SRR-CWDA-2012-00027
Revision 1

TANK 5 INVENTORY DETERMINATION

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1.0 SUMMARY

This document describes the inventory development for Tank 5 residual material. Discrete tank elements containing residual material were identified and inventories developed. These inventories were totaled to determine the overall Tank 5 inventory.

The approach taken developed three inventories with different levels of conservatism. The multiple inventories allow the end use to drive the appropriate inventory chosen (e.g., deterministic model fate and transport analysis). The three inventories developed were "Average", "Best Estimate", and "Reasonably Conservative". The purpose of the various inventories was to provide a range of conservatisms starting with a slight level of conservatism (Average). The second level provided a moderate level of conservatism (Best Estimate). Lastly, an upper level of conservatism was set as one that reaches the upper level of practicality (Reasonably Conservative) without reaching an unrealistic or bounding level.

For each inventory, the various discrete elements' inventories were developed using values for that inventory's conservatism level. This approach provided a consistent level of conservatism throughout each inventory.

2.0 APPROACH

The methodology used to develop the tank inventory summed inventories from the waste tank discrete elements. The inventory for each element was determined by taking the material concentration and multiplying it by the element's volume (or surface area). This was repeated for each constituent (radionuclides and chemicals).

$$T_j = \sum (V_i \times c_{ij})$$

Where:

T_j	=	Total Inventory for constituent j
V_i	=	Volume (or surface area) of element i
C_{ij}	=	Concentration of constituent, j, in element, i

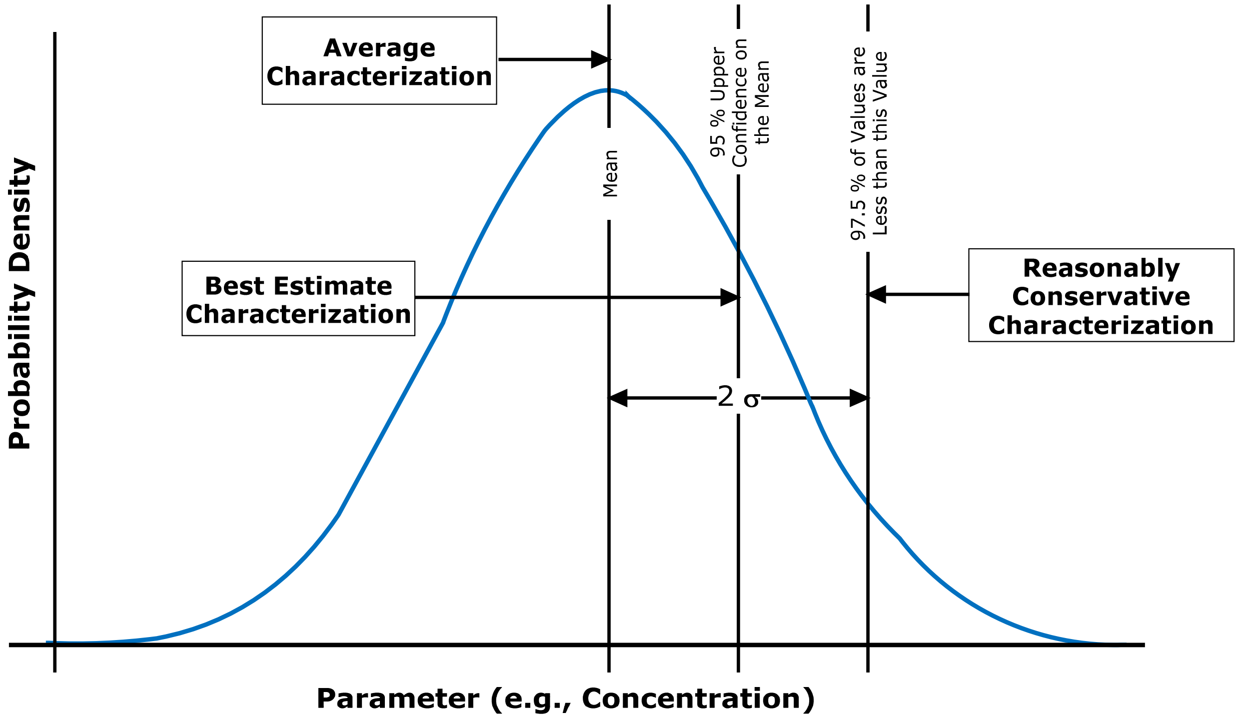
This methodology was repeated to develop three types of residual inventories. The first inventory is described as an "Average" inventory. The second inventory is described as the "Best Estimate" inventory. The Best Estimate represents the nominal Tank 5 inventory at closure. The third inventory is described as "Reasonably Conservative" and provides the most conservatism by using upper level inventory quantities. This varied approach provides multiple Tank 5 inventories, which can be used as appropriate for different performance assessment modeling scenarios or other evaluations.

For the Best Estimate inventory, values reflecting the expected inventory (with a moderate level of conservatism) were desired. For this reason, values representing the upper 95 % confidence limit on the mean were used. This approach reflects the desire to add some conservatism above the mean values. For components where an explicit confidence value could not be determined, a value approximating this level of conservatism was subsequently chosen.

For the Reasonably Conservative inventory, additional conservatism was desired. This inventory increased the margin provided over the Best Estimate inventory, but does not reach a physically

bounding level of conservatism. Figure 2.0-1 illustrates the various levels conservatisms and the approaches used in this document.

Figure 2.0-1: Illustration of Various Levels of Conservatism Used for Inventory Development



Although there are three levels of conservatism, the methodology used to determine each inventory is the same. The differences are in the specific values used in the methodology.

3.0 DISCRETE ELEMENT INVENTORY INPUTS

As described above, the methodology used to develop the inventory sums the inventories from discrete elements of the waste tank. The discrete elements to be determined are listed below.

- Waste tank floor
- Waste tank cooling coils and wall
- Other potential equipment build-up (e.g., pumps)
- Waste tank annulus

3.1 Waste Tank Floor

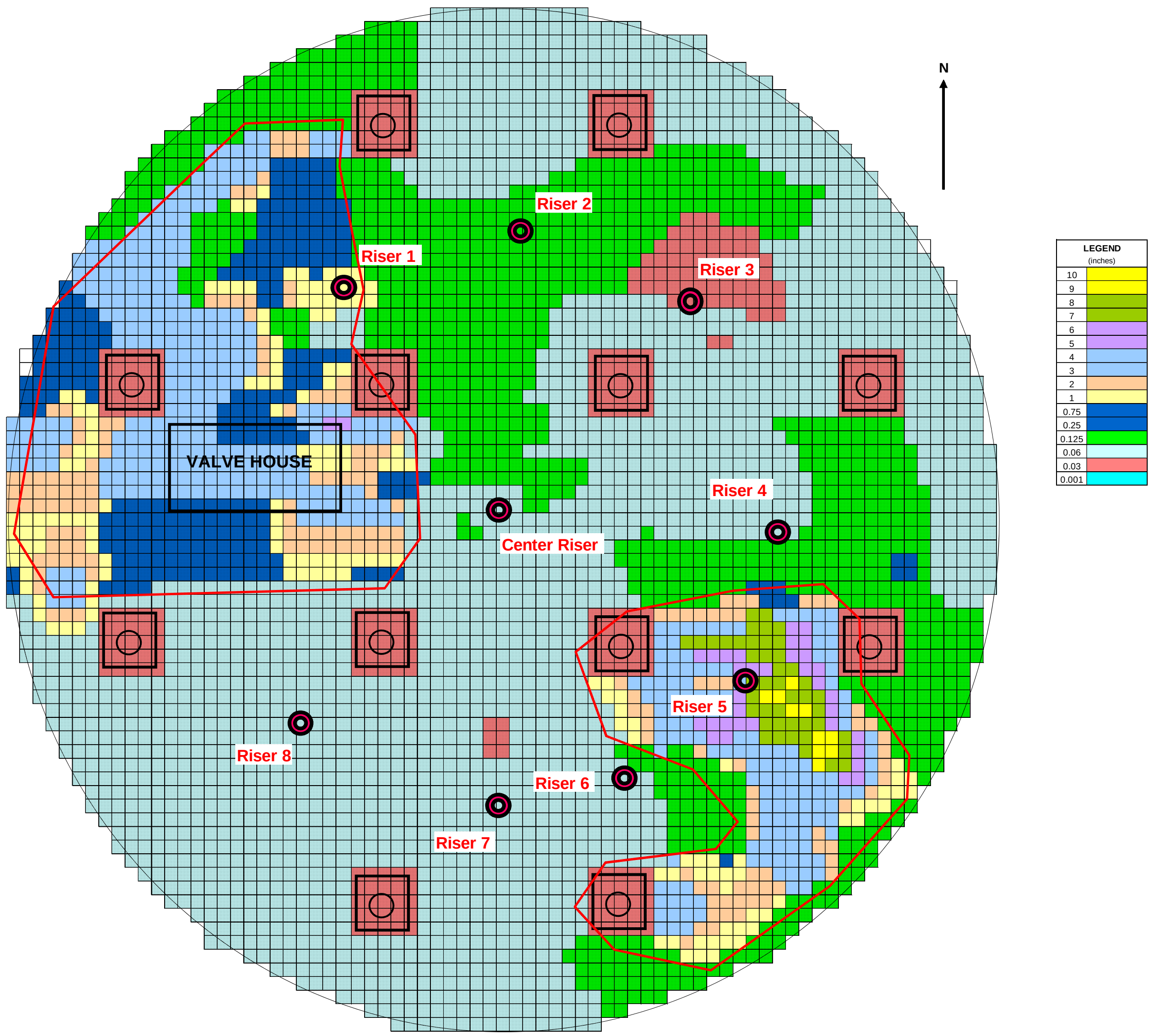
The floor residual inventory was developed using the residual material volume and the concentrations for both radionuclides and chemicals.

The floor inventory was determined by multiplying the floor volume by the concentration (for each constituent). Residual material samples were taken, composited, and analyzed to determine the concentrations. [SRR-LWE-2010-00285] These concentrations were in terms of dried solids mass; therefore, conversion to a volume basis was needed. For this reason, the density and solids content (dry solids to wet solids) were also measured.

3.1.1 Concentration

To determine the concentration of the constituents within the residual material, a sample plan was developed to provide the average concentration of the residual materials. Figure 3.1-1 shows the residual material map. [U-ESR-F-00048]

Figure 3.1-1: Tank 5 Residual Material Map



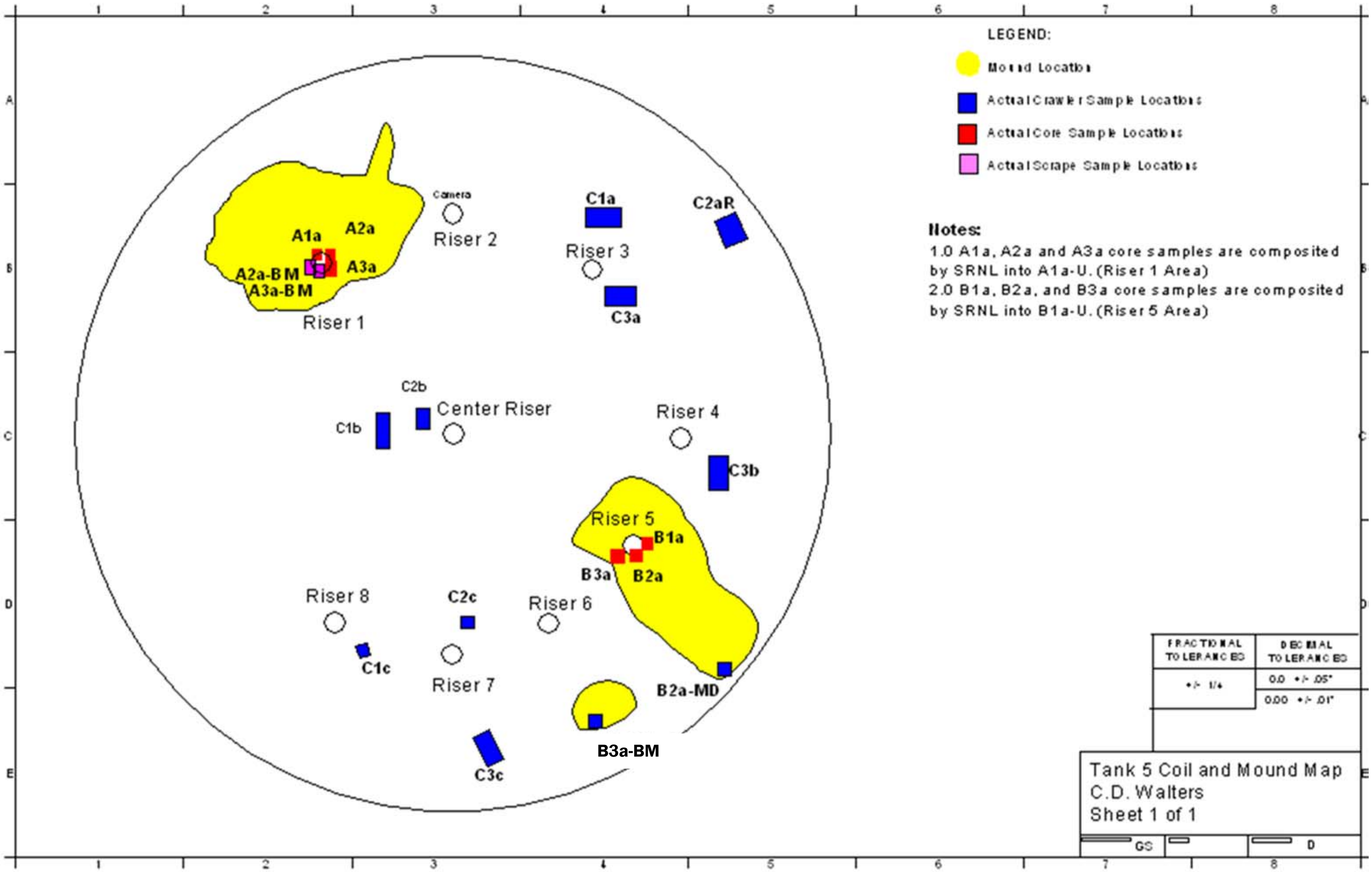
The sample plan was developed based on the preliminary estimate of the material distribution (i.e., locations of accumulations). This plan targeted samples based on the location of the accumulations. The residual material was divided into three areas, the accumulation under Riser 1, the accumulation under Riser 5, and the remainder of the waste tank floor.

Samples were planned for collection from these areas to be composited into three samples. Five samples were collected for each composite sample, totaling 15 discrete samples. These three composite samples were characterized and the results used for calculating the waste tank average residual material floor concentrations. The sample plan is described in SRR-LWE-2010-00285 and is consistent with the *Liquid Waste Tank Residuals Sampling and Analysis Program Plan*. [SRR-CWDA-2011-00050]

To address the uncertainty associated with the final residual volume, the proportions within the composite samples were varied based on the volumetric uncertainty. This method incorporates the volumetric uncertainty into the composite samples and the analytical results reflected the volumetric uncertainty, as well as the other uncertainties (measurement, sampling, and material). This method was reviewed and supported by statistical experts in the Applied Computational Engineering and Statistics Group in the Savannah River National Laboratory. [SRNL-STI-2011-00323] The analysis results from the three composites allow the overall uncertainty to be reflected in the confidence limits on the mean concentrations.

Within each area, the sample locations were distributed throughout the area. This was done to ensure a good distribution of material was represented. Although it should be noted that the material was considered randomized by the waste removal and waste tank cleaning processes which resulted in well mixed material. Figure 3.1-2 illustrates the sample locations. [SRR-LWE-2010-00285]

Figure 3.1-2: Tank 5 Floor Sample Locations



The composite samples were analyzed by Savannah River National Laboratory to characterize the constituents listed in Table 3.1-1. [SRR-LWE-2010-00285, HLE-TTR-2010-004, SRNL-RP-2010-01695] A majority of the analytes was digested in triplicate and each resulting solution analyzed for the requested constituents. For a few constituents, it was recognized that reaching the target detection limits was going to be challenging and thus new or modified analytical methods and/or additional sample material were required to achieve these detection limit values. Special emphasis was placed on achieving these target detection limits for at least one sample. In addition, there were a set of constituents where the purpose of the analysis was to confirm that the constituent was absent or present only in extremely low concentrations. These analyses were also expected to be challenging. Only one replicate per sample was performed for these analytes. For additional details on the sample analyses, refer to SRNL-STI-2012-00034.

Table 3.1-1: Tank 5 Floor Material Analytes

Ac-227	Cm-243	Eu-154	Pa-231	Ra-226	Th-230	Ag	Cu	Pb
Al-26	Cm-244	H-3	Pd-107	Sb-126	U-232	Al	F	PO_4
Am-241	Cm-245	I-129	Pt-193	Sb-126m	U-233	As	Fe	Sb
Am-242m	Cm-247	K-40	Pu-238	Se-79	U-234	B	Hg	Se
Am-243	Cm-248	Nb-93m	Pu-239	Sm-151	U-235	Ba	Mn	SO_4
Ba-137m	Co-60	Nb-94	Pu-240	Sn-126	U-236	Cd	Mo	Sr
C-14	Cs-135	Ni-59	Pu-241	Sr-90	U-238	Cl	Ni	U
Cf-249	Cs-137	Ni-63	Pu-242	Tc-99	Y-90	Co	NO_2	Zn
Cl-36	Eu-152	Np-237	Pu-244	Th-229	Zr-93	Cr	NO_3	

The suite of analytes selected for inventory determination was based on type of constituent: radionuclide or chemical. Radionuclide constituent selection was based on those radionuclides modeled in the F-Tank Farm performance assessment. [SRR-CWDA-2009-00045] Chemical constituent selection was based on *Tanks 18 and 19 Chemical Screening for Residual Inventory Determination* (SRR-CWDA-2011-00162). Since the material in Tank 5 was produced from the same process as Tanks 18 and 19, the constituents are the same. The only differences expected would be in the concentrations of those analytes.

A statistical study of the sampling results was performed and provided the means, standard deviations, and upper 95 % confidence limits on the mean. For additional details, refer to the *Statistical Analysis of Tank 5 Floor Sample Results (U)*. [SRNL-STI-2011-00613] Table 3.1-2 lists the floor material concentrations.

For those non-detected analytes, the lowest and highest minimum detection concentrations were used. Those results are in *Analysis of the Tank 5F Final Characterization Samples-2011*. [SRNL-STI-2012-00034] These constituents as listed in Table 3.1-3.

Table 3.1-2: Tank 5 Floor Material Measured Concentrations

Constituents	Concentrations			Constituents	Concentrations		
	Mean (µCi/g)	Upper 95 % Conf. Mean Limit (µCi/g)	Standard Deviation (µCi/g)		Mean (µCi/g or mg/g)	Upper 95 % Conf. Mean Limit (µCi/g or mg/g	Standard Deviation (µCi/g or mg/g)
Am-241	7.0E+01	7.3E+01	4.7E+00	U-235	2.0E-04	2.1E-04	2.4E-05
Am-242m	1.6E-01	1.8E-01	2.4E-02	U-236	2.4E-04	2.6E-04	2.8E-05
Am-243	5.3E-01	5.6E-01	3.8E-02	U-238	4.6E-03	4.9E-03	5.6E-04
Ba-137m*	3.9E+02	4.2E+02	4.7E+01	Y-90*	1.2E+04	1.3E+04	3.5E+02
Cm-244	3.0E+00	3.2E+00	3.0E-01	Zr-93	3.0E+00	3.1E+00	2.6E-01
Co-60	6.8E+00	7.1E+00	4.4E-01	Ag	2.5E-01	3.1E-01	4.1E-02
Cs-135	2.1E-03	2.3E-03	3.2E-04	Al	4.9E+00	5.8E+00	1.5E+00
Cs-137	4.2E+02	4.5E+02	5.0E+01	B	1.3E+00	1.4E+00	7.3E-02
Eu-154	3.0E+01	3.1E+01	1.6E+00	Ba	2.0E+00	2.2E+00	1.7E-01
I-129	1.8E-04	2.3E-04	6.2E-05	Cd	9.0E-02	9.3E-02	5.6E-03
Nb-93m*	3.0E+00	3.1E+00	2.6E-01	Cl	3.4E-02	4.4E-02	1.2E-02
Ni-59	5.5E+00	6.3E+00	1.2E+00	Co	2.2E-01	2.6E-01	2.7E-02
Ni-63	3.0E+02	3.5E+02	8.0E+01	Cr	1.1E+00	1.1E+00	1.3E-01
Np-237	2.3E-02	2.7E-02	7.0E-03	Cu	7.2E-01	7.8E-01	9.4E-02
Pd-107	3.8E-03	5.2E-03	2.0E-03	Fe	4.9E+02	5.1E+02	2.8E+01
Pu-238	2.6E+00	2.8E+00	2.7E-01	Hg	2.3E+00	2.5E+00	3.1E-01
Pu-239	8.2E+00	8.9E+00	9.3E-01	Mn	3.4E+01	3.6E+01	2.7E+00
Pu-240	1.9E+00	2.1E+00	2.2E-01	Mo	4.7E-02	5.2E-02	2.9E-03
Pu-242	3.8E-04	4.1E-04	5.3E-05	Ni	5.5E+01	6.0E+01	7.4E+00
Se-79	1.0E-02	1.3E-02	5.0E-03	NO_2	5.0E-02	5.2E-02	1.0E-02
Sm-151	7.8E+02	8.1E+02	5.5E+01	NO_3	1.2E-01	2.1E-01	9.3E-02
Sr-90	1.2E+04	1.3E+04	3.5E+02	Pb	3.7E+00	3.8E+00	1.3E-01
Tc-99	1.0E-02	1.1E-02	1.5E-03	SO_4	2.3E-01	2.8E-01	7.8E-02
Th-229	1.0E-05	3.1E-05	1.4E-05	Sr	3.8E-01	4.3E-01	3.1E-02
Th-230	1.6E-03	2.3E-03	1.1E-03	U	9.0E+00	9.6E+00	1.1E+00
U-234	4.2E-03	4.7E-03	8.1E-04	Zn	4.5E-01	5.1E-01	9.8E-02

* Based on equilibrium relationship

Table 3.1-3: Tank 5 Floor Material Detection Limit Concentrations

Constituent	Lowest Minimum Detection Concentration (µCi/g)	Highest Minimum Detection Concentration (µCi/g)	Constituent	Lowest Minimum Detection Concentration (µCi/g or mg/g)	Highest Minimum Detection Concentration (µCi/g or mg/g)
Ac-227	<9.5E-05	<4.7E-02	Pt-193	<4.2E-04	<6.4E-03
Al-26	<1.3E-02	<2.3E-02	Pu-241	<8.5E+00	<1.4E+01
C-14	<7.4E-04	<3.4E-03	Pu-244	<7.4E-07	<1.2E-06
Cf-249	<7.4E-03	<1.9E-02	Ra-226	<6.8E-04	<9.8E-03
Cl-36	<2.9E-03	<3.9E-02	Sb-126*	<1.1E-01	<1.8E-01
Cm-243	<5.8E-02	<1.4E+00	Sb-126m*	<8.1E-01	<1.3E+00
Cm-245	<5.6E-04	<1.5E-03	Sn-126	<8.1E-01	<1.3E+00
Cm-247	<1.0E-07	<5.4E-07	U-232	<4.6E-06	<3.5E-05
Cm-248	<1.3E-05	<5.7E-05	U-233	<2.3E-04	<7.6E-03
Eu-152	<1.5E-01	<2.3E-01	As	<9.4E-03	<1.1E-02
H-3	<8.4E-03	<1.8E-02	F	<3.6E-02	<4.9E-02
K-40	<8.2E-04	<7.3E-03	PO_4	<3.6E-02	<4.9E-02
Nb-94	<1.1E-03	<4.9E-02	Sb	<7.7E-01	<8.7E-01
Pa-231	<1.4E-04	<1.0E-03	Se	<2.0E-03	<2.0E-01

* Based on equilibrium relationship

3.1.2 Density

The density was measured for each of the composite samples to allow for the conversion from the volume of the residual material to a mass basis. The sample analysis results were evaluated in the statistical study and mean, standard deviation, and upper 95 % confidence limit on the mean are included in Table 3.1-4. [SRNL-STI-2011-00613] For additional information on the sample analysis, refer to the *Analysis of the Tank 5F Final Characterization Samples – 2011* (SRNL-STI-2012-00034).

Table 3.1-4: Tank 5 Floor Material Density

Measure	Associated Inventory	Density
Mean	Average	1.35 g/mL
Upper 95 % Confidence Mean Limit	Best Estimate	1.38 g/mL
Standard Deviation	-	0.048 g/ml
Average + 2 sigma	Reasonably Conservative	1.45 g/mL

3.1.3 Solids Content

For the analysis of the residual samples, the material was dried to remove water. Due to this, the sample analysis returns concentrations in terms of dried solids. To adjust the measured concentrations to appropriate concentrations of the residual material, the percentage of solids in the residual material was measured and presented in Table 3.1-5 (based on information in Appendix A). For additional information, refer to SRNL-STI-2012-00034.

Table 3.1-5: Tank 5 Floor Material Solids Content

Measure	Associated Inventory	Solids
Mean	Average	96.3 %
Upper 95 % Confidence Mean Limit	Best Estimate	96.7 %
Standard Deviation	-	0.50 %
Average + 2 sigma	Reasonably Conservative	97.3 %

3.1.4 Volume

The method employed to determine the final Tank 5 residual floor volume provided a slight conservatism based on the volume uncertainty estimated in *Tank 5 Volume Determination and Uncertainty Estimate Report* (U-ESR-F-00048, Figure 3.1-1). The final volume was determined to be 1.9E+03 gallons.

The mapping team re-evaluated selected areas in the waste tank to assign an uncertainty range. Areas included examples of previously assigned material height. The mapping team re-evaluated the material heights using high quality digital photographs with enhancement software and video footage. For each area, the mapping team assigned a low-end material height estimate and a high-end material height estimate. Then, a low-end volume estimate was calculated by replacing the previously assigned material heights with the low-end material height estimates, and a high-end volume estimate was calculated by replacing the previously assigned material heights with the high-end material height estimates. The low-end volume estimate and high-end volume estimate were calculated to be approximately 1,331 gallons and 2,657 gallons respectively. For additional information associated with the volume determination process, refer to U-ESR-F-00048. Table 3.1-6 contains the different volume determinations.

Table 3.1-6: Tank 5 Floor Material Volume

Parameter	Associated Inventory	Value
Low Volume Estimate	-	1.3E+03 gal
Determined Final Volume	Average and Best Estimate	1.9E+03 gal
High Volume Estimate	Reasonably Conservative	2.7E+03 gal

3.2 Waste Tank Cooling Coils and Wall

Samples of the waste tank cooling coils were collected to determine the amount of inventory associated with the cooling coil surface area and tank wall. Two samples were taken of one of the Tank 5 cooling coils, one below the level of 45 inches and one above 45 inches. During the acid cleaning process, the liquid level was raised to 45 inches using oxalic acid. [SRR-CWDA-2011-00033] The two samples are shown in Figure 3.2-1.

Figure 3.2-1: Tank 5 Cooling Coil Samples

Tank 5 cooling coil - TK 5-R1-A45 Above 45 inches	Tank 5 cooling coil - TK 5-R1-B45 Below 45 inches

3.2.1 Cooling Coil Analyte Concentrations

The two cooling coil samples were analyzed for the constituents listed in Table 3.2-1. A reduced constituent suite was selected because a negligible residual inventory was expected. The results confirmed this expectation. The analysis of the cooling coils was assumed to be applicable to the tank wall given that both were made of similar material. Additional constituents were reported as part of the analyses.

Table 3.2-1: Tank 5 Cooling Coil Constituents

Am-241	Pu-239	U-233
Co-60	Pu-240	U-234
Cs-137	Pu-241	U-235
Np-237	Pu-242	U-236
Pu-238	Pu-244	U-238
	Sr-90	

The samples were acid leached and the leachate analyzed. [SRNL-STI-2011-00372] The characterization results were reported with respect to the surface area of the outside of the cooling coil.

A second leaching of the samples was performed to ensure that the initial leaching was adequate to remove the majority of the specified constituents. A comparison of the results from the second leaching demonstrated that the first leaching accounted for essentially all the concentrations measured.

Table 3.2-2 lists the average concentrations from the cooling coil analyses. [SRNL-STI-2011-00372]

Table 3.2-2: Tank 5 Cooling Coil Concentrations

Constituent	**Coil above 45 inches in Tank 5 – TK5-R1-A45 (Ci/ft^2)**	**Coil below 45 inches in Tank 5 – TK5-R1-B45 (Ci/ft^2)**
Am-241	1.2E-05	3.3E-05
Cm-242	2.1E-08	6.3E-08
Cm-244	9.2E-07	2.8E-06
Co-60	3.5E-06	6.4E-06
Cs-137	7.3E-04	8.1E-04
Eu-154	5.8E-06	1.4E-05
Eu-155	9.4E-07	2.3E-06
Np-237	1.1E-08	1.4E-08
Pu-238	9.8E-07	1.8E-06
Pu-239	2.1E-06	5.2E-06
Pu-240	5.5E-07	1.2E-06
Pu-241	<3.0E-05	<1.1E-05
Pu-242	1.3E-10	2.5E-10
Pu-244	<4.3E-13	<4.3E-13
Sb-126	<3.2E-08	≤1.0E-07
Sr-90	1.3E-02	8.9E-03
U-233	<8.6E-09	<1.6E-09
U-234	<5.6E-09	2.3E-09
U-235	1.5E-10	1.3E-10
U-236	1.8E-10	1.4E-10
U-238	3.6E-09	2.8E-09

3.2.2 Cooling Coil and Tank Wall Surface Area

The wall surface area was determined by using the formulas and dimensions in *Type I and II Waste Tank Cooling Coil to Tank Volume Ratios and Area Ratios* (C-CLC-G-00364). The calculations were modified to determine the Tank 5 surface area below and above 45 inches.

Table 3.2-3: Tank 5 Surface Area

	Surface Area Below 45 inches (ft^2)	Surface Area Above 45 inches (ft^2)
Wall	8.8E+02	4.9E+03
Columns	2.5E+02	1.6E+03
Column Bases	8.1E+01	NA
Column Stiffeners	8.9E+01	NA
Horizontal Coils	1.0E+03	NA
Horizontal Coil Risers	4.3E+00	2.6E+01
Horizontal Coil Supports	4.2E+01	NA
Vertical Coil Vertical Sections	4.1E+02	6.5E+03
Vertical Coil Loops	1.2E+03	1.2E+03
Vertical Coil Risers	4.6E+01	9.9E+02
Vertical Coil Leads	2.8E+03	NA
Vertical Coil Supports	2.8E+02	NA
Total	7.1E+03	1.5E+04

3.3 Equipment Build-up

Tank 5 contains various types of equipment used during the operational life of the waste tank and the waste removal process. This equipment includes several types of pumps and piping. There is potential for material build-up in these equipment pieces and the amount of associated inventory has been determined. In addition, the inventory is expected to be minimal since any build-up material associated with this equipment would have experienced similar treatment conditions to the residual material on the floor. This treatment process used an acid cleaning phase, which was expected to reduce significantly any minimal build-up present.

3.3.1 Equipment Concentration

The residual concentrations for any equipment build-up were assumed equal to the floor residuals because this equipment would have been in contact with the residual material prior to completion of waste removal activities.

3.3.2 Equipment Volume

The potential build-up residual volume was estimated to be 4.7 gallons. [SRR-LWE-2012-00102]

3.4 Waste Tank Annulus

Tank 5 has an annulus pan that surrounds the primary tank liner. Inspections of the Tank 5 annulus space confirmed the presence of a small amount of residual material.

3.4.1 Waste Tank Annulus Concentration

Residual material observed in the annulus appeared to be primarily saltcake. This suggests the material source was supernate that leaked from the primary tank liner. Since the volume of this material was negligible relative to the waste tank residual material volume, an

in-depth characterization was not deemed necessary. The constituents present would be the soluble species; mainly Cs-137 and Tc-99. The concentration of these soluble constituents was not considered greater than that of the waste tank floor residual material.

3.4.2 Waste Tank Annulus Volume

The Tank 5 annulus has been estimated to contain less than 15 gallons of residual material. [U-ESR-F-00048]

4.0 TOTAL RESIDUAL INVENTORIES

Each of the discrete inventories (floor, coils/walls, equipment, and annulus) was evaluated. The appropriate inventories were totaled for the Average, Best Estimate, and Reasonably Conservative inventories. The radiological inventories were decayed to support performance assessment modeling. The decay period was based on the 2012 analysis date for the samples and the start date of F-Tank Farm Performance Assessment modeling, 10/01/2020.

4.1 Floor Inventory

The floor inventory was determined by using the information presented in Section 3.1 in the following formula:

Radionuclides

$$I_{Fi} = c_{Fi} \times \frac{1Ci}{10^6 \mu Ci} \times V_F \times \frac{3.785L}{gal} \times \frac{1000mL}{L} \times \rho \times \frac{s}{100}$$

Where:

I_{Fi}	=	Floor inventory for constituent i (Ci)
c_{Fi}	=	Floor concentration for constituent i (µCi/g)
V_F	=	Residual material floor volume (gal)
ρ	=	Residual material density (g/mL)
s	=	Residual material solids content (wt %)

Chemicals

$$I_{Fi} = c_{Fi} \times \frac{1kg}{10^6 mg} \times V_F \times \frac{3.785L}{gal} \times \frac{1000mL}{L} \times \rho \times \frac{s}{100}$$

Where:

I_{Fi}	=	Floor inventory for constituent i (kg)
c_{Fi}	=	Floor concentration for constituent i (mg/g)
V_F	=	Residual material floor volume (gal)
ρ	=	Residual material density (g/mL)
s	=	Residual material solids content (wt %)

For the Average inventory determination, the means of all factors were used. Some constituents were not detected in any of the samples and no statistical analysis was performed. The analysis of constituents with very low concentrations reached the limits of the analytical equipment and procedures. Based on many factors, such as interference from other radionuclides, the reported minimum detectable concentration (MDC) can differ between sample analyses. For constituents that were not detected, the lowest MDC was used for the Average inventory determination.

For the Best Estimate inventory determination, the upper 95 % confidence limit on the mean for each of the factors was used. For constituents that were not detected, the lowest MDC was used.

For the Reasonably Conservative inventory determination, the value used for each of the factors was determined by adding twice the standard deviation to the mean. For constituents that were not detected, the highest MDC was used.

The Tank 5 Floor Average, Best Estimate, and Reasonably Conservative Inventories, decayed to 10/01/2020, are presented in Table 4.1-1. The Tank 5 Floor Best Estimate Inventory, not decayed, is also presented in Table 4.1-1.

Table 4.1-1: Tank 5 Floor Inventories

Constituent	Units	Average (2020)	Best Estimate (2012)	Best Estimate (2020)	Reasonably Conservative (2020)
Ac-227	Ci	<6.7E-04	<9.1E-04	<6.9E-04	<5.1E-01
Al-26	Ci	<1.2E-01	<1.2E-01	<1.2E-01	<3.3E-01
Am-241	Ci	6.5E+02	7.0E+02	6.9E+02	1.1E+03
Am-242m	Ci	1.5E+00	1.7E+00	1.7E+00	2.9E+00
Am-243	Ci	5.0E+00	5.3E+00	5.3E+00	8.6E+00
Ba-137m	Ci	3.0E+03	4.0E+03	3.3E+03	5.6E+03
C-14	Ci	<6.9E-03	<7.1E-03	<7.1E-03	<4.8E-02
Cf-249	Ci	<6.8E-02	<7.1E-02	<7.0E-02	<2.6E-01
Cl-36	Ci	<2.7E-02	<2.8E-02	<2.8E-02	<5.5E-01
Cm-243	Ci	<4.4E-01	<5.5E-01	<4.5E-01	<1.6E+01
Cm-244	Ci	2.0E+01	3.1E+01	2.2E+01	3.7E+01
Cm-245	Ci	<5.3E-03	<5.4E-03	<5.4E-03	<2.1E-02
Cm-247	Ci	<9.4E-07	<9.7E-07	<9.7E-07	<7.7E-06
Cm-248	Ci	<1.2E-04	<1.3E-04	<1.3E-04	<8.1E-04
Co-60	Ci	2.0E+01	6.8E+01	2.2E+01	3.4E+01
Cs-135	Ci	2.0E-02	2.2E-02	2.2E-02	3.9E-02
Cs-137	Ci	3.2E+03	4.3E+03	3.5E+03	6.0E+03
Eu-152	Ci	<8.8E-01	<1.4E+00	<9.0E-01	<2.0E+00
Eu-154	Ci	1.4E+02	3.0E+02	1.5E+02	2.3E+02
H-3	Ci	<4.8E-02	<8.0E-02	<4.9E-02	<1.6E-01
I-129	Ci	1.7E-03	2.2E-03	2.2E-03	4.4E-03
K-40	Ci	<7.7E-03	<7.9E-03	<7.9E-03	<1.0E-01
Nb-93m	Ci	2.8E+01	3.0E+01	3.0E+01	5.0E+01
Nb-94	Ci	<1.1E-02	<1.1E-02	<1.1E-02	<6.9E-01
Ni-59	Ci	5.2E+01	6.0E+01	6.0E+01	1.1E+02
Ni-63	Ci	2.6E+03	3.3E+03	3.1E+03	6.1E+03
Np-237	Ci	2.2E-01	2.6E-01	2.6E-01	5.3E-01
Pa-231	Ci	<1.3E-03	<1.4E-03	<1.4E-03	<1.4E-02
Pd-107	Ci	3.5E-02	5.0E-02	5.0E-02	1.1E-01
Pt-193	Ci	<3.5E-03	<4.1E-03	<3.6E-03	<8.0E-02
Pu-238	Ci	2.3E+01	2.6E+01	2.5E+01	4.1E+01
Pu-239	Ci	7.7E+01	8.5E+01	8.5E+01	1.4E+02
Pu-240	Ci	1.8E+01	2.0E+01	2.0E+01	3.3E+01
Pu-241	Ci	<5.2E+01	<8.2E+01	<5.3E+01	<1.3E+02
Pu-242	Ci	3.5E-03	3.9E-03	3.9E-03	6.8E-03
Pu-244	Ci	<6.9E-06	<7.1E-06	<7.1E-06	<1.7E-05
Ra-226	Ci	<6.3E-03	<6.5E-03	<6.5E-03	<1.4E-01
Sb-126	Ci	<1.1E+00	<1.1E+00	<1.1E+00	<2.5E+00
Sb-126m	Ci	<7.5E+00	<7.7E+00	<7.7E+00	<1.8E+01
Se-79	Ci	9.5E-02	1.3E-01	1.3E-01	2.9E-01

Table 4.1-1: Tank 5 Floor Inventories (Continued)

Constituent	Units	Average (2020)	Best Estimate (2012)	Best Estimate (2020)	Reasonably Conservative (2020)
Sm-151	Ci	6.8E+03	7.8E+03	7.3E+03	1.2E+04
Sn-126	Ci	<7.5E+00	<7.7E+00	<7.7E+00	<1.8E+01
Sr-90	Ci	9.3E+04	1.2E+05	9.7E+04	1.5E+05
Tc-99	Ci	9.3E-02	1.0E-01	1.0E-01	1.8E-01
Th-229	Ci	9.7E-05	2.9E-04	2.9E-04	5.4E-04
Th-230	Ci	1.4E-02	2.2E-02	2.2E-02	5.4E-02
U-232	Ci	<4.0E-05	<4.4E-05	<4.1E-05	<4.5E-04
U-233	Ci	<2.2E-03	<2.2E-03	<2.2E-03	<1.1E-01
U-234	Ci	3.9E-02	4.5E-02	4.5E-02	8.2E-02
U-235	Ci	1.8E-03	2.0E-03	2.0E-03	3.5E-03
U-236	Ci	2.3E-03	2.5E-03	2.5E-03	4.2E-03
U-238	Ci	4.3E-02	4.7E-02	4.7E-02	8.0E-02
Y-90	Ci	9.3E+04	1.2E+05	9.7E+04	1.5E+05
Zr-93	Ci	2.8E+01	3.0E+01	3.0E+01	5.0E+01
Ag	kg	2.3E+00	3.0E+00		4.7E+00
Al	kg	4.6E+01	5.5E+01		1.1E+02
As	kg	<8.8E-02	<9.1E-02		<1.5E-01
B	kg	1.2E+01	1.3E+01		2.1E+01
Ba	kg	1.8E+01	2.1E+01		3.2E+01
Cd	kg	8.4E-01	9.0E-01		1.4E+00
Cl	kg	3.2E-01	4.3E-01		8.2E-01
Co	kg	2.0E+00	2.5E+00		3.8E+00
Cr	kg	9.9E+00	1.1E+01		1.9E+01
Cu	kg	6.8E+00	7.5E+00		1.3E+01
F	kg	<3.4E-01	<3.5E-01		<6.9E-01
Fe	kg	4.6E+03	4.9E+03		7.7E+03
Hg	kg	2.1E+01	2.4E+01		4.1E+01
Mn	kg	3.2E+02	3.4E+02		5.6E+02
Mo	kg	4.4E-01	5.0E-01		7.5E-01
Ni	kg	5.2E+02	5.8E+02		9.9E+02
NO_2	kg	4.6E-01	5.0E-01		1.0E+00
NO_3	kg	1.1E+00	2.0E+00		4.3E+00
Pb	kg	3.5E+01	3.6E+01		5.6E+01
PO_4	kg	<3.4E-01	<3.5E-01		<6.9E-01
Sb	kg	<7.2E+00	<7.4E+00		<1.2E+01
Se	kg	<1.9E-02	<1.9E-02		<2.8E+00
SO_4	kg	2.2E+00	2.7E+00		5.5E+00
Sr	kg	3.6E+00	4.1E+00		6.2E+00
U	kg	8.4E+01	9.3E+01		1.6E+02
Zn	kg	4.2E+00	4.9E+00		9.1E+00

4.2 Cooling Coil and Waste Tank Wall Inventory

The inventories associated with the cooling coils and waste tank wall were determined using the information presented in Section 3.2 in the following formula:

$$I_{CCi} = c_{CAi} \times \sum SA_{Aj} + c_{CBi} \times \sum SA_{Bj}$$

Where:

I_{CCi}	=	Cooling coil and tank wall inventory for constituent i (Ci)
c_{CAi}	=	Cooling coil concentration above 45 inches for constituent i (Ci/ft^2)
c_{CBi}	=	Cooling coil concentration below 45 inches for constituent i (Ci/ft^2)
SA_{Aj}	=	Surface area above 45 inches for section j (ft^2)
SA_{Bj}	=	Surface area below 45 inches for section j (ft^2)

The inventory present on the surface areas of the cooling coils and waste tank wall was compared to the residual floor inventory. The cooling coil concentrations from the two samples were assumed to be representative of the total area above and below the 45 inch acid-cleaning level including the wall material. The inventories based on the Average Inventory were used for this evaluation. The inventories are compared in Table 4.2-1.

Table 4.2-1: Tank 5 Cooling Coil and Wall Inventory Comparison to Floor Inventory

Constituent	Average Floor Inventory Decayed to 2020 (Ci)	Average Coil/Wall Inventory Decayed to 2020 (Ci)	Relative Inventory $\left(\frac{Coil/Wall}{Floor}\right) \times 100$
Am-241	6.5E+02	4.0E-01	0.1 %
Cm-244	2.0E+01	2.4E-02	0.1 %
Co-60	2.0E+01	3.1E-02	0.2 %
Cs-137	3.2E+03	1.4E+01	0.4 %
Eu-154	1.4E+02	9.3E-02	0.1 %
Np-237	2.2E-01	2.6E-04	0.1 %
Pu-238	2.3E+01	2.6E-02	0.1 %
Pu-239	7.7E+01	6.9E-02	0.1 %
Pu-240	1.8E+01	1.7E-02	0.1 %
Pu-241	<5.2E+01	<3.5E-01	<0.7 %
Pu-242	3.5E-03	3.8E-06	0.1 %
Pu-244	<6.9E-06	<9.5E-09	<0.1 %
Sb-126	<1.1E+00	<1.2E-03	<0.1 %
Sr-90	9.3E+04	2.2E+02	0.2 %
U-233	<2.2E-03	<1.4E-04	<6.5 %
U-234	3.9E-02	<1.0E-04	<0.3 %
U-235	1.8E-03	3.1E-06	0.2 %
U-236	2.3E-03	3.8E-06	0.2 %
U-238	4.3E-02	7.4E-05	0.2 %

Examining the results in Table 4.2-1, all but one of the relative inventories are less than 1 %. This minimal amount of inventory present on the surface areas of the cooling coils and waste tank wall was not unexpected due to the acid treatment waste removal process step. This treatment was expected to reduce the overall inventory on the waste tank's surface areas.

The exception (U-233) greater than 1 % observation; both the floor and coil analysis resulted in MDCs. For this constituent, the relative inventory was not included since the inventory ratio was based on MDCs.

Based on the finding that, for the constituents analyzed, the cooling coil and tank wall inventories were less than 1 % of the floor inventory, these surface area inventories were considered negligible and were not included in the overall Tank 5 residual inventory.

4.3 Equipment Inventory

Based on the estimate of the residual volume build-up associated with abandoned equipment was less than 19 gallons (1 % of the residual floor material volume) and expected concentration as described in Section 3.3, this inventory was determined to be negligible and was not included in the overall Tank 5 residual inventory. The equipment inventory was considered to be relatively insignificant due to the relative low expected volume (<1 % of the residual floor material volume). [SRR-LWE-2012-00102]

4.4 Annulus Inventory

The estimate of the annulus residual volume was 15 gallons or less and expected concentrations as described in Section 3.4, this inventory was determined to be negligible. In addition to the insignificant relative volume, the constituents' concentrations would generally be significantly less than in the waste-tank floor material. The constituents significant in the annulus residual material would be those constituents present in supernate. For all the other constituents, their concentrations would be significantly less than the tank floor residual material. Therefore, the inventory associated with the annulus material was considered relatively insignificant as compared to the floor inventory due to the relative low volume (<1 % of the residual floor material volume) and concentrations. For this reason, the annulus residual inventory was not included in the overall Tank 5 residual inventory. [U-ESR-F-00048]

4.5 Total Residual Inventory

Because the cooling coil and wall, equipment, and annulus inventories were considered negligible, the floor inventory accounted for the total Tank 5 residual inventory. The Best Estimate inventory is considered the final total inventory and is shown in Table 4.5-1.

Table 4.5-1: Tank 5 Final Residual Inventories

Constituent	Units	Average (2020)	Best Estimate (2012)	Best Estimate (2020)	Reasonably Conservative (2020)
Ac-227	Ci	<6.7E-04	<9.1E-04	<6.9E-04	<5.1E-01
Al-26	Ci	<1.2E-01	<1.2E-01	<1.2E-01	<3.3E-01
Am-241	Ci	6.5E+02	7.0E+02	6.9E+02	1.1E+03
Am-242m	Ci	1.5E+00	1.7E+00	1.7E+00	2.9E+00
Am-243	Ci	5.0E+00	5.3E+00	5.3E+00	8.6E+00
Ba-137m	Ci	3.0E+03	4.0E+03	3.3E+03	5.6E+03
C-14	Ci	<6.9E-03	<7.1E-03	<7.1E-03	<4.8E-02
Cf-249	Ci	<6.8E-02	<7.1E-02	<7.0E-02	<2.6E-01
Cl-36	Ci	<2.7E-02	<2.8E-02	<2.8E-02	<5.5E-01
Cm-243	Ci	<4.4E-01	<5.5E-01	<4.5E-01	<1.6E+01
Cm-244	Ci	2.0E+01	3.1E+01	2.2E+01	3.7E+01
Cm-245	Ci	<5.3E-03	<5.4E-03	<5.4E-03	<2.1E-02
Cm-247	Ci	<9.4E-07	<9.7E-07	<9.7E-07	<7.7E-06
Cm-248	Ci	<1.2E-04	<1.3E-04	<1.3E-04	<8.1E-04
Co-60	Ci	2.0E+01	6.8E+01	2.2E+01	3.4E+01
Cs-135	Ci	2.0E-02	2.2E-02	2.2E-02	3.9E-02
Cs-137	Ci	3.2E+03	4.3E+03	3.5E+03	6.0E+03
Eu-152	Ci	<8.8E-01	<1.4E+00	<9.0E-01	<2.0E+00
Eu-154	Ci	1.4E+02	3.0E+02	1.5E+02	2.3E+02
H-3	Ci	<4.8E-02	<8.0E-02	<4.9E-02	<1.6E-01
I-129	Ci	1.7E-03	2.2E-03	2.2E-03	4.4E-03
K-40	Ci	<7.7E-03	<7.9E-03	<7.9E-03	<1.0E-01
Nb-93m	Ci	2.8E+01	3.0E+01	3.0E+01	5.0E+01
Nb-94	Ci	<1.1E-02	<1.1E-02	<1.1E-02	<6.9E-01
Ni-59	Ci	5.2E+01	6.0E+01	6.0E+01	1.1E+02
Ni-63	Ci	2.6E+03	3.3E+03	3.1E+03	6.1E+03
Np-237	Ci	2.2E-01	2.6E-01	2.6E-01	5.3E-01
Pa-231	Ci	<1.3E-03	<1.4E-03	<1.4E-03	<1.4E-02
Pd-107	Ci	3.5E-02	5.0E-02	5.0E-02	1.1E-01
Pt-193	Ci	<3.5E-03	<4.1E-03	<3.6E-03	<8.0E-02
Pu-238	Ci	2.3E+01	2.6E+01	2.5E+01	4.1E+01
Pu-239	Ci	7.7E+01	8.5E+01	8.5E+01	1.4E+02
Pu-240	Ci	1.8E+01	2.0E+01	2.0E+01	3.3E+01
Pu-241	Ci	<5.2E+01	<8.2E+01	<5.3E+01	<1.3E+02
Pu-242	Ci	3.5E-03	3.9E-03	3.9E-03	6.8E-03
Pu-244	Ci	<6.9E-06	<7.1E-06	<7.1E-06	<1.7E-05
Ra-226	Ci	<6.3E-03	<6.5E-03	<6.5E-03	<1.4E-01
Sb-126	Ci	<1.1E+00	<1.1E+00	<1.1E+00	<2.5E+00
Sb-126m	Ci	<7.5E+00	<7.7E+00	<7.7E+00	<1.8E+01
Se-79	Ci	9.5E-02	1.3E-01	1.3E-01	2.9E-01

Table 4.5-1: Tank 5 Final Residual Inventories (Continued)

Constituent	Units	Average (2020)	Best Estimate (2012)	Best Estimate (2020)	Reasonably Conservative (2020)
Sm-151	Ci	6.8E+03	7.8E+03	7.3E+03	1.2E+04
Sn-126	Ci	<7.5E+00	<7.7E+00	<7.7E+00	<1.8E+01
Sr-90	Ci	9.3E+04	1.2E+05	9.7E+04	1.5E+05
Tc-99	Ci	9.3E-02	1.0E-01	1.0E-01	1.8E-01
Th-229	Ci	9.7E-05	2.9E-04	2.9E-04	5.4E-04
Th-230	Ci	1.4E-02	2.2E-02	2.2E-02	5.4E-02
U-232	Ci	<4.0E-05	<4.4E-05	<4.1E-05	<4.5E-04
U-233	Ci	<2.2E-03	<2.2E-03	<2.2E-03	<1.1E-01
U-234	Ci	3.9E-02	4.5E-02	4.5E-02	8.2E-02
U-235	Ci	1.8E-03	2.0E-03	2.0E-03	3.5E-03
U-236	Ci	2.3E-03	2.5E-03	2.5E-03	4.2E-03
U-238	Ci	4.3E-02	4.7E-02	4.7E-02	8.0E-02
Y-90	Ci	9.3E+04	1.2E+05	9.7E+04	1.5E+05
Zr-93	Ci	2.8E+01	3.0E+01	3.0E+01	5.0E+01
Ag	kg	2.3E+00	3.0E+00		4.7E+00
Al	kg	4.6E+01	5.5E+01		1.1E+02
As	kg	<8.8E-02	<9.1E-02		<1.5E-01
B	kg	1.2E+01	1.3E+01		2.1E+01
Ba	kg	1.8E+01	2.1E+01		3.2E+01
Cd	kg	8.4E-01	9.0E-01		1.4E+00
Cl	kg	3.2E-01	4.3E-01		8.2E-01
Co	kg	2.0E+00	2.5E+00		3.8E+00
Cr	kg	9.9E+00	1.1E+01		1.9E+01
Cu	kg	6.8E+00	7.5E+00		1.3E+01
F	kg	<3.4E-01	<3.5E-01		<6.9E-01
Fe	kg	4.6E+03	4.9E+03		7.7E+03
Hg	kg	2.1E+01	2.4E+01		4.1E+01
Mn	kg	3.2E+02	3.4E+02		5.6E+02
Mo	kg	4.4E-01	5.0E-01		7.5E-01
Ni	kg	5.2E+02	5.8E+02		9.9E+02
NO_2	kg	4.6E-01	5.0E-01		1.0E+00
NO_3	kg	1.1E+00	2.0E+00		4.3E+00
Pb	kg	3.5E+01	3.6E+01		5.6E+01
PO_4	kg	<3.4E-01	<3.5E-01		<6.9E-01
Sb	kg	<7.2E+00	<7.4E+00		<1.2E+01
Se	kg	<1.9E-02	<1.9E-02		<2.8E+00
SO_4	kg	2.2E+00	2.7E+00		5.5E+00
Sr	kg	3.6E+00	4.1E+00		6.2E+00
U	kg	8.4E+01	9.3E+01		1.6E+02
Zn	kg	4.2E+00	4.9E+00		9.1E+00

5.0 INVENTORY MULTIPLIERS

Inventory multipliers were developed for the radionuclide inventories to represent the uncertainty associated with the inventory determinations for use in the Tank 5 Special Analysis sensitivity analysis. This allows the inventories to be represented by probability distributions instead of the single value characteristics such as the different inventories discussed above. These distributions can be used in probabilistic analyses to assess the impact of the inventory uncertainties.

The statistical analysis results provided the basis for the development of the radionuclide inventory multipliers. Multipliers have been used in modeling as an adjustment to the modeled inventory to reflect inventory uncertainty. A ratio of the residual inventory distribution to the modeled inventory was developed. This resulted in a unitless multiplier that can be inserted into the modeling as an adjustment in the probabilistic analysis where the inventory is used.

The uncertainties from the three significant inventory areas were considered. Based on the results above, because only the floor residual inventory was significant, only it was used to develop the inventory distribution.

The floor's inventory probability distribution was developed using the parameters used to develop the floor inventory and their uncertainties. The formula used to determine the floor inventory was input into GoldSim with each parameter's uncertainty distributions.

Since the Best Estimate inventory is considered the Tank 5 final inventory, the ratio (inventory multiplier) of the probability distribution parameters (mean and standard deviation) to the Best Estimate inventory for each radionuclide was determined.

5.1 Inventory Distribution

The formula described in Section 4.1 was used to determine the residual inventory distribution. The concentration means and standard deviations were used (Table 5.1-1), as were those for the density and solids content (Table 5.1-2). Due to the sampling plan, the volume uncertainty impact on sample concentration is incorporated by volume proportional compositing. [SRNL-STI-2011-00323] The volume was varied using the residual depths uncertainties associated with the *Tank 5 Final Volume Determination and Uncertainty Estimate Report*. [U-ESR-F-00048] The analysis used 10,000 realizations to develop the probability distributions for each radionuclide. The final distributions from these realizations are presented in Table 5.1-3. All distributions were normal distributions unless noted.

Those constituents with only MDCs were not included in the development of inventory distributions as discussed below.

Although Th-230 passed the goodness-of-fit test for a normal distribution, the resulting inventory distribution contained a significant number of values truncated at zero. For this reason, modeling the Th-230 concentration with a gamma distribution was determined to be more appropriate. This provided a more realistic inventory distribution by eliminating the zero inventories. Therefore, Th-230 inventory should be modeled as a gamma distribution.

The Pu-239 concentration was also modeled as a gamma distribution based on the statistical evaluation of the sample results. [SRNL-STI-2011-00613] The resulting Pu-239 inventory

distribution resembled a normal distribution. Therefore, the residual inventory should be modeled as a normal distribution.

The Pd-107 and Th-229 concentrations were modeled as gamma distributions based on the statistical evaluation of the sample results. [SRNL-STI-2011-00613] The resulting inventories should both be modeled as gamma distributions.

Table 5.1-1: Tank 5 Floor Concentration Distributions – Means and Standard Deviations (from Table 3.1-2)

Radionuclide	Units	Mean	Standard Deviation	Radionuclide	Units	Mean	Standard Deviation
Am-241	µCi/g	7.0E+01	4.7E+00	Pu-239*	µCi/g	8.2E+00	9.3E-01
Am-242m	µCi/g	1.6E-01	2.4E-02	Pu-240	µCi/g	1.9E+00	2.2E-01
Am-243	µCi/g	5.3E-01	3.8E-02	Pu-242	µCi/g	3.8E-04	5.3E-05
Cm-244	µCi/g	3.0E+00	3.0E-01	Se-79	µCi/g	1.0E-02	5.0E-03
Co-60	µCi/g	6.8E+00	4.4E-01	Sm-151	µCi/g	7.8E+02	5.5E+01
Cs-135	µCi/g	2.1E-03	3.2E-04	Sr-90	µCi/g	1.2E+04	3.5E+02
Cs-137	µCi/g	4.2E+02	5.0E+01	Tc-99	µCi/g	1.0E-02	1.5E-03
Eu-154	µCi/g	3.0E+01	1.6E+00	Th-229*	µCi/g	1.0E-05	1.4E-05
I-129	µCi/g	1.8E-04	6.2E-05	Th-230*	µCi/g	1.6E-03	1.1E-03
Ni-59	µCi/g	5.5E+00	1.2E+00	U-234	µCi/g	4.2E-03	8.1E-04
Ni-63	µCi/g	3.0E+02	8.0E+01	U-235	µCi/g	2.0E-04	2.4E-05
Np-237	µCi/g	2.3E-02	7.0E-03	U-236	µCi/g	2.4E-04	2.8E-05
Pd-107*	µCi/g	3.8E-03	2.0E-03	U-238	µCi/g	4.6E-03	5.6E-04
Pu-238	µCi/g	2.6E+00	2.7E-01	Zr-93	µCi/g	3.0E+00	2.6E-01

Note: all distributions were truncated at zero
*Gamma Distribution

Table 5.1-2: Tank 5 Floor Density and Solids Content – Mean and Standard Deviations

	Mean	Standard Deviation
Density	1.35 g/mL	0.048 g/mL
Solids Content	96.3 wt %	0.50 wt %

Table 5.1-3: Tank 5 Final Residual Inventory Distributions – Means and Standard Deviations

Radionuclide	Units	Mean	Standard Deviation	Radionuclide	Units	Mean	Standard Deviation
Am-241	Ci	6.9E+02	5.3E+01	Pu-239	Ci	8.0E+01	9.6E+00
Am-242m	Ci	1.6E+00	2.4E-01	Pu-240	Ci	1.9E+01	2.3E+00
Am-243	Ci	5.2E+00	4.2E-01	Pu-242	Ci	3.7E-03	5.4E-04
Cm-244	Ci	2.9E+01	3.1E+00	Se-79	Ci	1.0E-01	4.6E-02
Co-60	Ci	6.7E+01	4.9E+00	Sm-151	Ci	7.7E+03	6.1E+02
Cs-135	Ci	2.1E-02	3.2E-03	Sr-90	Ci	1.2E+05	5.4E+03
Cs-137	Ci	4.1E+03	5.1E+02	Tc-99	Ci	9.8E-02	1.5E-02
Eu-154	Ci	2.9E+02	1.9E+01	Th-229*	Ci	1.0E-04	1.4E-04
I-129	Ci	1.8E-03	6.1E-04	Th-230*	Ci	1.6E-02	1.1E-02
Ni-59	Ci	5.4E+01	1.2E+01	U-234	Ci	4.1E-02	8.1E-03
Ni-63	Ci	2.9E+03	7.9E+02	U-235	Ci	2.0E-03	2.5E-04
Np-237	Ci	2.3E-01	6.9E-02	U-236	Ci	2.4E-03	2.9E-04
Pd-107*	Ci	3.7E-02	2.0E-02	U-238	Ci	4.5E-02	5.7E-03
Pu-238	Ci	2.6E+01	2.8E+00	Zr-93	Ci	2.9E+01	2.8E+00

*Gamma Distribution

5.2 Inventory Distribution Multipliers

The means and standard deviations for each radionuclide inventory distribution were divided by the 2012 Best Estimate for that radionuclide inventory. The resulting ratio represents the radionuclide inventory multiplier that can be used in the dose model to represent the final residual inventory uncertainties.

The radionuclides with only MDCs also needed probability distributions. First, a normal distribution curve was chosen to represent the probability distribution of radionuclides with only MDCs. It is probable that the expected value will decrease from the detection limit therefore; the distribution was truncated at the mean. This allows the distribution curve to be at a maximum at the mean and the probability to decrease as the inventory moves less than the mean. Also, since the Best Estimate inventories for these radionuclides was based on the MDC and the multipliers are ratios to the Best Estimate inventory, a mean of 1.0 was set for the MDC radionuclides. To allow the values to curve significantly away from the mean, a standard deviation of 0.5 was chosen.

The inventory multipliers developed for both the radionuclides with detectable sample results and radionuclides based on detection limit, sample analysis are presented in Table 5.2-1.

Table 5.2-1: Tank 5 Inventory Multipliers

Radionuclide	Average Multiplier	Standard Deviation Multiplier	Radionuclide	Average Multiplier	Standard Deviation Multiplier
Ac-227 (a)	1	0.5	Pa-231 (a)	1	0.5
Al-26 (a)	1	0.5	Pd-107 (c)	0.75	0.40
Am-241	0.99	0.08	Pt-193 (a)	1	0.5
Am-242m	0.93	0.14	Pu-238	0.98	0.11
Am-243	0.97	0.08	Pu-239	0.94	0.11
Ba-137m (b)	0.96	0.12	Pu-240	0.96	0.12
C-14 (a)	1	0.5	Pu-241 (a)	1	0.5
Cf-249 (a)	1	0.5	Pu-242	0.94	0.14
Cl-36 (a)	1	0.5	Pu-244 (a)	1	0.5
Cm-243 (a)	1	0.5	Ra-226 (a)	1	0.5
Cm-244	0.93	0.10	Sb-126 (a)(b)	1	0.5
Cm-245 (a)	1	0.5	Sb-126m (a)(b)	1	0.5
Cm-247 (a)	1	0.5	Se-79	0.78	0.36
Cm-248 (a)	1	0.5	Sm-151	0.99	0.08
Co-60	0.99	0.07	Sn-126 (a)	1	0.5
Cs-135	0.95	0.14	Sr-90	1.00	0.05
Cs-137	0.96	0.12	Tc-99	0.94	0.14
Eu-152 (a)	1	0.5	Th-229 (c)	0.34	0.48
Eu-154	0.98	0.06	Th-230 (c)	0.74	0.51
H-3 (a)	1	0.5	U-232 (a)	1	0.5
I-129	0.80	0.27	U-233 (a)	1	0.5
K-40 (a)	1	0.5	U-234	0.91	0.18
Nb-93m (b)	0.96	0.09	U-235	0.98	0.12
Nb-94 (a)	1	0.5	U-236	0.97	0.12
Ni-59	0.90	0.20	U-238	0.96	0.12
Ni-63	0.87	0.24	Y-90 (b)	1.00	0.05
Np-237	0.87	0.26	Zr-93	0.96	0.09

Notes
- All inventory multipliers were based on a normal distribution except were noted
- All distributions should be truncated at zero
- Multipliers applicable to all decay dates

(a) These distributions were based on detection limits and should be truncated at a maximum of 1.0
(b) Distribution based on equilibrium relationship
(c) Gamma distribution

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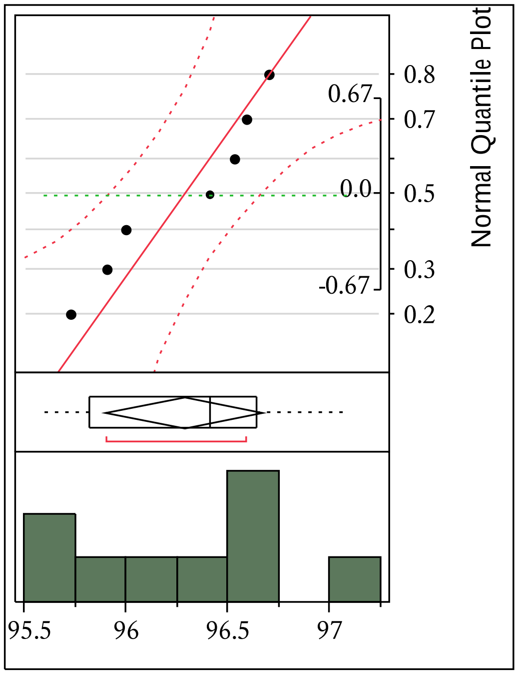
APPENDIX A: ADDITIONAL STATISTICAL ANALYSIS

A.0 Solids

A.0.1 Concentration Distribution (wt %)

Figure A.0-1: Normal Quantile Plot



A.0.2 Quantiles

100.0 %	maximum	97.08
90.0 %		97.08
75.0 %	quartile	96.645
50.0 %	median	96.41
25.0 %	quartile	95.82
10.0 %		95.59
0.0 %	minimum	95.59

A.0.3 Moments

Mean	96.282222
Std Dev	0.4982163
Std Err Mean	0.1660721
Upper 95 % Mean	96.665185
Lower 95 % Mean	95.899259
N	9

A.0.4 One-sided Confidence Interval

Parameter	Estimate	Lower CI	Upper CI	1-Alpha
Mean	96.28222	.	96.59104	0.950
Std Dev	0.498216	.	0.852456	0.950