in DWPF glass is estimated to be 2,010 g/m^3. This is lower than 2,500 g/m^3 fissile limit but may approach 2,500 g/m3 in sludge batches that are higher in U-235 such as SB12. This was calculated from the initial sludge using a calcine factor of 0.75 kg calcined solids/kg total solids. The calcine factor is typically 0.7-0.8 for sludge (0.75 is conservative for this calculation). Typically, glass is 36 wt % waste loading (64 wt % frit in glass). The glass has a predicted density of 2.7 kg/L. Because the predicted fissile loading is lower than the planned fissile limit of 2,500 g/m^3, more ABD can be added to future sludge batches than was evaluated in this study. Though not expected to be a concern, the addition of more ABD will also add more aluminum, uranium and gadolinum concentration to future sludge batches and will need to be evaluated by SRR in preparing future sludge batches.

The average sludge, SRAT product, and SME product is just that, the average of the planned future batches. For each sludge batch, a batch qualification will be performed by SRR to ensure the planned sludge batch will meet all Product Composition Control System (PCCS) requirements. To run PCCS on this average SME product, a frit would have to be identified that would meet all PCCS requirements with a large window for waste loading and other planned variability.

Instead of developing a frit for an average sludge batch that will never be processed, an analysis was completed to show that the addition of the ABD stream would be within the bounds of PCCS without identifying this ideal frit. The only significant ABD material addition to the glass is the added sodium, aluminum, and uranium. For sodium, the contribution from the ABD material is very similar to the contribution from the sludge, so it does not impact glass quality. For uranium, the U-235 concentration is higher, but the total uranium concentration is comparable to previous sludge batches such as SB4. The Gd addition significantly increases the Gd in glass but the Gd concentration is much smaller than the 0.5 wt% in glass threshold as specified by the DWPF Waste Form Compliance Plan.[25]

Flowsheet Assessment: The remaining sludge batches will be a challenge for DWPF. The high aluminum HM sludge that will be processed along with the higher volume demands because of SWPF processing combine to be challenging to DWPF. The ABD stream is sludge-like and probably won't add significant complications to DWPF. The addition of ABD material will increase the actinide composition although this isn't expected to impact processing. It should be noted that the actinide solubility will increase due to the pH change during CPC processing. The concentration of Gd is an 18X increase but the amount added is about 140X smaller than the amount of Mn that would have been needed for criticality control. So, during typical processing, the ABD stream will have a minimal impact on DWPF processing.

The addition of mercury from ABD material decreases the mercury concentration in the resulting blended sludge because the mercury concentration is lower in the ABD slurry. But the lack of mercury removal in DWPF and the return of much of the mercury to the recycle stream may lead to longer production times in DWPF in later sludge batches. This may especially impact later sludge batches as completely homogenizing the mercury with the sludge is difficult in a million-gallon waste tank. So, the last two sludge batches may be very high in mercury. Improving the mercury recovery in DWPF will minimize the mercury in the condensate stream which will minimize the mercury concentration in later sludge batches.

What could impact the composition of the glass product or recycle stream is process upsets caused by entrainment or foaming. But it should be noted that the impact of ABD material on DWPF processing issues like foaming, melter entrainment, etc. cannot be fully assessed in a paper study but will be address in each sludge batch specific flowsheet study. Together the melter and CPC produce about 3 million gallons of condensate a year.[18] If high entrainment of melter feed in the melter or excessive foamovers in DWPF occur on a higher frequency than currently, evaporation of recycle or processing of 2H evaporator overheads could lead to 2H evaporator feeds that exceed the WAC limits. Of particular concern is foaming because the foam is stabilized by very fine particles. These fine particles would not settle as fast in Tank 22 and will increase the fissile concentration in the recycle and 2H evaporator. The implementation of the nitric-glycolic flowsheet and a new antifoamer, Momentive Y-17112 together are expected to mitigate this.

Another issue that could impact DWPF is the aging of the facility and equipment. If repairs to equipment contaminated with large quantities of slurry (such as agitator blades, cooling, or steam coils) need decontamination, much larger quantities of slurry will be added to the recycle stream than planned.

The melter uses argon bubblers to improve mixing and increase melt rate. This also leads to more melter entrainment than without the argon bubblers. Turning off or down the argon flow in batches where the melt rate is high enough without bubblers would minimize recycle contamination by the melter entrainment.

The implementation of the nitric-glycolic flowsheet has a distinct disadvantage in recycle processing and recycle evaporation. Although the glycolate concentration is approximately 5% of the formate concentration in the DWPF recycle stream, it generates much more hydrogen[26] in the CSTF evaporators than formate does. Consequently, sodium permanganate will be added to the RCT to destroy any glycolate that is present.[27] The resulting recycle stream will be higher in Mn with the increase dependent on the amount of sodium permanganate needed to destroy the glycolate. Minimizing the added sodium permanganate will minimize the impact of added Mn to Tank 22. But if the frequency of CPC foamovers (not expected because of new antifoam) or melter entrainment leads to more glycolate in the recycle, even more Mn will be added to the recycle stream.

3.7 Stage 7: Recycle, High Level Waste Evaporators, and Effluent Treatment Facility Processing

The recycle stream produced by DWPF is expected to be about 3 million gallons a year due to the high volumes of MST/SS and SE that will be produced by SWPF. The nitric-glycolic acid recycle stream will be much lower in formate than the recycle that is produced with the nitric-formic acid flowsheet. In addition, the glycolate in the recycle will be treated with a permanganate process to destroy the glycolate. To be consistent with the current plans for recycle diversion, 39 gallons of SRAT product slurry and 0.7 gallons of frit is assumed to be entrained in each 7900-gal RCT batch. In addition, the destruction of glycolate by sodium permanganate will add additional MnO_2 to the recycle stream, which was not added in the analysis below, since it won't impact any of the components added with the ABD material. The nitric-glycolic acid flowsheet combined with a new antifoam will reduce the frequency of CPC foamovers, decreasing the contamination of the recycle stream. The predicted composition of the RCT is summarized in Table 3-6.

Table 3-6. Predicted Recycle Composition

Analysis	RCT Average	Sludge Composition	RCT Average	CSTF WAC	Meets CSTF WAC?
Base Equiv M	2.53E-01	5.83E-01	2.54E-01	NA	NA
NH3, mg/L	1.71E+01	0.00E+00	1.70E+01	6.00E+01	yes
Formate, mg/L	1.30E+03	1.00E+04	1.34E+03	NA	NA
Nitrate, mg/L	8.30E+03	2.11E+04	8.36E+03	For 0.02 M < [NO3-] < 1.0 M: [OH-] > 1.0 M or [NO2-] > 1.66 * [NO3-] also: [NO3-] < 8.5 M;	yes
Nitrite, mg/L	1.30E+04	0.00E+00	1.29E+04	NA	NA
Cl,	5.24E+02	1.28E+02	5.22E+02	NA	NA
TOC, mg/L	2.10E+02	8.00E+03	2.48E+02	NA	NA
TIC, mg/L	2.00E+02	1.41E+03	2.06E+02	NA	NA
Density, g/mL	1.01E+00	1.12E+00	1.02E+00	NA	NA
Fe, mg/L	2.34E+02	2.30E+00	2.33E+02	NA	NA
Li, mg/L	4.35E+01	0.00E+00	4.33E+01	NA	NA
Si, mg/L	9.55E+01	0.00E+00	9.50E+01	NA	NA
Al, mg/L	2.08E+02	1.08E+04	2.60E+02	NA	NA
Beta, bq/g	2.01E+07	0.00E+00	2.00E+07	NA	NA
Alpha, bq/g	1.01E+11	0.00E+00	1.00E+11	NA	NA
Cs-137, bq/g	4.80E+05	7.21E+08	4.02E+06	NA	NA
Am-241, bq/g	3.67E+04	0.00E+00	3.65E+04	NA	NA
Co-60, bq/g	1.93E+04	0.00E+00	1.92E+04	NA	NA
Eu-154, bq/g	1.28E+05	0.00E+00	1.27E+05	NA	NA
Ru-106, bq/g	6.12E+04	0.00E+00	6.09E+04	NA	NA

The supernate from Tank 22 will be processed by the 2H evaporator unless the recycle diversion is processing the DWPF recycle. It is assumed in this study that this is a 15X evaporation. Also, the development of an antifoam for the 2H evaporator would protect ETF from 2H evaporator foamovers. The expected composition of the Evaporator bottoms is summarized in. Table 3-7.

Table 3-7. Predicted 2H Composition

Analysis	Tank 22 Supernate	2H Bottoms	2H WAC	Meets WAC?
Base Equiv M	2.54E-01	3.81E+00	NA	NA
NH3, mg/L	0.00E+00	0.00E+00	NA	NA
Formate, mg/L	5.83E+02	8.75E+03	NA	NA
Nitrate, mg/L	8.36E+03	1.25E+05	For 1.0 M ≤ [NO3-] < 2.75 M: [OH-] > 0.1 * [NO3-] and [OH-] + [NO2-] > 0.4 * [NO3-] also: [NO3-] < 8.5 M;	yes
Nitrite, mg/L	1.29E+04	1.94E+05	NA	NA
Cl,	2.46E+03	3.69E+04	NA	NA
TOC, mg/L	2.48E+02	3.72E+03	NA	NA
TIC, mg/L	2.06E+02	3.09E+03	NA	NA
Fe, mg/L	0.00E+00	0.00E+00	NA	NA
Li, mg/L	0.00E+00	0.00E+00	NA	NA
Si, mg/L	0.00E+00	0.00E+00	NA	NA
Al, mg/L	0.00E+00	0.00E+00	NA	NA
Mn, mg/L	0.00E+00	0.00E+00	NA	NA
Beta, bq/g	0.00E+00	0.00E+00	NA	NA
Alpha, bq/g	0.00E+00	0.00E+00	NA	NA
Cs-137, bq/g	4.02E+06	6.03E+07	NA	NA
Am-241, bq/g	0.00E+00	0.00E+00	NA	NA
Co-60, bq/g	0.00E+00	0.00E+00	NA	NA
Eu-154, bq/g	0.00E+00	0.00E+00	NA	NA
Ru-106, bq/g	0.00E+00	0.00E+00	NA	NA

The overheads from the 2H evaporator will be processed through ETF along with rainwater and other water sources. This assessment just looked at the stream from 2H overheads to be conservative. It is assumed that there will be 1% entrainment of the evaporator bottoms in the condensate processed through ETF.

Flowsheet Assessment: Processing of recycle works best when the recycle is a solution with a minimum of solids from entrainment, foamovers, decontamination and dissolution. Addition of sludge, glass, melter feed, mercury, and manganese to the recycle from entrainment, etc., will fill up Tank 22 faster and require more frequent transfers of Tank 22 to the sludge preparation tank. In addition, the higher the volume of insoluble solids, the higher the risk of entrainment in the supernate feed to the 2H evaporator. So, minimizing solids in Tank 22 may improve recycle processing.

The implementation of the nitric-glycolic flowsheet has a distinct disadvantage in recycle processing and recycle evaporation. Although the glycolate concentration is approximately 5% of the formate concentration compared to the nitric-formic flowsheet, because glycolate generates much more hydrogen in the HLW evaporators, sodium permanganate will be added to the recycle stream to destroy glycolate. The resulting recycle stream will be high in Mn as needed to destroy glycolate. Minimizing the sodium permanganate addition will minimize the impact of added Mn to Tank 22.

The actinides were not detected in the RCT product except for one sample after a foamover. Although the RCT and Tank 22 *slurry* may have a higher fissile and manganese concentration due to the ABD addition and the glycolate destruction, the Tank 22 *liquid* will not be any higher in the actinides or manganese than that seen historically. The only radionuclides that are increased in the release to the tank farm are uranium, plutonium, and neptunium (i.e., alpha-emitters that normally would be removed by canyon processing). These actinides would be higher in the slurry feed to DWPF and thus higher in the RCT. The alkaline conditions limit the soluble fraction of these actinides and manganese to their respective solubilities which is no different than that for typical canyon waste. The RCT material then processes through the evaporator (note: the insoluble solids could have a higher actinide and manganese concentrations than typical sludge waste). However, the concentrations of the actinides and manganese in the *liquid* fraction would be no higher due to the chemistry. The overheads from the evaporator would have similar DF values for the various radionuclides and manganese as that observed historically with canyon waste. Consequently the condensed overheads from the evaporator that form the feed to the ETF should be no higher in the respective radionuclides and manganese than that seen historically.

Impact of Recycle Diversion on processing: The addition of a recycle evaporator has been studied since 2002. Each time it has been studied[28],[29] the recommendation is to add an additional evaporator for recycle. During typical processing in the CPC (about 80% of the recycle volume is generated in the CPC) the condensate is a very dilute nitric acid solution with elemental mercury that has been stripped from the SRAT or SME. Except for the presence of mercury, this is a stream that can be evaporated to produce a concentrate with 1/30th the volume of the condensate; the presence of mercury makes the engineering of a processing solution more challenging.[22] The presence of manganese from glycolate destruction and other insoluble solids from CPC foamovers and offgas entrainment makes the fouling of heat exchanger surfaces more likely but there is likely no impact from the ABD stream addition on this potential evaporator.

4.0 Conclusions

A flowsheet review was completed to assess the impact of adding ABD material to future sludge batches to accelerate the deinventory of SNF in L Basin. The addition of SNF increases the mass of fissiles in each future sludge batch, due to the high enrichment of these SNFs and the subsequent addition of U-238. The addition of ABD material will increase the number of canisters produced by DWPF because of the mass increase. A separate report addressed the impacts to glass. The review and subsequent calculations used average ABD slurry, compositions for predicted future sludge batches, average past salt batches, and average past recycle batches to predict the individual feeds that will be processed in SWPF, DWPF, Saltstone, the 2H evaporator, and ETF. Each of the processes was evaluated for potential issues

Using these average composition predictions, WAC requirements for the fissiles and other significant radionuclides that are added with the ABD, including Cs-137, Sr-90 and U-235 can be met, except for the ETF feed. The addition of ABD material did increase the mass of aluminum and sodium, but this did not significantly increase the concentration of these in the blended sludge due to LTAD and sludge washing in the CSTF. The ABD stream is also high in nitrate but much of this is removed through washing of the sludge batch. DWPF compensates for higher nitrate by adding more reducing acid, leading to a similar SME product. The main impact is the increase in fissile isotopes, primarily U-235 and the mass of U-238 needed to reduce the enrichment ratio ≤ 5%. The predicted fissile concentration in glass is 2,010 g/m^3, lower than the planned 2,500 g/m^3 maximum. This provides margin to add additional fissiles to one or more of the future sludge batches. But this added uranium doesn't exceed the uranium concentration that has been previously evaluated using the DWPF glass models.

It should be noted that this review was based on averages and past experience. There are some projected sludge or salt tanks that will be high in some radionuclides which might exceed one of the WAC limits if it is not blended properly and could limit the amount of ABD material added. In addition, there are a number of process upsets that could cause a product to exceed the WAC limit such as a foamover in the CPC, excessive melter entrainment, decontamination of failed equipment such as steam or cooling coils, or foaming in the 2H evaporator; however, these process upsets are just as likely to occur without added ABD material.

5.0 Recommendations, Path Forward or Future Work

Based on this assessment, it is viable to add ABD material to future sludge batches to deinventory the SNF in L basin. Note that optimal processing will minimize the impact of process upsets on downstream processing facilities such as Saltstone and ETF. But even optimal processing might slow down throughput and extend total processing time compared to operation without the ABD material.

Since this review focused on average compositions, the flowsheet reviews that SRR completes for each sludge batch are necessary to ensure the WAC limits can be met for each sludge batch. SRR should begin their planning soon to support receiving ABD in preparation of SB11.

6.0 References

1. Smith, T. E. *System Impact Analysis to Assess Potential Facility Impacts of Raising Fissile Limit in Glass*; NMMD-HTS-2020-3466, Revision 0; Savannah River Nuclear Solutions, Aiken, SC, 2020.
2. Johnson, F. C. *Supporting Information to Increase the Fissile Mass Loading in the DWPF Glass Waste Form Above 897 g/m^3*; SRNL-L3300-2020-00017, Revision 0; Savannah River National Laboratory, Aiken, SC, 2020.
3. Fee, N. C. *Process Flow Diagram for Post-Accelerated Basin De-Inventory Initiative Implementation Canyon Processing*; SRNS-RP-2021-00062; Savannah River Nuclear Solutions, Aiken, SC, 2021.
4. Lambert, D. P. *Task Technical and Quality Assurance Plan for Increased Fissile Loading Flowsheet Review*; SRNL-RP-2021-00027, Revision 0; Savannah River National Laboratory, Aiken, SC, 2021.
5. Bannochie, C. J.; Bibler, N. E. *Determination of Reportable Radionuclides for DWPF Sludge Batch 3 (Macrobatch 4)*; WSRC-TR-2005-00157, Revision 0; Savannah River National Laboratory, Aiken, SC, 2005.
6. Pareizs, J. M.; Bannochie, C. J.; Click, D. R.; Lambert, D. P.; Stone, M. E.; Pickenheim, B. R.; Billings, A. L.; Bibler, N. E. *Sludge Washing and Demonstration of the DWPF Flowsheet in the SRNL Shielded Cells for Sludge Batch 5 Qualification*; SRNS-STI-2008-00111, Revision 0; Savannah River National Laboratory, Aiken, SC, 2008.
7. Henley, D. B. *System Impact Evaluation for Sodium Reactor Experiment (SRE) Addition to Sludge Batch 10*; X-ESR-H-01030, Revision 0; Savannah River Remediation LLC, Aiken, SC, 2020.
8. Benedict, J. M. *Waste Acceptance Criteria for Liquid Waste Transfers to the Tank Farms*; X-SD-G-00009, Revision 8; Savannah River Remediation, Aiken, SC, 2021.
9. Smith, T. E.; Clifton, W. H. *Inventory Of Aluminum Spent Nuclear Fuel Evaluation*; SRNS-E1122-2020-00008, Revision 0; Savannah River Remediation, Aiken, SC, 2020.
10. Williams, M. S.; Martino, C. J.; Coleman, C. J. *Gadolinium Poison Solubility Testing for the Downstream Impacts from Accelerated Basin De-Inventory*; SRNL-STI-2021-00006, Revision 0; Savannah River National Laboratory, Aiken, SC, 2021.
11. Smith, T. E. *Accelerated Basin Deinventory Baseline Projection*; SRNS-E1122-2020-00021, Revision 0; Savannah River Nuclear Solutions, Aiken, SC, 2021.
12. Williams, M. S. *Gadolinium Poison Solubility Testing for the Downstream Impacts from Accelerated Basin De-Inventory*; SRNL-STI-2021-00006, Revision 0; Savannah River National Laboratory, Aiken, SC, 2021.
13. Lambert, D. P. Perform Flowsheet Evaluation for Impact of Adding ABD to Future Sludge Batches (eNotebook), eNotebook Experiment ID 07787-00055-33, Savannah River National Laboratory, Aiken, SC, 2021.
14. Ray, J. W. *Waste Acceptance Criteria for Raw Salt Solution, Sludge and SWPF Salt Streams Transfers to DWPF*; X-SD-S-00001, Revision 2; Savannah River Remediation, Aiken, SC, 2021.
15. Norton, M. R. *Salt Waste Processing Facility Feed Waste Acceptance Criteria*; X-ESR-J-00001, Revision 6; Parsons, Aiken, SC, 2021.
16. Harrington, S. J. *Waste Acceptance Criteria for Transfers to the Z-Area Saltstone Production Facility During Salt Disposition Integration (SDI)*; X-SD-Z-00004, Revision: 4; Savannah River Remediation, Aiken, SC, 2021.

17. Isom, S. T., Salt Batch Constituents.xlsx. Lambert, D. P., Ed. Savannah River Remediation: Aiken, SC, 2021.

18. Chew, D. P.; Hamm, B. A.; Wells, M. N. *Liquid Waste System Plan*; SRR-LWP-2009-00001, Revision 21; Savannah River Remediation, LLC, Aiken, SC, 2019.

19. Lambert, D. P.; Williams, M. S.; Brandenburg, C. H.; Luther, M. C.; Newell, J. D.; Woodham, W. H. *Sludge Batch 9 Simulant Runs Using the Nitric-Glycolic Acid Flowsheet*; SRNL-STI-2016-00319, Revision 0; Savannah River National Laboratory, Aiken, SC, 2016.

20. Lambert, D. P.; Howe, A. M.; Woodham, W. H.; Williams, M. S.; Hunter, S. C. *Antifoam Development for Eliminating Flammability Hazards and Decreasing Cycle Time in the Defense Waste Processing Facility*; SRNL-STI-2019-00677, Revision 3; Savannah River National Laboratory, Aiken, SC, 2021.

21. Kmiec, V. M.; Jabour, J. D. *Waste Laboratory Services -Laboratory Information Management System (WLS LIMS) Data Generated to Scope Hydrogen Generation Rate (HGR) Experiments*; X-ESR-S-00365, Revision 0; Savannah River Remediation, LLC, Aiken, SC, 2018.

22. Silker, A. I.; Baxter, D. J.; Henley, D. B. *DWPF Recycle Diversion Process Flow Diagram Inputs and Assumptions*; X-ESR-S-00418, Revision A; Savannah River Remediation, Aiken, SC, 2021.

23. Harrison, E. *F/H Effluent Treatment Project Waste Acceptance Criteria*; X-SD-H-00009, Revision 7; Savannah River Remediation, Aiken, SC, 2020.

24. Wiersma, B. J.; Fuentes, R. E.; Stock, L. M. *Chemistry Envelope for Pitting and Stress Corrosion Cracking Mitigation*; SRNL-STI-2019-00217, Revision 0; Savannah River National Laboratory, Aiken, SC, 2019.

25. *DWPF Waste Form Compliance Plan*; WSRC-IM-91-116-0, Revision 12; Savannah River Remediation, Aiken, SC, 2018.

26. Martino, C. J.; Newell, J. D.; Woodham, W. H.; Pareizs, J. M.; Edwards, T. B.; Lambert, D. P.; Howe, A. M. *Investigation of Thermolytic Hydrogen Generation Rate of Tank Farm Simulated and Actual Waste*; SRNL-STI-2017-00611, Revision 0; Savannah River National Laboratory, Aiken, SC, 2017.

27. Siegfried, M. J.; Ramsey, W. G.; Williams, M. S. *Permanganate Oxidation of Defense Waste Processing Facility (DWPF) Recycle Collection Tank (RCT) Simulants Larger Scale Protocol Runs - Chemical Process Cell (CPC) Nominal and Foamover Conditions*; SRNL-STI-2019-00588, Revision 0; Savannah River National Laboratory, Aiken, SC, 2019.

28. Lambert, D. P.; Barnes, C. D.; Phillips, S. G. *DWPF Recycle Evaporator – Feasibility Study*; WSRC-RP-2001-01101; 2002.

29. Stone, M. E.; Daniel, W. E.; Peeler, D. K.; Edwards, T. B. *DWPF Recycle Evaporator Flowsheet Evaluation*; WSRC-TR-2005-00226, Revision 0; Savannah River National Laboratory, Aiken, SC, 2005.

Appendix A. Complete ABD material Composition

Two spreadsheets were used to predict the composition of the ABD slurry before (Table A-1) and after washing (Table A-2). These two tables are included in this appendix. Also included is the composition of Tank 10.2, which was used to add isotopes as needed for the ABD slurry. I created large tables to make this easy to see on a big monitor.

Table A-1. Calculated ABD Slurry Composition before Washing

Inputs		Gd:U-235 eq	≥0.5	Gd:U-235 Ratio		0.03	Gd:U-235 Ratio after Gd addition				0.50					
U Enrichment, % U-235 eq SLU	5%	Fe:Pu-239 eq	≥160	Fe:Pu eq Ratio		0.00	Fe:Pu Ratio after Fe added				Fe not added					
Pu Isotopic, % Pu-241	82.206%	U-235 eqSLU	2912.9	kg	Pu-239 eq		Enrichment				4.99%					
Fissiles	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**		
U-233	Yes	311.99	233.00	275.67	0.54	lbs	0.24	kg	0.00	wt %	0.18	0.22	kg	0.0001		
U-235	Yes	313.99	235.00	277.67	8,580	lbs	3,892	kg	0.10	wt %	2912.64	3441.44	kg	1.36		
Pu-239	Yes	290.02	239.00	271.00	95	lbs	43	kg	0.00	wt %	35.39	40.13	kg	0.0150		
Pu-241	Yes	292.02	241.00	273.00	20	lbs	9	kg	0.00	wt %	7.67	8.69	kg	0.0032		
Np-237	Yes	288.02	237.00	269.00	108	lbs	49	kg	0.00	wt %	40.16	45.58	kg	0.0170		
Other significant Radioactive species																
U-234	Yes	312.99	234.00	276.67	265	lbs	120	kg	0.00	wt %	90	106	kg	0.0		
U-236	Yes	314.99	236.00	278.67	1,853	lbs	841	kg	0.02	wt %	630	744	kg	0.3		
U-238	Yes	316.99	238.00	280.67	163,011	lbs	73,941	kg	1.91	wt %	55,516	65,468	kg	25.8		
I-131			131.00			lbs	0	kg	0.00	wt %	#DIV/0!	#DIV/0!	kg	-		
Tc-99	No	185.987	99.00	154.998	301	lbs	137	kg	0.00	wt %	72.73	113.87	kg	0.0476		
Sr-90	Yes	124.015	90.00	105.999	106	lbs	48	kg	0.00	wt %	34.77	40.95	kg	0.0167		
Cs-137	No	154.007	137.00	168.999	274	lbs	124	kg	0.00	wt %	110.42	136.21	kg	0.0433		
Sum for U and Pu											H Canyon Tank 10.2 Data from SRNL-STI-2021-00006, Gd Report					
Total U	Yes	316.84	237.850	280.52	171,591	lbs	77,833	kg	2.01	wt %	58,429	68,910	kg	27.1308		
Total Pu	Yes	291.67	240.64	272.64	115	lbs	52	kg	0.00	wt %	43	49	kg	0.0182		
Chemical Species	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**		
Sodium pertechnetate - NaTcO4, Tc2O7	No	185.987	99.00	154.998	301	lbs	137	kg	0.00	wt %	72.73	113.87	kg	0.0476	Sodium pertechnetate - NaTcO4, Tc2O7	
Cs-137 Hydroxide - CsOH, Cs2O	No	154.007	137.00	168.999	265	lbs	120	kg	0.00	wt %	106.93	131.91	kg	0.0419		
Sodium Hydroxide	No	40.00	22.99	61.98	303,203	lbs	137,531	kg	3.55	wt %	79,051	106,558	kg	47.94	OH-	1.20
Mercuric Hydroxide - Hg(OH)2	Yes	234.60	200.59	0.00	2,111	lbs	957	kg	0.02	wt %	819	0	kg	0.33		
Sodium Nitrate - NaNO3, Na2O	No	84.99	22.99	61.98	2,303,357	lbs	1,044,787	kg	26.96	wt %	282,599	380,934	kg	364.19	NO3-	4.28
Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	337	lbs	153	kg	0.00	wt %	115	133	kg	0.05		
Added Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	3,916	lbs	1,776	kg	0.05	wt %	1,341	1,546	kg	0.62		
Aluminum Hydroxide - Al(OH)3, Al2O3	Partially	78.00	26.98	101.96	646,776	lbs	293,373	kg	7.57	wt %	101,478	191,739	kg	102.26		
Sodium Diuranate - Na2U2O7, U3O8	Yes	633.68	237.85	841.55	171,591	lbs	77,833	kg	2.01	wt %	29,214	34,455	kg	27.13		
Neptunium Hydroxide - Np(OH)4, NpO2	Yes	305.03	237.00	269.00	108	lbs	49	kg	0.00	wt %	38	43	kg	0.02		
Plutonium Hydroxide - Pu(OH)4, PUO2	Yes	307.39	239.36	271.35	115	lbs	52	kg	0.00	wt %	41	46	kg	0.02		
Silicon - Si, SiO2	Yes	28.09	28.09	60.08	692	lbs	314	kg	0.01	wt %	314	671	kg	0.11		
Chromium Hydroxide, Cr(OH)3	No	77.51	52.00	151.99	419	lbs	190	kg	0.00	wt %	127	373	kg	0.07		
Calcium Hydroxide, Ca(OH)2, CaO	Yes	74.09	40.08	56.08	856	lbs	388	kg	0.01	wt %	210	294	kg	0.14		
Ferric Hydroxide - Fe(OH)2, Fe2O3	Yes	106.87	55.85	159.69												
Water	No	18.02			5,110,861	lbs	2,318,251	kg	59.82	wt %	495,010	716,125	kg			
Total Mass					8,544,342	lbs	3,875,654	kg	100.00	wt %	2,868,786	L		1.351	kg/L	
Total Solids					3,433,480	lbs	1,557,403	kg	40.18	wt %						
Insoluble Solids					826,920	lbs	375,085	kg	9.68	wt %	77,264			4.855	kg/L	
Supernate					7,717,422	lbs	3,500,568	kg	90.32	wt %	2,791,522	L		1.254	kg/L	
Soluble					2,606,560	lbs	1,182,318	kg	30.51	wt %						
Water					5,110,861	lbs	2,318,251	kg	59.82	wt %						
Calcined Solids									0.00	wt %						
Slurry Density, g/mL																
Supernate Density, g/mL																
Slurry Volume									2,868,786	L						
NaOH Volume					221,046	Gallons	836,660	L		L						
Batch	Insoluble	MW Compound	MW Metal	MW Oxide	Compound		Compound	Metal	Oxide							
Mercuric Hydroxide - Hg(OH)2	Yes	234.605	200.590	0.000	2,111	lbs	957	819	0	kg						
Sodium Hydroxide - NaOH, Na2O	No	39.997	22.990	61.979	303,203	lbs	137,531	79,051	106,558	kg						
Sodium Nitrate - NaNO3, Na2O	No	84.995	22.990	61.979	2,298,563	lbs	1,042,612	282,011	380,141	kg						
Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.272	157.250	362.498	337	lbs	153	115	133	kg						
Aluminum Hydroxide - Al(OH)3, Al2O3	Yes	78.004	26.982	101.961	646,776	lbs	293,373	101,478	191,739	kg						
Sodium Diuranate - Na2U2O7, U3O8	Yes	633.675	237.850	841.545	171,591	lbs	77,833	29,214	34,455	kg						
Neptunium Hydroxide - Np(OH)4, NpO2	Yes	288.022	237.000	268.999	107.586	lbs	49	40	46	kg						
Plutonium Hydroxide - Pu(OH)4, PUO2	Yes	290.246	239.224	271.223	115.164	lbs	52	43	49	kg	Pu	43.1	kg			
Silicon - Si, SiO2	Yes	28.086	28.086	60.084	692	lbs	314	314	671	kg	Minimum Fe	34,736	kg			
Water	No	18.015			5,110,861	lbs	2,318,251			kg	Fe:Pu-239 ratio	806.8				
Total Mass					8,534,358	lbs	3,871,125	493,085	713,792	kg						
Total Volume					757,050	gallons	2,865,434	L			1.669847233					

Table A-2. Calculated ABD Composition After Washing

Inputs		Gd:U-235 eq	≥0.5	Gd:U-235 Ratio		0.5	Gd:U-235 Ratio after Gd addition				0.50			Na Wash Target, M		0.820
U Enrichment, % U-235 eq SLU	5%	Fe:Pu-239 eq	≥160	Fe:Pu eq Ratio		0.00	Fe:Pu Ratio after Fe added				Fe not added			% Al Removed		70.0%
Pu Isotopic, % Pu-241	82.206%	U-235 eqSLU	2912.9	kg	Pu-239 eq		Enrichment				5%	4.99%		% final supernate decant		50
Total Mass					8,544,908	lbs	3,875,910	kg	100.00	wt %	524,741	751,306	kg			
Total Solids					3,434,046	lbs	1,557,659	kg	40.19	wt %						
Insoluble Solids					826,501	lbs	374,895	kg	9.67	wt %						
Supernate					7,718,407	lbs	3,501,015	kg	90.33	wt %						
Calcined Solids					751,306	lbs	340,787	kg	8.79	wt %						
Water					5,110,861	lbs	2,318,251	kg	59.81	wt %						
Slurry Density, g/mL									1.353	kg/L						
Supernate Density, g/mL									1.254	kg/L						
Slurry Volume					757,050	gallons	2,865,434	L								
Supernate Volume					737,616	gallons	2,791,878	L								
Insoluble Solids Volume					19,433	gallons	73,556	L								
Soluble Species before washing	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**	**Anion**	**M**
Sodium pertechnetate - NaTcO4, Tc2O7	No	185.987	99.00	154.998	301	lbs	137	kg	0.00	wt %	72.73	113.87	kg	0.0477	Sodium pertechnetate - NaTcO4, Tc2O7	0.00
Cs-137 Hydroxide - CsOH, Cs2O	No	154.007	137.00	168.999	265	lbs	120	kg	0.00	wt %	106.93	131.91	kg	0.0420		0.00
Sodium Hydroxide - NaOH, Na2O	No	40.00	22.99	61.98	303,203	lbs	137,531	kg	3.55	wt %	79,051	106,558	kg	48.00	OH-	1.20
Sodium Nitrate - NaNO3, Na2O	No	84.99	22.99	61.98	2,303,357	lbs	1,044,787	kg	26.96	wt %	282,599	380,934	kg	364.62	NO3-	4.29
Chromium Hydroxide, Cr(OH)3	No	77.51	52.00	76.00	419	lbs	190	kg	0.00	wt %	127	186	kg	0.07		0.00
Water	No	18.02			5,110,861	lbs	2,318,251	kg	59.81	wt %			kg			
Insoluble Species before washing	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**		
U-233	Yes	311.99	233.00	275.67	0.54	lbs	0.24	kg	0.00	wt %	0.18	0.22	kg	0.0001		
U-234	Yes	312.99	234.00	276.67	265	lbs	120	kg	0.00	wt %	90	106	kg	0.0		
U-235	Yes	313.99	235.00	277.67	8,580	lbs	3,892	kg	0.10	wt %	2,913	3,441	kg	1.36		
U-236	Yes	314.99	236.00	278.67	1,853	lbs	841	kg	0.02	wt %	630	744	kg	0.3		
U-238	Yes	316.99	238.00	280.67	163,011	lbs	73,941	kg	1.91	wt %	55,516	65,468	kg	25.8		
Total U	Yes	316.84	237.850	280.52	171,591	lbs	77,833	kg	2.01	wt %	58,429	68,910	kg	27.1626		
Pu-239	Yes	290.02	239.00	271.00	95	lbs	43	kg	0.00	wt %	35.39	40.13	kg	0.0150		
Pu-241	Yes	292.02	241.00	273.00	20	lbs	9	kg	0.00	wt %	7.67	8.69	kg	0.0032		
Total Pu	Yes	291.67	240.64	272.64	115	lbs	52	kg	0.00	wt %	43	49	kg	0.0182		
Np-237	Yes	288.02	237.00	269.00	108	lbs	49	kg	0.00	wt %	40.16	45.58	kg	0.0170		
Sr-90	Yes	124.015	90.00	105.999	106	lbs	48	kg	0.00	wt %	34.77	40.95	kg	0.0167		
Mercuric Hydroxide - Hg(OH)2	Yes	234.60	200.59	0.00	2,111	lbs	957	kg	0.02	wt %	819	0.00	kg	0.33		
Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	337	lbs	153	kg	0.00	wt %	115	133	kg	0.05		
Added Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	3,916	lbs	1,776	kg	0.05	wt %	1,341	1,546	kg	0.62		
Aluminum Hydroxide - Al(OH)3, Al2O3	Partially	78.00	26.98	101.96	646,776	lbs	293,373	kg	7.57	wt %	101,478	191,739	kg	102.38		
Sodium Diuranate - Na2U2O7, U3O8	Yes	316.84	237.85	841.55	171,591	lbs	77,833	kg	2.01	wt %	58,429	68,910	kg	27.16		
Neptunium Hydroxide - Np(OH)4, NpO2	Yes	305.03	237.00	269.00	108	lbs	49	kg	0.00	wt %	38	43	kg	0.02		
Plutonium Hydroxide - Pu(OH)4, PUO2	Yes	307.39	239.36	271.35	115	lbs	52	kg	0.00	wt %	41	46	kg	0.02		
Silicon - Si, SiO2	Yes	28.09	28.09	60.08	692	lbs	314	kg	0.01	wt %	314	671	kg	0.11		
Calcium Hydroxide, Ca(OH)2, CaO	Yes	74.09	40.08	56.08	856	lbs	388	kg	0.01	wt %	210	294	kg	0.14		
Ferric Hydroxide - Fe(OH)2, Fe2O3	Yes	106.87	55.85	159.69												
Step 1 Aluminum Removal	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**	**Anion**	**M**
Aluminum Hydroxide - Al(OH)3, Al2O3	Partially	78.00	26.98	101.96	646,776	lbs	293,373	kg	7.57	wt %	101,478	191,739	kg	102.38		
Aluminum Removed	Partially	78.00	26.98	101.96	452,743	lbs	205,361	kg	5.30	wt %	71,035	134,218	kg	71.67		
Aluminum Hydroxide - Al(OH)3, Al2O3	Partially	78.00	26.98	101.96	194,033	lbs	88,012	kg	2.27	wt %	30,443	57,522	kg	30.72		
Step 2 Soluble Species after washing	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**	**Anion**	**M**
Tc-99	No	185.987	99.00	154.998	45	lbs	20	kg	0.00	wt %	10.86	17.01	kg	0.01	Tc-99	
Cs-137	No	154.007	137.00	168.999	40	lbs	18	kg	0.00	wt %	15.97	19.70	kg	0.01		
Sodium Hydroxide	No	40.00	22.99	61.98	45,286	lbs	20,541	kg	0.66	wt %	11,807	15,915	kg	7.17	OH-	0.179
Sodium Nitrate - NaNO3, Na2O	No	84.99	22.99	61.98	344,026	lbs	156,048	kg	5.05	wt %	42,209	56,896	kg	54.46	NO3-	0.641
Chromium Hydroxide, Cr(OH)3	No	77.51	52.00	151.99	63	lbs	28	kg	0.00	wt %	19	56	kg	0.01		
Water	No	18.02			6,442,531	lbs	2,922,287	kg					kg			
Step 2 Insoluble Species after washing	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**		
U-233	Yes	311.99	233.00	275.67	0.54	lbs	0.24	kg	0.00	wt %	0.18	0.22	kg	0.0001		
U-234	Yes	312.99	234.00	276.67	265	lbs	120	kg	0.00	wt %	90	106	kg	0.0		
U-235	Yes	313.99	235.00	277.67	8,580	lbs	3,892	kg	0.13	wt %	2912.64	3441.44	kg	1.36		
U-236	Yes	314.99	236.00	278.67	1,853	lbs	841	kg	0.03	wt %	630	744	kg	0.3		
U-238	Yes	316.99	238.00	280.67	163,011	lbs	73,941	kg	2.39	wt %	55,516	65,468	kg	25.8		
Total U	Yes	316.84	237.850	280.52	171,591	lbs	77,833	kg	2.52	wt %	58,429	68,910	kg	27.1626		
Pu-239	Yes	290.02	239.00	271.00	95	lbs	43	kg	0.00	wt %	35.39	40.13	kg	0.0150		
Pu-241	Yes	292.02	241.00	273.00	20	lbs	9	kg	0.00	wt %	7.67	8.69	kg	0.0032		
Total Pu	Yes	291.67	240.64	272.64	115	lbs	52	kg	0.00	wt %	43	49	kg	0.0182		
Np-237	Yes	288.02	237.00	269.00	108	lbs	49	kg	0.00	wt %	40.16	45.58	kg	0.0170		
Sr-90	Yes	124.015	90.00	105.999	106	lbs	48	kg	0.00	wt %	34.77	40.95	kg	0.0167		
Mercuric Hydroxide - Hg(OH)2	Yes	234.60	200.59	0.00	2,111	lbs	957	kg	0.03	wt %	819	0	kg	0.33		
Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	337	lbs	153	kg	0.00	wt %	115	133	kg	0.05		
Added Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	3,916	lbs	1,776	kg	0.06	wt %	1,341	1,546	kg	0.62		
Aluminum Hydroxide - Al(OH)3, Al2O3	Partially	78.00	26.98	101.96	194,033	lbs	88,012	kg	2.85	wt %	30,443	57,522	kg	30.72		
Sodium Diuranate - Na2U2O7, U3O8	Yes	316.84	237.85	841.55	171,591	lbs	77,833	kg	2.52	wt %	58,429	68,910	kg	27.16		
Neptunium Hydroxide - Np(OH)4, NpO2	Yes	305.03	237.00	269.00	108	lbs	49	kg	0.00	wt %	38	43	kg	0.02		
Plutonium Hydroxide - Pu(OH)4, PUO2	Yes	308.67	240.64	272.64	115	lbs	52	kg	0.00	wt %	41	46	kg	0.02		
Silicon - Si, SiO2	Yes	28.09	28.09	60.08	692	lbs	314	kg	0.01	wt %	314	671	kg	0.11		
Calcium Hydroxide, Ca(OH)2, CaO	Yes	74.09	40.08	56.08	856	lbs	388	kg	0.01	wt %	210	294	kg	0.14		
Ferric Hydroxide - Fe(OH)2, Fe2O3	Yes	106.87	55.85	159.69	0											

Total Mass					6,816,289	lbs	3,091,821	kg	100.00	wt %	80,721	202,109	kg			
Total Solids					763,217	lbs	346,190	kg	11.20	wt %						
Insoluble Solids				373,758	373,758	lbs	169,534	kg	5.48	wt %						
Supernate				389,460	6,442,531	lbs	2,922,287	kg	94.52	wt %						
Calcined Solids					445,573	lbs	202,109	kg	6.54	wt %						
Slurry Density, g/mL									1.058	kg/L						
Supernate Density, g/mL									1.047	kg/L	OLI Calc					
Slurry Volume					Slurry Volume		757,050	gallons	2,865,434	L						
Supernate Volume					Supernate Volume		737,616	gallons	2,791,878	L						

Step 3: Soluble Species after final supernate decant	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**Total Mass All Batches**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**	**Anion**	**M**
Tc-99	No	185.987	99.00	154.998	22	lbs	10	kg	0.00	wt %	5.43	8.50	kg	0.0069	Tc-99	
Cs-137	No	154.007	137.00	168.999	20	lbs	9	kg	0.00	wt %	7.99	9.85	kg	0.0061		
Sodium Hydroxide	No	40.00	22.99	61.98	22,643	lbs	10,271	kg	0.60	wt %	5,903	7,958	kg	6.99	OH-	0.175
Sodium Nitrite - NaNO2, Na2O	No	69.00	22.99	61.98		lbs	38,525	kg	0.00	wt %	12,837	17,304	kg	26.22	NO2-	0.200
Sodium Nitrate - NaNO3, Na2O	No	84.99	22.99	61.98	172,013	lbs	78,024	kg	4.54	wt %	21,104	28,448	kg	53.10	NO3-	0.625
Chromium Hydroxide, Cr(OH)3	No	77.51	52.00	151.99	31	lbs	14	kg	0.00	wt %	10	28	kg	0.01		
Water	No	18.02			3,221,265	lbs	1,461,143	kg					kg			

Step 3: Insoluble Species after final decant	**Insoluble**	**MW Compound**	**MW Metal**	**MW Oxide**	**Total Mass All Batches**	**Units**	**.**	**Units**	**Solids**	**wt %**	**Metal**	**Oxide**	**Units**	**g/L**		
U-233	Yes	311.99	233.00	275.67	0.54	lbs	0.24	kg	0.00	wt %	0.18	0.22	kg	0.0002		
U-234	Yes	312.99	234.00	276.67	265.01	lbs	120	kg	0.01	wt %	90	106	kg	0.1		
U-235	Yes	313.99	235.00	277.67	8,579.56	lbs	3,892	kg	0.23	wt %	2912.64	3441.44	kg	2.65		
U-236	Yes	314.99	236.00	278.67	1,853.16	lbs	841	kg	0.05	wt %	630	744	kg	0.6		
U-238	Yes	316.99	238.00	280.67	163,011.14	lbs	73,941	kg	4.30	wt %	55,516	65,468	kg	50.3		
Total U	Yes	168.99	90.000	132.67	171,591.25	lbs	77,833	kg	4.53	wt %	41,452	61,103	kg	52.9655		
Pu-239	Yes	290.02	239.00	271.00	94.67	lbs	43	kg	0.00	wt %	35.39	40.13	kg	0.0292		
Pu-241	Yes	292.02	241.00	273.00	20.49	lbs	9.29	kg	0.00	wt %	7.67	8.69	kg	0.0063		
Total Pu	Yes	208.27	157.25	189.25	115.16	lbs	52	kg	0.00	wt %	39	47	kg	0.0355		
Np-237	Yes	288.02	237.00	269.00	107.59	lbs	49	kg	0.00	wt %	40.16	45.58	kg	0.0332		
Sr-90	Yes	124.015	90.00	105.999	105.62	lbs	48	kg	0.00	wt %	34.77	40.95	kg	0.0326		
Mercuric Hydroxide - Hg(OH)2	Yes	234.60	200.59	0.00	2,110.88	lbs	957	kg	0.06	wt %	819	0	kg	0.65		
Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	337.21	lbs	153	kg	0.01	wt %	115	133	kg	0.10		
Added Gadolinium Hydroxide - Gd(OH)3, GD2O3	Yes	208.27	157.25	181.25	3,915.53	lbs	1,776	kg	0.10	wt %	1,341	1,546	kg	1.21		
Aluminum Hydroxide - Al(OH)3, Al2O3	Partially	78.00	26.98	101.96	194,032.83	lbs	88,012	kg	5.12	wt %	30,443	57,522	kg	59.89		
Sodium Diuranate - Na2U2O7, U3O8	Yes	168.99	90.00	398.00	171,591.25	lbs	77,833	kg	4.53	wt %	41,452	61,103	kg	52.97		
Neptunium Hydroxide - Np(OH)4, NpO2	Yes	305.03	237.00	269.00	107.59	lbs	49	kg	0.00	wt %	38	43	kg	0.03		
Plutonium Hydroxide - Pu(OH)4, PUO2	Yes	225.28	157.25	189.25	115.16	lbs	52	kg	0.00	wt %	36	44	kg	0.04		
Silicon - Si, SiO2	Yes	28.09	28.09	60.08	691.63	lbs	314	kg	0.02	wt %	314	671	kg	0.21		
Calcium Hydroxide, Ca(OH)2, CaO	Yes	74.09	40.08	56.08	855.62	lbs	388	kg	0.02	wt %	210	294	kg	0.26		
Ferric Hydroxide - Fe(OH)2, Fe2O3	Yes	106.87	55.85	159.69	0.00											
Total Mass		Total Mass			3,789,859	lbs	1,719,053	kg	100.00	wt %	0	175,152	kg			
Total Solids Mass		Solids Mass			568,593	lbs	257,910	kg	15.00	wt %						
Insoluble Solids Mass		Insoluble Solids Mass			373,863	lbs	169,582	kg	9.86	wt %						
Supernate Mass		Supernate Mass			3,415,995	lbs	1,549,472	kg	90.14	wt %						
Calcined Solids Mass					386,143	lbs	175,152	kg	10.19	wt %						
Slurry Density, g/mL									1.177	kg/L						
Supernate Density, g/mL									1.047	kg/L						
Slurry Volume					Slurry Volume		388,242	gallons	1,469,495	L						
Supernate Volume					Supernate Volume		368,808	gallons	1,395,939	L						

Table A-3. Tank 10.2 Composition

m/z	average (mg/L)	RSD	kg	analyte	average (mg/L)	RSD
59	1.22	0.70%	5.31E+00	Ag	<5.29E+01	--
82	0.37	3.90%	1.61E+00	Al	39,900.00	3.30%
84	<3.06E-02	--		B	<4.28E+01	--
85	3.85	0.70%	1.68E+01	Ba	53.60	1.10%
86	≤3.42E-02	--		Be	<2.60E+00	--
87	7.85	0.60%	3.42E+01	Ca	574.00	1.90%
88	11.30	0.80%	4.92E+01	Cd	<4.40E+01	--
89	15.00	1.10%	6.53E+01	Ce	<1.18E+02	--
90	11.00	0.50%	4.79E+01	Co	<5.41E+01	--
91	13.70	0.80%	5.97E+01	Cr	281.00	2.80%
92	12.50	0.60%	5.44E+01	Cu	55.40	2.10%
93	15.00	1.70%	6.53E+01	Fe	1,090.00	2.60%
94	14.00	2.90%	6.10E+01	Gd	198.00	2.40%
95	9.20	2.00%	4.01E+01	K	<8.50E+02	--
96	12.60	1.10%	5.49E+01	La	33.90	3.90%
97	8.06	0.10%	3.51E+01	Li	<3.02E+01	--
98	8.13	1.30%	3.54E+01	Mg	306.00	2.10%
99	16.70	0.40%	7.27E+01	Mn	46.00	9.90%
100	9.41	4.20%	4.10E+01	Mo	<1.67E+02	--
101	18.50	0.50%	8.06E+01	Na	<1.54E+02	--
102	16.10	1.10%	7.01E+01	Ni	<2.69E+02	--
103	10.00	0.30%	4.36E+01	P	<3.24E+02	--
104	8.32	2.00%	3.62E+01	Pb	<3.70E+02	--
105	1.63	1.10%	7.10E+00	Sb	<7.06E+02	--
106	1.78	1.70%	7.75E+00	Si	<1.68E+02	--
107	0.62	3.20%	2.70E+00	Sn	<3.24E+02	--
108	0.22	4.30%	9.41E-01	Sr	21.10	2.00%
109	0.30	3.10%	1.29E+00	Th	<9.53E+01	--
110	0.18	4.20%	7.97E-01	Ti	<1.12E+01	--
111	0.13	2.50%	5.66E-01	U	3,100.00	1.80%

m/z	average (mg/L)	RSD	kg
112	0.14	2.80%	5.92E-01
113	0.04	6.10%	1.55E-01
114	0.11	1.20%	4.79E-01
116	0.09	3.20%	4.02E-01
117	0.63	3.20%	2.72E+00
118	10.90	4.90%	4.75E+01
119	17.80	1.80%	7.75E+01
120	0.16	1.00%	7.10E-01
121	0.05	9.20%	1.98E-01
122	0.08	4.40%	3.55E-01
123	≤3.21E-02	--	
124	0.15	5.10%	6.32E-01
125	0.16	5.00%	6.79E-01
126	11.00	1.40%	4.79E+01
128	2.28	1.60%	9.93E+00
130	7.77	0.80%	3.38E+01
133	30.70	1.90%	1.34E+02
134	1.44	0.60%	6.27E+00
135	3.01	0.90%	1.31E+01
136	0.11	13.70%	4.62E-01
137	28.50	0.60%	1.24E+02
138	35.00	1.20%	1.52E+02
139	34.90	1.50%	1.52E+02
140	34.30	1.00%	1.49E+02
141	31.80	1.50%	1.38E+02
142	33.00	1.80%	1.44E+02
143	27.60	2.20%	1.20E+02
144	33.80	1.90%	1.47E+02
145	20.00	0.90%	8.71E+01
146	17.00	1.80%	7.40E+01
147	9.73	1.00%	4.24E+01
148	10.80	1.10%	4.70E+01
149	0.46	1.40%	2.00E+00
150	8.85	0.70%	3.85E+01
151	0.43	1.70%	1.87E+00
152	3.10	1.00%	1.35E+01
153	1.44	0.90%	6.27E+00
154	5.42	0.50%	2.36E+01
155	27.80	3.00%	1.21E+02
156	38.30	3.70%	1.67E+02
157	28.60	2.90%	1.25E+02
158	47.50	2.50%	2.07E+02
159	0.46	1.90%	2.01E+00
160	43.20	2.10%	1.88E+02
161	0.36	2.90%	1.59E+00
162	0.24	3.50%	1.05E+00
163	0.14	3.10%	6.10E-01
164	0.10	2.40%	4.44E-01
165	0.09	2.80%	3.72E-01
166	≤3.07E-02	--	
167	0.06	3.00%	2.50E-01
168	<3.06E-02	--	
169	<3.06E-02	--	
170	<3.06E-02	--	
171	0.15	0.90%	6.32E-01
172	0.37	1.40%	1.61E+00
173	0.42	0.20%	1.81E+00
174	0.42	2.20%	1.83E+00
175	0.51	0.30%	2.23E+00
176	0.19	1.30%	8.19E-01
177	0.36	1.50%	1.56E+00
178	<3.06E-02	--	
179	<3.06E-02	--	
180	<3.06E-02	--	
181	<3.06E-02	--	
182	<3.06E-02	--	
183	<3.06E-02	--	
184	<3.06E-02	--	
185	<3.06E-02	--	
186	<3.06E-02	--	
187	<3.06E-02	--	
191	<3.06E-02	--	
193	<3.06E-02	--	
194	<3.06E-02	--	
195	<3.06E-02	--	
196	0.71	1.20%	3.10E+00
198	36.20	5.20%	1.58E+02
203	<3.06E-02	--	
204	22.80	4.70%	9.93E+01
205	<3.06E-02	--	
206	0.38	0.70%	1.63E+00
207	0.33	1.70%	1.44E+00
208	0.79	1.00%	
229	<3.06E-02	--	
230	<3.06E-02	--	

analyte	average (mg/L)	RSD
V	<2.93E+01	--
Zn	34.40	3.30%
Zr	77.40	2.50%

m/z	average (mg/L)	RSD	kg	analyte	average (mg/L)	RSD
232	≤3.33E-02	--				
233	<1.22E-01	--				
234	27.60	2.50%	1.20E+02			
235	1,970.00	0.70%	8.58E+03			
236	193.00	1.40%	8.41E+02			
237	5.39	0.50%	2.35E+01			
238	1,040.00	1.00%	4.53E+03			
239	10.30	0.10%	4.49E+01			
240	2.36	0.10%	1.03E+01			
241	1.27	0.90%	5.53E+00			
242	0.42	0.90%	1.84E+00			
243	0.05	1.40%	2.14E-01			
244	<3.06E-02	--				

Appendix B. Complete Sludge Composition

A spreadsheet was used to predict the composition of the sludge composition after (Table B-1) combining washed sludge with the washed ABD slurry (Table B-2). A complete table is included in this appendix. I created a large table to make this easy to see on a big monitor.

Table B-1. Sludge Composition After ABD Addition, System Plan R-22 Case 2 Draft, ABD Excluded

Calcine Factor	0.75	kg oxide/kg dried sludge solids		Waste Loading, kg glass / kg dried solids			36%		Glass Density	2.7	kg/L	2010	g fissile/m3 glass	
Quantity	**SB11/Tk51**	**SB12/Tk42**	**SB13/Tk51**	**SB14/Tk42**	**SB15/Tk51**	**SB16/Tk42**	**SB17/Tk51**	**SB18/Tk42**	**Sum SB11-18**	**Average SB11-18**	**ABD**	**Sum SB11-18 & ABD**	**% ABD**	**X increase**
Calcined Solids												2.03E+06		
Glass												5.63E+06		
Supernate Vol, gal	4.35E+05	3.39E+05	5.05E+05	3.89E+05	5.30E+05	3.23E+05	3.86E+05	2.29E+05	3.14E+06	4.14E+05	3.69E+05	3.51E+06	11%	1.12
Insol. Solid Vol, gal	2.24E+04	2.43E+04	2.55E+04	2.66E+04	2.38E+04	2.37E+04	2.40E+04	2.09E+04	1.91E+05	2.41E+04	1.94E+04	2.11E+05	9%	1.10
Slurry Vol, gal	4.58E+05	3.63E+05	5.30E+05	4.16E+05	5.53E+05	3.46E+05	4.10E+05	2.50E+05	3.33E+06	4.38E+05	3.88E+05	3.72E+06	10%	1.12
Insol. Solid Mass, kg	1.96E+05	2.11E+05	2.16E+05	2.29E+05	2.10E+05	2.06E+05	2.19E+05	1.87E+05	1.68E+06	2.11E+05	1.70E+05	1.85E+06	9%	1.10
Supernate SpG	1.04E+00	1.04E+00	1.04E+00	1.04E+00	1.04E+00	1.04E+00	1.04E+00	1.04E+00	NA	1.04E+00	1.05E+00	1.05E+00	100%	NA
Supernate Mass, kg	1.71E+06	1.33E+06	1.99E+06	1.53E+06	2.08E+06	1.27E+06	1.52E+06	9.03E+05	1.23E+07	1.54E+06	1.55E+06	1.39E+07	11%	1.13
Slurry Mass, kg	1.91E+06	1.54E+06	2.20E+06	1.76E+06	2.29E+06	1.48E+06	1.74E+06	1.09E+06	1.40E+07	1.75E+06	1.72E+06	1.57E+07	11%	1.12
Slurry SpG	1.10E+00	1.12E+00	1.10E+00	1.12E+00	1.09E+00	1.13E+00	1.12E+00	1.15E+00	NA	1.20E+00	1.18E+00	1.12E+00	105%	NA
Wt% Insol. Solids	1.03E+01	1.37E+01	9.80E+00	1.30E+01	9.17E+00	1.40E+01	1.26E+01	1.72E+01	9.97E+01	1.20E+01	9.86E+00	1.17E+01	84%	0.12
Soluble Solids Mass, kg	9.87E+04	8.98E+04	1.24E+05	9.81E+04	1.25E+05	7.88E+04	9.47E+04	5.88E+04	7.68E+05	9.59E+04	8.83E+04	8.56E+05	10%	1.12
Total Solids Mass, kg	2.95E+05	3.01E+05	3.40E+05	3.27E+05	3.35E+05	2.85E+05	3.14E+05	2.46E+05	2.44E+06	3.05E+05	2.58E+05	2.70E+06	10%	1.11
Wt% Total Solids	1.55E+01	1.95E+01	1.54E+01	1.86E+01	1.46E+01	1.93E+01	1.81E+01	2.26E+01	1.44E+02	1.74E+01	1.50E+01	1.72E+01	87%	0.12
NO2, M	2.78E-01	2.28E-01	2.19E-01	2.23E-01	2.14E-01	2.34E-01	2.26E-01	2.29E-01	NA	2.31E-01	2.00E-01			
NO3, M	2.09E-01	4.74E-01	3.52E-01	3.94E-01	2.99E-01	3.11E-01	3.60E-01	3.84E-01	NA	3.41E-01	7.07E-01			
OH, M	3.71E-01	1.69E-01	2.91E-01	2.07E-01	3.69E-01	2.16E-01	2.42E-01	1.33E-01	NA	2.66E-01	9.31E-02			
Cl, M	4.67E-04	3.26E-04	4.59E-04	6.16E-04	6.31E-04	6.02E-04	5.84E-04	6.35E-04	NA	5.37E-04	0.00E+00			
SO4, M	1.07E-02	1.23E-02	1.47E-02	2.11E-02	8.71E-03	9.92E-03	1.30E-02	3.27E-02	NA	1.43E-02	0.00E+00			
F, M	5.64E-04	1.53E-03	7.59E-04	6.22E-04	2.01E-03	1.30E-03	6.67E-04	5.32E-04	NA	1.04E-03	0.00E+00			
CO3-2, M	1.95E-02	2.50E-02	2.13E-02	2.15E-02	1.59E-02	8.77E-02	3.28E-02	2.80E-02	NA	2.93E-02	0.00E+00			
AlO2, M	3.68E-02	1.94E-02	2.91E-02	2.00E-02	3.81E-02	2.00E-02	2.50E-02	1.36E-02	NA	2.69E-02	0.00E+00			
C2O4-2, M	3.93E-03	1.17E-03	5.40E-03	7.48E-03	3.04E-03	1.35E-03	4.81E-04	2.68E-02	NA	5.14E-03	0.00E+00			
PO4-3, M	5.86E-04	1.60E-03	9.41E-04	1.17E-03	1.06E-03	1.13E-03	1.11E-03	1.15E-03	NA	1.07E-03	0.00E+00			
K, M	1.56E-03	1.18E-03	2.03E-03	2.67E-03	3.03E-03	1.71E-03	2.53E-03	2.88E-03	NA	2.21E-03	0.00E+00			
Sludge Batch	**SB11/Tk51**	**SB12/Tk42**	**SB13/Tk51**	**SB14/Tk42**	**SB15/Tk51**	**SB16/Tk42**	**SB17/Tk51**	**SB18/Tk42**	**Sum SB11-18**	**Average SB11-18**	**ABD**	**Sum SB11-18 & ABD**	**% ABD**	**X increase**
NaNO2, kg	3.16E+04	2.02E+04	2.89E+04	2.27E+04	2.95E+04	1.98E+04	2.28E+04	1.37E+04	1.89E+05	2.49E+04	1.93E+04	2.08E+05	9%	1.10
NaNO3, kg	2.92E+04	5.18E+04	5.71E+04	4.93E+04	5.09E+04	3.23E+04	4.47E+04	2.83E+04	3.44E+05	4.45E+04	8.39E+04	4.27E+05	20%	1.24
NaOH, kg	2.44E+04	8.67E+03	2.22E+04	1.22E+04	2.96E+04	1.06E+04	1.42E+04	4.63E+03	1.26E+05	1.76E+04	5.20E+03	1.32E+05	4%	1.04
NaCl, kg	4.50E+01	2.45E+01	5.12E+01	5.30E+01	7.40E+01	4.30E+01	4.99E+01	3.22E+01	3.73E+02	4.91E+01	0.00E+00	3.73E+02	0%	1.00
Na2SO4, kg	2.51E+03	2.24E+03	4.00E+03	4.41E+03	2.48E+03	1.72E+03	2.69E+03	4.03E+03	2.41E+04	3.00E+03	0.00E+00	2.41E+04	0%	1.00
NaF, kg	3.90E+01	8.25E+01	6.09E+01	3.85E+01	1.69E+02	6.67E+01	4.09E+01	1.94E+01	5.17E+02	7.08E+01	0.00E+00	5.17E+02	0%	1.00
Na2CO3, kg	3.40E+03	3.40E+03	4.33E+03	3.36E+03	3.39E+03	1.13E+04	5.08E+03	2.58E+03	3.69E+04	4.51E+03	0.00E+00	3.69E+04	0%	1.00
NaAlO2, kg	4.96E+03	2.04E+03	4.57E+03	2.41E+03	6.26E+03	2.01E+03	3.00E+03	9.68E+02	2.62E+04	3.65E+03	0.00E+00	2.62E+04	0%	1.00
Na2C2O4, kg	8.67E+02	2.02E+02	1.38E+03	1.48E+03	8.17E+02	2.21E+02	9.43E+01	3.12E+03	8.18E+03	9.48E+02	0.00E+00	8.18E+03	0%	1.00
Na3PO4, kg	1.58E+02	3.37E+02	2.95E+02	2.83E+02	3.50E+02	2.27E+02	2.66E+02	1.63E+02	2.08E+03	2.68E+02	0.00E+00	2.08E+03	0%	1.00
KNO3, kg	2.59E+02	1.53E+02	3.93E+02	3.98E+02	6.15E+02	2.11E+02	3.74E+02	2.52E+02	2.66E+03	3.55E+02	0.00E+00	2.66E+03	0%	1.00
Sludge Batch	**SB11/Tk51**	**SB12/Tk42**	**SB13/Tk51**	**SB14/Tk42**	**SB15/Tk51**	**SB16/Tk42**	**SB17/Tk51**	**SB18/Tk42**	**Sum SB11-18**	**Average SB11-18**	**ABD**	**Sum SB11-18 & ABD**	**% ABD**	**X increase**
Tc-99	2.16E+05	1.81E+05	2.36E+05	2.49E+05	2.40E+05	2.26E+05	1.74E+05	1.79E+05	1.70E+06	2.13E+05	5.43E+00	1.70E+06	0%	1.00
Cs-137	3.21E+00	2.62E+00	4.30E+00	3.97E+00	4.82E+00	2.32E+00	2.25E+00	8.61E-01	2.44E+01	3.04E+00	7.99E+00	3.23E+01	25%	1.33
Sr-90	8.72E+03	7.21E+03	1.51E+04	1.24E+04	1.37E+04	6.51E+03	6.70E+03	2.12E+03	7.25E+04	9.06E+03	3.48E+01	7.25E+04	0%	1.00
Th-232	3.35E+03	1.66E+03	3.58E+02	2.20E+02	7.78E+01	1.54E+01	8.45E+00	1.29E+02	5.82E+03	7.28E+02	0.00E+00	5.82E+03	0%	1.00
Np-237	2.82E+00	1.91E+00	1.40E+01	1.42E+01	1.36E+01	6.62E+00	3.73E+00	3.06E+00	5.99E+01	7.49E+00	4.02E+01	1.00E+02	40%	1.67
U-233	6.00E-01	3.03E-01	6.49E-02	4.07E-02	3.47E-02	2.85E-03	2.51E-03	4.10E-02	1.09E+00	1.36E-01	1.83E-01	1.27E+00	14%	1.17
U-234	4.31E-01	3.25E-01	1.44E+00	1.05E+00	1.20E+00	4.97E-01	3.82E-01	1.35E-01	5.46E+00	6.83E-01	8.99E+01	9.53E+01	94%	17.5
U-235	3.34E+01	1.75E+01	1.21E+02	1.25E+02	1.20E+02	7.53E+01	5.51E+01	5.79E+01	6.05E+02	7.57E+01	2.91E+03	3.52E+03	83%	5.81
U-236	7.76E+00	6.91E+00	2.48E+01	1.82E+01	2.07E+01	9.22E+00	7.51E+00	2.43E+00	9.76E+01	1.22E+01	6.30E+02	7.27E+02	87%	7.46
U-238	1.63E+03	5.88E+02	2.77E+04	4.66E+04	2.35E+04	1.56E+04	4.91E+03	9.18E+03	1.30E+05	1.62E+04	5.55E+04	1.85E+05	30%	1.43
Pu-239	6.39E+01	4.72E+01	1.18E+02	1.28E+02	1.04E+02	6.68E+01	4.88E+01	3.57E+01	6.12E+02	7.65E+01	3.54E+01	6.48E+02	5%	1.06
Pu-240	8.66E+03	7.16E+03	1.50E+04	1.23E+04	1.36E+04	6.45E+03	6.65E+03	2.09E+03	7.19E+04	8.98E+03	0.00E+00	7.19E+04	0%	1.00
Pu241	4.15E-01	3.81E-01	1.33E+00	9.23E-01	1.01E+00	3.71E-01	3.45E-01	8.02E-02	4.85E+00	6.07E-01	7.67E+00	1.25E+01	61%	2.58
Am-242m	9.10E-04	7.14E-04	1.48E-03	1.59E-03	2.00E-03	1.02E-03	8.63E-04	5.09E-04	9.08E-03	1.14E-03	0.00E+00	9.08E-03	0%	1.00
Cm-244	5.88E-02	3.94E-02	9.54E-01	6.82E-01	6.72E-01	1.15E-01	6.05E-02	2.10E-02	2.60E+00	3.25E-01	0.00E+00	2.60E+00	0%	1.00
Cm-245	9.21E-05	5.38E-05	4.58E-02	3.47E-02	3.58E-02	6.39E-03	3.35E-03	1.40E-03	1.28E-01	1.59E-02	0.00E+00	1.28E-01	0%	1.00
Total Fissile (kg)	9.84E+01	6.53E+01	2.40E+02	2.54E+02	2.25E+02	1.42E+02	1.04E+02	9.37E+01	1.22E+03	1.53E+02	2.96E+03	4.18E+03	71%	3.42
Al	1.39E+04	2.13E+04	1.23E+04	1.09E+04	1.17E+04	1.65E+04	2.05E+04	1.41E+04	1.21E+05	1.51E+04	3.04E+04	1.51E+05	20%	1.25
Fe	3.63E+04	2.64E+04	4.35E+04	3.97E+04	4.57E+04	4.73E+04	2.92E+04	9.37E+01	2.68E+05	3.35E+04	0.00E+00	2.68E+05	0%	1.00
Ca	3.92E+03	4.52E+03	4.21E+03	4.20E+03	4.27E+03	4.41E+03	5.14E+03	3.68E+03	3.43E+04	4.29E+03	2.10E+02	3.46E+04	1%	1.01
Cr	4.70E+02	3.62E+02	5.07E+02	4.94E+02	6.06E+02	4.89E+02	4.55E+02	3.97E+02	3.78E+03	4.73E+02	0.00E+00	3.78E+03	0%	1.00
Hg	1.06E+04	8.98E+03	7.60E+03	4.69E+03	9.53E+03	5.36E+03	8.93E+03	8.97E+02	5.66E+04	7.07E+03	8.19E+02	5.74E+04	1%	1.01
Gd	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.75E+01	0.00E+00	4.10E+01	7.85E+01	9.81E+00	1.46E+03	1.53E+03	95%	19.6
Mn	7.61E+03	3.69E+03	9.28E+03	6.03E+03	7.34E+03	5.40E+03	3.09E+03	5.02E+03	4.75E+04	5.93E+03	0.00E+00	4.75E+04	0%	1.00
U-235 enrichment	2.00%	2.86%	0.43%	0.27%	0.51%	0.48%	1.11%	0.63%	0.46%	1.04%	4.92%	1.86%	265%	4.00
Total U	1.67E+03	6.13E+02	2.79E+04	4.67E+04	2.37E+04	1.57E+04	4.98E+03	9.24E+03	1.30E+05	1.63E+04	5.84E+04	1.30E+05	45%	1.81
U-235eqSLU	3.43E+01	1.79E+01	1.21E+02	1.25E+02	1.20E+02	7.53E+01	5.51E+01	5.79E+01	6.07E+02	7.59E+01	2.91E+03	3.52E+03		
Pu-239eq	8.67E+01	5.92E+01	2.00E+02	2.11E+02	1.85E+02	1.16E+02	8.51E+01	7.35E+01	1.02E+03	1.27E+02	1.94E+03	2.95E+03		
Fe:Pu	4.18E+02	4.45E+02	2.18E+02	1.88E+02	2.48E+02	4.06E+02	3.44E+02	1.27E+00	2.64E+02	2.64E+02	0.00E+00	9.08E+01		
Gd/U-235eqSLU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.98E-01	0.00E+00	7.07E-01	1.29E-01	1.29E-01	5.00E-01	4.36E-01		
H-3	4.81E-11	1.87E-11	3.52E-12	1.16E-12	2.18E-13	6.87E-14	1.92E-14	4.44E-15	7.19E-11	8.98E-12	0.00E+00	7.19E-11	0%	1.00
C-14	5.20E-05	3.01E-05	5.51E-05	4.88E-05	4.79E-05	7.38E-05	4.38E-05	5.11E-05	4.03E-04	5.03E-05	0.00E+00	4.03E-04	0%	1.00
Ni-59	2.34E+00	1.78E+00	2.78E+00	2.48E+00	3.47E+00	1.91E+00	2.09E+00	8.34E-01	1.77E+01	2.21E+00	0.00E+00	1.77E+01	0%	1.00
Co-60	1.68E-03	1.48E-03	9.97E-03	6.90E-03	5.88E-03	1.62E-03	1.08E-03	2.99E-04	2.89E-02	3.61E-03	0.00E+00	2.89E-02	0%	1.00
Ni-63	2.61E-01	2.00E-01	3.23E-01	2.89E-01	3.92E-01	2.15E-01	2.28E-01	9.04E-02	2.00E+00	2.50E-01	0.00E+00	2.00E+00	0%	1.00
Se-79	1.46E+00	1.13E+00	1.83E+00	1.71E+00	2.38E+00	1.23E+00	1.34E+00	5.35E-01	1.16E+01	1.45E+00	0.00E+00	1.16E+01	0%	1.00
Sr-90	3.41E+01	2.66E+01	4.54E+01	3.97E+01	4.94E+01	2.34E+01	2.39E+01	7.99E+00	2.50E+02	3.13E+01	0.00E+00	2.50E+02	0%	1.00
Y-90	8.85E-03	6.91E-03	1.18E-02	1.03E-02	1.28E-02	6.08E-03	6.19E-03	2.07E-03	6.49E-02	8.12E-03	0.00E+00	6.49E-02	0%	1.00
Nb-94	1.42E-04	1.10E-04	2.57E-04	3.12E-04	3.81E-04	2.04E-04	1.62E-04	1.22E-04	1.69E-03	2.11E-04	0.00E+00	1.69E-03	0%	1.00
Tc-99	1.02E+02	7.86E+01	1.29E+02	1.21E+02	1.67E+02	8.68E+01	9.39E+01	3.79E+01	8.16E+02	1.02E+02	0.00E+00	8.16E+02	0%	1.00
Ru-106	6.54E-09	3.01E-09	2.80E-06	7.69E-07	2.86E-07	1.79E-08	2.83E-09	4.25E-10	3.89E-06	4.86E-07	0.00E+00	3.89E-06	0%	1.00
Rh-106	6.54E-13	3.01E-13	2.80E-10	7.69E-11	2.86E-11	1.79E-12	2.83E-13	4.25E-14	3.89E-10	4.86E-11	0.00E+00	3.89E-10	0%	1.00
Sb-125	2.49E-05	2.02E-05	1.33E-03	8.26E-04	5.05E-04	9.02E-05	3.35E-05	1.14E-05	2.84E-03	3.55E-04	0.00E+00	2.84E-03	0%	1.00
Sn-126	3.42E+00	2.64E+00	5.39E+00	5.95E+00	7.56E+00	4.02E+00	3.57E+00	2.18E+00	3.47E+01	4.34E+00	0.00E+00	3.47E+01	0%	1.00
I-129	3.38E-02	2.61E-02	4.65E-02	4.70E-02	6.25E-02	3.28E-02	3.25E-02	1.59E-02	2.97E-01	3.71E-02	0.00E+00	2.97E-01	0%	1.00
Cs-134	7.43E-07	5.24E-07	9.90E-05	4.55E-05	2.83E-05	3.08E-06	1.11E-06	2.09E-07	1.78E-04	2.23E-05	0.00E+00	1.78E-04	0%	1.00
Cs-135	9.65E-01	7.44E-01	1.22E+00	1.15E+00	1.58E+00	8.22E-01	8.89E-01	3.59E-01	7.73E+00	9.66E-01	0.00E+00	7.73E+00	0%	1.00
Cs-137	3.21E+00	2.62E+00	4.30E+00	3.97E+00	4.82E+00	2.32E+00	2.25E+00	8.61E-01	2.44E+01	3.04E+00	0.00E+00	2.44E+01	0%	1.00
Ba-137m	4.90E-07	4.00E-07	6.55E-07	6.04E-07	7.35E-07	3.54E-07	3.43E-07	1.31E-07	3.71E-06	4.64E-07	0.00E+00	3.71E-06	0%	1.00
Ce-144	1.77E-09	7.20E-10	2.55E-06	5.11E-07	1.39E-07	6.34E-09	5.73E-10	8.19E-11	3.21E-06	4.01E-07	0.00E+00	3.21E-06	0%	1.00
Pr-144	7.51E-14	3.05E-14	1.08E-10	2.16E-11	5.88E-12	2.69E-13	2.43E-14	3.47E-15	1.36E-10	1.70E-11	0.00E+00	1.36E-10	0%	1.00
Pm-147	2.52E-03	1.62E-03	3.76E-02	2.13E-02	1.36E-02	2.11E-03	8.16E-04	2.32E-04	7.98E-02	9.98E-03	0.00E+00	7.98E-02	0%	1.00
Eu-154	7.03E-02	6.02E-02	1.84E-01	1.29E-01	1.36E-01	4.86E-02	4.52E-02	9.86E-03	6.83E-01	8.54E-02	0.00E+00	6.83E-01	0%	1.00
Th-232	3.35E+03	1.66E+03	3.58E+02	2.20E+02	7.78E+01	1.54E+01	8.45E+00	1.29E+02	5.82E+03	7.28E+02	0.00E+00	5.82E+03	0%	1.00
U-232	1.05E-07	6.20E-08	1.35E-06	2.25E-06	2.22E-06	1.32E-06	5.26E-07	9.59E-07	8.79E-06	1.10E-06	0.00E+00	8.79E-06	0%	1.00

U-233	5.99E-01	3.02E-01	6.48E-02	4.06E-02	3.46E-02	2.85E-03	3.76E-03	4.09E-02	1.09E+00	1.36E-01	0.00E+00	1.09E+00	0%	1.00
U-234	4.34E-01	3.28E-01	1.45E+00	1.06E+00	1.21E+00	5.00E-01	4.28E-01	1.36E-01	5.55E+00	6.93E-01	0.00E+00	5.55E+00	0%	1.00
U-235	3.28E+01	1.72E+01	1.21E+02	1.29E+02	1.25E+02	8.06E+01	8.30E+01	6.41E+01	6.52E+02	8.15E+01	0.00E+00	6.52E+02	0%	1.00
U-236	7.72E+00	6.88E+00	2.47E+01	1.82E+01	2.06E+01	9.18E+00	8.22E+00	2.42E+00	9.78E+01	1.22E+01	0.00E+00	9.78E+01	0%	1.00
Np-237	2.82E+00	1.91E+00	1.40E+01	1.42E+01	1.36E+01	6.62E+00	3.73E+00	3.06E+00	5.99E+01	7.49E+00	0.00E+00	5.99E+01	0%	1.00
U-238	1.61E+03	5.81E+02	2.74E+04	4.60E+04	2.33E+04	1.54E+04	5.71E+03	9.07E+03	1.29E+05	1.61E+04	0.00E+00	1.29E+05	0%	1.00
Pu-238	1.08E+01	1.01E+01	1.81E+01	1.22E+01	1.74E+01	8.11E+00	1.10E+01	1.66E+00	8.93E+01	1.12E+01	0.00E+00	8.93E+01	0%	1.00
Pu-239	6.41E+01	4.73E+01	1.16E+02	1.22E+02	9.74E+01	6.02E+01	4.57E+01	2.84E+01	5.81E+02	7.27E+01	0.00E+00	5.81E+02	0%	1.00
Pu-240	8.58E+00	7.10E+00	1.48E+01	1.22E+01	1.35E+01	6.39E+00	7.08E+00	2.07E+00	7.17E+01	8.96E+00	0.00E+00	7.17E+01	0%	1.00
Ingrown Pu-240	5.38E-02	3.79E-02	8.23E-01	6.63E-01	7.20E-01	1.33E-01	1.03E-01	2.97E-02	2.56E+00	3.20E-01	0.00E+00	2.56E+00	0%	1.00
Pu-241	4.19E-01	3.86E-01	1.34E+00	9.30E-01	1.00E+00	3.67E-01	3.66E-01	7.71E-02	4.89E+00	6.11E-01	0.00E+00	4.89E+00	0%	1.00
Am-241	5.39E+00	4.44E+00	7.71E+00	7.19E+00	2.26E+01	1.04E+01	7.78E+00	4.34E+00	6.98E+01	8.73E+00	0.00E+00	6.98E+01	0%	1.00
Ingrown Am-241	5.40E-01	5.19E-01	1.61E+00	1.26E+00	1.57E+00	7.04E-01	8.07E-01	1.85E-01	7.20E+00	9.00E-01	0.00E+00	7.20E+00	0%	1.00
Am-242m	8.82E-04	6.93E-04	1.43E-03	1.54E-03	1.94E-03	9.88E-04	9.04E-04	4.94E-04	8.88E-03	1.11E-03	0.00E+00	8.88E-03	0%	1.00
Pu-242	6.67E-01	6.56E-01	2.02E+00	1.43E+00	1.85E+00	9.79E-01	9.96E-01	2.60E-01	8.86E+00	1.11E+00	0.00E+00	8.86E+00	0%	1.00
Cm-244	5.72E-02	3.86E-02	9.37E-01	6.70E-01	6.51E-01	1.08E-01	7.31E-02	1.95E-02	2.56E+00	3.19E-01	0.00E+00	2.56E+00	0%	1.00
Cm-245	9.30E-05	5.43E-05	4.62E-02	3.50E-02	3.61E-02	6.46E-03	4.69E-03	1.41E-03	1.30E-01	1.63E-02	0.00E+00	1.30E-01	0%	1.00
Ag	9.57E+01	3.37E+01	1.77E+02	2.53E+02	1.10E+02	2.74E+02	7.94E+01	2.61E+02	1.28E+03	1.60E+02	0.00E+00	1.28E+03	0%	1.00
Al	1.39E+04	2.13E+04	1.23E+04	1.09E+04	1.17E+04	1.65E+04	2.05E+04	1.41E+04	1.21E+05	1.51E+04	3.04E+04	1.51E+05	20%	1.25
B	1.52E+02	1.18E+02	1.21E+01	8.39E+00	8.88E-01	5.87E-01	9.64E-02	4.47E-02	2.92E+02	3.65E+01	0.00E+00	2.92E+02	0%	1.00
Ba	3.36E+02	5.11E+02	4.61E+02	5.10E+02	5.74E+02	4.59E+02	6.43E+02	4.16E+02	3.91E+03	4.89E+02	0.00E+00	3.91E+03	0%	1.00
Ca	3.92E+03	4.52E+03	4.21E+03	4.20E+03	4.27E+03	4.41E+03	5.14E+03	3.68E+03	3.43E+04	4.29E+03	2.10E+02	3.46E+04	1%	1.01
Ce	4.58E+02	3.57E+02	6.86E+02	6.38E+02	6.78E+02	6.95E+02	4.11E+02	3.85E+02	4.31E+03	5.39E+02	0.00E+00	4.31E+03	0%	1.00
Co	5.62E+00	2.42E+00	7.26E+00	1.01E+01	3.55E+00	1.15E+01	3.22E+00	1.10E+01	5.47E+01	6.83E+00	0.00E+00	5.47E+01	0%	1.00
Cr	4.70E+02	3.62E+02	5.07E+02	4.94E+02	6.06E+02	4.89E+02	4.55E+02	3.97E+02	3.78E+03	4.73E+02	1.27E+02	3.91E+03	3%	1.03
Cs	2.47E-01	3.13E-01	1.96E-02	2.23E-02	1.44E-03	1.56E-03	1.57E-04	1.19E-04	6.06E-01	7.57E-02	0.00E+00	6.06E-01	0%	1.00
Cu	1.64E+02	1.14E+02	1.94E+02	2.10E+02	1.97E+02	2.18E+02	1.50E+02	1.55E+02	1.40E+03	1.75E+02	0.00E+00	1.40E+03	0%	1.00
Fe	3.63E+04	3.74E+04	4.35E+04	4.61E+04	4.57E+04	4.72E+04	4.30E+04	4.99E+04	3.49E+05	4.36E+04	0.00E+00	3.49E+05	0%	1.00
Gd	1.05E+01	1.26E-01	2.95E+01	3.56E+01	3.89E+01	3.75E+01	5.85E+01	4.09E+01	2.52E+02	3.14E+01	1.46E+03	1.71E+03	85%	6.79
Hg	1.06E+04	8.98E+03	7.60E+03	4.69E+03	9.53E+03	5.36E+03	8.93E+03	8.97E+02	5.66E+04	7.07E+03	8.19E+02	5.74E+04	1%	1.01
K	3.92E+02	2.80E+02	4.32E+02	4.29E+02	4.26E+02	4.72E+02	3.66E+02	3.16E+02	3.11E+03	3.89E+02	0.00E+00	3.11E+03	0%	1.00
La	2.25E+02	1.69E+02	3.00E+02	2.87E+02	2.98E+02	3.12E+02	2.05E+02	1.87E+02	1.98E+03	2.48E+02	0.00E+00	1.98E+03	0%	1.00
Li	5.40E+02	3.85E+02	4.29E+01	2.74E+01	3.15E+00	1.92E+00	3.42E-01	1.46E-01	1.00E+03	1.25E+02	0.00E+00	1.00E+03	0%	1.00
Mg	8.49E+02	6.44E+02	5.22E+02	4.33E+02	6.01E+02	4.25E+02	4.48E+02	2.56E+02	4.18E+03	5.22E+02	0.00E+00	4.18E+03	0%	1.00
Mn	5.98E+03	7.69E+03	9.15E+03	7.45E+03	7.33E+03	5.40E+03	7.76E+03	7.26E+03	5.80E+04	7.25E+03	0.00E+00	5.80E+04	0%	1.00
Mo	1.56E+01	1.07E+01	1.24E+00	7.62E-01	9.09E-02	5.33E-02	9.87E-03	4.06E-03	2.84E+01	3.55E+00	0.00E+00	2.84E+01	0%	1.00
Na	1.00E+04	1.06E+04	8.68E+03	8.13E+03	9.58E+03	8.26E+03	1.09E+04	7.80E+03	7.39E+04	9.24E+03	3.21E+04	1.06E+05	30%	1.43
Nb	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA
Nd	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA
Ni	1.24E+03	3.07E+03	1.46E+03	2.28E+03	3.34E+03	1.97E+03	3.35E+03	2.72E+03	1.94E+04	2.43E+03	0.00E+00	1.94E+04	0%	1.00
P	8.33E+01	9.15E+02	9.12E+01	1.49E+02	1.13E+02	9.09E+01	1.02E+03	9.54E+02	3.42E+03	4.27E+02	0.00E+00	3.42E+03	0%	1.00
Pb	1.25E+03	8.59E+02	5.54E+02	6.03E+02	5.11E+02	5.35E+02	2.40E+02	3.68E+02	4.91E+03	6.14E+02	0.00E+00	4.91E+03	0%	1.00
Pr	1.88E+02	1.39E+02	2.58E+02	2.56E+02	2.58E+02	2.76E+02	1.84E+02	1.74E+02	1.73E+03	2.17E+02	0.00E+00	1.73E+03	0%	1.00
Pu	8.65E+01	5.91E+01	7.43E+00	4.92E+00	1.27E+00	1.03E+00	1.20E+00	8.25E-01	1.62E+02	2.03E+01	0.00E+00	1.62E+02	0%	1.00
Ru	2.45E+02	1.28E+02	3.99E+02	5.35E+02	3.43E+02	5.45E+02	2.25E+02	4.78E+02	2.90E+03	3.62E+02	0.00E+00	2.90E+03	0%	1.00
Si	1.26E+04	9.78E+03	6.08E+03	4.06E+03	7.12E+03	4.32E+03	6.84E+03	3.12E+03	5.39E+04	6.74E+03	3.14E+02	5.42E+04	1%	1.01
S	5.41E+02	4.49E+02	4.25E+02	3.95E+02	4.44E+02	4.16E+02	4.36E+02	5.45E+02	3.65E+03	4.56E+02	0.00E+00	3.65E+03	0%	1.00
Sr	2.15E+02	1.61E+02	1.82E+02	1.83E+02	2.22E+02	1.70E+02	1.54E+02	9.74E+01	1.38E+03	1.73E+02	0.00E+00	1.38E+03	0%	1.00
Th	4.06E+03	1.97E+03	4.27E+02	2.56E+02	8.84E+01	1.80E+01	9.60E+00	1.24E+02	6.95E+03	8.69E+02	0.00E+00	6.95E+03	0%	1.00
Ti	3.52E+01	3.58E+01	2.80E+00	2.56E+00	2.06E-01	1.79E-01	2.23E-02	5.41E+01	1.31E+02	1.64E+01	0.00E+00	1.31E+02	0%	1.00
U	4.33E+03	2.03E+03	2.86E+04	4.73E+04	2.39E+04	1.57E+04	5.89E+03	9.90E+03	1.38E+05	1.72E+04	0.00E+00	1.38E+05	0%	1.00
Y	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA
Zn	2.03E+02	1.24E+02	2.75E+02	3.36E+02	2.50E+02	3.49E+02	1.86E+02	7.00E+02	2.42E+03	3.03E+02	0.00E+00	2.42E+03	0%	1.00
Zr	8.54E+02	6.34E+02	9.18E+02	8.94E+02	9.76E+02	9.39E+02	7.43E+02	5.75E+02	6.53E+03	8.16E+02	0.00E+00	6.53E+03	0%	1.00

Appendix C. Complete Salt Composition

The data from all the analyzed sludge batches was used to predict the composition of future sludge batches. The reports used to compile this data are summarized in Table C-1. The data from the analysis of the salt batches is summarized in Table C-2. A spreadsheet was used to predict the composition of the salt batch, DSS and MST/SS stream composition after (Table C-3). I created a large table to make this easy to see on a big monitor.

Table C-1.

Salt Batch	1	2	3	4	5	6	7	8	9	10	11
Report Number	WSRC-STI-2008-00117	SRNL-STI-2008-00446/X-ESR-H-00157	SRNL-STI-2010-00136 /X-ESR-H-00209	SRNL-STI-2011-00061	SRNL-STI-2012-00076	SRNL-STI-2012-00707	SRNL-STI-2013-00437	SRNL-STI-2014-00561	SRNL-STI-2015-00622	SRNL-STI-2017-00055	SRNL-STI-2017-00698
SWPF Batch	**1**	**2**	**2**	**3**							
Report Number	X-ESR-H-01001	SRNL-STI-2019-00621	SRNL-STI-2019-00621/SRNL-STI-2019-00661	X-ESR-H-01071							

Table C-2. Analysis of Salt Batches

		Salt Batch											SWPF Batch							
Component	Units	1	2	3	4	5	6	7	8	9	10	11	1	2	2	3	minimum	average	maximum	%rsd
Ag	mg/L	<64.2	20.3	1.65	<2.14	<1.46	<1.74	<1.12	<1.94	<1.17	<1.53	<3.05	2.14		<1.74		1.65	8.03	20.3	132%
Al	mg/L	9260	7067	4810	3900	7125	5380	3320	5410	6010	6770	7020	6600		6920	5530	3320	6080	9260	25%
As	mg/L	<1	0.628	0.212	0.274	0.322	0.683	0.181	0.229	0.381	0.221	0.102	0.203				0.102	0.312	0.683	59%
B	mg/L	<8.35	8.65		70.7	35.8	45.4	56.6	70.8	48.7	60.5	57.7	56.7		57.1		8.65	51.7	70.8	34%
Ba	mg/L	<1.49	2.51	0.356	<0.13	<0.52	<0.97	<0.62	<1.00	0.12	<0.116	<0.232	0.211		<0.995		0.12	0.799	2.51	143%
Be	mg/L	<0.37			<0.11	<0.08	<0.24	<0.12	<0.14	<0.106	<0.0483	<0.097			<0.253		0		0	
Br	mg/L	<526	<250		<100	<500	<500	<1000	<500	<500	<500	<10			<100		0		0	
Ca	mg/L	<26.7	1.5		1.35	<0.56	<1.49	1.18	1.25	1.04	<1.24	<2.47			<1.98		1.04	1.26	1.5	14%
Cd	mg/L	<2.74	2.71	0.717	1.54	0.85	<1.21	<0.84	<1.27	<1.60	<1.5	<2.99	2.17		<2.46		0.717	1.60	2.71	53%
Ce	mg/L	<106.5	75.8		<6.6	<6.03	<7.91	<6.45	<11.2	<4.61	<4.66	<8.01			<27.4		75.8	75.8	75.8	
Cl	mg/L	<150	<250		122	<500	100	264	401	696	722	473	584		317	168	100	385	722	60%
Cr	mg/L	89	59.3	66.2	51.9	41	45.7	38	72.4	67.2	52	60.9	59.9		74.9		38	59.9	89	24%
Cu	mg/L	<5.48	4.01	1.8	1.48	1.29	0.76	<0.98	<3.54	<1.17	<5.46	<10.9	6.8		<5.17		0.76	2.69	6.8	86%
F	mg/L	<150	<250		<100	<10	<100	<100	<100	<100	<100	<10			<100		0		0	
Fe	mg/L	9	1390		3.93	5.54	2.84	1.51	<1.39	4.21	<2.36	<4.08	3.49		<6.31		1.51	178	1390	276%
Gd	mg/L	<11.6			<1.36	<2.15	<1.92	<1.38	<4.44	<1.44	<1.15	<2.30			<3.76		0		0	
Hg	mg/L	9.17	9.05	37.3	42	88.2	12.8	79	129	58.5	112	119	116	35.5		32.6	9.05	65.0	129	69%
K	mg/L	317	242	526	447	324	460	288	643	558	425	399	450		440	715	242	445	715	30%
La	mg/L	<14.1	10.1		<1.08	<0.67	<1.36	<1.26	<1.97	1.12	<1.17	<1.80			<1.92		1.12	5.61	10.1	113%
Li	mg/L	<9.79	7.51		22.8	10.4	14.6	21.9	19.5	<8.86	11.8	14.6	12.7		<6.91		7.51	15.1	22.8	35%
Mg	mg/L	<1.15	2.08		<0.25	<0.15	<0.12	0.183	<8.61	<0.129	<0.283	<0.434			0.22		0.183	0.828	2.08	131%
Mn	mg/L	<3.19	2.85	0.428	<0.2	<0.53	<0.34	<0.16	<0.8	<0.419	<0.21	<0.420	0.376		<0.454		0.376	1.22	2.85	116%
Mo	mg/L	<10.55	7.6		6.89	7.79	<11.2	<5.99	24.9	25.7	13.6	<17.2	18.3		20.7		6.89	15.7	25.7	50%
Na	M	5.05	5.55	6.53	6.77	6.35	6.48	5.96	6.18	6.27	6.07	6.48	6.26		6.22	5.87	5.05	6.15	6.77	7%
Ni	mg/L	<7.63		1.95	<2.35	<1.6	<3.70	<2.07	<4.94	<4.18	<6.04	<5.12	5.11		<15.8		1.95	3.53	5.11	63%
P	mg/L	433	385	226	190	168	191	212	231	198	134	151			152		134	223	433	42%
Pb	mg/L	<27.3	29.7	8.11	<7.31	<7.16	<17.6	<8.18	<130	<17.1	<20.7	<41.5	34.0		<19.6		8.11	23.9	34	58%
S	mg/L	4780	3687		2340	2910	3450	3140	2490	1930	1690	<2600	2190		2420		1690	2821	4780	32%
Sb	mg/L	<52.5			<6.88	<10.7	<36.2	<34.5	<41.1	<34.8	<42.7	<43.6			<35.4		0		0	NA
Se	mg/L	<2	1.28	0.35	0.244	0.201	0.224	0.308	<0.205	0.265	0.275	0.246	0.255				0.201	0.3648	1.28	89%
Si	mg/L	<174	48.26		60.6	46.8	37.2	74.2	57.4	12.9	21.7	21.6	21.4		13.2	15.2	12.9	35.9	74.2	59%
Sn	mg/L	<156			<4.29	<5.61	<14.7	<11.8	<93.1	<22.1	<13.1	<26.2			<113		0		0	NA
Sr	mg/L	<13.9	9.47		<0.07	<0.05	<0.15	<0.05	<12.8	<0.094	<0.0422	<0.084	0.645		<0.232		0.645	5.0575	9.47	123%
Th	mg/L				<8.91	<2.68	<7.30	<5.12	<11.6	<0.005	<0.001	<2.37			<14.3		0		0	NA
Ti	mg/L	<12.6	8.96	0.252	<0.17	<0.38	<0.400	<0.58	<0.93	<9.35	<8.96	<9.29			<3.04		0.252	4.61	8.96	134%
U	mg/L	<635	401		<44.5	<32.7	<45.0	<28.2	<69.9	<51.3	<43.9	<35.1			<97		401	401	401	NA
V	mg/L	<6.05			<0.52	<0.47	<0.52	<0.63	<0.69	1.19	<0.7	<1.40			<1.63		1.19	1.19	1.19	NA
Zn	mg/L	<34.1	1.41		6.37	4.4	5.07	4.9	5.13	4.56	1.79	13.7	7.9		6.25		1.41	5.59	13.7	59%
Zr	mg/L	<3.78	5.1		<0.47	>0.25	<0.56	<0.49	<0.62	<0.412	<0.707	<1.41			<1.15		5.1	5.1	5.1	NA
C2O4	mg/L	<526	<250		200	242	377	392	187	453	420	413	411		349	425	187	352	453	27%
TIC (CO3)	mg/L				3087	2860	2510	3590	3300	2920	3400	3800	3492		4280	18000	2510	4658	18000	96%
TOC	mg/L			189	322	220	385	327	216	184	238	296	250		180	157	157	247	385	29%
CHOO	mg/L	<526	326	1780	961	<10	330	649	468	127	258	317	264		<100	<100	127	548	1780	90%
Free OH	M	0.613	2.14		2.622	2.08	1.9	1.93	2.24	2.52	2.71	2.79			2.64	2.328316087	0.61	2.21	2.79	27%
NO2	mg/L		10193		40933	25750	21800	33000	38400	31700	34600	38500	35600		34100	25900	10193	30873	40933	28%
NO3	mg/L		132000		202067	175000	138500	148000	122000	106000	92200	102000	101000		121000	152000	92200	132647	202067	25%
PO4	mg/L	1100	798		418	485	383	556	545	455	315	382	386		338	621	315	522	1100	42%
SO4	mg/L		8927		6493	7305	6480	9080	5270	5660	4350	4720	4840		6920	15300	4350	7112	15300	42%
H-3	pCi/mL	<3.40E+03	7.49E+02	8.27E+02	6.36E+02	9.46E+02	<9.13E+02	5.28E+02	<2.01E+03	1.79E+03	1.54E+03	1.31E+03	1.50E+03		3.80E+03		5.28E+02	1.36E+03	3.80E+03	70%
C-14	pCi/mL	6.08E+02	5.82E+02	1.02E+03	7.55E+02	7.20E+02	<5.45E+03	7.40E+02	6.48E+02	8.66E+02	9.00E+02	5.47E+02	7.22E+02		9.78E+02		5.47E+02	7.57E+02	1.02E+03	20%
Ni-59	pCi/mL	<1.04E+02	4.04E+02	1.90E+02	<9.50E-01	<2.00E+01	<2.17E+01	<2.03E+00	<3.56E+01	<1.42E+01	<2.12E+01	<5.31E+01	3.44E+01				3.44E+01	2.09E+02	4.04E+02	89%
Ni-63	pCi/mL	1.56E+02	1.38E+02	2.33E+03	<1.54E+01	<4.06E+02	<2.53E+01	<3.15E+01	<1.81E+01	<3.09E+01	<1.76E+01	<5.13E+02					1.38E+02	8.75E+02	2.33E+03	144%
Co-60	pCi/mL		1.03E+01	7.11E+00	<2.11E+00	<5.63E+00	<4.12E+00	<1.88E+00	<6.17E+00	<6.93E+00	<6.62E+00	<3.77E+00	2.33E+02		<1.91E+01		7.11E+00	8.35E+01	2.33E+02	155%
Se-79	pCi/mL	<4.64E+01	5.99E+01														5.99E+01	5.99E+01	5.99E+01	NA
Sr-90	pCi/mL		2.93E+05	1.19E+05	1.88E+05	1.93E+05	1.76E+05	2.61E+05	4.91E+05	4.31E+05	3.06E+05	2.61E+05	3.20E+05	3.93E+05	2.85E+05	5.87E+05	1.19E+05	3.01E+05	5.87E+05	44%
Y-90	pCi/mL		2.93E+05	1.19E+05	1.88E+05	1.93E+05	1.76E+05	2.61E+05	4.91E+05	4.31E+05	3.06E+05	2.61E+05	3.20E+05	3.93E+05	2.85E+05		1.19E+05	2.77E+05	4.91E+05	38%
Nb-94	pCi/mL		1.76E+02	1.06E+01	<3.02E+00	<6.08E+00	<9.95E+00	<1.03E+01	<1.54E+01	<9.54E+00	<7.88E+00	<3.50E+01	2.07E+01				1.06E+01	6.91E+01	1.76E+02	134%
Tc-99	pCi/mL	7.16E+04	6.89E+04	3.00E+04	2.06E+04	2.28E+04	2.17E+04	1.67E+04	5.76E+04	6.28E+04	3.87E+04	4.17E+04	4.59E+04		4.19E+04		1.67E+04	4.16E+04	7.16E+04	46%
Ru-106	pCi/mL		1.41E+02	3.76E+02	<5.23E+01	<8.19E+01	<1.81E+02	<1.41E+02	<6.35E+01	<9.27E+01	<1.08E+02	<7.56E+01	8.77E+01				8.77E+01	2.02E+02	3.76E+02	76%
Rh-106	pCi/mL		1.41E+02	3.76E+02	<5.23E+01	<8.19E+01	<1.81E+02	1.41E+02	<6.35E+01	<9.27E+01	<1.08E+02	<7.56E+01	8.77E+01				8.77E+01	1.86E+02	3.76E+02	69%
Sb-125	pCi/mL		6.57E+01	3.03E+02	<3.77E+01	<5.99E+01	<1.48E+02	<1.07E+02	<4.27E+01	<6.98E+01	2.51E+02	8.96E+01	1.27E+02		6.28E+02		6.57E+01	2.44E+02	6.28E+02	86%
Te-125m	pCi/mL						<1.48E+02	<1.07E+02	<4.27E+01	<6.98E+01	2.51E+02	8.96E+01	1.27E+02				8.96E+01	1.56E+02	2.51E+02	54%
Sn-126	pCi/mL		2.53E+02	1.04E+02	1.37E+02	1.93E+02	2.26E+02	1.32E+04	5.72E+02	4.68E+02	3.69E+02	3.78E+02	4.01E+02		5.26E+02		1.04E+02	1.40E+03	1.32E+04	265%
I-129	pCi/mL	1.66E+01	<3.38E+01	2.04E+01	1.91E+01	1.30E+01	1.79E+01	1.21E+01	4.53E+01	4.97E+01	2.57E+01	2.88E+01	3.31E+01		<4.42E+01		1.21E+01	2.56E+01	4.97E+01	49%
Cs-134	pCi/mL	<1.46E+05	<3.30E+03	4.01E+03	<7.07E+03	<5.54E+03	<6.39E+03	<4.07E+03	<4.50E+04	<3.37E+04	<2.27E+04	<7.70E+04	5.02E+04				4.01E+03	2.71E+04	5.02E+04	120%
Cs-135	pCi/mL		6.84E+02	3.90E+02	2.97E+02	2.81E+02	3.66E+02	2.47E+02	8.24E+02	1.26E+03	4.91E+02	5.31E+02	6.91E+02				2.47E+02	5.51E+02	1.26E+03	55%
Cs-137	pCi/mL	6.48E+07	5.34E+07	7.57E+07	5.27E+07		5.76E+07	4.61E+07	2.13E+08	2.44E+08	1.24E+08	1.54E+08	1.67E+08	1.78E+08	1.78E+08		4.61E+07	1.19E+08	2.44E+08	59%
Ba-137m	pCi/mL	6.12E+07	5.05E+07	7.15E+07	4.99E+07	5.59E+07	5.45E+07	4.37E+07	2.04E+08	2.31E+08	1.17E+08	1.46E+08	1.58E+08	1.69E+08	1.71E+08		4.37E+07	1.09E+08	2.31E+08	61%
Ce-144	pCi/mL		1.68E+02	3.45E+02	<5.27E+01	<7.70E+01	<1.69E+02	<1.16E+02	<1.36E+02	<1.56E+02	<1.45E+02	<1.08E+02	1.30E+02		<6.32E+01		1.30E+02	2.14E+02	3.45E+02	54%
Pr-144	pCi/mL		1.68E+02	3.45E+02	<5.27E+01	<7.70E+01	<1.69E+02	<1.16E+02	<1.36E+02	<1.56E+02	<1.45E+02	<1.08E+02	1.30E+02				1.30E+02	2.14E+02	3.45E+02	54%
Pm-147	pCi/mL	<9.07E+02	6.88E+02	6.36E+01	<1.61E+02	<1.80E+02	<4.77E+01	<2.71E+01	<7.56E+01	<1.53E+02	<1.06E+02	<5.67E+01	9.22E+01				6.36E+01	2.81E+02	6.88E+02	125%
Sm-151	pCi/mL	<5.53E+02	4.43E+02	4.26E+01	<8.51E+01	<1.53E+02	<2.34E+01	<1.23E+01	<3.68E+01	<9.27E+01	<4.30E+01	<3.56E+01	5.02E+01				4.26E+01	1.79E+02	4.43E+02	128%
Eu-154	pCi/mL		8.30E+01	2.54E+01	<9.73E+00	<1.53E+01	<1.38E+01	<7.11E+00	<1.98E+01	<1.99E+01	<2.11E+01	<1.19E+01	1.65E+01		<6.32E+00		1.65E+01	4.16E+01	8.30E+01	87%
Eu-155	pCi/mL		2.47E+02	1.42E+02	<2.53E+01	<3.62E+01	<6.62E+01	<4.73E+01	<7.02E+01	<6.62E+01	<4.36E+01	<4.77E+01	5.15E+01		<3.64E+01		5.15E+01	1.47E+02	2.47E+02	67%
Ra-226	pCi/mL		4.84E+02	1.43E+03	<1.91E+02	<3.12E+02	<1.04E+03	<6.71E+01	<5.76E+01	<8.24E+00	<9.18E+00	<9.45E+00	1.27E+01				1.27E+01	6.42E+02	1.43E+03	112%
Th-232	pCi/mL		8.97E-03		<3.30E-03	<1.10E-03	<2.20E-03								<1.10E-04		8.97E-03	8.97E-03	8.97E-03	
U-232	pCi/mL		1.58E+00	2.30E+00	<1.94E+02	4.33E+00	2.91E+00	2.32E+00	3.24E+00	2.12E+00	8.57E+00	2.39E+00	5.05E+00				1.58E+00	3.48E+00	8.57E+00	60%
U-233	pCi/mL		<1.45E+03	3.20E+02	<1.94E+02	<9.68E+01	<1.94E+02	<9.68E+01	<2.83E+01	1.71E+01	2.08E+01	2.53E+01	2.27E+01	<2.01E+02	1.91E+01	2.01E+02	1.71E+01	8.94E+01	3.20E+02	136%

		Salt Batch											SWPF Batch							
Component	Units	1	2	3	4	5	6	7	8	9	10	11	1	2	2	3	minimum	average	maximum	%rsd
U-234	pCi/mL		3.24E+02	1.64E+02	<1.25E+02	9.00E+01	<1.25E+02	9.66E+01	1.18E+02	9.25E+01	8.75E+01	1.13E+02	1.01E+02	<1.30E+02	1.12E+02	1.88E+02	8.75E+01	1.35E+02	3.24E+02	52%
U-235	pCi/mL		2.50E-01	3.65E-01	3.72E-01	1.94E-01	3.33E-01	4.19E-01	4.18E-01	2.32E-01	6.80E-01	4.97E-01	4.81E-01	5.46E-01	5.71E-01	2.65E-01	1.94E-01	3.91E-01	6.80E-01	36%
U-236	pCi/mL		5.18E+00	3.63E+00	<1.29E+00	1.08E+00	<1.29E+00	1.09E+00	1.57E+00	1.41E+00	3.31E+00	2.38E+00	2.36E+00	2.82E+00	2.90E+00	2.14E+00	1.08E+00	2.46E+00	5.18E+00	51%
U-238	pCi/mL		1.67E+00	6.69E+00	9.16E+00	3.70E+00	6.57E+00	9.16E+00	8.42E+00	3.55E+00	4.05E+00	4.86E+00	4.50E+00	3.20E+00	3.45E+00	1.63E+00	1.63E+00	5.19E+00	9.16E+00	50%
Total U	pCi/mL													<3.37E+02	1.38E+02	5.06E+00	5.06E+00	7.15E+01	1.38E+02	131%
Np-237	pCi/mL		<7.05E+01	1.64E+01	1.45E+01	3.39E+00	<2.82E+01	<7.05E+00	<7.05E+00	<3.53E+00	4.34E+00	3.65E+00	3.98E+00		6.66E+00		3.39E+00	7.56E+00	1.64E+01	73%
Pu-238	pCi/mL		2.65E+04	8.90E+03	1.17E+04	1.46E+04	1.08E+04	1.20E+04	5.63E+04	4.16E+04	1.83E+04	2.98E+04	3.02E+04	2.81E+04	2.86E+04	5.60E+04	8.90E+03	2.66E+04	5.63E+04	62%
Pu-239	pCi/mL		8.49E+02	3.20E+02				1.57E+03	9.89E+02	6.97E+02	7.81E+02	8.55E+02	8.04E+02			1.23E+03	3.20E+02	8.99E+02	1.57E+03	39%
Pu-240	pCi/mL		8.49E+02	3.20E+02				<2.28E+03	3.61E+02	<1.14E+03	3.16E+04	2.15E+02	9.63E+00			2.48E+03	9.63E+00	5.12E+03	3.16E+04	229%
Pu-239/40	pCi/mL													1.65E+03	2.00E+03		2.00E+03	2.00E+03	2.00E+03	
Pu-241	pCi/mL		<2.52E+03	1.28E+03	<8.20E+03	<5.22E+03	<3.52E+03	2.21E+03	2.23E+04	<1.70E+04	5.63E+03	9.43E+03	1.06E+04		1.85E+04	1.80E+05	1.28E+03	3.12E+04	1.80E+05	194%
Pu-242	pCi/mL		8.00E+01	1.64E+02	<7.64E+01	<3.82E+01	<7.64E+02	<3.82E+01	<3.82E+01	<1.91E+01	<3.82E+00	<1.91E+01	1.65E+01	<7.92E+01	<3.82E+00	4.30E+01	1.65E+01	7.59E+01	1.64E+02	85%
Pu-244	pCi/mL		2.40E-01	1.61E+00	<3.54E-01	<1.77E-01	<3.54E+00	<1.77E-01	<1.77E-01	<8.85E-02	<1.77E-02	<8.55E-02	7.49E-02	<3.67E-01	<1.77E-02	2.00E-01	7.49E-02	5.31E-01	1.61E+00	136%
Am-241	pCi/mL	<2.09E+03	1.87E+03	1.24E+01	<1.72E+01	<7.6E+00	6.17E+01	<2.53E+00	<5.85E+00	<3.46E+00	1.32E+00	6.21E+00	4.25E+00		4.93E+00		1.32E+00	2.80E+02	1.87E+03	250%
Am-242m	pCi/mL	<5.68E+02	7.78E+02														7.78E+02	7.78E+02	7.78E+02	
Am-243	pCi/mL	<5.35E+02	1.64E+03	1.77E+00	<2.22E+00	<3.98E+00	<2.70E+00	<7.16E-01	<7.07E+00	<3.65E+00	<3.20E+00	<3.10E+00	3.40E+00				1.77E+00	5.48E+02	1.64E+03	172%
Cm-242	pCi/mL		5.22E+01														5.22E+01	5.22E+01	5.22E+01	
Cm-243	pCi/mL	<1.55E+03															0.00E+00		0.00E+00	
Cm-244	pCi/mL	<4.70E+02	6.86E+02	4.65E+00	3.48E+00	1.05E+01	6.89E+01	2.34E+00	1.99E+00	1.94E+00	4.95E+01	6.80E-01	1.04E+00		1.76E+01		6.80E-01	7.07E+01	6.86E+02	276%
Cm-245	pCi/mL	<1.26E+03	1.39E+03	4.52E+00	<5.77E+00	<1.13E+01	<7.20E+00	<1.87E+00	<1.83E+01	<9.23E+00	<8.24E+00	<7.47E+00	8.51E+00		<1.66E+01		4.52E+00	4.68E+02	1.39E+03	171%
Total Alpha	pCi/mL		<1.02E+05	9.82E+03	<1.68E+04	<7.47E+03	<1.26E+04	<1.01E+05	<4.33E+04	<3.43E+04	<2.36E+04	<3.88E+04		<1.86E+06	<2.39E+06	2.21E+05	9.82E+03	1.15E+05	2.21E+05	129%
Total Beta	pCi/mL		6.38E+07	8.52E+07	6.89E+07	6.55E+07	7.58E+07	9.18E+07	2.73E+08	2.65E+08	1.55E+08	1.64E+08		1.95E+08	1.92E+08	2.63E+08	6.38E+07	1.47E+08	2.73E+08	57%
Total Gamma	pCi/mL		5.10E+07	7.34E+07	5.27E+07	5.90E+07	5.76E+07	4.61E+07	2.01E+08	2.31E+08	1.17E+08	1.46E+08				1.95E+08	4.61E+07	1.12E+08	2.31E+08	63%
Density	g/mL	1.258	1.273	1.263	1.284	1.301	1.304	1.272	1.257	1.250	1.254	1.269		1.310	1.281	1.31	1.250	1.275	1.310	2%

Table C-3. Composition of Salt Batch, DSS and SS-MST products

MST Target: 0.4 g/L

	Salt Batch Composition		SWPF Product/Saltstone Feed			Unwashed SS/MST Composition		Washed SS/MST Composition	MW Metal	MW Compound
Volume	9,000,000	Gallons	10,350,000	Gallons		125,000	Gallons	125,000	47.88	199.755
					Total Solids	3.45E+05	kg	7.48E+04		
					Insoluble Solids	3.79E+04	kg	3.79E+04		

Element	Result	Units	%RSD	Assumed DF	SWPF WAC	Units	Meets WAC?	Result	Units	%RSD	Saltstone WAC	Units	Meets WAC?	Result	Units	Result	DWPF WAC	Units	Meets WAC?
Al	6.08E+03	mg/L	25%	1	≤6.74E+03	mg/L	Yes	5.29E+03	mg/L	25%	≤1.19E+04	mg/L	Yes	5,287	mg/L	759	NA	mg/L	NA
As	3.12E-01	mg/L	59%	1	NA	mg/L	NA	2.66E-01	mg/L	59%				0.266	mg/L	0.27	NA	mg/L	NA
B	5.17E+01	mg/L	34%	1	NA	mg/L	NA	4.39E+01	mg/L	34%				43.9	mg/L	6.31	NA	mg/L	NA
Ba	7.99E-01	mg/L	143%	1	NA	mg/L	NA	6.79E-01	mg/L	143%				0.679	mg/L	1	NA	mg/L	NA
Be	0.00E+00	mg/L	0%	1	NA	mg/L	NA	0.00E+00	mg/L	0%				0.000	mg/L	0	NA	mg/L	NA
Br	0.00E+00	mg/L	0%	1	NA	mg/L	NA	0.00E+00	mg/L	0%				0.000	mg/L	0	NA	mg/L	NA
Ca	1.26E+00	mg/L	14%	1	NA	mg/L	NA	1.07E+00	mg/L	14%				1.07	mg/L	1.07	NA	mg/L	NA
Cd	1.60E+00	mg/L	53%	1	NA	mg/L	NA	1.36E+00	mg/L	53%				1.36	mg/L	1	NA	mg/L	NA
Ce	7.58E+01	mg/L	0%	1	NA	mg/L	NA	6.44E+01	mg/L	0%				64.4	mg/L	64.4	NA	mg/L	NA
Cl	3.85E+02	mg/L	60%	1	NA	mg/L	NA	3.27E+02	mg/L	60%				327	mg/L	327.0	NA	mg/L	NA
Cr	5.99E+01	mg/L	24%	1	NA	mg/L	NA	5.09E+01	mg/L	24%				50.9	mg/L	50.9	NA	mg/L	NA
Cu	2.69E+00	mg/L	86%	1	NA	mg/L	NA	2.29E+00	mg/L	86%				2.29	mg/L	2.3	NA	mg/L	NA
F	0.00E+00	mg/L	0%	1	NA	mg/L	NA	0.00E+00	mg/L	0%				0.000	mg/L	0.0	NA	mg/L	NA
Fe	1.78E+02	mg/L	276%	100	NA	mg/L	NA	1.51E+02	mg/L	276%	≤6.60E+03	mg/L	Yes	151	mg/L	150.9	NA	mg/L	NA
Gd	0.00E+00	mg/L	NA	100	NA	mg/L	NA	0.00E+00	mg/L	NA	NA	NA	NA	0.000	mg/L	0.0	NA	mg/L	NA
Hg	6.50E+01	mg/L	69%	100	≤3.25E+02	mg/L	Yes	5.52E+01	mg/L	69%	≤3.25E+02	mg/L	Yes	55.2	mg/L	55.2	NA	mg/L	NA
K	4.45E+02	mg/L	30%	1	≤2.24E+03	mg/L	Yes	3.78E+02	mg/L	30%	≤4.69E+03	mg/L	Yes	378	mg/L	54.3	NA	mg/L	NA
La	5.61E+00	mg/L	113%	1	NA	M	NA	4.77E+00	mg/L	113%				4.77	mg/L	4.77	NA	mg/L	NA
Li	1.51E+01	mg/L	35%	1	NA	mg/L	NA	1.28E+01	mg/L	35%				12.8	mg/L	12.8	NA	mg/L	NA
Mg	8.28E-01	mg/L	131%	1	NA	mg/L	NA	7.04E-01	mg/L	131%				0.704	mg/L	0.704	NA	mg/L	NA
Mn	1.22E+00	mg/L	116%	100	NA	mg/L	NA	1.04E+00	mg/L	116%	≤9.90E+02	mg/L	Yes	1.04	mg/L	1.04	NA	mg/L	NA
Mo	1.57E+01	mg/L	50%	1	NA	mg/L	NA	1.33E+01	mg/L	50%				13.3	mg/L	13.3	NA	mg/L	NA
Na	6.15E+00	M	7%	1	>5.6 [Na] > 7.0	pH	Yes	5.22E+00	M	7%	2.5 M ≤ $[Na^+]$ ≤ 7.0 M	M	Yes	5.22	mg/L	0.75	NA	mg/L	NA
Ni	3.53E+00	mg/L	63%	1	NA	mg/L	NA	3.00E+00	mg/L	63%				3.00	mg/L	3.00	NA	mg/L	NA
P	2.23E+02	mg/L	42%	1	NA	pCi/mL	Yes	1.89E+02	mg/L	42%				189	mg/L	27.2	NA	mg/L	NA
Pb	2.39E+01	mg/L	58%	1	NA	pCi/mL	NA	2.03E+01	mg/L	58%				20.3	mg/L	20.3	NA	mg/L	NA
S	2.82E+03	mg/L	32%	1	NA	pCi/mL	NA	2.45E+03	mg/L	32%	NA	mg/L	NA	2,453	mg/L	352	NA	mg/L	NA
Sb	0.00E+00	mg/L	NA		NA	pCi/mL	NA	NA	mg/L	NA		mg/L		NA	mg/L	NA	NA	mg/L	NA
Se	3.65E-01	mg/L	89%	1	NA	pCi/mL	NA	3.17E-01	mg/L	89%				0.317	mg/L	0.317	NA	mg/L	NA
Si	3.59E+01	mg/L	59%	100	≤8.42E+02	pCi/mL	Yes	3.12E-01	mg/L	59%	≤1.07E+04	mg/L	Yes	0.312	mg/L	0.312	NA	mg/L	NA
Sn	0.00E+00	mg/L	NA	1	NA	pCi/mL	NA	0.00E+00	mg/L	NA		mg/L		0.00	mg/L	0.00	NA	mg/L	NA
Sr	5.06E+00	mg/L	123%	1	NA	pCi/mL	NA	4.40E+00	mg/L	123%				4.40	mg/L	4.40	NA	mg/L	NA
Th	0.00E+00	mg/L	NA	1	NA	pCi/mL	NA	0.00E+00	mg/L	NA				0.00	mg/L	0.00	NA	mg/L	NA
MST				1	NA	pCi/mL	NA							28,800	mg/L	28,800	NA	mg/L	NA
Ti	4.61E+00	mg/L	134%	1	NA	%	Yes	4.01E+00	mg/L	134%				13,810	mg/L	13,810	NA	mg/L	NA
Ti	0.00E+00		NA	NA	NA	NA	NA	NA		NA	NA	mg/L	NA	13,806	mg/L	13,806	NA	mg/L	NA
U	1.55E+01	mg/L	NA	1.35	2.50E+01	NA	NA	NA	mg/L	NA	NA	mg/L	NA	10	mg/L	10	NA	mg/L	NA
Anion	**Result**	**Units**	**Units**	**DF**	**SWPF WAC**	**Units**	**Meets WAC?**	**Result**	**Units**	**Units**	**Saltstone WAC**	**Units**	**Meets WAC?**	**Result**	**Units**	**Result**	**DWPF WAC**	**Units**	**Meets WAC?**
C2O4	3.52E+02	mg/L	27%	1	≤2.72E+04	mg/L	Yes	3.06E+02	mg/L	27%	27,200	mg/L	Yes	306	mg/L	44	NA	mg/L	NA
TIC (CO3)	4.66E+03	mg/L	96%	1	≤2.40E+04	mg/L	Yes	4.05E+03	mg/L	96%	24,000	mg/L	Yes	4,052	mg/L	582	NA	mg/L	NA
TOC	2.47E+02	mg/L	29%	1	≤4.50E+03	mg/L	Yes	2.15E+02	mg/L	29%	4,500	mg/L	Yes	215	mg/L	31	NA	mg/L	NA
CHOO	5.48E+02	mg/L	90%	1	≤4.50E+03	mg/L	Yes	4.77E+02	mg/L	90%	6,380	mg/L	Yes	477	mg/L	68.4	NA	mg/L	NA
Free OH	2.21E+00	M	27%	1	≥2E+00	M	Yes	1.92E+00	M	27%	4.60	M	Yes	1.92	M	0.276	NA	M	NA
NO2	3.09E+04	mg/L	28%	1	NA	mg/L	NA	2.69E+04	mg/L	28%	82,800	mg/L	Yes	26,870	mg/L	3,858	NA	mg/L	NA
NO3	1.33E+05	mg/L	25%	1	NA	mg/L	NA	1.16E+05	mg/L	25%	291,000	mg/L	Yes	115,652	mg/L	16,604	NA	mg/L	NA
NO_{eff}	5.50E+00	M	25%	1	≥1	M	Yes	4.79E+00						5		1			
PO4	5.22E+02	mg/L	42%	1	≤3.14E+04	mg/L	Yes	4.54E+02	mg/L	42%	9,500	mg/L	Yes	454	mg/L	65.1	NA	mg/L	NA
SO4	7.11E+03	mg/L	42%	1	≤5.69E+04	mg/L	Yes	6.18E+03	mg/L	42%	34,600	mg/L	Yes	6,183	mg/L	887.6	NA	mg/L	NA
Radioisotope	**Result**	**Units**	**RSD**	**DF**	**SWPF WAC**	**Units**	**Meets WAC?**	**Result**	**Units**	**RSD**	**Saltstone WAC**	**RSD**	**Meets WAC?**	**Result**	**Units**	**Result**	**DWPF WAC**	**Units**	**Meets WAC?**
H-3	1.36E+03	pCi/mL	70%	1	NA	pCi/mL	NA	1.18E+03	pCi/mL	70%		pCi/mL		1.18E+03	pCi/mL	1.70E+02	NA	pCi/mL	

C-14	7.57E+02	pCi/mL	20%	1	NA	pCi/mL	NA	6.58E+02	pCi/mL	20%		pCi/mL		6.58E+02	pCi/mL	9.45E+01	NA	pCi/mL	
Ni-59	2.09E+02	pCi/mL	89%	1	NA	pCi/mL	NA	1.82E+02	pCi/mL	89%		pCi/mL		1.82E+02	pCi/mL	2.62E+01	NA	pCi/mL	
Ni-63	8.75E+02	pCi/mL	144%	1	NA	pCi/mL	NA	7.61E+02	pCi/mL	144%		pCi/mL		7.61E+02	pCi/mL	1.09E+02	NA	pCi/mL	
Co-60	8.35E+01	pCi/mL	155%	1	NA	pCi/mL	NA	7.26E+01	pCi/mL	155%	1.25E+06	pCi/mL		7.26E+01	pCi/mL	1.04E+01	1.98E+04	pCi/mL	Yes
Se-79	5.99E+01	pCi/mL	NA	1	NA	pCi/mL	NA	5.21E+01	pCi/mL	NA		pCi/mL		5.21E+01	pCi/mL	7.48E+00	NA	pCi/mL	NA
Sr-90	1.14E-03	Ci/gallon	44%	20	≤5.21 E-03	Ci/gallon	Yes	4.95E-05	Ci/gallon	44%	2.62E+06	pCi/mL	Yes	4.95E-05	pCi/mL	4.95E-05	NA	pCi/mL	NA
Y-90	2.77E+05	pCi/mL	38%	1	NA	pCi/mL	NA	2.41E+05	pCi/mL	38%		pCi/mL		2.41E+05	pCi/mL	2.41E+05	NA	pCi/mL	NA
Nb-94	6.91E+01	pCi/mL	134%	1	NA	pCi/mL	NA	6.01E+01	pCi/mL	134%		pCi/mL		6.01E+01	pCi/mL	6.01E+01	NA	pCi/mL	NA
Tc-99	4.16E+04	pCi/mL	46%	1	NA	pCi/mL	NA	3.62E+04	pCi/mL	46%	2.11E+03	pCi/mL	Yes	3.62E+04	pCi/mL	5.19E+03	NA	pCi/mL	NA
Ru-106	2.02E+02	pCi/mL	76%	1	NA	pCi/mL	NA	1.75E+02	pCi/mL	76%		pCi/mL		1.75E+02	pCi/mL	2.52E+01	NA	pCi/mL	NA
Rh-106	1.86E+02	pCi/mL	69%	1	NA	pCi/mL	NA	1.62E+02	pCi/mL	69%		pCi/mL		1.62E+02	pCi/mL	2.33E+01	NA	pCi/mL	NA
Sb-125	2.44E+02	pCi/mL	86%	1	NA	pCi/mL	NA	2.12E+02	pCi/mL	86%		pCi/mL		2.12E+02	pCi/mL	3.05E+01	NA	pCi/mL	NA
Te-125m	1.56E+02	pCi/mL	54%	1	NA	pCi/mL	NA	1.36E+02	pCi/mL	54%		pCi/mL		1.36E+02	pCi/mL	1.95E+01	NA	pCi/mL	NA
Sn-126	1.40E+03	pCi/mL	265%	1	NA	pCi/mL	NA	1.22E+03	pCi/mL	265%		pCi/mL		1.22E+03	pCi/mL	1.75E+02	NA	pCi/mL	NA
I-129	2.56E+01	pCi/mL	49%	1	NA	pCi/mL	NA	2.23E+01	pCi/mL	49%		pCi/mL		2.23E+01	pCi/mL	3.20E+00	NA	pCi/mL	NA
Cs-134	2.71E+04	pCi/mL	120%	40000	NA	pCi/mL	NA	5.89E-01	pCi/mL	120%		pCi/mL		2.36E+04	pCi/mL	3.38E+03	NA	pCi/mL	NA
Cs-135	5.51E+02	pCi/mL	55%	40000	NA	pCi/mL	NA	1.20E-02	pCi/mL	55%		pCi/mL		4.79E+02	pCi/mL	6.88E+01	NA	pCi/mL	NA
Cs-137	4.51E-01	pCi/mL	59%	40000	≤2E00	pCi/mL	Yes	9.81E-06	pCi/mL	59%	3.96E+06	pCi/mL	Yes	3.92E-01	pCi/mL	5.63E-02	NA	pCi/mL	NA
%RSD	3.18E+05	1 sigma	332%	1	NA	pCi/mL	NA	2.77E+05	1 sigma	332%		pCi/mL		2.77E+05	pCi/mL	3.97E+04	NA	pCi/mL	NA
Ba-137m	1.09E+08	pCi/mL	61%	1	NA	pCi/mL	NA	9.46E+07	pCi/mL	61%		pCi/mL		9.46E+07	pCi/mL	1.36E+07	NA	pCi/mL	NA
Ce-144	2.14E+02	pCi/mL	54%		NA	pCi/mL	NA	NA	pCi/mL	54%		pCi/mL		NA	pCi/mL	NA	NA	pCi/mL	NA
Pr-144	2.14E+02	pCi/mL	54%	1	NA	pCi/mL	NA	1.86E+02	pCi/mL	54%		pCi/mL		1.86E+02	pCi/mL	2.68E+01	NA	pCi/mL	NA
Pm-147	2.81E+02	pCi/mL	125%		NA	pCi/mL	NA	NA	pCi/mL	125%		pCi/mL		NA	pCi/mL	NA	NA	pCi/mL	NA
Sm-151	1.79E+02	pCi/mL	128%	1	NA	pCi/mL	NA	1.55E+02	pCi/mL	128%		pCi/mL		1.55E+02	pCi/mL	2.23E+01	NA	pCi/mL	NA
Eu-154	4.16E+01	pCi/mL	87%		NA	pCi/mL	NA	NA	pCi/mL	87%		pCi/mL		NA	pCi/mL	NA	NA	pCi/mL	NA
Eu-155	1.47E+02	pCi/mL	67%		NA	pCi/mL	NA	NA	pCi/mL	67%		pCi/mL		NA	pCi/mL	NA	NA	pCi/mL	NA
Ra-226	6.42E+02	pCi/mL	112%	1	NA	pCi/mL	NA	5.58E+02	pCi/mL	112%		pCi/mL		5.58E+02	pCi/mL	8.02E+01	NA	pCi/mL	NA
Th-232	8.97E-03	pCi/mL	0%	1	NA	pCi/mL	NA	7.80E-03	pCi/mL	0%		pCi/mL		7.80E-03	pCi/mL	1.12E-03	NA	pCi/mL	NA
U-232	3.48E+00	pCi/mL	60%	1.35	NA	pCi/mL	NA	2.24E+00	pCi/mL	60%		pCi/mL		2.24E+00	pCi/mL	3.22E-01	NA	pCi/mL	NA
U-233	8.94E+01	pCi/mL	136%	1.35	≤1.68+E04	pCi/mL	Yes	5.76E+01	pCi/mL	136%	1.25E+04	pCi/mL	Yes	5.76E+01	pCi/mL	5.76E+01	NA	pCi/mL	NA
U-234	1.35E+02	pCi/mL	52%	1.35	NA	pCi/mL	NA	8.71E+01	pCi/mL	52%	1.25E+04	pCi/mL	Yes	8.71E+01	pCi/mL	8.71E+01	NA	pCi/mL	NA
U-235	3.91E-01	pCi/mL	36%	1.35	≤1.68E+02	pCi/mL	Yes	2.52E-01	pCi/mL	36%	1.13E+02	pCi/mL	Yes	2.52E-01	pCi/mL	2.52E-01	NA	pCi/mL	NA
U-236	2.46E+00	pCi/mL	51%	1.35	NA	pCi/mL	NA	1.58E+00	pCi/mL	51%	1.13E+02	pCi/mL	Yes	1.58E+00	pCi/mL	1.58E+00	NA	pCi/mL	NA
U-238	5.19E+00	pCi/mL	50%	1.35	NA	pCi/mL	NA	3.34E+00	pCi/mL	50%	3.12E+01	pCi/mL	Yes	3.34E+00	pCi/mL	3.34E+00	NA	pCi/mL	NA
Total U	7.15E+01	pCi/mL	131%	1.35	NA	pCi/mL	Yes	4.61E+01	pCi/mL	131%		pCi/mL		4.61E+01	pCi/mL	4.61E+01	NA	pCi/mL	NA
Total U	1.55E+01	mg/L	73%	1.35	≤2.5E+01	mg/L	Yes	9.99E+00	mg/L	73%		pCi/mL		9.99E+00	pCi/mL	9.98E+00	NA	pCi/mL	NA
Np-237	7.56E+00	pCi/mL	73%	2.4	NA	pCi/mL	NA	2.74E+00	pCi/mL	73%	1.00E+04	pCi/mL	Yes	2.74E+00	pCi/mL	2.74E+00	NA	pCi/mL	NA
Pu-238	2.66E+04	pCi/mL	62%	5.5	NA	pCi/mL	NA	4.20E+03	pCi/mL	62%		pCi/mL		4.20E+03	pCi/mL	6.03E+02	NA	pCi/mL	NA
Pu-239	8.99E+02	pCi/mL	39%	5.5	NA	pCi/mL	NA	1.42E+02	pCi/mL	39%	6.67E+04	pCi/mL	Yes	1.42E+02	pCi/mL	2.04E+01	NA	pCi/mL	NA
Pu-240	5.12E+03	pCi/mL	229%	5.5	NA	pCi/mL	NA	8.09E+02	pCi/mL	229%		pCi/mL		8.09E+02	pCi/mL	1.16E+02	NA	pCi/mL	NA
Pu-239/40	2.00E+03	pCi/mL	0%	5.5	NA	pCi/mL	NA	3.16E+02	pCi/mL	0%		pCi/mL		3.16E+02	pCi/mL	4.54E+01	NA	pCi/mL	NA
Pu-241	3.12E+04	pCi/mL	194%	5.5	≤5.07E+06	pCi/mL	Yes	4.94E+03	pCi/mL	194%	4.94E+03	pCi/mL	Yes	4.94E+03	pCi/mL	7.09E+02	NA	pCi/mL	NA
Pu-242	7.59E+01	pCi/mL	85%	1	NA	pCi/mL	NA	6.60E+01	pCi/mL	85%	6.60E+01	pCi/mL		6.60E+01	pCi/mL	9.47E+00	NA	pCi/mL	NA
Pu-244	5.31E-01	pCi/mL	136%		NA	pCi/mL	NA	NA	pCi/mL	136%	NA	pCi/mL		NA	pCi/mL	1.46E+03	NA	pCi/mL	NA
Total Pu	5.81E-02	mg/L	NA	1	≤2.50E+00	mg/L	Yes	5.05E-02		NA						3.31E-03	NA	pCi/mL	NA
Am-241	2.80E+02	pCi/mL	250%	1	NA	pCi/mL	NA	2.44E+02	pCi/mL	250%	2.44E+02	pCi/mL		2.44E+02	pCi/mL	3.50E+01	NA	pCi/mL	NA
Am-242m	7.78E+02	pCi/mL	0%	1	NA	pCi/mL	NA	6.77E+02	pCi/mL	0%	6.77E+02	pCi/mL		6.77E+02	pCi/mL	9.71E+01	NA	pCi/mL	NA
Am-243	5.48E+02	pCi/mL	172%	1	NA	pCi/mL	NA	4.77E+02	pCi/mL	172%	4.77E+02	pCi/mL		4.77E+02	pCi/mL	6.85E+01	NA	pCi/mL	NA
Cm-242	5.22E+01	pCi/mL	0%	1	NA	pCi/mL	NA	4.54E+01	pCi/mL	0%	4.54E+01	pCi/mL		4.54E+01	pCi/mL	6.52E+00	NA	pCi/mL	NA
Cm-243	0.00E+00	pCi/mL	0%	1	NA	pCi/mL	NA	0.00E+00	pCi/mL	0%	0.00E+00	pCi/mL		0.00E+00	pCi/mL	0.00E+00	NA	pCi/mL	NA
Cm-244	7.07E+01	pCi/mL	276%	1	NA	pCi/mL	NA	6.15E+01	pCi/mL	276%	6.15E+01	pCi/mL		6.15E+01	pCi/mL	8.83E+00	NA	pCi/mL	NA
Cm-245	4.68E+02	pCi/mL	171%	1	NA	pCi/mL	NA	4.07E+02	pCi/mL	171%	4.07E+02	pCi/mL		4.07E+02	pCi/mL	5.84E+01	NA	pCi/mL	NA
Cm-247	0.00E+00	pCi/mL	0%	1	NA	pCi/mL	NA	0.00E+00	pCi/mL	0%	0.00E+00	pCi/mL		0.00E+00	pCi/mL	0.00E+00	NA	pCi/mL	NA
Cf-249	0.00E+00	pCi/mL	0%	1	NA	pCi/mL	NA	0.00E+00	pCi/mL	0%	0.00E+00	pCi/mL		0.00E+00	pCi/mL	0.00E+00	NA	pCi/mL	NA
Cf-251	0.00E+00	pCi/mL	0%	1	NA	pCi/mL	NA	0.00E+00	pCi/mL	0%	0.00E+00	pCi/mL		0.00E+00	pCi/mL	0.00E+00	NA	pCi/mL	NA
Total Alpha	1.15E+05	pCi/mL	129%	1	NA	pCi/mL	NA	1.00E+05	pCi/mL	129%	1.00E+05	pCi/mL		1.00E+05	pCi/mL	1.44E+04	NA	pCi/mL	NA
Total Beta	1.47E+08	pCi/mL	57%	1	NA	pCi/mL	NA	1.28E+08	pCi/mL	57%	1.28E+08	pCi/mL		1.28E+08	pCi/mL	1.83E+07	NA	pCi/mL	NA
U-235 Enrichment	1.15E+00				≤8.00E+00	%	Yes	1.15E+00	%		4.47E-01	pCi/mL		0.168	%	1.145	8	%	Yes
Total Gamma	1.12E+08	pCi/mL	63%						pCi/mL	63%		pCi/mL			pCi/mL		NA	pCi/mL	
Other	**Result**	**Units**	**RSD**	**DF**	**SWPF WAC**	**Units**	**Meets WAC?**	**Result**	**Units**	**RSD**	**Saltstone WAC**	**RSD**	**Meets WAC?**	**Result**	**Units**	**Result**	**DWPF WAC**	**Units**	**Meets WAC?**
Density	1.28	g/mL	2%					1.23	g/mL	2%	NA		NA	1.23	g/mL	1.03	NA	g/mL	NA
Insoluble Solids					≤1,200	mg/L		≤1.00E+00	wt %		15	wt %	Yes		Wt %		15	wt %	

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