Appendix A. Generator Certification

Generator Certification Approval Letter

March 21, 2023

Betsy Westover
Solid Waste Engineering
Savannah River Nuclear Solutions, LLC
Building 704-60E
Aiken, SC 29808

RE: US DOE SAVANNAH RIVER NUCLEAR SOLUTIONS, LLC - SCSRNSSRS

Generator Certification Valid March 21, 2023 through March 31, 2024

Dear Betsy,

On March 21, 2023, Waste Control Specialists LLC (WCS) completed a review and found US DOE Savannah River Nuclear Solutions, LLC to have an acceptable waste management program and is authorized to ship waste materials to the Waste Control Specialists LLC Federal Waste Disposal Facility (FWF).

Be reminded, any change to the US DOE Savannah River Nuclear Solutions, LLC waste management program which reduces administrative control requires notification to Waste Control Specialists LLC. This Certification is valid until the last day of the month, 12 months from the date of issue.

The generator certification identification number is required on all documentation or correspondence with Waste Control Specialists LLC regarding waste disposal.

Waste Control Specialists LLC is pleased to have the opportunity to provide you with the quality waste management services that you need. If you have any questions or need further assistance, please feel free to contact me at (432) 525-8722 or at (432) 425-3517.

Sincerely,
WASTE CONTROL SPECIALISTS LLC

Jeff Shouse

Jeff Shouse
Director of Quality Assurance

Appendix B. Waste Characterization of the Tank 28 LM-75 Drill String

Calculation Cover Sheet

Proc. Ref. E7, 2.31

Project/Task	Calculation Number	Project/Task Number
N/A	Q-CLC-F-00372	N/A

Title
Waste Characterization of the Tank 28 LM-75 Drill String (FT14005196)

Functional Classification	Discipline
General Service (GS)	Environmental
Calculation Type: (●) Type 1 ( ) Type 2	Type 1 Calculation Status: ( ) Preliminary (●) Confirmed
Computer Program Number ☐ N/A MS Excel	Version/Release Number Office 365
Purpose and Objective The purpose of this calculation is to document the radiological and hazardous characterization of F-Tank Farm (FTF) container FT14005196 in accordance with requirements from the SRS Manual 1S for final disposition in an appropriate landfill.	DC/RO Date N/A

Summary of Conclusion
FTF B-36 container FT14005196 contains a Tank 28 LM-75 Drill String with lead blankets contaminated with Tank 28 supernate. The radiological distribution and package activity is provided in Attachment 4, Table A4-2.

- The U-235 fissile gram equivalent (FGE) is 2.66E-01 g.
- The Pu-239 plutonium equivalent curies (PEC) is 1.83E-02 Ci.
- The TRU concentration is 1.03E-01 nCi/g.
- The NRC Waste Classification is Class B.

The waste form is RCRA hazardous for Lead (D008). Cadmium (D006), Chromium (D007), Mercury (D009), and Silver (D011) are the UHCs. A complete RCRA summary is provided in Attachment 7, Table A7-2.

Revisions

Rev. No.	Revision Description
0	Initial Issue

Sign Off

Rev. No.	Originator (Print / Sign & Date)	Verification/Checking Method	Verification/Checker (Print/Sign/Date)	Manager (Print/ Sign/Date)
0	C.D. Walters Clif Walters — Digitally signed by e7661 Date: 2022.01.03 11:23:13 -05'00'	☐ Design Check (GS/PS only) ☒ Document Review ☐ Qualification Testing ☐ Alternate Calculation ☐ Operational Testing	M. Ngachin Merlin Ngachin — Digitally signed by Merlin Ngachin Date: 2022.01.03 16:30:23 -05'00'	J.S. Kirk f3566 — Digitally signed by f3566 Date: 2022.01.06 07:19:00 -05'00'
0		☐ Design Check (GS/PS only) ☒ Document Review ☐ Qualification Testing ☐ Alternate Calculation ☐ Operational Testing	K.R. Liner, ECA KEITH LINER (Affiliate) — Digitally signed by KEITH LINER (Affiliate) Date: 2022.01.04 09:50:59 -05'00'	

Additional Reviewer (Print)	Signature	Date
R.J. Petras	ROBERT PETRAS (Affiliate) — Digitally signed by ROBERT PETRAS (Affiliate) Date: 2022.01.04 09:18:26 -05'00'	01/04/2022
Design Authority (Print) N/A	Signature	Date
Release to Outside Agency (Print) N/A	Signature	Date

Security Classification of the Calculation
Unclassified

TABLE OF CONTENTS

1.0 OPEN ITEMS

There are no open items.

2.0 INTRODUCTION

The purpose of this calculation is to document the radiological and hazardous characterization of F-Tank Farm (FTF) container FT14005196 in accordance with requirements from the SRS Manual 1S. This legacy B-36 contains the Tank 28 LM-75 Drill String covered with lead blankets.

On March 28, 2006 dose rate alarms occurred during the removal of the Tank 28 LM-75 Drill String, which indicated significant material holdup. The Tank 28 LM-75 Drill String was temporarily placed into the B-36 transportation container and vinyl-covered lead blankets were laid on top of the drill string for shielding. Visual inspection of the B-36 has determined that it's no longer a suitable shipping container for Class 7 radioactive material and the ultimate disposition of the drill string and storage box is offsite disposal. Therefore, it will be placed into an approved DOT shipping packaging for offsite transportation. To meet the offsite disposal facility void space requirements, DOT shipping external dose rate requirements, and load securement requirements, CLSM (Controlled Low Strength Material) (Ref. 10) will be added to the B-36 container to stabilize the contents and provide additional external dose rate shielding.

The waste form to be characterized consists of the following: The Tank 28 LM-75 drill string, vinyl covered lead blankets, polyethylene (PE) plastic sheeting and containment sleeving, grout used for shielding and load securement and the B-36 container. Radioactive waste form characterization will be characterized using the decay corrected Tank 28 LM-75 waste sample results (Ref. 4). These samples were taken using the LM-75 drill and the results are representative of the material inside the B-36. To be conservative, the hazardous waste form characterization will only use the weight of the actual LM-75 drill string sample device and the lead blankets.

3.0 INPUTS

- I. 1 The Tank 28 supernate radionuclide sample results are from WSRC-STI-2006-00151 (Ref. 4).
- I. 2 The B-36 container inner dimensions are 420'' (L) by 44''(W) by 44'' (H) (Ref. 6 & 7).
- I. 3 The Tank 28 LM-75 Drill String is 1026 Carbon Steel tubing 2 ¼''OD x 3/16'' thick minimal wall (Ref. 12).
- I. 4 The B-36 tare weight is 5,300 lbs. (Attachment 1).
- I. 5 The Tank 28 Drill String and lead blankets weight is 1,700 lbs. (Attachment 1).
- I. 6 Half-lives are determined based on review of the Chart of the Nuclides (Ref. 8).

I. 7 The transportation dose rate requirements are 200 mrem/hr at 5 cm (all sides) and 10 mrem/hr at 2 m (excludes top and bottom) (Ref. 11).

I. 8 The Performance Assessment (PA) nuclides for LLW waste streams are obtained from SRS Manual 1S, Chapter 3 (Ref. 1).

I. 9 The TRU and Fissile isotopes are obtained from SRS Manual 1S, Chapter 3 (Ref. 1).

I. 10 The Pu-239 PEC weighting factors are downloaded from WITS reports (LLW PEC239) (Ref. 9) as provided in Table 3.0-1.

I. 11 The U-235 FGE equivalence factor and specific activity from SRS Manual 1S, Chapter 5 (Ref. 3) is provided in Table 3.0-1.

Table 3.0-1 Specific Activity (I. 11), Pu-239 PEC Weighting Factors (I. 10), and U-235 FGE Equivalence Factor (I. 11) for radionuclides after screening

Radionuclide	Specific Activity, SpA_i , Ci/g	Pu-239 PEC Weighting Factors, W_i	U-235 FGE Equivalence Factor, D_i
C-14		4.00E-05	
Al-26		1.30E-04	
Am-241		1.02E+00	
Am-242m	1.05E+01	1.00E+00	53.9
Am-243		1.02E+00	
Ba-137m		1.30E-04	
Cf-249	4.09E+00	1.02E+00	70
Cf-251	1.58E+00	1.02E+00	140
Cm-243	5.06E+01	1.02E+00	7.8
Cm-245	1.72E-01	1.06E+00	23.4
Cm-247	9.28E-05	1.02E+00	0.8
Cs-137		6.27E-04	
I-129		1.30E-04	
Np-237		9.63E-01	
Pu-238		9.02E-01	
Pu-239	6.21E-02	1.00E+00	1.6
Pu-240		1.02E+00	
Pu-241	1.03E+02	1.93E-02	3.5
Pu-242		1.02E+00	
Sr-90		2.55E-03	
Tc-99		1.47E-05	
Th-230		6.27E-01	
U-233	9.64E-03	2.55E-01	1.4
U-234		2.55E-01	

I. 12 The regulatory limit for the maximum concentration of the eight RCRA metals for the toxicity characteristic is listed in Ref. 15.

I. 13 SCHWMR R.61-79.268.48 lists the non-wastewater treatment standard limit for UHCs. (Ref. 15).

4.0 ASSUMPTIONS

A.1 The Tank 28 Drill String has 6.8 gal of supernate.

Justification: Engineering determined the maximum material holdup in the Tank 28 Drill String with a total length of 500'' to be 6.8 gal (Ref. 5). The B-36 container is 420'' long so there is built in conservatism for the engineering estimate. Per the radiation survey (Attachment 2), the top three pieces of the drill string (not plugged) were removed and placed into the B-36. Per the LM-75 Drill String calculation (Ref. 16), if the three top pieces were removed, a total plugged length of ((500" – 3(36'')) 392'' would remain. In addition, the survey data (Attachment 2) showed that the source material is concentrated toward the drill bit end (i.e., higher dose rates near one end).

A.2 The drill string is in two sections with a total length of 500'' (Ref. 16).

Justification: This assumption is used to determine the drill string weight for the RCRA hazardous determination. Per the radiation survey (Attachment 2), the top three pieces of the drill string (not plugged) were removed and placed into the B-36. The LM-75 Drill String calculation (Ref. 16) states the total length to be 498.58". This length has been rounded to 500'' for conservatism. The amount of material remaining in the drill string is 6.8 gal provided in Assumption 1.

A.3 The B-36 is part of the waste form to be characterized.

Justification: Due to the age and degraded physical condition of the B-36 it no longer meets DOT IP-1 packaging minimum design criteria therefore it is considered waste. Because of the remote loading of the LM-75 drill string into the B-36 and the length of time the material has been stored outdoors without weather protection the plastic sleeving surrounding the LM-75 drill string is considered to have failed from embrittlement. Therefore, the interior of the B-36 is contaminated with Tank 28 salt waste and is a component of the waste form. In addition, the final disposal container will be provided by the disposal facility after shipment for treatment. Therefore, the total volume of the waste characterized will be the inner dimensions of the B-36 container.

5.0 ANALYSIS METHOD AND CALCULATIONS

The total waste container activity was determined using sample analysis from Savannah River National Laboratory (SRNL) (I. 1) and 6.8 gal of supernate (A. 1).

5.1 Radionuclide Decay Correction and Screening

The SRNL sample results were reported in pCi/mL and then converted to Ci using Equation 1 which represents the initial activity prior to decay correction. The highest reported sample results were selected, and decay corrected using Equation 2.

$$A_o = A_C \times V \times \frac{3785.41}{1E+12} \qquad \text{Equation (1)}$$

Where,

Ao	=	Initial activity, Ci
A_C	=	Initial activity concentration, pCi/mL (I. 1)
V	=	Supernate volume, gal (A. 1)
3785.41	=	Unit conversion from gal to mL
1E+12	=	Unit conversion from Ci to pCi

$$A_t = A_o \times \exp\left(-0.693 \times \frac{t-t_o}{T_{1/2}}\right) \qquad \text{Equation (2)}$$

Where,

At	=	Activity at time t, Ci
Ao	=	Initial activity at time t_o, Ci
ΔT	=	Elapsed time ($t - t_o$) since the initial activity was determined, years
$T_{1/2}$	=	Half-Life, years (I. 6)

The elapsed time, ΔT was based on the date the samples were received at SRNL (2/14/2006) as the start date and 9/20/2021 as the end date. The results of equations 1 and 2 are provided in Attachment 3. Radionuclides less than 1E-09 Ci are highlighted gray as they have significantly decayed and are removed from the distribution. The expected final concentration of the highlighted gray radionuclides is less than 1 pCi/g as 1S, Chapter 3 allows for removal of very low concentrations of radionuclides.

The Ci % is determined using the equation below.

$$\%A_i = \frac{A_i}{A_{Total}} \qquad \text{Equation (3)}$$

Where,

A_i	=	Activity for radionuclide, i, Ci

$\%A_i$	=	Percent activity for radionuclide, i, Ci%
A_{Total}	=	Total activity (Ci)

The final decayed activity for each radionuclide is provided in Attachment 3. Each radionuclide was then reported using 1S, Chapter 3 methodology and the analytical result was revised based on the following methodology:

1. The PA radionuclides (I. 8) were reported as follows:
   a. For detected PA radionuclides (i.e., Sr-90, Tc-99, I-129), the decayed result was not changed.
   b. For non-detect PA radionuclides (i.e., C-14, U-234, U-235, Np-237), the decayed result of $0.1 \times MDA$ is used for activity quantification.
2. For TRU/Fissile radionuclides (I. 9):
   a. No TRU or Fissile radionuclides were detected above the MDA.
   b. For non-detect TRU and Fissile radionuclides, the decay result of $0.1 \times MDA$ is used for activity quantification.
3. For Non-PA, Non-TRU, and Non-Fissile radionuclides:
   a. Per 1S Manual Chapter 3, radionuclides were reported if their activity is greater than 1% of the total curie distribution (Ref. 1).
4. Daughter radionuclides were determined as described in 1S, Chapter 3 (Ref. 1).

The radionuclide screening process results are shown in Attachment 4 including the final normalized radionuclide distribution.

5.2 Radiation Shielding Modeling

Radiological Engineering developed a model to determine the amount of shielding required in the B-36 and underneath the container to meet transportation dose rate requirements. The transportation dose rate requirements are 200 mrem/hr at 5 cm on the top/sides/bottom and 10 mrem/hr at 2 m on the sides (I. 7). The results of the calculation determined that 9" of CLSM inside the B-36 is required to meet the transportation limits (Ref. 14). The CLSM weight was not included in the waste weight. The calculation also concluded that lead shielding will be required underneath the B-36 and on the sides exterior of the B-36 to meet the transportation dose rate requirements.

5.3 Pu-239 PEC, U-235 FGE, and TRU Calculation

5.3.1 PEC Calculation

The Pu-239 Plutonium Equivalent Curies (PEC) content is calculated using weighting factors downloaded from the Waste Information Tracking system (WITS) reports and Equation 4.

$$\mathrm{PEC} = \sum \mathrm{A_i} \times \mathrm{W_i} \qquad \text{Equation (4)}$$

Where,

W_i	=	Weighting factor for nuclide, i (I. 10)
A_i	=	Activity of nuclide, i, Ci
PEC	=	Total Pu-239 PEC for all radionuclides

The PEC value is calculated for the radionuclides remaining after the screening process and is shown in Attachment 5. The resulting PEC is compared to the maximum allowable value of 4 PEC per 1S Chapter 6 (Ref. 2).

5.3.2 U-235 FGE Calculation

U-235 Fissile Gram Equivalent (FGE) content is calculated based on information provided in 1S Chapter 5 (Ref. 3) along with the 1S Chapter 3 radionuclide screened activity shown in Attachment 4. The U-235 FGE radionuclides in the rad profile are U-233, U-235, Pu-239, Pu-241, Am-242m, Cm-243, Cm-245, Cm-247, Cf-249, and Cf-251.

$$\mathrm{FGE} = \sum \left(\frac{\mathrm{A_i}}{\mathrm{SpA_i}}\right) \times \mathrm{D_i} \qquad \text{Equation (5)}$$

Where,

A_i	=	Activity for nuclide, i, Ci
SpA_i	=	Specific activity of nuclide, i, Ci/g (I. 11)
D_i	=	Equivalence factor for nuclide, i (I. 11)
FGE	=	Total U-235 FGE from all radionuclides, g

The U-235 FGE is compared to the 50g limit in 1S Chapter 6 (Ref. 2). The results of the U-235 FGE calculation for the radionuclides remaining after the screening process are provided in Attachment 5.

5.3.3 TRU & Waste Weight Calculation

The transuranic (TRU) nuclide activity concentrations are calculated with Equation 6 and are used to confirm that the waste is not TRU waste (Ref. 2). Waste is considered TRU if it contains more than 100 nCi (alpha-emitting transuranic isotopes with half-lives greater than 20 years) per gram of waste. The TRU nuclides present in the waste form are Am-241, Am-243, Cm-243, Np-237, Pu-238, Pu-239, Pu-240, and Pu-242.

$$\mathrm{AC_i} = \frac{\mathrm{A_i}}{\mathrm{W_W} \times 453.6} \times 1\mathrm{E}+09 \qquad \text{Equation (6)}$$

Where,

AC_i	=	Activity concentration for radionuclide, i, nCi/g
A_i	=	Activity for radionuclide, i, Ci
W_W	=	Waste Weight, lbs. (Equation 7)

1E+09	=	Conversion factor from Ci to nCi
453.6	=	Conversion factor from lbs. to g

The waste weight is the weight of the Tank 28 LM-75 drill string, lead blankets, and B-36 container. To calculate a conservative TRU concentration, any additional weight used to fill the void space (e.g., CLSM) of the B-36 will not be included in the waste weight calculation.

$$W_W = W_{\text{Drill \& Blankets}} + W_{B-36} \qquad \text{Equation (7)}$$

Where,

$W_{\text{Drill \& Blankets}}$	=	Weight of the Tank 28 Drill String and Lead Blankets, lbs. (I. 5)
$W_{B\text{-}36}$	=	Weight of the B-36 container, lbs. (I. 4)

The TRU concentration is provided in Attachment 5 for the final distribution.

5.4 NRC Waste Classification

The procedure for calculating the Nuclear Regulatory Commission (NRC) Waste Classification is outlined in 10 CFR 61.55 (Ref. 13). Waste containing both long-lived and short-lived nuclides, such as the bounding activity for this waste, utilizes limits in 10 CFR 61.55 Table 1 (long-lived) and Table 2 (short-lived), along with the sum-of-fractions (SOF) methodology. The procedure for determining if waste is Class A, B, C, or Greater than Class C (GTCC) is outlined in Figure 5.4-1.

For those radionuclides based on an activity concentration (Ci/m^3 or Ci/g), those radionuclides' activity (Ci) was either divided by their waste volume (m^3) or mass (g). The waste volume (13.32 m^3) was determined using the internal B-36 dimensions (I. 2 & A. 3). The waste weight is from Equation 7. The NRC Waste Classification table uses the decayed radionuclide activities prior to the 1S, Chapter 3 radiological screening. The SOF calculation is provided by the below equation.

$$\text{SOF} = \sum \frac{\text{ACD}_i}{\text{L}_i} \qquad \text{Equation (8)}$$

Where,

ACD_i	=	Activity concentration of nuclide, i, nCi/g or Ci/m^3
L_i	=	Limit for nuclide, i, nCi/g or Ci/m^3 (Ref. 13)
SOF	=	Sum-of-Fractions based on all applicable nuclides

The NRC waste classification is provided in Attachment 6.

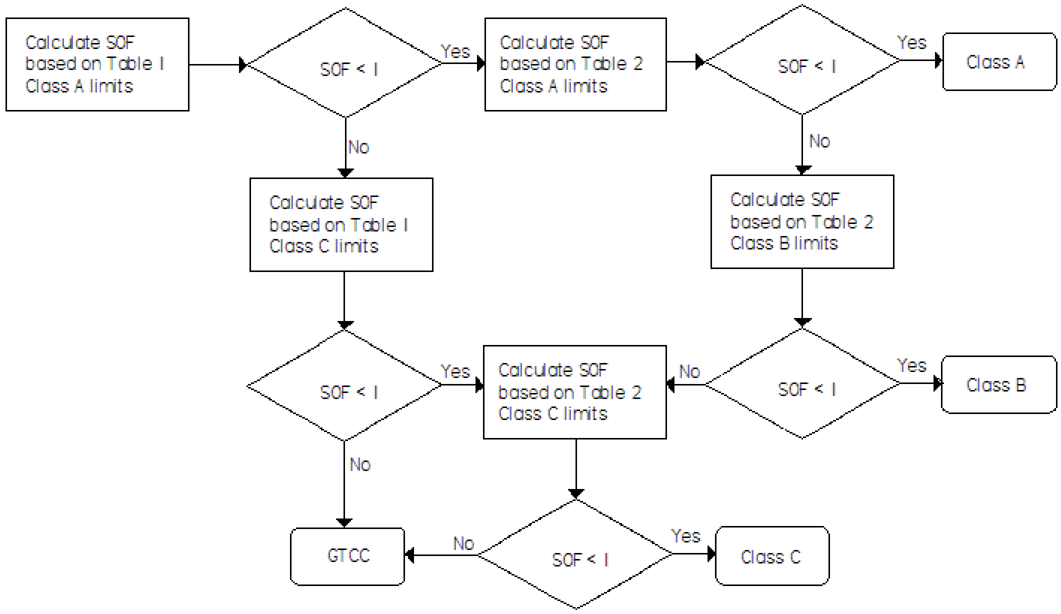

Figure 5.4-1: NRC Waste Classification Procedure

5.5 Resource Conservation and Recovery Act (RCRA) Waste Characterization and Underlying Hazardous Constituents (UHCs)

5.5.1 Ignitability Characteristic (SCHWMR R.61-79-.261.21; Hazardous Waste Code D001) (Ref. 15)

The B-36 containing the LM-75 drill string and lead blankets (subsequently referred to as the waste form) does not meet the RCRA requirements for ignitable materials. The waste form is not a liquid with an analyzed flash point below 140ºF. The waste form is not capable of spontaneous chemical changes, not capable of causing a fire through friction, not compressed gases, and not oxidizers.

5.5.2 Corrosivity Characteristic (SCHWMR R.61-79.261.22; Hazardous Waste Code D002) (Ref. 15)

The waste form does not meet the RCRA requirements for corrosive materials as this characteristic only applies to liquids. The waste form is not a liquid.

5.5.3 Reactivity Characteristic (SCHWMR R.61-79.261.23; Hazardous Waste Code D003) (Ref. 15)

The waste form does not meet the RCRA requirements for RCRA-reactive materials and is normally stable. The waste materials are 1) not unstable, 2) do not react violently with water, 3) do not form explosive mixtures with water, 4) do not generate toxic gasses when mixed with water, 5) are not cyanide or sulfide bearing wastes, 6) cannot detonate, and 7) are not explosive.

5.5.4 Toxicity Characteristic (SCHWMR R.61-79.261.24; Hazardous Waste Codes D004-D043) (Ref. 15)

RCRA regulations require that a waste generator determine if a waste is hazardous due to toxicity for any of the forty constituents by analyzing an extract of the waste obtained by the Toxicity Characteristic Leaching Procedure (TCLP). The forty constituents are a combination of twenty-six solvents and organic substances, six pesticides, and eight metals.

The supernate contains some metallic constituents. The lead blankets are considered waste which will make the waste form hazardous for lead.

5.5.4.1 Organics, Pesticides, and Insecticides (Hazardous Waste Codes D012-D043) (Ref. 15)

None of the thirty-two toxicity characteristic solvents, organic substances, or pesticides are constituents of the waste form.

5.5.4.2 Metallic Impurities (Hazardous Waste Codes D004-D011) (Ref. 15)

The Tank 28 supernate inside the drill string contains RCRA TCLP metals. Samples were obtained from the supernate and results provided in Attachment 7. The highest analytical result was reported in mg/L and converted to mg/kg using 6.8 gal of supernate and an estimated weight of the drill string. The drill string is assumed to be in two sections with a total length of 500’’ (A. 2). The weight of the drill string was determined as shown below using the standard carbon steel density of 0.284 lbs./in^3.

Table 5.5.4.2-1: Drill String Weight Estimate

Drill String Weight Estimate			
H (in) (A. 2)	Do (in) (I. 3)	Ro (in) = Do/2	Vo (in^3) = $\pi R_o^2 H$
500	2.25	1.125	1988
H (in) (A. 2)	Di (in) (I. 3)	Ri (in) = Di/2	Vi (in^3) = $\pi R_i^2 H$
500	1.875	0.9375	1381
V (in^3) = Vo - Vi	607		
W (lbs.) = V * ρ_{CS}	173		

D_o and D_i are the outer and inner diameter of the drill string, respectively. The RCRA results for the supernate are shown in Attachment 7. The RCRA Theoretical TCLP constituent is compared to the threshold concentration of the relevant RCRA metal from Reference 15 (I. 12). If the RCRA Theoretical TCLP constituent concentration value is higher than the RCRA limit, the material is considered hazardous for the toxicity characteristic.

The weight of the lead blankets is determined as shown below based on the initial drill string and lead blanket weight of 1700 lbs. (I. 5). For a conservative lead amount, the lead blankets are assumed to be 100% lead as shown in Attachment 7. The weight of the supernate is not considered.

Table 5.5.4.2-2: Lead Blanket Weight Estimate

Lead Blanket Weight Estimate			
A	B	C=A-B	D= C *453592
Weight (lbs.) (I. 5)	**W (lbs.) Drill String**	**W (lbs.) - Lead Blankets**	**W (mg) - Lead Blankets**
1700	173	1527	6.93E+08

5.5.5 Underlying Hazardous Constituents (UHCs) Determinations (SCHWMR R.61-79.268.48)

The waste form is considered hazardous for lead, therefore UHCs must be considered from the supernate. SCHWMR R.61-79.268.48 (I. 13 & Ref. 15) list the non-wastewater concentrations. The UHCs will be evaluated by comparing the RCRA Theoretical TCLP metal concentration to the UHC threshold presented in SCHWMR R.61-79.268.48 (Ref. 15). If the RCRA Theoretical TCLP constituent concentration value is higher than the UHC limit, the container is considered to contain that UHC. This comparison is provided in Attachment 7.

6.0 RESULTS AND CONCLUSIONS

FTF B-36 container FT14005196 contains a Tank 28 LM-75 Drill String with lead blankets contaminated with Tank 28 supernate. The radiological distribution and package activity is provided in Attachment 4, Table A4-2.

- The U-235 FGE is 2.66E-01 g.
- The Pu-239 PEC is 1.83E-02 Ci.
- The TRU concentration is 1.03E-01 nCi/g.
- The NRC Waste Classification is Class B.

The waste form is RCRA hazardous for Lead (D008). Cadmium (D006), Chromium (D007), Mercury (D009), and Silver (D011) are the UHCs. A complete RCRA summary is provided in Attachment 7, Table A7-2.

7.0 REFERENCES

1. SRS Manual 1S, Chapter 3, Rev. 5, "Waste Characterization Program," 1/28/2021.

2. SRS Manual 1S, Chapter 6, Rev. 4, "RCRA, TSCA, Mixed and LLLW," 3/26/2020.

3. SRS Manual 1S, Chapter 5, Rev. 2, "Low-Level Waste," 2/11/2021.

4. WSRC-STI-2006-00151, Rev. 0, "Analysis of Tank 28 Saltcake Core Samples FTF-456-467," 2/2007.

5. CBU-SPT-2006-00080, Rev. 0, "Tank 28, Riser B-1, LM-75 Drill String Removal Critique (3/30/2006)," 4/20/2006.

6. AC14761A-000001, Sheet 1, Rev. D, "DWG – Container Assembly SSB-470-30-ST-BRN," 3/19/2001.

7. Q-CLC-G-00156, Rev. 0, "SRR DTC Waste Characterization Calculations Standard Inputs and Assumptions," 4/27/2021.

8. Chart of the Nuclides, 16th Edition, 2002.

9. WITS Reports Download, "LLW PEC239," downloaded December 1, 2016.

10. SRR-CWDA-2020-00045, Rev. 0, "Characterization and Assessment of CLSM Grouts for Potential Use in Waste Tank Operations Closures," 6/22/2020.

11. 49 CFR 173.441, "Radiation Level Limitations and Exclusive Use Provisions," September 23, 2005.

12. P-PM-G-00117, Rev. 1, "CBU- Salt Processing Project Actinide Removal Process Core Sampler Drill String Arrangements," 2/8/2006.

13. 10 CFR Part 61.55, "Waste Classification," December 2, 2015.

14. SRR-RPE-2021-00015, Rev. 0, "Dose Rate and Shielding Evaluation for an Upcoming Waste Shipment Supporting a PEMP Milestone Award," 12/8/2021.

15. South Carolina Hazardous Waste Management Regulations (SCHWMR), R.61-79.

16. CBU-SPT-2005-00193, Rev. 1, "Tank 28 Salt Sample Drill String Calculation," 9/29/2005.

ATTACHMENT 1 – B-36 Tare Weight, Drill String and Lead Blanket Weight

Page 1 of 1

From: Tyrone Young
To: Clifton Walters
Subject: RE: Tank 28 Drill String
Date: Monday, August 2, 2021 2:50:10 PM

Yes, 1,700LBS. is what's on the logsheet and all the other documentation. The tare WT. is 5,300LBS.

From: Clifton Walters <Clifton.Walters@srs.gov>
Sent: Monday, August 02, 2021 1:35 PM
To: Tyrone Young <Tyrone.Young@srs.gov>
Subject: RE: Tank 28 Drill String

Per the ISOCS Phase 2 report the 5196 waste weight was 771 kg (1,700 lbs).

I just want to make sure this was the same number your logsheet or other documentation stated.

From: Tyrone Young <Tyrone.Young@srs.gov>
Sent: Thursday, July 29, 2021 2:45 PM
To: Clifton Walters <Clifton.Walters@srs.gov>
Subject: RE: Tank 28 Drill String

5196 is the drill string and 5447 is tank 4 jet.

From: Clifton Walters <Clifton.Walters@srs.gov>
Sent: Thursday, July 29, 2021 2:25 PM
To: Tyrone Young <Tyrone.Young@srs.gov>
Subject: Tank 28 Drill String

Hey Tyrone,

Do you know what the container # is for the B-36 that contains the Tank 28 Drill string?

We ISOCS two B-36 boxes in phase 2 and I'm not sure if its 5447 or 5196.

Also any idea if it's been weighed?

Clifton (Clif) Walters, PE
Environmental and Waste Characterization
707-3E, Room 1
O: 803-952-4736
C: 803-295-3687

ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12

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VSDS Standard Map RSLS

Survey TKFM-M-20060329-12

General Information

Title: Tank 28 drill string removal

Survey Date/Time: 03/29/2006 10:00

Lead Inspector: Grady, Frank

Survey Type: Job Coverage

Work Order/Task #: N/A

Counted By: Facility Inspector

KCN: I1924

RWP #: 06-FTF-116

Facility: FTF

Status: Approved by: Lewis-Buncomb, Edith, 03/30/2006

Ready For Review by: Grady, Frank, 03/30/2006

Additional Inspectors

Inspector	Cmp Alt	Approve
Chambers, Neal	y9747	☑
Hogarth, Doug	I3379	☑
Huskey, David	I4639	☑
Jordan, Shawn	b1436	☑
Salley, Tyrone	I2974	☑

Dose Rate (DR) Object Prefixes/Suffixes

Dose Rates with Prefixes:	Dose Rates with No Prefixes:	Default Prefixes:	Default Suffixes:
E = Extrem	W Body	HS = Hot Spot	"n" = Neutron
S = Skin			"b" = Beta
WR = Wrk Rt			"c" = Corrected

Postings Legend

There are no postings in this survey.

Instruments Used

#	Instrument Model	Instrument Serial #
1	12-110	4377
2	12-Alpha	7455
3	RO-20	8200
4	RO-20	CMC008000
5	Electra Plus	CMC009110
6	RO-20	CMC008529
7	2929	0939
8	HandECount	2743

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12

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VSDS Standard Map RSLS

Comments:

Entered hut at tank 28 to perform drill string removal. Camera was inserted into riser for job support. Drill string was lifted up, clamped off and top three pieces of string removed and flown into B-36. Other lifting bail was placed on string, sleeving was fed onto pipe and secured on top of pipe and flush ring. Drill string was then sleeved out of tank. Upon lifting it was noticed that the tank ventilation was collapsing the sleeving onto the pipe and would not feed properly. This had to be performed by hand.

As drill string was being pulled the dose rates increased to levels of concern. Working dose rate was 1500 mrem/hr. A time out was called and the PIC and RCO Management was notified. The decision was made to put pipe back into the tank as discussed in the pre-plan, however, with the sleeving bunching up on pipe this could not be performed. After further discussion, it was decided to continue with the pull since no other options were available. We were at a point of no return and needed to mitigate the situation.

Rates continued to increase and sleeving worked down pipe. B-line cut was made, and pipe flown out of hut into B-36. The hut was exited as drill rig was being flown into B-36, it was left posted as HRA/ARA/CA and secured. During the mitigation activities in the hut, EPD dose rate and dose alarms were received.

Vamps at several locations alarmed due to increase in background rates as the drill string was being flown out of the tank. Tanks 47,46 ,27, 28 and 2F evaporator were among these.

All FTF RCO responded to the area for vamp alarms, to restricted traffic to the area, and to perform radiological surveys. All personnel performing work in the area were required to sign in on the RWP and wear EPDs. Operations personnel began to place lead blankets in the B-36 to lower dose rates. Lid was placed on B-36 and it was moved to the high-rad laydown yard at the West pump house.

All Vamps were reset at job completion. TLDs of personnel inside the hut were pulled and sent up to dosimetry for analysis.

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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VSDS Standard Map RSLS

Map: 1	TANK 25 LM-75 DRILL STRING REMOVAL	Survey #: TKFM-M-20060329-12	Date/Time: 03/29/2006 10:00

Comments: LM-75 DRILL STRING REMOVAL

Summary of Highest Readings
(All available values may not be listed)

Smears	Air Samples & Wipes
	Wipe 2) ND DPM/Wipe α Wipe 2) ND DPM/Wipe β/γ

Type: Job Coverage

Symbol Legend (for example only)

15 Smear
15 Large Area
15 Air Sample
15 Direct Probe
DR Dose Rate

RWP #: 06-FTF-116
CLI Tag: F241928
System / Process: Tank 28
Room / Area: FTF

Unless otherwise noted, dose rates in mrem/hr.

Lead Inspector: Grady, Frank	Status: Approved by: Lewis-Buncomb, Edith, 03/30/2006
Location Code: F241925	Bldg/Area Name: TANK 25
Location Description: TANK 25 LM-75 DRILL STRING REMOVAL	

Document #: 635670/ 04
Survey #: TKFM-M-20060329-12 - PDF Generated On: 09/05/2008 14:43
Image File: FTF\Tank 25\LM-75 DRILL STRING REMOVAL
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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12

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VSDS Standard Map RSLS

Data Point Details

Survey #: TKFM-M-20060329-12

Map: 1 - FTF\Tank 25\LM-75 DRILL STRING REMOVAL

#	Type	Inst.	Value	Units	Position	Notes
1	DR γ	N/A	E 30	rem/hr	about 2 feet from bottom of string	
		N/A	S 15	rem/hr		
		N/A	WR 1600	mrem/hr		
1	Wipe		α ND	DPM/Wipe	ON LENGTH OF DRILL STRING	
			β/γ ND	DPM/Wipe		
2	Wipe		α ND	DPM/Wipe	ON BOTTOM OF DRILL STRING	
			β/γ ND	DPM/Wipe		

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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VSDS Standard Map RSLS

Map: 2	B-36 Staged 1	Survey #: TKFM-M-20060329-12	Date/Time: 03/29/2006 10:00

Comments: P.A.S. WORN IN HUT

Summary of Highest Readings
(All available values may not be listed)

Smears	Air Samples & Wipes
4) <20 DPM/100 cm2 α	A/S 3) ND DAC α
4) <200 DPM/100 cm2 β/γ	A/S 3) ND DAC β/γ

Type: Job Coverage

Symbol Legend (for example only)
15 Smear
15 Direct Probe
15 Large Area
DR Dose Rate
15 Air Sample

RWP #: 06-FTF-116
CLI Tag: F241928
System / Process: TANK 28
Room / Area: FTF

Unless otherwise noted, dose rates in mrem/hr.

Lead Inspector: Grady, Frank
Status: Approved by: Lewis-Buncomb, Edith, 03/30/2006
Location Code: F241928
Bldg/Area Name: TANK 28
Location Description: B-36 Staged 1

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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VSDS Standard Map RSLS

Data Point Details
Survey #: TKFM-M-20060329-12
Map: 2 - FTF\Tank 28\B-36 Staged 1

#	Type	Inst.	Value	Units	Position	Notes
1	DR γ	N/A N/A N/A	E 200 S 150 150	mrem/hr mrem/hr mrem/hr	EAST SIDE	
2	DR γ	N/A N/A N/A	E 600 S 230 230	mrem/hr mrem/hr mrem/hr	EAST CENTER	
3	DR γ	N/A N/A N/A	E 300 S 220 220	mrem/hr mrem/hr mrem/hr	WEST CENTER	
4	DR γ	N/A N/A N/A	E 350 S 220 220	mrem/hr mrem/hr mrem/hr	WEST SIDE	
1	Smear	N/A N/A	α <20 β/γ <200	DPM/100 cm2 DPM/100 cm2	OUTSIDE OF BOX	SMEAR TAKEN AFTER LID REPLACED
2	Smear	N/A N/A	α <20 β/γ <200	DPM/100 cm2 DPM/100 cm2	OUTSIDE OF BOX	AFTER LID REPLACED
3	Smear	N/A N/A	α <20 β/γ <200	DPM/100 cm2 DPM/100 cm2	OUTSIDE OF BOX	AFTER LID REPLACED
4	Smear	N/A N/A	α <20 β/γ <200	DPM/100 cm2 DPM/100 cm2	OUTSIDE OF BOX	AFTER LID REPLACED
1	Air Sample		ND ND	DAC α DAC β/γ	NORTH WEST	0329-12B
2	Air Sample		ND ND	DAC α DAC β/γ	RBA SOUTH	0329-12C
3	Air Sample		ND ND	DAC α DAC β/γ	NORTH EAST RBA	0329-12D

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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VSDS Standard Map RSLS

Supplemental Airborne Survey Information

#	Sample Type	Motor Pump Serial #	Sample Media	Respirator Type	Start Time	End Time	Total Run Time (min)	Flow Rates (ft3/min) Beginning	Ending	Average	Total Vol. (ft3)
1	MAP	68	3" Filter Paper (76mm)	N/A	03/29/2006 09:15	03/29/2006 13:15	240	3.5	3.5	4	960
2	MAP	72	3" Filter Paper (76mm)	Full Face	03/29/2006 09:15	03/29/2006 13:15	240	4	4	4	960
3	MAP	71	3" Filter Paper (76mm)	N/A	03/29/2006 09:15	03/29/2006 13:15	240	4	4	4	960

Initial/Final Probe

Air Sample No.	Reading Type	Value	Units	Date/Time
1	Initial Alpha	1600	DPM	03/29/2006 10:15
	Final Alpha	800	DPM	03/29/2006 13:15
	Initial Beta/Gamma	4000	DPM	03/29/2006 10:15
	Final Beta/Gamma	1000	DPM	03/29/2006 13:15
2	Initial Alpha	1600	DPM	03/29/2006 10:15
	Final Alpha	1000	DPM	03/29/2006 13:15
	Initial Beta/Gamma	4000	DPM	03/29/2006 10:15
	Final Beta/Gamma	3000	DPM	03/29/2006 13:15
3	Initial Alpha	1600	DPM	03/29/2006 10:15
	Final Alpha	800	DPM	03/29/2006 13:15
	Initial Beta/Gamma	4000	DPM	03/29/2006 10:15
	Final Beta/Gamma	3000	DPM	03/29/2006 13:15

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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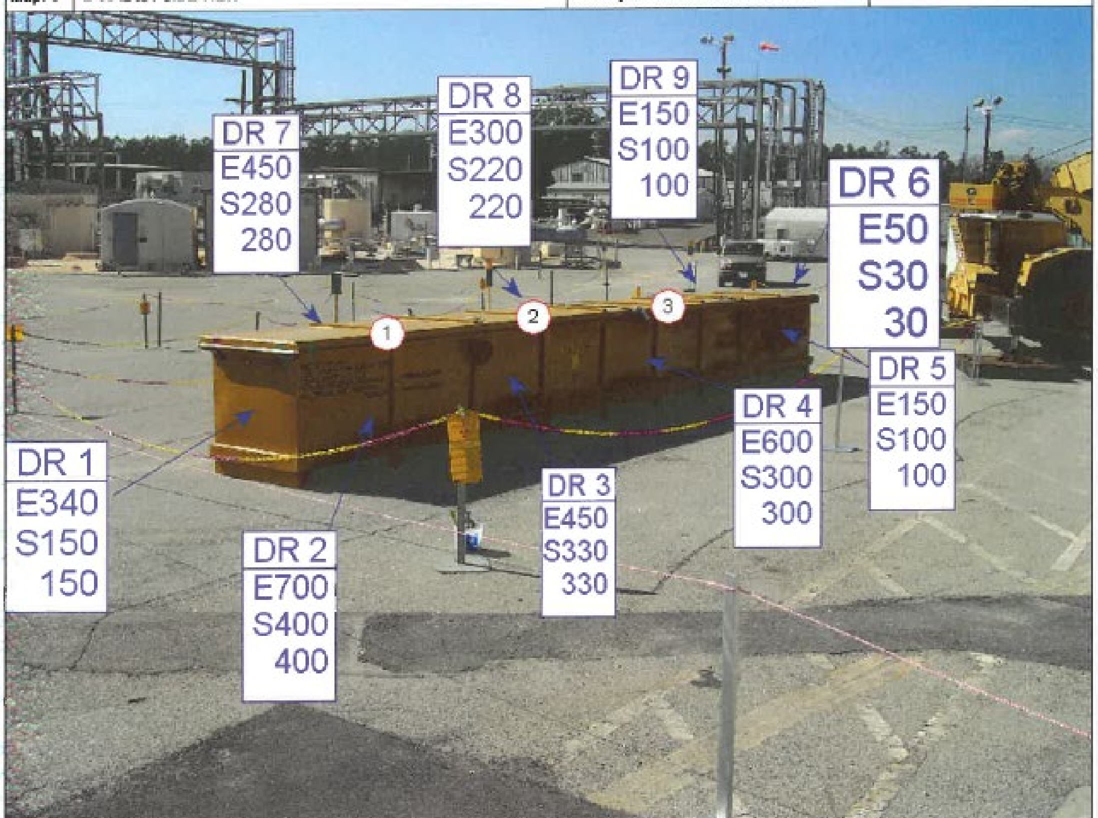
VSDS Standard Map RSLS

Map: 3	B-36 EAST SIDE VIEW	Survey #: TKFM-M-20060329-12	Date/Time: 03/29/2006 10:00



Comments: B-36 IN PICTURE REPRESENTS B-36 FROM TANK 28 BUT IS A PICTURE FROM TANK 25 B-36

Summary of Highest Readings
(All available values may not be listed)

Smears	Air Samples & Wipes
3) <20 DPM/100 cm2 α 3) <200 DPM/100 cm2 β/γ	

Type: Job Coverage

Symbol Legend (for example only)
15 Smear
15 Direct Probe
15 Large Area
DR Dose Rate
15 Air Sample

RWP #: 06-FTF-116
CLI Tag: F241928
System / Process: TANK 28
Room / Area: FTF

Unless otherwise noted, dose rates in mrem/hr.

Lead Inspector: Grady, Frank
Location Code: F241900
Location Description: B-36 EAST SIDE VIEW
Status: Approved by: Lewis-Buncomb, Edith, 03/30/2006
Bldg/Area Name: CONTAINERS

Document #: 635670/ 04
Survey #: TKFM-M-20060329-12 - PDF Generated On: 09/05/2008 14:43
Image File: FTF\Containers\B-36 EAST SIDE
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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12

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VSDS Standard Map RSLS

Data Point Details

Survey #: TKFM-M-20060329-12

Map: 3 - FTF\Containers\B-36 EAST SIDE

#	Type	Inst.	Value	Units	Position	Notes
1	DR γ	N/A N/A N/A	E 340 S 150 150	mrem/hr mrem/hr mrem/hr	END OF B-36	ON TANK 28 B-36 RATE IS ON WEST END
2	DR γ	N/A N/A N/A	E 700 S 400 400	mrem/hr mrem/hr mrem/hr	SIDE END OF BOX	
3	DR γ	N/A N/A N/A	E 450 S 330 330	mrem/hr mrem/hr mrem/hr	WEST CENTER	
4	DR γ	N/A N/A N/A	E 600 S 300 300	mrem/hr mrem/hr mrem/hr	EAST CENTER	
5	DR γ	N/A N/A N/A	E 150 S 100 100	mrem/hr mrem/hr mrem/hr	EAST SIDE	
6	DR γ	N/A N/A N/A	E 50 S 30 30	mrem/hr mrem/hr mrem/hr	EAST END	
7	DR γ	N/A N/A N/A	E 450 S 280 280	mrem/hr mrem/hr mrem/hr	WEST TOP	
8	DR γ	N/A N/A N/A	E 300 S 220 220	mrem/hr mrem/hr mrem/hr	TOP CENTER	
9	DR γ	N/A N/A N/A	E 150 S 100 100	mrem/hr mrem/hr mrem/hr	EAST TOP	
1	Smear	N/A N/A	α <20 β/γ <200	DPM/100 cm2 DPM/100 cm2	ON LIP	
2	Smear	N/A N/A	α <20 β/γ <200	DPM/100 cm2 DPM/100 cm2	ON LIP	
3	Smear	N/A N/A	α <20 β/γ <200	DPM/100 cm2 DPM/100 cm2	ON LIP	

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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VSDS Standard Map RSLS

Map: 4	LEAD OVER DRILL STRING 3	Survey #: TKFM-M-20060329-12	Date/Time: 03/29/2006 10:00

Comments:

Summary of Highest Readings (All available values may not be listed)	
Smears	Air Samples & Wipes
	Wipe 7) ND DPM/Wipe α Wipe 7) ND DPM/Wipe β/γ

Type: Job Coverage

Symbol Legend (for example only)
15 Smear
15 Large Area
15 Air Sample
15 Direct Probe
DR Dose Rate

RWP #: 06-FTF-116
CLI Tag: N/A
System / Process: LM-75
Room / Area: TANK 28

Unless otherwise noted, dose rates in mrem/hr.

Lead Inspector: Grady, Frank	Status: Approved by: Lewis-Buncomb, Edith, 03/30/2006
Location Code: F241928	Bldg/Area Name: TANK 28
Location Description: LEAD OVER DRILL STRING 3	

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12

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VSDS Standard Map RSLS

Data Point Details

Survey #: TKFM-M-20060329-12

Map: 4 - FTF\Tank 28\lead over drill srting 3

#	Type	Inst.	Value	Units	Position	Notes
1	DR γ	N/A	E 300	mrem/hr	BAGGED IN OF PIPE	
		N/A	S 100	mrem/hr		
		N/A	100	mrem/hr		
2	DR γ	N/A	E 600	mrem/hr		
		N/A	S 400	mrem/hr		
		N/A	400	mrem/hr		
3	DR γ	N/A	E 1000	mrem/hr		
		N/A	S 600	mrem/hr		
		N/A	600	mrem/hr		
4	DR γ	N/A	E 2000	mrem/hr		
		N/A	S 800	mrem/hr		
		N/A	800	mrem/hr		
1	Wipe		α ND	DPM/Wipe		
			β/γ ND	DPM/Wipe		
2	Wipe		α ND	DPM/Wipe		
			β/γ ND	DPM/Wipe		
3	Wipe		α ND	DPM/Wipe		
			β/γ ND	DPM/Wipe		
4	Wipe		α ND	DPM/Wipe		
			β/γ ND	DPM/Wipe		
5	Wipe		α ND	DPM/Wipe		
			β/γ ND	DPM/Wipe		
6	Wipe		α ND	DPM/Wipe		
			β/γ ND	DPM/Wipe		
7	Wipe		α ND	DPM/Wipe		
			β/γ ND	DPM/Wipe		
	Text		DOSE RATES TAKEN FROM CONTAINER SIDE			

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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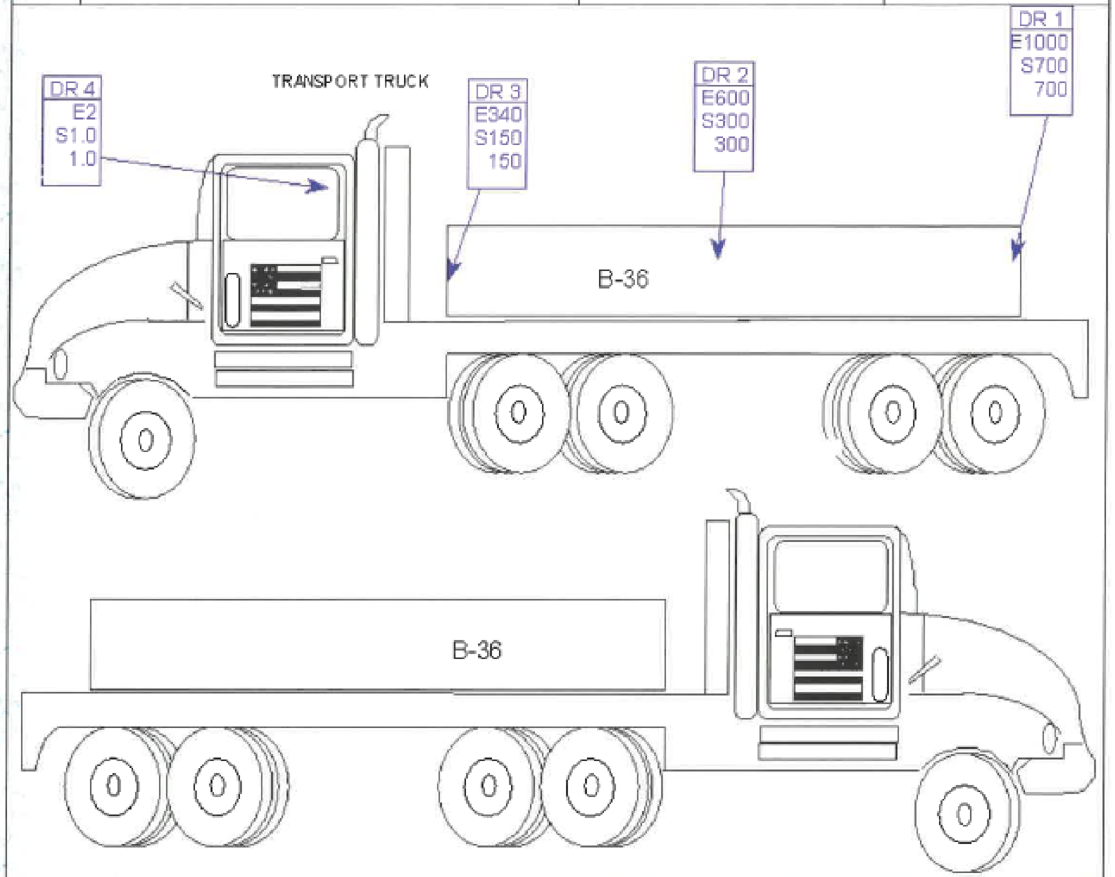
VSDS Standard Map RSLS

Map: 5	TRANSPORT B-36	Survey #: TKFM-M-20060329-12	Date/Time: 03/29/2006 10:00



Comments:

Summary of Highest Readings (All available values may not be listed)	
Smears	Air Samples & Wipes

Type: Job Coverage

Symbol Legend (for example only): 15 Smear; 15 Large Area; 15 Air Sample; 15 Direct Probe; DR Dose Rate

RWP #: 06-FTF-116
CLI Tag: N/A
System / Process: B-36
Room / Area: TANK 28

Unless otherwise noted, dose rates in mrem/hr.

Lead Inspector: Grady, Frank	Status: Approved by: Lewis-Buncomb, Edith, 03/30/2006
Location Code: F241900	Bldg/Area Name: VEHICLES/TRAILERS
Location Description: TRANSPORT B-36	

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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VSDS Standard Map RSLS

Data Point Details

Survey #: TKFM-M-20060329-12

Map: 5 - FTF\TRANSPORT\TRANSPORT B-36

#	Type	Inst.	Value	Units	Position	Notes
1	DR γ	N/A	E 1000	mrem/hr	AT REAR OF TRUCK	
		N/A	S 700	mrem/hr		
		N/A	700	mrem/hr		
2	DR γ	N/A	E 600	mrem/hr	MIDDLE OF TRUCK	
		N/A	S 300	mrem/hr		
		N/A	300	mrem/hr		
3	DR γ	N/A	E 340	mrem/hr	FRONT OF TRUCK	
		N/A	S 150	mrem/hr		
		N/A	150	mrem/hr		
4	DR γ	N/A	E 2	mrem/hr	IN CAB OF TRUCK	
		N/A	S 1.0	mrem/hr		
		N/A	1.0	mrem/hr		

ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12
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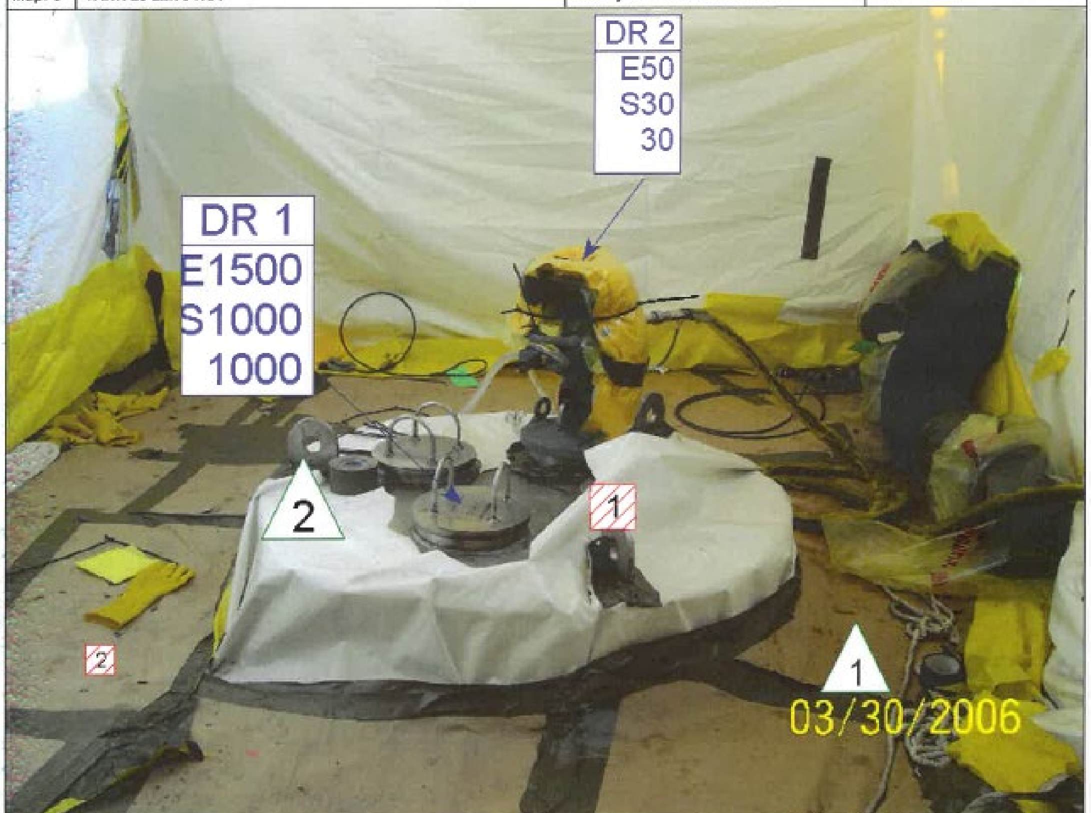
VSDS Standard Map RSLS

Map: 6	TANK 28 LM75 HUT	Survey #: TKFM-M-20060329-12	Date/Time: 03/29/2006 10:00



Comments:

Summary of Highest Readings
(All available values may not be listed)

Smears	Air Samples & Wipes
	A/S 2) .93 DAC-hr α A/S 2) 0 DAC-hr β/γ A/S 1) ND DAC β/γ A/S 1) ND DAC α Wipe 2) ND DPM/Wipe α Wipe 2) ND DPM/Wipe β/γ

Type: Job Coverage

Symbol Legend (for example only): 15 Smear; 15 Large Area; 15 Air Sample; 15 Direct Probe; DR Dose Rate

RWP #: 06-FTF-116
CLI Tag: F241928
System / Process: TANK 28
Room / Area: LM-75 HUT

Unless otherwise noted, dose rates in mrem/hr.

Lead Inspector: Grady, Frank
Location Code: F241928
Location Description: TANK 28 LM75 HUT

Status: Approved by: Lewis-Buncomb, Edith, 03/30/2006
Bldg/Area Name: TANK 28

Document #: 635670/ 04
Survey #: TKFM-M-20060329-12 - PDF Generated On: 09/05/2008 14:43

Image File: FTF\Tank 28\TANK 28 LM75 HUT
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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12

VSDS Standard Map RSLS

Data Point Details

Survey #: TKFM-M-20060329-12

Map: 6 - FTF\Tank 28\TANK 28 LM75 HUT

#	Type	Inst.	Value	Units	Position	Notes
1	DR γ	N/A N/A N/A	E 1500 S 1000 1000	mrem/hr mrem/hr mrem/hr	OVER OPEN PLUG	AFTER DRILL STRING REMOVAL. THIS RISER HAD CAMERA LEFT IN. HUT POSTED HIGH RAD.
2	DR γ	N/A N/A N/A	E 50 S 30 30	mrem/hr mrem/hr mrem/hr	OVER EMPTY FLUSH RIG	RATE OVER FLUSH RIG WITH DRILL STRING REMOVED
1	Wipe		α ND β/γ ND	DPM/Wipe DPM/Wipe	ON TOP OF RISER	SWIPE WAS ND DPM ABOVE BACKGROUND OF 20000 DPM DUE TO HIGH RATES
2	Wipe		α ND β/γ ND	DPM/Wipe DPM/Wipe	ON FLOOR AFTER JOB	ND DPM ABOVE HIGH BACKGROUND OF 20000 DPM
1	Air Sample		ND ND	DAC α DAC β/γ	INSIDE HUT	0329-12 A
2	Air Sample		.93 0	DAC-hr α DAC-hr β/γ	P.A.S. SAMPLE	0329-12E

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ATTACHMENT 2 – Drill String Initial Survey TKFM-M-20060329-12

VSDS Standard Map RSLS

Supplemental Airborne Survey Information

#	Sample Type	Motor Pump Serial #	Sample Media	Respirator Type	Start Time	End Time	Total Run Time (min)	Flow Rates (ft3/min) Beginning	Ending	Average	Total Vol. (ft3)
1	MAP	19	3" Filter Paper (76mm)	Full Face	03/29/2006 08:15	03/29/2006 12:00	165	4	4	4	660
2	PAS	20775	37mm Filter Paper	Full Face	03/29/2006 11:32	03/29/2006 12:15	43	10330	9795	10063	432709

Initial/Final Probe

Air Sample No.	Reading Type	Value	Units	Date/Time
1	Initial Alpha	1000	DPM	03/29/2006 10:15
	Final Alpha	800	DPM	03/29/2006 12:00
	Initial Beta/Gamma	2000	DPM	03/29/2006 10:15
	Final Beta/Gamma	2000	DPM	03/29/2006 12:00
2	Initial Alpha	N/A		
	Final Alpha	4.5	DPM	03/29/2006 14:20
	Initial Beta/Gamma	N/A		
	Final Beta/Gamma	33.4	DPM	03/29/2006 14:20

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ATTACHMENT 3 – Radionuclide Decay Calculations

Table A3-1: Radionuclide Decay Calculations

Analyte	FTF-462, pCi/mL[1]	Composite, pCi/mL[1]	FTF-462, pCi/mL	Composite, pCi/mL	Max Activity Concentration, pCi/mL (Ac)	Max Initial Activity, Ci (A_o) Equation 1	Initial Ci % Equation 3	Half Life, yr. ($T_{1/2}$)	Decay Activity, Ci (A_t) Equation 2	Ci % Equation 3
C-14	*<1.56E+04*	--	1.56E+04		1.56E+04	4.02E-04	6.03E-04	5.72E+03	4.01E-04	8.62E-04
Al-26	*<1.76E+02*	*<1.99E+02*	1.76E+02	1.99E+02	1.99E+02	5.12E-06	7.69E-06	7.10E+05	5.12E-06	1.10E-05
Co-60	*<2.83E+02*	*<2.31E+02*	2.83E+02	2.31E+02	2.83E+02	7.28E-06	1.09E-05	5.27E+00	9.35E-07	2.01E-06
Se-79	*<1.76E+04*	--	1.76E+04		1.76E+04	4.53E-04	6.80E-04	2.90E+05	4.53E-04	9.74E-04
Sr-90	6.42E+03	--	6.42E+03		6.42E+03	1.65E-04	2.48E-04	2.88E+01	1.14E-04	2.44E-04
Nb-94	*<2.23E+02*	*<1.96E+02*	2.23E+02	1.96E+02	2.23E+02	5.74E-06	8.61E-06	2.00E+04	5.74E-06	1.23E-05
Tc-99	2.32E+05	1.99E+05	2.32E+05	1.99E+05	2.32E+05	5.97E-03	8.96E-03	2.13E+05	5.97E-03	1.28E-02
Ru-106	*<1.62E+03*	*<1.38E+03*	1.62E+03	1.38E+03	1.62E+03	4.17E-05	6.26E-05	1.02E+00	1.03E-09	2.22E-09
Sb-125	*<6.68E+02*	*<6.37E+02*	6.68E+02	6.37E+02	6.68E+02	1.72E-05	2.58E-05	2.76E+00	3.40E-07	7.32E-07
Sb-126	2.66E+03	1.24E+03	2.66E+03	1.24E+03	2.66E+03	6.85E-05	1.03E-04	3.40E-02	3.40E-143	0.00E+00
Sn-126	3.73E+03	1.33E+03	3.73E+03	1.33E+03	3.73E+03	9.60E-05	1.44E-04	2.30E+05	9.60E-05	2.06E-04
I-129	1.36E+02	--	1.36E+02		1.36E+02	3.50E-06	5.25E-06	1.57E+07	3.50E-06	7.53E-06
Cs-134	*<1.32E+05*	*<1.28E+05*	1.32E+05	1.28E+05	1.32E+05	3.40E-03	5.10E-03	2.07E+00	1.80E-05	3.88E-05
Cs-137	1.33E+09	1.04E+09	1.33E+09	1.04E+09	1.33E+09	3.42E+01	5.14E+01	3.01E+01	2.39E+01	5.14E+01
Ce-144	*<1.43E+03*	*<9.97E+02*	1.43E+03	9.97E+02	1.43E+03	3.68E-05	5.52E-05	7.80E-01	3.47E-11	0.00E+00
Eu-154	*<3.90E+02*	*<2.85E+02*	3.90E+02	2.85E+02	3.90E+02	1.00E-05	1.51E-05	8.59E+00	2.85E-06	6.13E-06
Eu-155	*<7.69E+02*	*<4.34E+02*	7.69E+02	4.34E+02	7.69E+02	1.98E-05	2.97E-05	4.75E+00	2.03E-06	4.36E-06
Th-230	*<2.65E+03*	*<2.41E+03*	2.65E+03	2.41E+03	2.65E+03	6.82E-05	1.02E-04	7.54E+04	6.82E-05	1.47E-04

ATTACHMENT 3 – Radionuclide Decay Calculations

Table A3-1: Radionuclide Decay Calculations (Continued)

Analyte	FTF-462, pCi/mL[1]	Composite, pCi/mL[1]	FTF-462, pCi/mL	Composite, pCi/mL	Max Activity Concentration, pCi/mL (Ac)	Max Initial Activity, Ci (A_o) Equation 1	Initial Ci % Equation 3	Half Life, yr. ($T_{1/2}$)	Decay Activity, Ci (A_t) Equation 2	Ci % Equation 3
Th-232	*<3.44E-02*	*<3.13E-02*	3.44E-02	3.13E-02	3.44E-02	8.85E-10	1.33E-09	1.40E+10	8.85E-10	0.00E+00
U-233	*<1.22E+03*	*<1.10E+03*	1.22E+03	1.10E+03	1.22E+03	3.14E-05	4.71E-05	1.59E+05	3.14E-05	6.75E-05
U-234	*<7.85E+02*	*<7.13E+02*	7.85E+02	7.13E+02	7.85E+02	2.02E-05	3.03E-05	2.46E+05	2.02E-05	4.35E-05
U-235	*<2.71E-01*	*<2.47E-01*	2.71E-01	2.47E-01	2.71E-01	6.98E-09	1.05E-08	7.04E+08	6.98E-09	1.50E-08
U-236	*<8.12E+00*	*<7.38E+00*	8.12E+00	7.38E+00	8.12E+00	2.09E-07	3.14E-07	2.34E+07	2.09E-07	4.49E-07
Np-237	*<8.85E+01*	*<8.04E+01*	8.85E+01	8.04E+01	8.85E+01	2.28E-06	3.42E-06	2.14E+06	2.28E-06	4.90E-06
U-238	2.75E-01	5.23E-01	2.75E-01	5.23E-01	5.23E-01	1.35E-08	2.02E-08	4.47E+09	1.35E-08	2.89E-08
Pu-238	*<2.94E+03*	*<1.90E+03*	2.94E+03	1.90E+03	2.94E+03	7.57E-05	1.14E-04	8.77E+01	6.69E-05	1.44E-04
Pu-239	*<7.81E+03*	*<7.09E+03*	7.81E+03	7.09E+03	7.81E+03	2.01E-04	3.02E-04	2.41E+04	2.01E-04	4.32E-04
Pu-240	*<2.86E+04*	*<2.60E+04*	2.86E+04	2.60E+04	2.86E+04	7.36E-04	1.10E-03	6.56E+03	7.35E-04	1.58E-03
Pu-241	*<1.12E+05*	*<1.15E+05*	1.12E+05	1.15E+05	1.15E+05	2.96E-03	4.44E-03	1.44E+01	1.40E-03	3.00E-03
Pu-242	*<4.80E+02*	*<4.36E+02*	4.80E+02	4.36E+02	4.80E+02	1.24E-05	1.85E-05	3.75E+05	1.24E-05	2.66E-05
Am-241	*<6.00E+03*	--	6.00E+03		6.00E+03	1.54E-04	2.32E-04	4.33E+02	1.51E-04	3.24E-04
Am-243	*<2.45E+03*	--	2.45E+03		2.45E+03	6.31E-05	9.46E-05	7.37E+03	6.30E-05	1.35E-04
Am-242m	*<3.59E+04*	--	3.59E+04		3.59E+04	9.24E-04	1.39E-03	1.41E+02	8.56E-04	1.84E-03

ATTACHMENT 3 – Radionuclide Decay Calculations

Table A3-1: Radionuclide Decay Calculations (Continued)

Analyte	FTF-462, pCi/mL[1]	Composite, pCi/mL[1]	FTF-462, pCi/mL	Composite, pCi/mL	Max Activity Concentration, pCi/mL (Ac)	Max Initial Activity, Ci (A_o) Equation 1	Initial Ci % Equation 3	Half Life, yr. ($T_{1/2}$)	Decay Activity, Ci (A_t) Equation 2	Ci % Equation 3
Cm-243	*<9.17E+03*	--	9.17E+03		9.17E+03	2.36E-04	3.54E-04	2.91E+01	1.63E-04	3.50E-04
Cm-245	*<7.52E+03*	--	7.52E+03		7.52E+03	1.94E-04	2.90E-04	8.50E+03	1.93E-04	4.16E-04
Cm-247	*<1.17E+04*	--	1.17E+04		1.17E+04	3.01E-04	4.52E-04	1.56E+07	3.01E-04	6.48E-04
Cf-249	*<1.19E+04*	--	1.19E+04		1.19E+04	3.06E-04	4.60E-04	3.51E+02	2.97E-04	6.39E-04
Cf-251	*<8.63E+03*	--	8.63E+03		8.63E+03	2.22E-04	3.33E-04	9.00E+02	2.19E-04	4.72E-04
Cm-242	*<1.93E+02*	--	1.93E+02		1.93E+02	4.97E-06	7.46E-06	4.46E-01	1.45E-16	0.00E+00
Cm-244	2.97E+03	--	2.97E+03		2.97E+03	7.65E-05	1.15E-04	1.81E+01	4.21E-05	9.04E-05
Parents	**Daughters**									
Cs-137	Ba-137m				1.26E+09	3.24E+01	4.86E+01		2.26E+01	4.86E+01
Sr-90	Y-90				6.42E+03	1.65E-04	2.48E-04		1.14E-04	2.44E-04
U-235	Th-231				2.71E-01	6.98E-09	1.05E-08		6.98E-09	1.50E-08
U-238	Pa-234m				5.23E-01	1.35E-08	2.02E-08		1.35E-08	2.89E-08
U-238	Th-234				5.23E-01	1.35E-08	2.02E-08		1.35E-08	2.89E-08
Np-237	Pa-233				8.85E+01	2.28E-06	3.42E-06		2.28E-06	4.90E-06
				Total	**2.59E+09**	**6.66E+01**	**1.00E+02**		**4.65E+01**	**1.00E+02**

Note 1: The non-detect radionuclides (i.e., < MDA) from I.1 are highlighted red.
Note 2: Radionuclides less than 1E-09 Ci are shaded gray as they have significantly decayed and are removed from the distribution.

ATTACHMENT 3 – Radionuclide Decay Calculations

Table A3-2: Radionuclide Decay Inputs

6.8	Supernate Volume, gal (V)
2/14/2006	Start Date
9/20/2021	Reference Date
15.6	$\Delta T(t-t_o)$, years

ATTACHMENT 4 – Radionuclide Distribution

Table A4-1: Radionuclide Distribution Determination

Analyte	Category	Decay Activity, Ci (A_t) Equation 2	Ci % Equation 3	Revised Activity (Ci)	Revised Ci % Equation 3	Reasons for Inclusion in & Exclusion from Final Distribution
C-14	PA	4.01E-04	8.62E-04	4.01E-05	8.62E-05	Non-Detect PA <LLD, 0.1 X LLD
Al-26		5.12E-06	1.10E-05	0.00E+00	0.00E+00	<1%
Co-60		9.35E-07	2.01E-06	0.00E+00	0.00E+00	<1%
Se-79		4.53E-04	9.74E-04	0.00E+00	0.00E+00	<1%
Sr-90	PA	1.14E-04	2.44E-04	1.14E-04	2.44E-04	Detected PA
Nb-94		5.74E-06	1.23E-05	0.00E+00	0.00E+00	<1%
Tc-99	PA	5.97E-03	1.28E-02	5.97E-03	1.28E-02	Detected PA
Ru-106		1.03E-09	2.22E-09	0.00E+00	0.00E+00	<1%
Sb-125		3.40E-07	7.32E-07	0.00E+00	0.00E+00	<1%
Sb-126		3.40E-143	0.00E+00	0.00E+00	0.00E+00	<1%
Sn-126		9.60E-05	2.06E-04	0.00E+00	0.00E+00	<1%
I-129	PA	3.50E-06	7.53E-06	3.50E-06	7.53E-06	Detected PA
Cs-134		1.80E-05	3.88E-05	0.00E+00	0.00E+00	<1%
Cs-137		2.39E+01	5.14E+01	2.39E+01	5.14E+01	>1%
Ce-144		3.47E-11	0.00E+00	0.00E+00	0.00E+00	<1%
Eu-154		2.85E-06	6.13E-06	0.00E+00	0.00E+00	<1%
Eu-155		2.03E-06	4.36E-06	0.00E+00	0.00E+00	<1%
Th-230		6.82E-05	1.47E-04	0.00E+00	0.00E+00	<1%
Th-232		8.85E-10	0.00E+00	0.00E+00	0.00E+00	<1%

ATTACHMENT 4 – Radionuclide Distribution

Table A4-1: Radionuclide Distribution Determination (Continued)

Analyte	Category	Decay Activity, Ci (A_t) Equation 2	Ci % Equation 3	Revised Activity (Ci)	Revised Ci % Equation 3	Reasons for Inclusion in & Exclusion from Final Distribution
U-233	Fissile	3.14E-05	6.75E-05	3.14E-06	6.75E-06	Non-Detect Fissile, 0.1 X LLD
U-234	PA	2.02E-05	4.35E-05	2.02E-06	4.35E-06	Non-Detect PA <LLD, 0.1 X LLD
U-235	PA/Fissile	6.98E-09	1.50E-08	0.00E+00	0.00E+00	Non-Detect PA/Fissile <LLD, <<1E-09 Ci
U-236		2.09E-07	4.49E-07	0.00E+00	0.00E+00	<1%
Np-237	PA/TRU	2.28E-06	4.90E-06	2.28E-07	4.90E-07	Non-Detect PA/TRU <LLD, 0.1 X LLD
U-238		1.35E-08	2.89E-08	0.00E+00	0.00E+00	<1%
Pu-238	TRU	6.69E-05	1.44E-04	6.69E-06	1.44E-05	Non-Detect TRU, 0.1 X LLD
Pu-239	TRU/Fissile	2.01E-04	4.32E-04	2.01E-05	4.32E-05	Non-Detect TRU/Fissile, 0.1 X LLD
Pu-240	TRU	7.35E-04	1.58E-03	7.35E-05	1.58E-04	Non-Detect TRU, 0.1 X LLD
Pu-241	Fissile	1.40E-03	3.00E-03	1.40E-04	3.00E-04	Non-Detect Fissile, 0.1 X LLD
Pu-242	TRU	1.24E-05	2.66E-05	1.24E-06	2.66E-06	Non-Detect TRU, 0.1 X LLD
Am-241	TRU	1.51E-04	3.24E-04	1.51E-05	3.24E-05	Non-Detect TRU, 0.1 X LLD
Am-243	TRU	6.30E-05	1.35E-04	6.30E-06	1.35E-05	Non-Detect TRU, 0.1 X LLD
Am-242m	TRU/Fissile	8.56E-04	1.84E-03	8.56E-05	1.84E-04	Non-Detect TRU/Fissile, 0.1 X LLD

ATTACHMENT 4 – Radionuclide Distribution

Table A4-1: Radionuclide Distribution Determination (Continued)

Analyte	Category	Decay Activity, Ci (A_t) Equation 2	Ci % Equation 3	Revised Activity (Ci)	Revised Ci % Equation 3	Reasons for Inclusion in & Exclusion from Final Distribution
Cm-243	TRU/Fissile	1.63E-04	3.50E-04	1.63E-05	3.50E-05	Non-Detect TRU/Fissile, 0.1 X LLD
Cm-245	TRU/Fissile	1.93E-04	4.16E-04	1.93E-05	4.16E-05	Non-Detect TRU/Fissile, 0.1 X LLD
Cm-247	TRU/Fissile	3.01E-04	6.48E-04	3.01E-05	6.48E-05	Non-Detect TRU/Fissile, 0.1 X LLD
Cf-249	TRU/Fissile	2.97E-04	6.39E-04	2.97E-05	6.39E-05	Non-Detect TRU/Fissile, 0.1 X LLD
Cf-251	TRU/Fissile	2.19E-04	4.72E-04	2.19E-05	4.72E-05	Non-Detect TRU/Fissile, 0.1 X LLD
Cm-242		1.45E-16	0.00E+00	0.00E+00	0.00E+00	<1%
Cm-244		4.21E-05	9.04E-05	0.00E+00	0.00E+00	<1%
Parents	**Daughters**					
Cs-137	Ba-137m	2.26E+01	4.86E+01	2.26E+01	4.86E+01	>1%
Sr-90	Y-90	1.14E-04	2.44E-04	0.00E+00	0.00E+00	<1%
U-235	Th-231	6.98E-09	1.50E-08	0.00E+00	0.00E+00	<1%
U-238	Pa-234m	1.35E-08	2.89E-08	0.00E+00	0.00E+00	<1%
U-238	Th-234	1.35E-08	2.89E-08	0.00E+00	0.00E+00	<1%
Np-237	Pa-233	2.28E-06	4.90E-06	0.00E+00	0.00E+00	<1%
			Total	**4.65E+01**	**1.00E+02**	

Note 1: Non-detect U-235 was removed from the distribution due its very low activity.

ATTACHMENT 4 – Radionuclide Distribution

Table A4-2: FT14005196 Final Radionuclide Distribution

FT14005196 Final Radionuclide Distribution		
Radionuclide	**Activity (Ci)**	**Ci %, Equation 3**
C-14	4.01E-05	8.62E-05
Am-241	1.51E-05	3.24E-05
Am-242m	8.56E-05	1.84E-04
Am-243	6.30E-06	1.35E-05
Ba-137m	2.26E+01	4.86E+01
Cf-249	2.97E-05	6.39E-05
Cf-251	2.19E-05	4.72E-05
Cm-243	1.63E-05	3.50E-05
Cm-245	1.93E-05	4.16E-05
Cm-247	3.01E-05	6.48E-05
Cs-137	2.39E+01	5.14E+01
I-129	3.50E-06	7.53E-06
Np-237	2.28E-07	4.90E-07
Pu-238	6.69E-06	1.44E-05
Pu-239	2.01E-05	4.32E-05
Pu-240	7.35E-05	1.58E-04
Pu-241	1.40E-04	3.00E-04
Pu-242	1.24E-06	2.66E-06
Sr-90	1.14E-04	2.44E-04
Tc-99	5.97E-03	1.28E-02
U-233	3.14E-06	6.75E-06
U-234	2.02E-06	4.35E-06
Total	**4.65E+01**	**1.00E+02**

ATTACHMENT 5 – U-235 FGE, Pu-239 PEC, and TRU

Table A5-1: U-235 FGE, Pu-239 PEC, and TRU

FT14005196 Radionuclide Distribution			U-235 FGE	Pu-239 PEC	TRU
Radionuclide	**Activity (Ci)**	**Ci %, Equation 3**	**g, Equation 4**	**Ci, Equation 5**	**nCi/g, Equation 6**
C-14	4.01E-05	8.62E-05		1.60E-09	
Am-241	1.51E-05	3.24E-05		1.54E-05	4.74E-03
Am-242m	8.56E-05	1.84E-04	4.39E-04	8.56E-05	2.70E-02
Am-243	6.30E-06	1.35E-05		6.42E-06	1.98E-03
Ba-137m	2.26E+01	4.86E+01		2.94E-03	
Cf-249	2.97E-05	6.39E-05	5.08E-04	3.03E-05	9.35E-03
Cf-251	2.19E-05	4.72E-05	1.94E-03	2.24E-05	6.91E-03
Cm-243	1.63E-05	3.50E-05	2.51E-06	1.66E-05	5.13E-03
Cm-245	1.93E-05	4.16E-05	2.63E-03	2.05E-05	6.09E-03
Cm-247	3.01E-05	6.48E-05	2.60E-01	3.07E-05	9.49E-03
Cs-137	2.39E+01	5.14E+01		1.50E-02	
I-129	3.50E-06	7.53E-06		4.55E-10	
Np-237	2.28E-07	4.90E-07		2.19E-07	7.17E-05
Pu-238	6.69E-06	1.44E-05		6.03E-06	2.11E-03
Pu-239	2.01E-05	4.32E-05	5.18E-04	2.01E-05	6.33E-03
Pu-240	7.35E-05	1.58E-04		7.50E-05	2.31E-02
Pu-241	1.40E-04	3.00E-04	4.75E-06	2.70E-06	
Pu-242	1.24E-06	2.66E-06		1.26E-06	3.89E-04
Sr-90	1.14E-04	2.44E-04		2.89E-07	
Tc-99	5.97E-03	1.28E-02		8.78E-08	
U-233	3.14E-06	6.75E-06	4.56E-04	8.01E-07	
U-234	2.02E-06	4.35E-06		5.15E-07	
Total	**4.65E+01**	**1.00E+02**	**2.66E-01**	**1.83E-02**	**1.03E-01**

ATTACHMENT 6 – NRC Waste classification

Table A6-1: NRC Waste Classification

NRC Waste Classification															
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Radionuclide	**Activity (Ci)**	**Activity Concentration, C_i (nCi/g)**	**Activity Concentration, C_i (Ci/m^3)**	**Limits, L_i (Table 1)**	**Units**	**Ratio C_i/L_i (Table 1)**	**Limits, L_i (Col.1 Table 2)**	**Units**	**Ratio C_i/L_i (Col.1 Table 2)**	**Limits, L_i (Col.2 Table 2)**	**Units**	**Ratio C_i/L_i (Col.2 Table 2)**	**Limits, L_i (Col.3 Table 2)**	**Units**	**Ratio C_i/L_i (Col.3 Table 2)**
Am-241	1.51E-04	4.74E-02		10	nCi/g	4.74E-03									
Am-242m	8.56E-04	2.70E-01		10	nCi/g	2.70E-02									
Am-243	6.30E-05	1.98E-02		10	nCi/g	1.98E-03									
Ba-137m	2.26E+01	7.12E+03	1.70E+00				700	Ci/m3	2.42E-03	Unlimited	Ci/m3		Unlimited	Ci/m3	
C-14	4.01E-04		3.01E-05	0.8	Ci/m3	3.76E-05									
Co-60	9.35E-07		7.02E-08				700	Ci/m3	1.00E-10	Unlimited	Ci/m3		Unlimited	Ci/m3	
Cs-137	2.39E+01		1.79E+00				1	Ci/m3	1.79E+00	44	Ci/m3	4.07E-02	4600	Ci/m3	3.90E-04
I-129	3.50E-06		2.63E-07	0.008	Ci/m3	3.28E-05									
Np-237	2.28E-06	7.17E-04		10	nCi/g	7.17E-05									
Pu-238	6.69E-05	2.11E-02		10	nCi/g	2.11E-03									
Pu-239	2.01E-04	6.33E-02		10	nCi/g	6.33E-03									
Pu-240	7.35E-04	2.31E-01		10	nCi/g	2.31E-02									
Pu-241	1.40E-03	4.40E-01		350	nCi/g	1.26E-03									
Pu-242	1.24E-05	3.89E-03		10	nCi/g	3.89E-04									
Cm-242	1.45E-16	4.57E-14		2000	nCi/g	2.29E-17									
Cm-243	1.63E-04	5.13E-02		10	nCi/g	5.13E-03									
Cm-244	4.21E-05	1.32E-02		10	nCi/g	1.32E-03									
Cm-245	1.93E-04	6.09E-02		10	nCi/g	6.09E-03									
Cm-247	3.01E-04	9.49E-02		10	nCi/g	9.49E-03									
Cf-249	2.97E-04	9.35E-02		10	nCi/g	9.35E-03									
Cf-251	2.19E-04	6.91E-02		10	nCi/g	6.91E-03									
Nb-94	5.74E-06		4.31E-07	0.02	Ci/m3	2.15E-05									
Sr-90	1.14E-04		8.52E-06				0.04	Ci/m3	2.13E-04	150	Ci/m3	5.68E-08	7000	Ci/m3	1.22E-09
Tc-99	5.97E-03		4.48E-04	0.3	Ci/m3	1.49E-03									
Y-90	1.14E-04		8.52E-06				700	Ci/m3	1.22E-08	Unlimited	Ci/m3		Unlimited	Ci/m3	
Total	**4.65E+01**				**SOF**	**1.07E-01**			**1.80E+00**			**4.07E-02**			**3.90E-04**
WASTE CLASSIFICATION												**Class B**			

Best Available Copy

ATTACHMENT 7 – RCRA RESULTS

Page 1 of 2

Table A7-1: RCRA Results

Tank 28 Drill String Supernate RCRA Determination										
			A	B=A*6.8*3.78541	C=B / 173*0.453592	D=C/20				
Parameter	**FTF-462**	**Composite**	**mg/L**	**Mass (mg)**	**Total Concentration (mg/kg)**	**Theoretical TCLP Result (mg/L)**	**RCRA Limit (mg/L)**	**RCRA Hazardous?**	**UHC Limit (mg/L)**	**UHC?**
Mercury [Hg]	<6.61E+00	<6.74E+00	6.74E+00	1.73E+02	2.22E+00	1.11E-01	0.2	No	0.025	Yes
Arsenic [As]	<1.65E+00	<1.69E+00	1.69E+00	4.35E+01	5.56E-01	2.78E-02	5	No	5	No
Barium [Ba]	<1.30E+01	<1.43E+01	1.43E+01	3.68E+02	4.70E+00	2.35E-01	100	No	21	No
Cadmium [Cd]	<3.49E+01	<3.84E+01	3.84E+01	9.88E+02	1.26E+01	6.32E-01	1	No	0.11	Yes
Chromium [Cr]	6.51E+01	1.72E+02	1.72E+02	4.43E+03	5.66E+01	2.83E+00	5	No	0.6	Yes
Lead [Pb]	2.38E+00	2.71E+00	2.71E+00	6.98E+01	8.91E-01	4.46E-02	5	No	0.75	No
Selenium [Se]	<3.30E+00	<3.37E+00	3.37E+00	8.67E+01	1.11E+00	5.54E-02	1	No	5.7	No
Silver [Ag]	<2.44E+01	<2.68E+01	2.68E+01	6.90E+02	8.82E+00	4.41E-01	5	No	0.14	Yes

Lead Blankets RCRA Characterization					
	D (Table 5.5.4.2-2)	E=D/ 771	F=E/20		
Parameter	**Mass (mg)**	**Total Concentration (mg/kg)**	**Theoretical TCLP Result (mg/L)**	**RCRA Limit (mg/L)**	**RCRA Hazardous?**
Lead [Pb]	6.93E+08	8.99E+05	4.49E+04	5	Yes

Notes:

1. RCRA determinations do not include any additional shielding inside the B-36 or the B-36 itself.
2. The UHC results are based on the weight of the drill string only (173 lbs. - Table 5.5.4.2-1).
3. The lead RCRA results are based on the Tank 28 Drill String and lead blankets weight (771 kg or 1700 lbs., I. 5).
4. To determine the maximum theoretical TCLP, 20 L extract/kg waste is used.

ATTACHMENT 7 – RCRA RESULTS

Table A7-2: RCRA Results Summary

Hazardous Waste Code	Parameter	Total Concentration (mg/kg)	Theoretical TCLP Result (mg/L)	RCRA Hazardous?	UHC?
D009	Mercury [Hg]	2.22E+00	1.11E-01	No	Yes
D004	Arsenic [As]	5.56E-01	2.78E-02	No	No
D005	Barium [Ba]	4.70E+00	2.35E-01	No	No
D006	Cadmium [Cd]	1.26E+01	6.32E-01	No	Yes
D007	Chromium [Cr]	5.66E+01	2.83E+00	No	Yes
D008	Lead [Pb]	8.99E+05	4.49E+04	Yes	No[1]
D010	Selenium [Se]	1.11E+00	5.54E-02	No	No
D011	Silver [Ag]	8.82E+00	4.41E-01	No	Yes
Note 1 - Lead is not considered as a UHC since the waste is already hazardous for lead.					

ENGINEERING CHECKING AND VERIFICATION BY DOCUMENT REVIEW CHECKLIST

Procedure Ref. E7-2.31A and S4-ENG.51

Document Number: Q-CLC-F-00372 Revision: 0

Document Title: Waste Characterization of the Tank 28 LM-75 Drill String (FT14005196)

The following checklist is required to be completed and attached to the document under review in compliance with Manual E7 and S4 procedures. This list should not be considered all inclusive. Add any additional notes or comments to the end of the checklist.

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	VERSION / FORMAT		
1	If revising an existing document, are you starting with the latest, approved version of the document obtained from SmartPlant Foundation (SPF) or DCR?	N/A	
2	Are all OSR or SPF forms properly and completely filled out and include all the same fields as the current approved version of the form?	Yes	
3	Does the document format include all of the sections as described in manual E7 and S4 procedures (2.31A ,3.60, etc.)?	Yes	
4	Are all of the pages properly labeled with Document Number, Revision Number, and Sequential Page/Sheet Number?	Yes	
5	Are the Subject and Purpose clearly stated and do they meet the end-users needs?	Yes	
6	If the document is an NCSE, has the scope of the document been sufficiently defined (e.g., Dedicated Scoping/Kick Off Meetings held)?	N/A	
	REFERENCES		
7	Are all References properly documented within the document and can they be easily verified within Document Control, on-line, or within the library, etc.? If reference documents are not readily available, are they attached?	Yes	
8	Have the correct design bases documents been identified (e.g., Codes, Standards, DOE Orders, SRR Requirements, Regulatory Requirements, DSA)?	Yes	
	OPEN ITEMS / INPUT		
9	If data is transferred from other documents, calculations or sources, is this data correct and applicable?	Yes	
10	Are all inputs found in the body of the document or calculation individually listed and numbered in the Inputs section?	Yes	
11	Is there a reference/source for each input?	Yes	

OSR 46-574 Rev. 9 5/3/21	LW FORM **ENGINEERING CHECKING AND VERIFICATION BY DOCUMENT REVIEW CHECKLIST** Procedure Ref. E7-2.31A and S4-ENG.51	**Savannah River Site (SRS)** **Page** 2 **of** 4

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	OPEN ITEMS / INPUT – continued		
12	Do the identified references/sources fully support the inputs and does the data meet appropriate quality assurance requirements?	Yes	
13	Have the correct operational and functional requirements of the facility been properly considered?	N/A	
14	Have appropriate operational modes and worse case scenarios been considered?	Yes	
15	Are all assumptions used to support the document individually listed and numbered in the Assumptions section?	Yes	
16	Is there an adequate justification written for each assumption that includes a technical basis?	Yes	
17	If the document is a calculation and there are Open Items, has the calculation been statused as preliminary? Note: A Confirmed calculation cannot have Open Items.	N/A	There are no open items. This is a confirmed calculation.
18	If the document is a preliminary calculation, have actions required to change the status from "preliminary" to "confirmed" been listed as "open items"?	N/A	See Item # 17
19	If the document has open items, is there a method identified to track them? List tracking numbers in Comments (STAR, POD item number, etc.).	N/A	See Item # 17
	ANALYTICAL METHODS AND COMPUTATIONS		
20	Are the analytical methods and computations clearly spelled out step-by-step?	Yes	
21	Is the analytical approach in use clearly described with justification along with alternative methods?	Yes	
22	Is the methodology consistent with the purpose and objective?	Yes	
23	Are mathematical derivations correct, including dimensional consistency of results?	Yes	
24	Have calculations been checked for errors as applicable per E7-2.31A, Section 5.3.2.5? Where a calculation has multiple iterations of the same computation with numerous input and output values, the Verifier/Checker may select a representative sample of the total input and output values for review.	Yes	
25	Were the analysis inputs correctly incorporated into the analysis and are the outputs reasonable compared to the inputs?	Yes	
26	Is the Summary of Conclusion clearly stated? Does it meet the end-user's needs? Clearly state if results meet/do not meet the Objectives of the analysis?	Yes	

ENGINEERING CHECKING AND VERIFICATION BY DOCUMENT REVIEW CHECKLIST

Procedure Ref. E7-2.31A and S4-ENG.51

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	ANALYTICAL METHODS AND COMPUTATIONS – continued		
27	Are the numeric values consistent with the appropriate accuracy (significant figures) of the analysis?	Yes	
28	Are safety margins consistent with good engineering practice?	N/A	
28B	If this is an Accident Analysis Calculation, then are methodologies consistent with all relevant supplemental guidance documents located at \\wg08\ABDOC\Supplemental Guidance-Nuclear Safety and AA? Note: Always default to approved procedures and policies when the referenced supplemental guidance appears in conflict. Contact Manager of Nuclear Safety for access to wg08.	N/A	
	SOFTWARE		
29	Is software (including spreadsheets) used? If NO, then “N/A” this section.	Yes	MS Excel
30	Have computer software programs used for calculations been evaluated and properly classified for this activity using OSR form 19-337 (SWCD), per 1Q QAP 20-1 and E7-2.25? Notes: A) Engineering Calculations meeting the validation requirements of E7-2.31A, where a documented, approved process provides for verification of the results for each use are Exempt – see Row 38. B) The SWCD (software classification document) form is a site-wide application in Lotus Notes.	N/A	No software classification needed. See Item 29.
31	Is computer software used for the analysis being controlled per E7-2.31A, Section 5?	N/A	See Item 29.
32	Were appropriate analysis methods and computer methods used?	Yes	
33	If a computer program or model is used in the calculation, is it used within the range of validity, or is use outside the range of established validity justified?	Yes	
34	Was the software program used within any restriction, criteria or test frequency requirements in the Software Quality Assurance Plan? (SQAP) (e.g., computer operating system/platform criteria, software within testing frequency).	N/A	See Item 29.
35	Is the software used noted on the Calculation cover sheet and referenced appropriately in the calculation?	Yes	

OSR 46-574 Rev. 9 5/3/21	LW FORM **ENGINEERING CHECKING AND VERIFICATION BY DOCUMENT REVIEW CHECKLIST** Procedure Ref. E7-2.31A and S4-ENG.51	**Savannah River Site (SRS)** **Page** 4 **of** 4

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	SOFTWARE – continued		
36	If the calculation supports the DSA, is the software and version used on the SSIL (Safety Software Inventory List) when required? Provide explanation in Comments. Notes: A) Engineering Calculations meeting the validation requirements of E7-2.31A, where a documented, approved process provides for verification of the results for each use are Exempt – see Row 38 B) The SSIL is updated on an annual basis so recently approved SQAPs may not be added to the SSIL until the next annual update.	N/A	
37	Are the equations shown in the calculation, including example functions where Excel spreadsheets or MathCad is used?	Yes	
38	If using software not pre-verified as described in E7-2.31A, Section 5.5, then answer YES and describe verification method from 5.5.2[1] in Comments	N/A	
39	Have computer program error reports been checked for potential effect on the analysis?	Yes	
	RESULTS / CONCLUSIONS		
40	Are the results of the document consistent with the input and assumptions?	Yes	
41	Do the results of the document affect any other technical documents?	Yes	
42	Do the results substantiate the conclusion?	Yes	
	APPROVALS		
43	Does the document identify verification/checking method and does it have a signature block?	Yes	

Sign and date Checker block below. If this is a PS/GS document the verification page lines 44-56 is not required. If this is a SC/SS document, then after signing, proceed to complete items 44-56 for verification.

Checker: Merlin Ngachin / Merlin Ngachin Digitally signed by Merlin Ngachin Date: 2022.01.03 16:26:59 -05'00' Date: 01/03/2022

Print Signature

Appendix C. Waste Characterization of SRS DWPF Glass Bubblers and Glass Pumps

Calculation Cover Sheet

Proc. Ref. E7, 2.31

Project/Task	Calculation Number	Project/Task Number
N/A	Q-CLC-S-00144	N/A

Title
Radiological Distribution of the DWPF Melter Bubblers/Glass Pumps

Functional Classification	Discipline
General Service (GS)	Environmental
Calculation Type: (●) Type 1 ( ) Type 2	Type 1 Calculation Status: ( ) Preliminary (●) Confirmed
Computer Program Number ☐ N/A MS Excel, SRS DTC	Version/Release Number 365, DTC Version 4.0
Purpose and Objective The purpose of this calculation is to document the radiological characterization of the Defense Waste Processing Facility (DWPF) Melter glass pumps and bubblers to support off-site disposition as low level waste.	DC/RO Date N/A

Summary of Conclusion
The DWPF Melter bubbler/glass pumps radiological distribution and package activity (26 Ci) is provided in Table 6.1-1. Each container will have the same radionuclide distribution and package activity for disposal as LLW.

- The U-235 FGE is 0.255 g.
- The Pu-239 PEC is 0.174 Ci.
- The TRU concentration is 10.8 nCi/g.
- The NRC Waste Classification is Class C.

Revisions

Rev. No.	Revision Description
0	Initial Issue

Sign Off

Rev. No.	Originator (Print / Sign & Date)	Verification/Checking Method	Verification/Checker (Print/Sign/Date)	Manager (Print/ Sign/Date)
0	C.D. Walters Digitally signed by e7661 Date: 2022.10.17 07:59:19 -04'00'	☐ Design Check (GS/PS only) ☒ Document Review ☐ Qualification Testing ☐ Alternate Calculation ☐ Operational Testing	R.J. Petras ROBERT PETRAS (Affiliate) Digitally signed by ROBERT PETRAS (Affiliate) Date: 2022.10.17 12:35:05 -04'00'	J.S. Kirk J. Scott Kirk Digitally signed by J. Scott Kirk Date: 2022.10.18 15:42:34 -04'00'
0		☐ Design Check (GS/PS only) ☒ Document Review ☐ Qualification Testing ☐ Alternate Calculation ☐ Operational Testing	M. Ngachin Merlin Ngachin Digitally signed by Merlin Ngachin Date: 2022.10.17 11:50:52 -04'00'	

Additional Reviewer (Print)	Signature	Date
N/A		N/A
Design Authority (Print) N/A	Signature	Date N/A
Release to Outside Agency (Print) N/A	Signature	Date N/A

Security Classification of the Calculation
Unclassified

TABLE OF CONTENTS

1.0 INTRODUCTION

The purpose of this calculation is to document the radiological characterization of the Defense Waste Processing Facility (DWPF) Melter glass pumps and bubblers in accordance with the requirements from the SRS Manual 1S to support off-site disposition as Low-Level Waste (LLW).

The DWPF Melter glass pumps/bubblers were used to increase the melt rate and have exceeded their design life. There are currently 67 glass bubblers/pumps (10 of 67 are glass pumps) and will continue to be generated during DWPF operation. Six glass pumps or bubblers will be placed into an inner container and then into an approved DOT shipping package for offsite transportation. To meet the offsite disposal facility void space requirements, DOT shipping external dose rate requirements, and load securement requirements, CLSM (Controlled Low Strength Material) [Ref. 8.8] will be added to the internal container to stabilize the contents and provide additional external dose shielding.

The waste form to be characterized consists of the following: The DWPF Melter bubblers [Ref. 8.12-8.14] or glass pumps [Ref. 8.15], polyethylene (PE) plastic sheeting and containment sleeving, and CLSM used for shielding and load securement.

Characterization is performed in accordance with SRS Manual 1S Chapter 3 [Ref. 8.1] to meet the requirements of SRS Manual 1S Chapter 5 [Ref. 8.2]. The waste form will be evaluated against NRC Waste Classification requirements of 10 CFR Part 61.55 [Ref. 8.11]. Savannah River National Lab (SRNL) Melter pour stream analytical results and process knowledge were used in this evaluation for characterization.

2.0 OPEN ITEMS

None

3.0 INPUTS

3.1. Measured and calculated radioanalytical data from sludge batches 1a, 1b, 2, 3, 4, 5 and 6 pour stream glass samples are provided in SRNL-STI-2012-00157, Rev. 0 [Ref. 8.3].

3.2. Measured and calculated radioanalytical data from the sludge batch 7a pour stream glass samples are provided in SRNL-STI-2012-00017, Rev. 1 [Ref. 8.4].

3.3. Measured and calculated radioanalytical data from the sludge batch 7b pour stream glass samples are provided in SRNL-STI-2013-00462, Rev. 0 [Ref. 8.5].

3.4. Measured and calculated radioanalytical data from the sludge batch 8 pour stream glass samples are provided in SRNL-STI-2018-00699, Rev. 0 [Ref. 8.6].

3.5. Measured and calculated radioanalytical data from the sludge batch 9 pour stream glass samples are provided in X-CLC-S-00464, Rev. 0 [Ref. 8.7].

3.6. The TRU, Fissile, and PA radionuclides are listed in 1S, Chapter 3 [Ref. 8.1].

3.7. The Maximum Allowable Lower Limit of Detection (MALLD) and package reporting thresholds for each radionuclide are listed in 1S, Chapter 3 [Ref. 8.1].

3.8. The Waste Dilution Factor (WDF) for SB7b is 2.3, provided in SRNL-STI-2013-00462 [Ref. 8.5].

3.9. The CLSM density is 115 lbs/ft^3 [Ref. 8.10].

3.10. Pu-239 PEC Weighting factors shown in Attachment 6 are from Consolidated Waste Tracking System (CWTS) reports [Ref. 8.9].

3.11. The U-235 FGE equivalence factors and specific activities are from SRS Manual 1S, Chapter 5 [Ref. 8.2].

3.12. The inner dimensions of the inner container are 12 ft (L) x 6 ft (W) x 3 ft (H) [Attachment 7 and Ref. 8.16].

4.0 ASSUMPTIONS

4.1 The inside of the bubblers/glass pumps do not contain glass.

Justification: The bubblers/glass pumps have a continuous flow of argon/air through them while installed which prohibits the buildup of glass inside the bubblers/glass pumps (Attachment 5).

4.2 The bubblers/glass pumps will be coated with 0.23 lbs. (0.10 kg) of glass.

Justification: The outer surfaces of the glass pumps contain the most amount of glass at 0.23 lbs. because there is more surface area for glass adhesion when compared to the bubblers.

In addition, both the bubblers and glass pumps are assumed to be submerged to the maximum melt pool level (Attachment 6). Therefore, assuming both waste items contain the same amount of glass is conservative and will result in the highest package activity.

4.3 The Cs-137 concentration for sludge batch 9 is determined using an average of batches 803-817 at 11.9 Ci/kg.

Justification: The most recent sludge batch (SB9) has the highest Cs-137 concentration due to the addition of Cs-137 loaded strip effluent from the Salt Waste Processing Facility (SWPF). Review of the sludge batch 9 records provided in Ref. 8.7 indicate a consistent increase of Cs-137 loading around batch 803. The Cs-137 concentration of 11.9 Ci/kg bounds all previous sludge batches and will provide the highest Cs-137 and package activity.

5.0 ANALYTICAL METHODS AND COMPUTATIONS

The DWPF Melter glass radionuclide distribution is applicable to both the DWPF Melter bubblers and glass pumps radionuclide distribution. The radiological characterization will determine the radionuclides represented in the DWPF Melter bubblers and glass pumps. The waste form will be characterized to meet the 1S requirements [Ref 8.1 & 8.2] and then evaluated against the NRC waste classification requirements found in 10 CFR Part 65.55 [Ref. 8.11] for offsite disposal as Class C Waste.

5.1 Radiological Characterization

5.1.1 Activity Calculations

Correlating a specific sludge batch to a distinct Melter glass pump or bubbler is not possible. Therefore, a conservative radionuclide distribution will be developed using all the sludge batches that have been processed through DWPF. The radionuclide data is taken from each sludge batch pour stream glass samples. A measured and calculated radionuclide concentration (determined using a Waste Dilution Factor (WDF)) is typically provided in the SRNL reports (I. 3.1-3.4). Sludge batch 7b (I. 3.3) did not provide a calculated radionuclide concentration in Ci/kg, therefore it was determined using Equation 1 with results in Attachment 1, Table A1-1.

$$\mathrm{SB7b} = \frac{\mathrm{SB7b\ WAPS}}{\mathrm{WDF}} \qquad \text{Equation (1)}$$

Where,

SB7b	=	Calculated sludge batch 7b radionuclide concentration, Ci/kg
SB7b WAPS	=	Sludge batch 7b Waste Acceptance Program Specification sample results, Ci/kg (I. 3.3)
WDF	=	Waste Dilution Factor (WDF), unitless (I. 3.8)

The maximum radionuclide concentration between the measured and calculated pour stream activity concentrations for all sludge batches shown in Attachment 1 is used to apply the 1S, Chapter 3 characterization methodology. The most recent sludge batch 9 has the highest Cs-137 concentration due to the increase in strip effluent from the Salt Waste Processing Facility (SWPF) (I. 3.5). The Cs-137 concentration for sludge batch 9 is determined using an average of Batches 803-817 at 11.9 Ci/kg (A. 4.3) shown in Attachment 1, Table A1-2. Maximum radionuclide concentration data for all the sludges batches was transferred from Attachment 1, Table A1-3 to Attachment 2, Table A2-1.

The Ci% is determined using the equation below.

$$\%A_i = \frac{A_i}{A_T} \qquad \text{Equation (2)}$$

Where,

A_i	=	Activity for radionuclide, i, Ci

$\%A_i$	=	Percent activity for radionuclide, i, Ci%
A_T	=	Total Activity (Ci)

The activity per bubbler or glass pump is determined using Equation 3. Glass is assumed to not be present on the inside of the glass pumps or bubblers (A. 4.1).

$$A_{i,1} = W_{Glass} \times A_{C,i} \qquad \text{Equation (3)}$$

Where,

$A_{i,1}$	=	Activity per radionuclide per bubbler/glass pump, i, Ci
W_{Glass}	=	Weight of glass, kg (A. 4.2)
$A_{C,i}$	=	Maximum activity concentration per radionuclide, i, Ci/kg

The package activity is then determined by the number of bubblers/glass pumps in the container. A total of 6 bubblers or glass pumps will be placed into the inner waste container. Therefore, the total package activity can be determined using the equation below.

$$A_{Package} = A_{i,1} \times N \qquad \text{Equation (4)}$$

Where,

$A_{Package}$	=	Package Activity, i, Ci
N	=	Number of glass pumps or bubblers (6) per package

The final activity for each radionuclide is provided in Attachment 2. Each radionuclide was then reported using 1S, Chapter 3 methodology and the analytical result was revised based on the following methodology:

1. The PA radionuclides (I. 3.6) were reported as follows:
    a. For detected PA radionuclides (i.e., C-14, Sr-90, Tc-99, I-129, U-234, U-235, Np-237) the result was not changed.
2. For TRU/Fissile radionuclides (I. 3.6):
    a. All detected TRU or Fissile radionuclides were reported.
    b. For non-detect TRU and Fissile radionuclides, the decay result of $0.1 \times MDA$ (i.e., Cm-247, Cm-248) is used for activity quantification since the MDA's are all above the MALLD (I. 3.7).
    c. Non-detect Bk-247 is not expected in the waste stream and was not reported.
3. For Non-PA, Non-TRU, and Non-Fissile radionuclides:
    a. Per 1S Manual Chapter 3, radionuclides were reported if their activity is greater than 1% of the total curie distribution and/or above the LLW Package Thresholds (I. 3.7).

4. Daughter radionuclides were determined as described in 1S, Chapter 3 [Ref. 8.1] as shown below.

    a. Ba-137m = 0.946 * Cs-137
    b. Pa-234m = 1.00 * U-238
    c. Th-234 = 1.00 * U-238
    d. Pa-233 = 1.00 * Np-237
    e. Th-231 = 1.00 * U-235
    f. Y-90 = 1.00 * Sr-90

The radionuclide screening process results are shown in Attachment 2 including the final normalized radionuclide distribution (Table A2-2).

5.1.2 U-235 FGE Calculation

U-235 Fissile Gram Equivalent (FGE) content is calculated based on information provided in 1S Chapter 5 [Ref. 8.2] along with the 1S Chapter 3 radionuclide screened activity shown in Attachment 2. The U-235 FGE radionuclides in the rad profile are U-233, U-235, Pu-239, Pu-241, Am-242m, Cm-245, Cm-247, Cf-249, and Cf-251.

$$\mathrm{FGE} = \sum \left(\frac{\mathrm{A_i}}{\mathrm{SpA_i}}\right) \times \mathrm{D_i} \qquad \text{Equation (5)}$$

Where,

A_i	=	Activity for nuclide, i, Ci
SpA_i	=	Specific activity of nuclide, i, Ci/g (I. 3.11)
D_i	=	Equivalence factor for nuclide, i (I. 3.11)
FGE	=	Total U-235 FGE from all radionuclides, g

The U-235 FGE is compared to the 50g limit in 1S Chapter 5 [Ref. 8.2]. The results of the U-235 FGE calculation for the radionuclides remaining after the screening process are provided in Attachment 3, Table A3-2.

5.1.3 Pu-239 PEC Calculation

The Pu-239 Plutonium Equivalent Curies (PEC) content is calculated using weighting factors downloaded from the CWTS reports and Equation 6.

$$\mathrm{PEC} = \sum \mathrm{A_i} \times \mathrm{W_i} \qquad \text{Equation (6)}$$

Where,

W_i	=	Weighting factor for nuclide, i (I. 3.10)
A_i	=	Activity of nuclide, i, Ci
PEC	=	Total Pu-239 PEC for all radionuclides

The PEC value is calculated for the radionuclides remaining after the screening process and is shown in Attachment 3, Table A3-2. The resulting PEC is compared to the maximum allowable value of 4 PEC per 1S Chapter 5 [Ref. 8.2].

5.1.4 TRU Concentration Calculation

Waste is considered TRU if it contains more than 100 nCi (alpha-emitting transuranic isotopes with half-lives greater than 20 years) per gram of waste. The TRU nuclides present in the DWPF glass are Np-237, Pu-238, Pu-239, Pu-240, Pu-242, Am-241, Am-242m, Am-243, Cm-245, Cm-246, Cm-247, Cm-248, Cf-249, and Cf-251.

$$AC_i = \frac{A_i}{W_W} \times 1E+09 \qquad \text{Equation (7)}$$

Where,

AC_i	=	Activity concentration for radionuclide, i, nCi/g
A_i	=	Activity of radionuclide, i, Ci
W_w	=	Total Waste Weight, g (Equation 8)
1E+09	=	Conversion factor from Ci to nCi

The waste weight is the weight of the CLSM shielding and bubbler/glass pumps. The inner waste container will be filled with CLSM to provide shielding and waste stabilization. The weight of the bubblers/glass pumps is relatively small when compared to the weight of the CLSM shielding and will be ignored for conservatism.

$$W_w = (L \times W \times H)\rho_{CLSM} \qquad \text{Equation (8)}$$

Where,

W_w	=	Waste Weight, lbs.
L	=	Inner Length of the waste container, ft (I. 3.12)
W	=	Inner Width of the waste container, ft (I. 3.12)
H	=	Inner Height of the waste container, ft (I. 3.12)
ρ_{CLSM}	=	Density of the CLSM, lbs./ft^3 (I. 3.9)

The waste weight is provided in Attachment 3, Table A3-1 and TRU concentration is provided in Attachment 3, Table A3-2.

5.1.5 NRC Waste Classification

The procedure for calculating the Nuclear Regulatory Commission (NRC) Waste Classification is outlined in 10 CFR 61.55 [Ref. 8.11]. Waste containing both long-lived and short-lived nuclides, such as the bounding activity for this waste, utilizes limits in 10 CFR 61.55 Table 1 (long-lived) and Table 2 (short-lived), along with the sum-of-fractions (SOF) methodology. The procedure for determining if waste is Class A, B, C, or Greater than Class C (GTCC) is outlined in Figure 5.1.5-1.

For those radionuclides based on an activity concentration (Ci/m^3 or Ci/g), those radionuclides' activity (Ci) was either divided by their waste volume (m^3) or weight (g). The waste volume (6.116 m^3) was determined using the internal waste container dimensions (I. 3.12). The waste weight is from Equation 8. The NRC Waste Classification table uses the decayed radionuclide activities prior to the 1S, Chapter 3 radiological screening. The SOF calculation is provided by the below equation provided in Attachment 4.

$$SOF = \sum \frac{ACD_i}{L_i} \qquad \text{Equation (9)}$$

Where,

ACD_i = Activity concentration of nuclide, i, nCi/g or Ci/m^3
L_i = Limit for nuclide, i, nCi/g or Ci/m^3 [Ref. 8.11]
SOF = Sum-of-Fractions based on all applicable nuclides

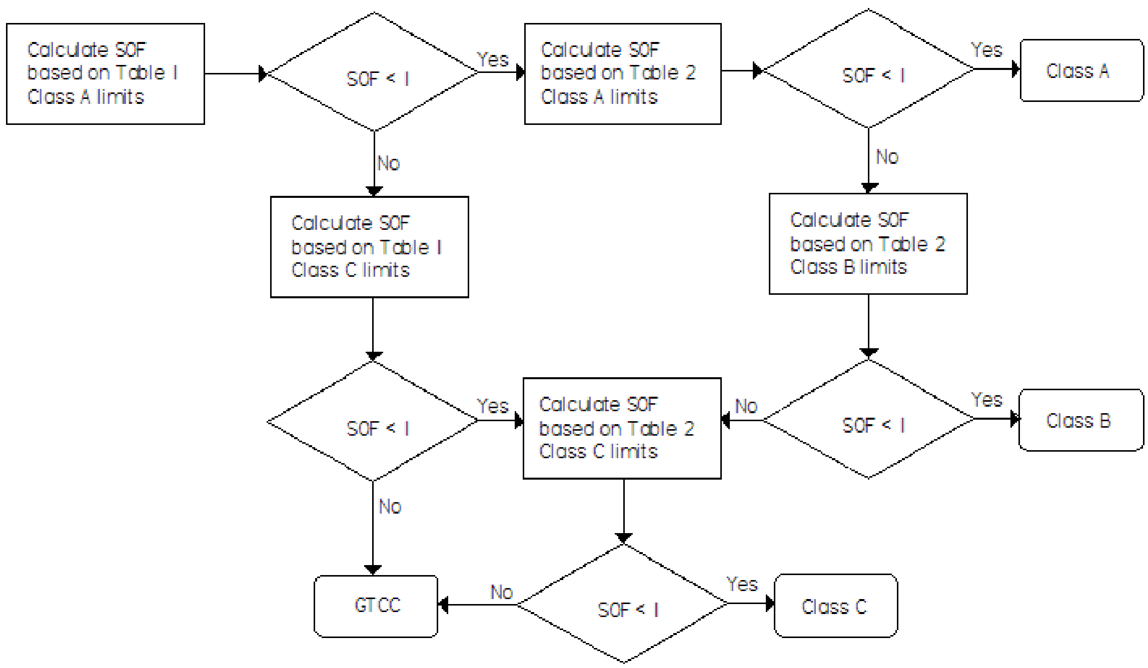

Figure 5.1.5-1: NRC Waste Classification Procedure

6.0 RESULTS

6.1 Activity Calculations

The activity calculations are provided in Attachment 5, Table A5-1 through A5-3. The radiological distribution is provided in Table 6.1-1 for one package.

Table 6.1-1: DWPF Melter Bubblers/Glass Pumps Radionuclide Distribution

DWPF Melter Bubblers/Glass Pumps Radionuclide Distribution		
Radionuclide	Activity Per Package (Ci)	Ci%
Am-241	1.00E-02	3.86E-02
Am-242m	6.13E-05	2.36E-04
Am-243	1.13E-03	4.34E-03
Ba-137m	7.03E+00	2.71E+01
C-14	1.05E-06	4.05E-06
Cf-249	5.50E-06	2.12E-05
Cf-251	1.56E-05	6.02E-05
Cm-244	4.01E-02	1.54E-01
Cm-245	5.32E-06	2.05E-05
Cm-246	1.75E-05	6.75E-05
Cm-247	7.95E-07	3.06E-06
Cm-248	8.33E-07	3.20E-06
Cs-137	7.43E+00	2.86E+01
I-129	1.15E-06	4.43E-06
Ni-59	7.08E-04	2.72E-03
Np-237	1.74E-05	6.70E-05
Pu-238	1.04E-01	4.00E-01
Pu-239	5.13E-03	1.97E-02
Pu-240	1.82E-03	6.99E-03
Pu-241	3.06E-02	1.18E-01
Pu-242	2.39E-06	9.21E-06
Sr-90	5.66E+00	2.18E+01
Tc-99	1.12E-04	4.31E-04
U-233	4.38E-05	1.69E-04
U-234	2.63E-05	1.01E-04
U-235	2.29E-07	8.82E-07
Y-90	5.66E+00	2.18E+01
Zr-93	3.38E-04	1.30E-03
Total	2.60E+01	1.00E+02

6.2 TRU Concentration

The TRU concentration for one package is 10.8 nCi/g as provided in Attachment 3.

6.3 U-235 FGE, and Pu-239 PEC

The U-235 FGE is 0.255 g and the Pu-239 PEC is 0.174 PEC as shown in Attachment 3.

6.4 NRC Waste Classification

The NRC waste classification is Class C as shown in Attachment 4.

7.0 CONCLUSION

The DWPF Melter bubbler/glass pumps radiological distribution and package activity (26 Ci) is provided in Table 6.1-1. Each container will have the same radionuclide distribution and package activity.

- The U-235 FGE is 0.255 g.
- The Pu-239 PEC is 0.174 Ci.
- The TRU concentration is 10.8 nCi/g.
- The NRC Waste Classification is Class C.

8.0 REFERENCES

8.1 SRS Manual 1S, Chapter 3, “Waste Characterization Program,” Rev. 5, January 28, 2021.

8.2 SRS Manual 1S, Chapter 5, “Low-Level Waste,” Rev. 2, February 11, 2021.

8.3 SRNL-STI-2012-00157, “Elimination of the Characterization of DWPF Pour Stream Sample and the Glass Fabrication and Testing of the DWPF Sludge Batch Qualification Sample,” Rev. 0, May 2012.

8.4 SRNL-STI-2012-00017, “Analysis of DWPF Sludge Batch 7a (Macrobatch 8) Pour Stream Samples,” Rev. 1, October 2012.

8.5 SRNL-STI-2013-00462, “Analysis of the Sludge Batch 7b (Macrobatch 9) DWPF Pour Stream Glass Sample,” Rev. 1, November 2020.

8.6 SRNL-STI-2018-00699, “Analysis of the Sludge Batch 8 (Macrobatch 10) DWPF Pour Stream Glass Sample,” Rev. 0, May 2019.

8.7 X-CLC-S-00464, “Reporting the Radionuclide Inventory for Macrobatch 11 Canisters,” Rev. 0, October 13, 2022.

8.8 SRR-CWDA-2020-00045, Rev. 0, “Characterization and Assessment of CLSM Grouts for Potential Use in Waste Tank Operations Closures,” June 22, 2022.

8.9 CWTS Reports Downloaded September 19, 2022, “LLW PEC 239,” v3.0.

8.10 N-CLC-S-00154, "DWPF Melter Bubbler and Glass Pump Transport Shielding Evaluation," Rev. 1, October 18, 2022.

8.11 10 CFR Part 61.55, "Waste Classification," December 2, 2015.

8.12 SRR-WSE-2011-00029, "Results of Melter Bubbler Inspection 1/5/11 & 1/6/11," Rev. 0, February 2011.

8.13 SRR5666-10-000041, Sheet 41, "DWPF Melter Bubbler Reusable Top Component Design B1 Lower Instrument Weldment", Rev. C, September 16, 2013.

8.14 SRR5666-10-000078, Sheet 78, "DWPF Melter Bubbler Reusable Top Component Design C4 Lower Instrument Weldment," Rev. C, September 16, 2013.

8.15 M-DCP-S-05001, "Glass Pump," Rev. 0, April 19, 2005.

8.16 M-SPP-H-00402, "DOT IP-1/IP-2 Container," Rev. 9, January 1, 2022.

ATTACHMENTS

1. Radionuclide Data
2. Radionuclide Analysis
3. Waste Weight, U-235 FGE, Pu-239 PEC, and TRU
4. NRC Waste Classification
5. Email Supporting Assumption 4.1
6. Glass Pumps/Bubblers Glass Weight
7. Container Dimensions

Attachment 1: Radionuclide Data

Table A1-1: Sludge Batch 7b Radionuclide Data

	Sludge Batch 7b	
	SRNL-STI-2013-00462, R0	
Radionuclide	SB7b WAPS (Ci/kg)	Calculated Concentration in Glass (Ci/kg) - Equation 1
C-14	-	-
Cl-36	<4.1E-06	<1.78E-06
Ni-59	2.60E-03	1.13E-03
Ni-63	1.60E-01	6.96E-02
Se-79	1.50E-05	6.52E-06
Sr-90	1.30E+01	5.65E+00
Zr-93	4.60E-04	2.00E-04
Nb-93m	4.20E-04	1.83E-04
Tc-99	9.70E-05	4.22E-05
Rh-106	-	-
Ru-106	-	-
Cd-113m	3.30E-03	1.43E-03
Sn-121m	5.00E-04	2.17E-04
Sn-126	<7.0E-04	<3.04E-04
I-129	-	-
Cs-134	-	-
Cs-135	-	-
Cs-137	6.40E-01	2.78E-01
Ce-144	-	-
Pm-147	-	-
Sm-151	2.50E-01	1.09E-01
Th-229	-	-
Th-232	1.20E-06	5.22E-07
U-233	4.20E-05	1.83E-05
U-234	4.10E-05	1.78E-05
U-235	6.10E-07	2.65E-07
U-236	9.00E-07	3.91E-07
U-238	1.60E-05	6.96E-06
Np-237	2.50E-05	1.09E-05
Pu-238	1.40E-01	6.09E-02
Pu-239	1.10E-02	4.78E-03
Pu-240	3.60E-03	1.57E-03
Pu-241	5.10E-02	2.22E-02
Pu-242	<9.0E-06	<3.91E-06
Am-241	3.60E-02	1.57E-02
Am-242m	-	-
Am-243	5.00E-04	2.17E-04
Cm-244	1.80E-02	7.83E-03
Cm-245	-	-
Cm-246	6.60E-06	2.87E-06
Cm-247	-	-
Cm-248	-	-
Bk-247	-	-
Cf-249	-	-
Cf-251	-	-

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Table A1-2: Sludge Batch 9 Recent Batch Data and Cs-137 concentration [Ref. 8.7]

LIMS Data for Cs-137 Content			Calculated		
Input 7			Equation 10		Average Cs-137 Concentration (Batches 803-817)
Batch	Sample ID	Cs-137 Content	Cs-137 Content		Ci/kg
		bq/gm	Ci/g	Ci/Canister	1.19E+01
817	30058	2.02E+08	5.46E-03	9.91E+03	
816	29803	6.93E+08	1.87E-02	3.40E+04	
815	29502	4.76E+08	1.29E-02	2.33E+04	
814	29476	5.19E+08	1.40E-02	2.55E+04	
813	29393	6.31E+08	1.71E-02	3.09E+04	
812	29283	5.47E+08	1.48E-02	2.68E+04	
811	29173	2.29E+08	6.18E-03	1.12E+04	
810	28944	4.20E+08	1.13E-02	2.06E+04	
809	28844	3.04E+08	8.22E-03	1.49E+04	
808	28682	6.50E+08	1.76E-02	3.19E+04	
807	28623	4.52E+08	1.22E-02	2.22E+04	
806	28529	3.55E+08	9.59E-03	1.74E+04	
805	28470	3.84E+08	1.04E-02	1.88E+04	
804	28354	3.54E+08	9.56E-03	1.73E+04	
803	28312	3.76E+08	1.02E-02	1.84E+04	
802	28222	2.51E+08	6.79E-03	1.23E+04	
801	28131	1.45E+08	3.92E-03	7.11E+03	
800	27988	3.76E+08	1.02E-02	1.84E+04	
799	27881	3.57E+08	9.64E-03	1.75E+04	
798	27807	3.93E+08	1.06E-02	1.93E+04	
797	27774	1.83E+08	4.95E-03	8.97E+03	
796	27624	1.22E+08	3.31E-03	6.00E+03	
795	27406	2.43E+07	6.57E-04	1.19E+03	
Average		3.67E+08	9.92E-03	**1.80E+04**	

Note 1: Average Cs-137 Concentration (Ci/kg) = (Cs-137 Concentration Average over Batches 803-817 (Ci/g)) * 1000 g/kg

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Table A1-3: Radionuclide Data

	Sludge Batch 9	
	X-CLC-S-00464, R0	
Radionuclide	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)
C-14	-	-
Cl-36	1.68E-05	-
Ni-59	2.35E-04	-
Ni-63	2.66E-02	-
Se-79	1.77E-05	-
Sr-90	3.17E+00	-
Zr-93	1.09E-04	-
Nb-93m	9.30E-05	-
Tc-99	1.17E-04	-
Rh-106	-	-
Ru-106	-	-
Cd-113m	-	-
Sn-121m	-	-
Sn-126	1.71E-05	-
I-129	1.84E-06	-
Cs-134	-	-
Cs-135	2.04E-06	-
Cs-137	1.19E+01	-
Ce-144	-	-
Pm-147	-	-
Sm-151	5.58E-02	-
Ac-227	4.73E-07	-
Th-229	9.97E-08	-
Pa-231	<1.06E-05	-
Th-232	-	-
U-233	2.81E-05	-
U-234	2.02E-05	-
U-235	-	-
U-236	-	-
U-238	4.21E-06	-
Np-237	8.16E-06	-
Pu-238	5.49E-02	-
Pu-239	2.33E-03	-
Pu-240	8.28E-04	-
Pu-241	1.14E-02	-
Pu-242	1.83E-06	-
Am-241	7.27E-03	-
Am-242m	-	-
Am-243	7.52E-05	-
Cm-244	2.47E-03	-
Cm-245	-	-
Cm-246	1.20E-06	-
Cm-247	-	-
Cm-248	-	-
Bk-247	-	-
Cf-249	-	-
Cf-251	-	-

Table A1-3: Radionuclide Data (continued)

	Sludge Batch 8		Sludge Batch 7b	
	SRNL-STI-2018-00699, R0		SRNL-STI-2013-00462, R0	
Radionuclide	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)
C-14	-	-	-	-
Cl-36	-	-	<1.78E-06	-
Ni-59	3.94E-04	-	1.13E-03	-
Ni-63	4.82E-02	-	6.96E-02	-
Se-79	5.44E-06	-	6.52E-06	-
Sr-90	4.91E+00	5.43E+00	5.65E+00	4.60E+00
Zr-93	3.67E-04	3.00E-04	2.00E-04	1.60E-04
Nb-93m	3.26E-04	-	1.83E-04	-
Tc-99	1.79E-04	3.11E-05	4.22E-05	7.10E-06
Rh-106	-	-	-	-
Ru-106	-	-	-	-
Cd-113m	1.11E-03	-	1.43E-03	-
Sn-121m	-	-	2.17E-04	-
Sn-126	1.47E-04	9.26E-05	<3.04E-04	-
I-129	-	-	-	-
Cs-134	-	-	-	-
Cs-135	2.38E-06	<5.08E-06	-	-
Cs-137	4.26E-01	9.25E-01	2.78E-01	7.90E-01
Ce-144	-	-	-	-
Pm-147	-	-	-	-
Sm-151	8.42E-02	-	1.09E-01	-
Ac-227	-	-	-	-
Th-229	1.29E-07	-	-	-
Pa-231	-	-	-	-
Th-232	4.68E-07	4.27E-07	5.22E-07	4.80E-07
U-233	3.14E-05	3.28E-05	1.83E-05	<3.8E-05
U-234	2.35E-05	2.24E-05	1.78E-05	<2.4E-05
U-235	2.83E-07	2.42E-07	2.65E-07	2.40E-07
U-236	5.28E-07	4.90E-07	3.91E-07	4.00E-07
U-238	6.54E-06	5.62E-06	6.96E-06	6.80E-06
Np-237	1.31E-05	1.02E-05	1.09E-05	9.20E-06
Pu-238	1.02E-01	6.85E-02	6.09E-02	5.40E-02
Pu-239	4.07E-03	3.64E-03	4.78E-03	4.80E-03
Pu-240	1.48E-03	1.25E-03	1.57E-03	1.50E-03
Pu-241	2.05E-02	1.28E-02	2.22E-02	1.80E-02
Pu-242	3.82E-06	1.75E-06	<3.91E-06	<1.5E-05
Am-241	1.43E-02	1.20E-02	1.57E-02	1.50E-02
Am-242m	7.37E-05	-	-	-
Am-243	9.83E-04	-	2.17E-04	-
Cm-244	3.30E-02	-	7.83E-03	-
Cm-245	5.65E-06	-	-	-
Cm-246	1.62E-05	-	2.87E-06	-
Cm-247	-	-	-	-
Cm-248	-	-	-	-
Bk-247	-	-	-	-
Cf-249	8.78E-06	-	-	-
Cf-251	2.50E-05	-	-	-

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Table A1-3: Radionuclide Data (continued)

	Sludge Batch 7a		Sludge Batch 6	
	SRNL-STI-2012-00017, R1		SRNL-STI-2012-00157, R0	
Radionuclide	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)
C-14	-	-	-	-
Cl-36	-	-	-	-
Ni-59	6.50E-04	-	4.70E-04	-
Ni-63	1.10E-02	-	4.70E-02	-
Se-79	3.30E-06	-	3.90E-06	-
Sr-90	6.10E+00	3.90E+00	8.10E+00	5.90E+00
Zr-93	2.30E-04	5.40E-04	2.00E-04	5.30E-04
Nb-93m	2.00E-04	-	1.60E-04	-
Tc-99	4.30E-05	1.80E-05	<4.8E-05	<1.3E-04
Rh-106	-	-	-	-
Ru-106	-	-	-	-
Cd-113m	-	-	-	-
Sn-121m	-	-	<2.0E-03	-
Sn-126	<2.8E-04	-	<6.4E-05	-
I-129	-	-	-	-
Cs-134	-	-	-	-
Cs-135	-	-	-	-
Cs-137	2.60E-01	4.30E-01	1.70E+00	1.30E+00
Ce-144	-	-	-	-
Pm-147	-	-	-	-
Sm-151	1.00E-01	-	1.10E-01	-
Ac-227	-	-	-	-
Th-229	-	-	-	-
Pa-231	-	-	-	-
Th-232	7.00E-07	6.50E-07	1.00E-06	9.30E-07
U-233	5.70E-05	<2.4E-04	3.80E-05	7.00E-05
U-234	2.10E-05	<1.4E-04	3.60E-05	4.20E-05
U-235	2.80E-07	2.90E-07	2.60E-07	2.30E-07
U-236	4.80E-07	<7.9E-07	5.50E-07	6.30E-07
U-238	6.50E-06	7.00E-06	5.10E-06	5.10E-06
Np-237	9.60E-06	<1.9E-05	1.50E-05	1.70E-05
Pu-238	7.80E-02	7.90E-02	1.60E-01	1.40E-01
Pu-239	5.70E-03	6.10E-03	7.70E-03	7.70E-03
Pu-240	1.80E-03	<4.5E-03	2.80E-03	2.90E-03
Pu-241	2.40E-02	2.40E-02	<3.5E-02	3.70E-02
Pu-242	<1.0E-05	<5.6E-05	<6.4E-06	<1.4E-05
Am-241	1.60E-02	1.50E-02	1.40E-02	1.40E-02
Am-242m	-	-	9.80E-05	-
Am-243	2.50E-04	-	1.80E-03	-
Cm-244	8.30E-03	-	6.40E-02	-
Cm-245	-	-	8.50E-06	-
Cm-246	3.20E-06	-	2.80E-05	-
Cm-247	-	-	-	-
Cm-248	-	-	<3.0E-06	-
Bk-247	-	-	-	-
Cf-249	-	-	<9.8E-06	-
Cf-251	<4.0E-06	-	<2.3E-05	-

Table A1-3: Radionuclide Data (continued)

	Sludge Batch 5 SRNL-STI-2012-00157, R0		Sludge Batch 4 SRNL-STI-2012-00157, R0	
Radionuclide	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)
C-14	-	-	-	-
Cl-36	<3.92E-04	-	-	-
Ni-59	5.22E-04	-	2.57E-04	-
Ni-63	4.46E-02	-	2.98E-02	-
Se-79	-	-	7.29E-06	-
Sr-90	9.04E+00	5.03E+00	3.27E+00	2.85E+00
Zr-93	2.10E-04	3.53E-04	1.19E-04	1.76E-04
Nb-93m	1.58E-04	-	9.46E-05	-
Tc-99	6.14E-05	4.74E-05	6.38E-05	<5.51E-05
Rh-106	<1.26E-04	-	-	-
Ru-106	<1.26E-04	-	-	-
Cd-113m	-	-	-	-
Sn-121m	-	-	-	-
Sn-126	<1.38E-04	-	<1.47E-04	-
I-129	-	-	-	-
Cs-134	<3.56E-04	-	-	-
Cs-135	-	-	-	-
Cs-137	1.45E-01	1.67E-01	1.13E-01	1.03E-01
Ce-144	<2.9E-04	-	-	-
Pm-147	<2.90E-04	-	-	-
Sm-151	7.31E-02	-	5.11E-02	-
Ac-227	-	-	-	-
Th-229	-	-	-	-
Pa-231	-	-	-	-
Th-232	-	-	-	-
U-233	8.92E-06	<1.56E-05	<8.64E-06	<2.36E-05
U-234	2.47E-05	2.38E-05	1.54E-05	1.64E-05
U-235	2.81E-07	2.79E-07	2.90E-07	2.41E-07
U-236	5.38E-07	5.29E-07	3.67E-07	3.27E-07
U-238	6.71E-06	6.37E-06	8.01E-06	6.36E-06
Np-237	2.78E-05	1.91E-05	1.18E-05	9.33E-06
Pu-238	1.11E-01	1.66E-01	5.52E-02	3.78E-02
Pu-239	8.19E-03	6.69E-03	4.66E-03	4.45E-03
Pu-240	2.65E-03	2.06E-03	2.04E-03	1.87E-03
Pu-241	3.91E-02	3.49E-02	4.89E-02	<1.27E-02
Pu-242	2.74E-06	<1.58e-05	2.64E-06	<1.60E-05
Am-241	1.31E-02	1.06E-02	7.96E-03	7.66E-03
Am-242m	<1.75E-04	-	3.17E-05	-
Am-243	3.87E-04	-	7.42E-04	-
Cm-244	1.85E-02	-	4.10E-02	-
Cm-245	<1.72E-04	-	<1.38E-05	-
Cm-246	5.18E-06	-	8.60E-06	-
Cm-247	-	-	<2.56E-06	-
Cm-248	-	-	<2.67E-06	-
Bk-247	-	-	<6.15E-05	-
Cf-249	-	-	-	-
Cf-251	<9.28E-06	-	<8.51E-06	-

Table A1-3: Radionuclide Data (continued)

Radionuclide	Sludge Batch 3 SRNL-STI-2012-00157, R0 Calculated Concentration in Glass (Ci/kg)	Sludge Batch 3 SRNL-STI-2012-00157, R0 Measured Concentration in Glass (Ci/kg)	Sludge Batch 2 SRNL-STI-2012-00157, R0 Calculated Concentration in Glass (Ci/kg)	Sludge Batch 2 SRNL-STI-2012-00157, R0 Measured Concentration in Glass (Ci/kg)
C-14	-	-	-	-
Cl-36	-	-	-	-
Ni-59	3.17E-04	-	1.26E-04	-
Ni-63	2.59E-02	-	8.23E-03	-
Se-79	<9.42E-06	-	2.50E-05	-
Sr-90	2.32E+00	1.89E+00	1.82E+00	1.47E+00
Zr-93	2.12E-05	2.13E-04	5.46E-05	1.51E-04
Nb-93m	-	-	-	-
Tc-99	9.38E-05	5.92E-05	5.06E-05	4.63E-05
Rh-106	-	-	-	-
Ru-106	-	-	-	-
Cd-113m	-	-	-	-
Sn-121m	1.12E-03	-	1.46E-03	-
Sn-126	6.79E-06	-	1.80E-05	-
I-129	-	-	-	-
Cs-134	-	-	-	-
Cs-135	-	-	-	-
Cs-137	1.51E-01	1.45E-01	1.10E-01	8.64E-02
Ce-144	-	-	-	-
Pm-147	-	-	-	-
Sm-151	9.38E-02	8.89E-02	7.11E-02	6.95E-02
Ac-227	-	-	-	-
Th-229	-	-	-	-
Pa-231	-	-	-	-
Th-232	-	-	-	-
U-233	7.46E-06	4.30E-06	4.30E-06	5.12E-06
U-234	1.45E-05	1.35E-05	1.43E-05	1.64E-05
U-235	3.49E-07	3.66E-07	2.64E-07	2.96E-07
U-236	4.05E-07	4.16E-07	3.79E-07	4.53E-07
U-238	1.08E-05	9.94E-06	1.02E-05	9.65E-06
Np-237	1.58E-05	-	5.34E-06	5.74E-06
Pu-238	1.24E-02	1.32E-02	1.55E-02	1.24E-02
Pu-239	6.56E-03	7.55E-03	3.08E-03	4.02E-03
Pu-240	2.30E-03	2.40E-03	9.56E-04	1.27E-03
Pu-241	2.59E-02	2.83E-02	1.12E-02	8.48E-03
Pu-242	2.61E-06	1.72E-06	1.84E-06	3.01E-06
Am-241	8.85E-03	7.86E-03	1.31E-02	1.03E-02
Am-242m	<4.27E-05	-	-	-
Am-243	7.42E-04	7.53E-04	2.14E-04	1.92E-04
Cm-244	3.35E-02	-	1.78E-02	-
Cm-245	5.22E-06	-	1.55E-06	-
Cm-246	7.75E-06	-	9.96E-06	-
Cm-247	<1.27E-05	-	-	-
Cm-248	<1.33E-05	-	-	-
Bk-247	-	-	-	-
Cf-249	<1.35E-05	-	-	-
Cf-251	<1.07E-05	-	4.78E-06	-

Table A1-3: Radionuclide Data (continued)

	Sludge Batch 1b		Sludge Batch 1a	
	SRNL-STI-2012-00157, R0		SRNL-STI-2012-00157, R0	
Radionuclide	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)
C-14	1.68E-06	<7.4E-08	-	-
Cl-36	-	-	-	-
Ni-59	1.82E-05	-	6.62E-06	-
Ni-63	3.21E-03	-	1.29E-03	-
Se-79	<1.6E-05	-	3.83E-06	-
Sr-90	1.62E+00	1.40E+00	2.13E-01	2.00E-01
Zr-93	3.14E-05	1.00E-04	1.85E-05	2.00E-05
Nb-93m	2.50E-05	-	1.46E-05	-
Tc-99	7.18E-05	7.00E-05	7.67E-05	8.00E-05
Rh-106	-	-	-	-
Ru-106	-	-	-	-
Cd-113m	-	-	-	-
Sn-121m	<4.8E-04	-	-	-
Sn-126	<3.0E-06	-	2.26E-06	-
I-129	4.16E-07	4.10E-08	-	-
Cs-134	-	-	-	-
Cs-135	-	-	-	-
Cs-137	6.07E-02	5.00E-02	2.20E-02	2.10E-02
Ce-144	-	-	-	-
Pm-147	-	-	-	-
Sm-151	2.41E-02	2.10E-02	4.18E-03	6.60E-03
Ac-227	-	-	-	-
Th-229	2.51E-08	-	4.53E-08	-
Pa-231	-	-	-	-
Th-232	-	-	-	-
U-233	1.66E-05	1.70E-05	9.06E-06	1.10E-05
U-234	1.10E-05	1.30E-05	9.06E-06	9.40E-06
U-235	1.07E-07	1.20E-07	1.22E-07	1.10E-07
U-236	2.82E-07	4.10E-07	2.93E-07	2.80E-07
U-238	2.47E-06	3.00E-06	3.83E-06	2.90E-06
Np-237	4.92E-06	5.90E-06	4.88E-06	5.10E-06
Pu-238	3.80E-02	3.30E-02	4.88E-02	2.90E-02
Pu-239	1.87E-03	1.90E-03	2.37E-03	1.90E-03
Pu-240	6.79E-04	6.60E-04	6.27E-04	6.80E-04
Pu-241	1.08E-02	1.60E-02	1.11E-02	1.00E-02
Pu-242	1.42E-06	1.10E-06	5.57E-07	1.30E-06
Am-241	2.54E-03	2.30E-03	2.16E-03	2.40E-03
Am-242m	-	-	-	-
Am-243	2.16E-05	2.00E-05	1.32E-05	2.40E-05
Cm-244	1.69E-03	2.50E-03	4.18E-03	2.80E-03
Cm-245	-	-	1.99E-07	-
Cm-246	1.55E-05	1.60E-05	1.92E-06	-
Cm-247	-	-	-	-
Cm-248	-	-	-	-
Bk-247	-	-	-	-
Cf-249	-	-	-	-
Cf-251	-	-	-	-

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Table A1-3: Radionuclide Data (continued)

Radionuclide	Maximum Calculated or Measured Concentration (Ci/kg)	Maximum MDA (Ci/kg)
C-14	1.68E-06	
Cl-36	1.68E-05	3.92E-04
Ni-59	1.13E-03	
Ni-63	6.96E-02	
Se-79	2.50E-05	
Sr-90	9.04E+00	
Zr-93	5.40E-04	
Nb-93m	3.26E-04	
Tc-99	1.79E-04	
Rh-106	0.00E+00	1.26E-04
Ru-106	0.00E+00	1.26E-04
Cd-113m	1.43E-03	
Sn-121m	1.46E-03	
Sn-126	1.47E-04	
I-129	1.84E-06	
Cs-134	0.00E+00	3.56E-04
Cs-135	2.38E-06	
Cs-137	1.19E+01	
Ce-144	0.00E+00	2.90E-04
Pm-147	0.00E+00	2.90E-04
Sm-151	1.10E-01	
Ac-227	4.73E-07	
Th-229	1.29E-07	
Pa-231	0.00E+00	1.06E-05
Th-232	1.00E-06	
U-233	7.00E-05	
U-234	4.20E-05	
U-235	3.66E-07	
U-236	6.30E-07	
U-238	1.08E-05	
Np-237	2.78E-05	
Pu-238	1.66E-01	
Pu-239	8.19E-03	
Pu-240	2.90E-03	
Pu-241	4.89E-02	
Pu-242	3.82E-06	
Am-241	1.60E-02	
Am-242m	9.80E-05	
Am-243	1.80E-03	
Cm-244	6.40E-02	
Cm-245	8.50E-06	
Cm-246	2.80E-05	
Cm-247	0.00E+00	1.27E-05
Cm-248	0.00E+00	1.33E-05
Bk-247	0.00E+00	6.15E-05
Cf-249	8.78E-06	
Cf-251	2.50E-05	

Attachment 2: Radionuclide Analysis

Table A2-1: Radionuclide Analaysis

Radionuclide	Category	Maximum Calculated or Measured Concentration (Ci/kg)	Maximum MDA (Ci/kg)	Compare to MALLD (Ci/kg)	Initial Concentration (Ci/kg)	Initial Ci %, Equation 2	Initial Activity (Ci) Per Bubbler or Glass Pump Equation 3	Initial Package Activity (Ci) -- 6 Bubblers or Glass Pumps Equation 4	Package Reporting Threshold (Ci/pkg)	Revised Package Activity (Ci)	Revised Ci % Equation 2	Reasons for Inclusion in & Exclusion From Final Distribution
C-14	PA	1.68E-06			1.68E-06	4.03E-06	1.75E-07	1.05E-06		1.05E-06	4.05E-06	Detected PA
Cl-36		1.68E-05	3.92E-04	No MALLD, Remove								MDA, No MALLD
Ni-59		1.13E-03			1.13E-03	2.71E-03	1.18E-04	7.08E-04	4.10E-04	7.08E-04	2.72E-03	>Ci/pkg Threshold
Ni-63		6.96E-02			6.96E-02	1.67E-01	7.26E-03	4.35E-02	1.00E+01			<1% & < Ci/pkg Threshold
Se-79		2.50E-05			2.50E-05	6.00E-05	2.61E-06	1.56E-05	7.50E-02			<1% & < Ci/pkg Threshold
Sr-90	PA	9.04E+00			9.04E+00	2.17E+01	9.43E-01	5.66E+00		5.66E+00	2.18E+01	Detected PA & >1%
Zr-93		5.40E-04			5.40E-04	1.30E-03	5.63E-05	3.38E-04	1.60E-05	3.38E-04	1.30E-03	>Ci/pkg Threshold
Nb-93m		3.26E-04			3.26E-04	7.82E-04	3.40E-05	2.04E-04	1.00E+01			<1% & < Ci/pkg Threshold
Tc-99	PA	1.79E-04			1.79E-04	4.29E-04	1.87E-05	1.12E-04		1.12E-04	4.31E-04	Detected PA
Rh-106		0.00E+00	1.26E-04	No MALLD, Remove								MDA, No MALLD
Ru-106		0.00E+00	1.26E-04	No MALLD, Remove								MDA, No MALLD
Cd-113m		1.43E-03			1.43E-03	3.44E-03	1.50E-04	8.98E-04	3.10E+00			<1% & < Ci/pkg Threshold
Sn-121m		1.46E-03			1.46E-03	3.50E-03	1.52E-04	9.14E-04	8.90E-02			<1% & < Ci/pkg Threshold
Sn-126		1.47E-04			1.47E-04	3.53E-04	1.53E-05	9.20E-05	2.00E-04			<1% & < Ci/pkg Threshold
I-129	PA	1.84E-06			1.84E-06	4.41E-06	1.92E-07	1.15E-06		1.15E-06	4.43E-06	Detected PA
Cs-134		0.00E+00	3.56E-04	No MALLD, Remove								MDA, No MALLD
Cs-135		2.38E-06			2.38E-06	5.71E-06	2.48E-07	1.49E-06	3.20E-05			<1% & < Ci/pkg Threshold
Cs-137		1.19E+01			1.19E+01	2.85E+01	1.24E+00	7.43E+00	3.30E-01	7.43E+00	2.86E+01	>1% & >Ci/pkg Threshold
Ce-144		0.00E+00	2.90E-04	No MALLD, Remove								MDA, No MALLD
Pm-147		0.00E+00	2.90E-04	No MALLD, Remove								MDA, No MALLD
Sm-151		1.10E-01			1.10E-01	2.64E-01	1.15E-02	6.89E-02	1.00E+01			<1% & < Ci/pkg Threshold
Ac-227		4.73E-07			4.73E-07	1.14E-06	4.94E-08	2.96E-07	7.80E-04			<1% & < Ci/pkg Threshold
Th-229		1.29E-07			1.29E-07	3.09E-07	1.35E-08	8.07E-08	2.40E-03			<1% & < Ci/pkg Threshold
Pa-231		0.00E+00	1.06E-05	No MALLD, Remove								MDA, No MALLD
Th-232		1.00E-06			1.00E-06	2.40E-06	1.04E-07	6.26E-07	1.80E-04			<1% & < Ci/pkg Threshold
U-233	Fissile	7.00E-05			7.00E-05	1.68E-04	7.30E-06	4.38E-05		4.38E-05	1.69E-04	Detected Fissile
U-234	PA	4.20E-05			4.20E-05	1.01E-04	4.38E-06	2.63E-05		2.63E-05	1.01E-04	Detected PA
U-235	PA/Fissile	3.66E-07			3.66E-07	8.78E-07	3.82E-08	2.29E-07		2.29E-07	8.82E-07	Detected PA/Fissile
U-236		6.30E-07			6.30E-07	1.51E-06	6.57E-08	3.94E-07	9.80E-03			<1% & < Ci/pkg Threshold
U-238		1.08E-05			1.08E-05	2.59E-05	1.13E-06	6.76E-06	3.10E-02			<1% & < Ci/pkg Threshold
Np-237	PA/TRU	2.78E-05			2.78E-05	6.67E-05	2.90E-06	1.74E-05		1.74E-05	6.70E-05	Detected PA/TRU
Pu-238	TRU	1.66E-01			1.66E-01	3.98E-01	1.73E-02	1.04E-01		1.04E-01	4.00E-01	Detected TRU
Pu-239	TRU/Fissile	8.19E-03			8.19E-03	1.96E-02	8.54E-04	5.13E-03		5.13E-03	1.97E-02	Detected TRU/Fissile
Pu-240	TRU	2.90E-03			2.90E-03	6.96E-03	3.03E-04	1.82E-03		1.82E-03	6.99E-03	Detected TRU
Pu-241	Fissile	4.89E-02			4.89E-02	1.17E-01	5.10E-03	3.06E-02		3.06E-02	1.18E-01	Detected Fissile
Pu-242	TRU	3.82E-06			3.82E-06	9.16E-06	3.99E-07	2.39E-06		2.39E-06	9.21E-06	Detected TRU

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Table A2-1: Radionuclide Analaysis (Continued)

Radionuclide	Category	Maximum Calculated or Measured Concentration (Ci/kg)	Maximum MDA (Ci/kg)	Compare to MALLD (Ci/kg)	Initial Concentration (Ci/kg)	Initial Ci %, Equation 2	Initial Activity (Ci) Per Bubbler or Glass Pump Equation 3	Initial Package Activity (Ci) -- 6 Bubblers or Glass Pumps Equation 4	Package Reporting Threshold (Ci/pkg)	Revised Package Activity (Ci)	Revised Ci % Equation 2	Reasons for Inclusion in & Exclusion From Final Distribution
Am-241	TRU	1.60E-02			1.60E-02	3.84E-02	1.67E-03	1.00E-02		1.00E-02	3.86E-02	Detected TRU
Am-242m	TRU/Fissile	9.80E-05			9.80E-05	2.35E-04	1.02E-05	6.13E-05		6.13E-05	2.36E-04	Detected TRU/Fissile
Am-243	TRU	1.80E-03			1.80E-03	4.32E-03	1.88E-04	1.13E-03		1.13E-03	4.34E-03	Detected TRU
Cm-244		6.40E-02			6.40E-02	1.54E-01	6.68E-03	4.01E-02	9.80E-03	4.01E-02	1.54E-01	> Ci/pkg Threshold
Cm-245	TRU/Fissile	8.50E-06			8.50E-06	2.04E-05	8.87E-07	5.32E-06		5.32E-06	2.05E-05	Detected TRU/Fissile
Cm-246	TRU	2.80E-05			2.80E-05	6.72E-05	2.92E-06	1.75E-05		1.75E-05	6.75E-05	Detected TRU
Cm-247	TRU/Fissile	0.00E+00	1.27E-05	1E-09 Ci/kg, Keep (Reduce by Factor of 10)	1.27E-06	3.05E-06	1.32E-07	7.95E-07		7.95E-07	3.06E-06	Non-Detect TRU/Fissile, 0.1 X LLD
Cm-248	TRU	0.00E+00	1.33E-05	1E-09 Ci/kg, Keep (Reduce by Factor of 10)	1.33E-06	3.19E-06	1.39E-07	8.33E-07		8.33E-07	3.20E-06	Non-Detect TRU, 0.1 X LLD
Bk-247	TRU	0.00E+00	6.15E-05	Removed due to Process Knowledge (No plausible production mechanism)								Removed due to Process Knowledge (No plausible production mechanism)
Cf-249	TRU/Fissile	8.78E-06			8.78E-06	2.11E-05	9.16E-07	5.50E-06		5.50E-06	2.12E-05	Detected TRU/Fissile
Cf-251	TRU/Fissile	2.50E-05			2.50E-05	6.00E-05	2.61E-06	1.56E-05		1.56E-05	6.02E-05	Detected TRU/Fissile
Daughters												
Ba-137m					1.12E+01	2.70E+01	1.17E+00	7.03E+00	1.00E+01	7.03E+00	2.71E+01	>1%
Pa-234m					1.08E-05	2.59E-05	1.13E-06	6.76E-06	1.00E+01			<1% & < Ci/pkg Threshold
Th-234					1.08E-05	2.59E-05	1.13E-06	6.76E-06	1.00E+01			<1% & < Ci/pkg Threshold
Pa-233					2.78E-05	6.67E-05	2.90E-06	1.74E-05	1.00E+01			<1% & < Ci/pkg Threshold
Th-231					3.66E-07	8.78E-07	3.82E-08	2.29E-07	1.00E+01			<1% & < Ci/pkg Threshold
Y-90					9.04E+00	2.17E+01	9.43E-01	5.66E+00	1.00E+01	5.66E+00	2.18E+01	>1%
Total					4.17E+01	1.00E+02	4.35E+00	2.61E+01		2.60E+01	1.00E+02	

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Table A2-2: DWPF Glass Pumps/Bubblers Radionuclide Distribution

Final Radionuclide Distribution		
Radionuclide	Activity Per Package (Ci)	Ci%
Am-241	1.00E-02	3.86E-02
Am-242m	6.13E-05	2.36E-04
Am-243	1.13E-03	4.34E-03
Ba-137m	7.03E+00	2.71E+01
C-14	1.05E-06	4.05E-06
Cf-249	5.50E-06	2.12E-05
Cf-251	1.56E-05	6.02E-05
Cm-244	4.01E-02	1.54E-01
Cm-245	5.32E-06	2.05E-05
Cm-246	1.75E-05	6.75E-05
Cm-247	7.95E-07	3.06E-06
Cm-248	8.33E-07	3.20E-06
Cs-137	7.43E+00	2.86E+01
I-129	1.15E-06	4.43E-06
Ni-59	7.08E-04	2.72E-03
Np-237	1.74E-05	6.70E-05
Pu-238	1.04E-01	4.00E-01
Pu-239	5.13E-03	1.97E-02
Pu-240	1.82E-03	6.99E-03
Pu-241	3.06E-02	1.18E-01
Pu-242	2.39E-06	9.21E-06
Sr-90	5.66E+00	2.18E+01
Tc-99	1.12E-04	4.31E-04
U-233	4.38E-05	1.69E-04
U-234	2.63E-05	1.01E-04
U-235	2.29E-07	8.82E-07
Y-90	5.66E+00	2.18E+01
Zr-93	3.38E-04	1.30E-03
Total	2.60E+01	1.00E+02

Attachment 3: Waste Weight, U-235 FGE, Pu-239 PEC, and TRU
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Table A3-1: Waste Weight

Glass Weight			Reference
0.23	lbs	Total Glass Weight	A 4. 2
0.10	kg	Total Glass Weight	A 4. 2
Waste Weight			Reference
12	ft	Length (L)	I. 3.12
6	ft	Width (W)	I. 3.12
3	ft	Height (H)	I. 3.12
216	ft^3	Volume (V) = (L X W X H)	
115	lbs/ft^3	CLSM Density (ρ)	I. 3.9
24840	lbs	Waste Weight (W) = (V * ρ)	Equation 8

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Table A3-2: U-235 FGE, Pu-239 PEC, and TRU Per Package

TRU, U-235 FGE, and Pu-239 PEC Per Package							
Radionuclide	Activity Per Package (Ci)	TRU (nCi/g) Equation 7	Specific Activity (Ci/g)	U-235 Equivalence Factor	U-235 FGE Equation 5	Pu-239 PEC Weighting Factor	Pu-239 PEC Equation 6
C-14	1.05E-06					4.00E-05	4.21E-11
Am-241	1.00E-02	8.89E-01				1.02E+00	1.02E-02
Am-242m	6.13E-05	5.44E-03	1.05E+01	5.39E+01	3.15E-04	1.00E+00	6.13E-05
Am-243	1.13E-03	1.00E-01				1.02E+00	1.15E-03
Ba-137m	7.03E+00					1.30E-04	9.14E-04
Cf-249	5.50E-06	4.88E-04	4.09E+00	7.00E+01	9.41E-05	1.02E+00	5.61E-06
Cf-251	1.56E-05	1.39E-03	1.58E+00	1.40E+02	1.39E-03	1.02E+00	1.60E-05
Cm-244	4.01E-02					1.02E+00	4.09E-02
Cm-245	5.32E-06	4.72E-04	1.72E-01	2.34E+01	7.24E-04	1.06E+00	5.64E-06
Cm-246	1.75E-05	1.56E-03				1.02E+00	1.79E-05
Cm-247	7.95E-07	7.06E-05	9.28E-05	8.00E-01	6.85E-03	1.02E+00	8.11E-07
Cm-248	8.33E-07	7.39E-05				1.02E+00	8.49E-07
Cs-137	7.43E+00					6.27E-04	4.66E-03
I-129	1.15E-06					1.30E-04	1.50E-10
Ni-59	7.08E-04					1.30E-04	9.20E-08
Np-237	1.74E-05	1.54E-03				9.63E-01	1.68E-05
Pu-238	1.04E-01	9.22E+00				9.02E-01	9.37E-02
Pu-239	5.13E-03	4.55E-01	6.21E-02	1.60E+00	1.32E-01	1.00E+00	5.13E-03
Pu-240	1.82E-03	1.61E-01				1.02E+00	1.85E-03
Pu-241	3.06E-02		1.03E+02	3.50E+00	1.04E-03	1.93E-02	5.91E-04
Pu-242	2.39E-06	2.12E-04				1.02E+00	2.44E-06
Sr-90	5.66E+00					2.55E-03	1.44E-02
Tc-99	1.12E-04					1.47E-05	1.65E-09
U-233	4.38E-05		9.64E-03	1.40E+00	6.36E-03	2.55E-01	1.12E-05
U-234	2.63E-05					2.55E-01	6.70E-06
U-235	2.29E-07		2.16E-06	1.00E+00	1.06E-01	2.34E-01	5.36E-08
Y-90	5.66E+00					1.30E-04	7.36E-04
Zr-93	3.38E-04					6.27E-04	2.12E-07
Total	2.60E+01	1.08E+01			2.55E-01		1.74E-01

Attachment 4: NRC Waste Classification

Page 1 of 1 "Best Available Copy"

Table A4-1: NRC Waste Classification

NRC Waste Classification															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Radionuclide	**Activity (Ci)** [1, 2]	**Activity Concentration, C_i (nCi/g)** [3]	**Activity Concentration, C_i (Ci/m^3)** [4]	**Limits, L_i (Table 1)**	**Units**	**Ratio C_i/L_i (Table 1)**	**Limits, L_i (Col.1 Table 2)**	**Units**	**Ratio C_i/L_i (Col.1 Table 2)**	**Limits, L_i (Col.2 Table 2)**	**Units**	**Ratio C_i/L_i (Col.2 Table 2)**	**Limits, L_i (Col.3 Table 2)**	**Units**	**Ratio C_i/L_i (Col.3 Table 2)**
Ni-63	4.35E-02		7.12E-03				3.5	Ci/m^3	2.03E-03	70	Ci/m^3	1.02E-04	700	Ci/m^3	1.02E-05
Am-241	1.00E-02	8.89E-01		10	nCi/g	8.89E-02									
Am-242m	6.13E-05	5.44E-03		10	nCi/g	5.44E-04									
Am-243	1.13E-03	1.00E-01		10	nCi/g	1.00E-02									
Ba-137m	7.03E+00		1.15E+00				700	Ci/m^3	1.64E-03	Unlimited	Ci/m^3		Unlimited	Ci/m^3	
C-14	1.05E-06		1.72E-07	0.8	Ci/m^3	2.15E-07									
Cm-244	4.01E-02	3.56E+00		10	nCi/g	3.56E-01									
Cm-245	5.32E-06	4.72E-04		10	nCi/g	4.72E-05									
Cm-246	1.75E-05	1.56E-03		10	nCi/g	1.56E-04									
Cm-247	7.95E-06	7.06E-04		10	nCi/g	7.06E-05									
Cm-248	8.33E-06	7.39E-04		10	nCi/g	7.39E-05									
Cf-249	5.50E-06	4.88E-04		10	nCi/g	4.88E-05									
Cf-251	1.56E-05	1.39E-03		10	nCi/g	1.39E-04									
Cs-137	7.43E+00		1.22E+00				1	Ci/m^3	1.22E+00	44	Ci/m^3	2.76E-02	4600	Ci/m^3	2.64E-04
I-129	1.15E-06		1.88E-07	0.008	Ci/m^3	2.35E-05									
Np-237	1.74E-05	1.54E-03		10	nCi/g	1.54E-04									
Pu-238	1.04E-01	9.22E+00		10	nCi/g	9.22E-01									
Pu-239	5.13E-03	4.55E-01		10	nCi/g	4.55E-02									
Pu-240	1.82E-03	1.61E-01		10	nCi/g	1.61E-02									
Pu-241	3.06E-02	2.72E+00		350	nCi/g	7.76E-03									
Pu-242	2.39E-06	2.12E-04		10	nCi/g	2.12E-05									
Sr-90	5.66E+00	5.02E+02	9.25E-01				0.04	Ci/m^3	2.31E+01	150	Ci/m^3	6.17E-03	7000	Ci/m^3	1.32E-04
Tc-99	1.12E-04		1.83E-05	0.3	Ci/m^3	6.11E-05									
Y-90	5.66E+00	5.02E+02	9.25E-01				700	Ci/m^3	1.32E-03	Unlimited	Ci/m^3		Unlimited	Ci/m^3	
SOF	2.60E+01					1.45E+00			2.43E+01			3.39E-02			4.07E-04
											WASTE CLASSIFICATION	**Class C**			

Notes:

1 - Cm-247 and Cm-248 activity concentrations are based on their MDA prior to the 1S, Chapter 3 screening criteria.

2 - Activity uses the 0.23 lbs. (0.104 kg) of glass and six items per container.

3 - Activity concentration (nCi/g) is based on the weight of the equipment and shielding of 24,840 lbs. (1.13E+07 g).

4 - Activity concentration (Ci/m^3) is based on the volume of the waste container of 6.116 m^3 (12ft x 6ft x 3ft).

Attachment 5: Email Supporting Assumption 4.1

Page 1 of 1

RE: DWPF Melter Bubbler information

Brandon Hodges
To Clifton Walters
Cc Kent Rosenberger; Robert Petras
Retention Policy non HLO 7 year retention policy (7 years) Expires 1/19/2028
You forwarded this message on 12/21/2021 9:14 AM.

Clif,

Yes, that is the assumption. The bubblers have a continuous flow of argon gas through them while installed.

Let me know if you have anything further. Thanks.

Brandon Hodges
Melter Engineering Group

From: Clifton Walters <Clifton.Walters@srs.gov>
Sent: Wednesday, January 20, 2021 9:14 AM
To: Kent Rosenberger <kent.rosenberger@srs.gov>; Robert Petras <robert.petras@srs.gov>; Brandon Hodges <Brandon.Hodges@srs.gov>
Subject: FW: DWPF Melter Bubbler information

Brandon,

I'm working on characterizing the bubblers/glass pumps for disposal and have a quick question on your estimated glass below.

Is it safe to assume no glass remains on the inside the bubblers? It looks like your calculation in the below email, it only accounts for the outer glass film.

Clifton (Clif) Walters, PE
Environmental and Waste Characterization
707-3E, Room 1
O: 803-952-4736
C: 803-295-3687

Attachment 6: Glass Pumps/Bubblers Glass Weight

Page 1 of 2

Glass Pump

Kent Rosenberger

From: Brandon Hodges
Sent: Tuesday, September 29, 2020 7:24 AM
To: Kent Rosenberger
Cc: Kevin Brotherton
Subject: RE: DWPF Melter Bubbler information

Kent,

Based on our conversation yesterday, I did the math for the amount of glass on each glass pump left on the cell covers in DWPF. Using the same math and assumptions I did in the email below for the bubblers, the weight of glass left on each glass pump equals ~**0.23 lbs. of glass**.

The glass pumps were fabricated based on the old melter center thermowell design (the OD = 3.63"), so there is more surface area for glass to adhere to versus the bubblers.

Please let me know if you need anything further.

Brandon Hodges
Melter Engineering Group

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Attachment 6
Page 2 of 2

Bubbler

To: Kent Rosenberger <kent.rosenberger@srs.gov>
Subject: DWPF Melter Bubbler information

Kent,

I have attached the drawings for the bubbler lower sections. These have the overall lengths for the bubbler tubes (the material of construction is Inconel 690). I have also attached a couple images that show what they look like once removed from the melter. These don't show the entire tube, but do provide an idea of how much glass spalls off and the depth of the glass film left on the bubbler.

I also performed the following during some earlier talks about disposal of the bubblers:

The bubblers extend approximately 34 inches into the glass pool (this is a conservative number based on the maximum glass level in the melter).
Below is a breakdown of how I got to a value for lbs. of glass on each bubbler tube.

¾ inch schedule 160 pipe OD = 1.050 inches (1 foot of this pipe weighs 2.04 lbs.)
Surface are available for glass to be present = 2*3.14*(1.050"/2)*36" = 112.098 sq. inches
Assume glass thickness = 0.020 inches
Density from the MLTR SDD = 0.0868 lb./ cubic inch

Multiply all of this out = 0.19 lbs. of glass

However, we know that a majority of the glass spalls off as the glass and bubbler cool once removed from the melter. Assuming that 50% of the glass spalls off (I would consider this a conservative %) then the amount of glass on each tube is ~ 0.10 lbs.

Let me know if you need further information or have any questions.

Brandon Hodges
Melter Engineering Group
8-7182

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Attachment 7: Container Dimensions

Page 1 of 2

ATTACHMENT 5.1 (page 1 of 3)
Container Features/Options Sheet (CFOS)

Description/Instructions for Use: This template is required to be copied, completed, and signed for each procurement utilizing specification M-SPP-H-00402. The completed signed CFOS is a required attachment for each procurement package and subsequent contract. Completed forms must be authorized/signed by a Packaging and Transportation RE. *NOTE: Listed Ref. numbers apply to associated specification paragraphs or attachments. N/A indicates Not Applicable.*

A. Ordering Information and Packaging Name		
1. Purchase Requisition No.: 000199139R	2. Issue Date: 07-06-2022 (**See NOTE at page bottom)	3. Packaging Name (if applicable): Bubbler Shipping Packaging

B. Design Features/Options	
1. DOT Design Type (Ref. 3.2.1) ☐ IP-1 ☒ IP-2	2. Dimensions/Tolerance (Ref. 3.2.2) a. Overall Length = 14' - 0" (ft. – in.) Width = 7'-0" (ft. – in.) Height = 4'-6" (ft. – in.) b. Dimension Applies To: ☒ Internal Cavity Clearance ☐ Overall External Box Size c. Tolerance (for Overall Dimensions) ☒ ½ inch ☐ Other: ________inch
3. Payload (Ref. 3.2.3) *Design payload weight and loading capability may exceed but not be less than:* ☒ Weight: 43,000* lbs. ☐ The Specified Content Loading Criteria Provided in Comments Section. * See Section E for details.	
4. Payload/Materials Description (Ref. 3.2.3) See Section E for details.	5. Lid and Walls Structural Components (Ref. 3.2.5) ☒ Standard – Located on the Interior ☐ Locate on Box Exterior
6. Payload Tie-offs (Ref. 3.2.6) ☐ This Block N/A ☒ Include in Design * See Section E ☐ Alternate Location to paragraph 3.2.6: ________	7. Closure Fastener Hardware (Ref. 3.2.9.4 & 5) ☒ Bolts, Nuts, Washers ☐ Ratchet Load Binders ☐ Quick Make/release Clamps ☐ Clarification of Use/Application Provided in Comments Sections
8. Box Lifting Attachments (Ref. 3.2.10.3) ☐ This Block N/A ☒ Include Attachments for Lifting from Above ☒ Design Attachments for Standard 0° to 30° lift angle ☐ Design Attachments for Alternate Lift Angle: ________	9. Lid Lifting (Ref 3.2.10.E) ☒ Include Lid Lift Fork Channels ☒ Include Lid Lift Attachments (e.g., D-rings)
10. Finish Coating (Ref. 3.2.11) a. Option ☐ Supplier Standard Coating ☒ Long Lasting Paint per Attachment 5.7. b. Color ☒ Yellow (standard) ☐ Other: ________	11. Vent/View Ports (Ref. 3.2.12.) ☒ Position per 3.2.12.2 ☐ In lieu of 3.2.12.2 requirement, locate the vent/view ports as follows: ________

**NOTE: The CFOS for Req. 000199139R issued 07-06-2022 is the current version and supersedes any previously issued CFOS of an earlier date.

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Attachment 7
Page 2 of 2

ATTACHMENT 5.1 (page 3 of 3)
Container Features/Options Sheet (CFOS)

E. Comments

(1) Reference Block B.3; The payload weight of 43,000 lbs. is exclusive to the payload container/contents only and does not include any cribbing/bracing or tie-downs used to secure the payload.

(2) Reference Block B.4; Payload contents include a carbon steel storage container with metal piping secured within solidified grout. The carbon steel storage container has dimensions 12-ft length x 3-ft height x 6-ft width.

(3) Reference Block B.6; In addition to payload tie-offs, container design shall include a reusable cribbing/bracing structure to be accessible for install/removal from the topside using overhead crane. Cribbing/bracing may span the entire length of the storage container or otherwise oriented to sufficiently secure the payload for Normal Conditions of Transport. The supplier will provide detailed construction and assembly drawings for the cribbing/bracing structure for field installation. Delivery of the IP-2 container will not include the cribbing/bracing structure itself.

(4) In reference to specification paragraph 3.2.11.2, the top perimeter of the box base, used as the seating surface for the closure system gasket, shall be considered an interior surface and shall be primer coated only. This coating requirement shall be clearly noted on the box drawing and any other document that is used to prescribe surface coating locations.

(5) In reference to specification paragraph 3.11.2, the box base area used as the seating surface for the closure system gasket shall be entirely coated/conditioned with a material that functions as a lubricant that will serve to mitigate adhesion of the gasket to the seating surface during transportation and storage prior to use. The material selected shall not have an adverse effect on the gasket or box coatings. The material shall not require any effort for removal at time of box use at SRS.

F. Continuation Page

Continuation Page(s) Included ☐ Yes ☒ No No. of Pages________

Packaging and Transportation RE: MATTHEW GARRETT (Affiliate) Digitally signed by MATTHEW GARRETT (Affiliate) Date: 2022.07.06 12:37:35 -04'00'
Print/Sign/Date

01/10/2022

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ENGINEERING CHECKING AND VERIFICATION BY DOCUMENT REVIEW CHECKLIST

Procedure Ref. E7-2.31A and S4-ENG.51

Document Number: Q-CLC-S-00144 Revision: 0

Document Title: Radiological Distribution of the DWPF Melter Bubblers/Glass Pumps

The following checklist is required to be completed and attached to the document under review in compliance with Manual E7 and S4 procedures. This list should not be considered all inclusive. Add any additional notes or comments to the end of the checklist.

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	VERSION / FORMAT		
1	If revising an existing document, are you starting with the latest, approved version of the document obtained from SmartPlant Foundation (SPF) or DCR?	N/A	
2	Are all OSR or SPF forms properly and completely filled out and include all the same fields as the current approved version of the form?	Yes	OSR 45-24 is an old version but includes the same fields as the current approved form.
3	Does the document format include all of the sections as described in manual E7 and S4 procedures (2.31A ,3.60, etc.)?	Yes	
4	Are all of the pages properly labeled with Document Number, Revision Number, and Sequential Page/Sheet Number?	Yes	
5	Are the Subject and Purpose clearly stated and do they meet the end-users needs?	Yes	
6	If the document is an NCSE, has the scope of the document been sufficiently defined (e.g., Dedicated Scoping/Kick Off Meetings held)?	N/A	
	REFERENCES		
7	Are all References properly documented within the document and can they be easily verified within Document Control, on-line, or within the library, etc.? If reference documents are not readily available, are they attached?	Yes	
8	Have the correct design bases documents been identified (e.g., Codes, Standards, DOE Orders, SRR Requirements, Regulatory Requirements, DSA)?	Yes	
	OPEN ITEMS / INPUT		
9	If data is transferred from other documents, calculations or sources, is this data correct and applicable?	Yes	
10	Are all inputs found in the body of the document or calculation individually listed and numbered in the Inputs section?	Yes	
11	Is there a reference/source for each input?	Yes	

LW FORM

ENGINEERING CHECKING AND VERIFICATION BY DOCUMENT REVIEW CHECKLIST

Procedure Ref. E7-2.31A and S4-ENG.51

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	OPEN ITEMS / INPUT – continued		
12	Do the identified references/sources fully support the inputs and does the data meet appropriate quality assurance requirements?	Yes	
13	Have the correct operational and functional requirements of the facility been properly considered?	N/A	
14	Have appropriate operational modes and worse case scenarios been considered?	N/A	
15	Are all assumptions used to support the document individually listed and numbered in the Assumptions section?	Yes	
16	Is there an adequate justification written for each assumption that includes a technical basis?	Yes	
17	If the document is a calculation and there are Open Items, has the calculation been statused as preliminary? Note: A Confirmed calculation cannot have Open Items.	N/A	There are no open items.
18	If the document is a preliminary calculation, have actions required to change the status from “preliminary” to “confirmed” been listed as “open items”?	N/A	This is a "Confirmed" calculation.
19	If the document has open items, is there a method identified to track them? List tracking numbers in Comments (STAR, POD item number, etc.).	N/A	See Item 17.
	ANALYTICAL METHODS AND COMPUTATIONS		
20	Are the analytical methods and computations clearly spelled out step-by-step?	Yes	
21	Is the analytical approach in use clearly described with justification along with alternative methods?	Yes	
22	Is the methodology consistent with the purpose and objective?	Yes	
23	Are mathematical derivations correct, including dimensional consistency of results?	Yes	
24	Have calculations been checked for errors as applicable per E7-2.31A, Section 5.3.2.5? Where a calculation has multiple iterations of the same computation with numerous input and output values, the Verifier/Checker may select a representative sample of the total input and output values for review.	Yes	
25	Were the analysis inputs correctly incorporated into the analysis and are the outputs reasonable compared to the inputs?	Yes	
26	Is the Summary of Conclusion clearly stated? Does it meet the end-user’s needs? Clearly state if results meet/do not meet the Objectives of the analysis?	Yes	

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	ANALYTICAL METHODS AND COMPUTATIONS – continued		
27	Are the numeric values consistent with the appropriate accuracy (significant figures) of the analysis?	Yes	
28	Are safety margins consistent with good engineering practice?	N/A	
28B	If this is an Accident Analysis Calculation, then are methodologies consistent with all relevant supplemental guidance documents located at \\wg08\ABDOC\Supplemental Guidance-Nuclear Safety and AA? Note: Always default to approved procedures and policies when the referenced supplemental guidance appears in conflict. Contact Manager of Nuclear Safety for access to wg08.	N/A	
	SOFTWARE		
29	Is software (including spreadsheets) used? If NO, then "N/A" this section.	Yes	
30	Have computer software programs used for calculations been evaluated and properly classified for this activity using OSR form 19-337 (SWCD), per 1Q QAP 20-1 and E7-2.25? Notes: A) Engineering Calculations meeting the validation requirements of E7-2.31A, where a documented, approved process provides for verification of the results for each use are Exempt – see Row 38. B) The SWCD (software classification document) form is a site-wide application in Lotus Notes.	N/A	MS Excel. No evaluation or classification needed.
31	Is computer software used for the analysis being controlled per E7-2.31A, Section 5?	N/A	See Item 30.
32	Were appropriate analysis methods and computer methods used?	Yes	
33	If a computer program or model is used in the calculation, is it used within the range of validity, or is use outside the range of established validity justified?	Yes	
34	Was the software program used within any restriction, criteria or test frequency requirements in the Software Quality Assurance Plan? (SQAP) (e.g., computer operating system/platform criteria, software within testing frequency).	N/A	See Item 30.
35	Is the software used noted on the Calculation cover sheet and referenced appropriately in the calculation?	Yes	

ENGINEERING CHECKING AND VERIFICATION BY DOCUMENT REVIEW CHECKLIST

Procedure Ref. E7-2.31A and S4-ENG.51

Item No.	Item	Yes / No N/A	Comments (use continuation page at end of form if more space is needed)
	SOFTWARE – continued		
36	If the calculation supports the DSA, is the software and version used on the SSIL (Safety Software Inventory List) when required? Provide explanation in Comments. Notes: A) Engineering Calculations meeting the validation requirements of E7-2.31A, where a documented, approved process provides for verification of the results for each use are Exempt – see Row 38 B) The SSIL is updated on an annual basis so recently approved SQAPs may not be added to the SSIL until the next annual update.	N/A	
37	Are the equations shown in the calculation, including example functions where Excel spreadsheets or MathCad is used?	Yes	
38	If using software not pre-verified as described in E7-2.31A, Section 5.5, then answer YES and describe verification method from 5.5.2[1] in Comments	N/A	See Item 30.
39	Have computer program error reports been checked for potential effect on the analysis?	Yes	
	RESULTS / CONCLUSIONS		
40	Are the results of the document consistent with the input and assumptions?	Yes	
41	Do the results of the document affect any other technical documents?	Yes	
42	Do the results substantiate the conclusion?	Yes	
	APPROVALS		
43	Does the document identify verification/checking method and does it have a signature block?	Yes	

Sign and date Checker block below. If this is a PS/GS document the verification page lines 44-56 is not required. If this is a SC/SS document, then after signing, proceed to complete items 44-56 for verification.

Checker: Merlin Ngachin / Merlin Ngachin Digitally signed by Merlin Ngachin Date: 2022.10.17 09:05:00 -04'00' Date: 10/17/2022

Print Signature

Appendix D. SRS Manual 1S, Radioactive Waste Requirements, Chapter 3

Revision Log

Pages Affected	Description of Revision
Summary	Revised to incorporate the following changes: • Added new section to provide greater detail on the reporting of radionuclides for TRU waste. • Specified requirements for generators of LLW and TRU to provide a non-hazardous determination with submittals of waste stream characterization documentation. • Provided updates and clarification on regulatory associated waste disposition (Mixed/Hazardous Waste). • Updated database list to reflect the upcoming migration of waste tracking to CWTS. • Added guidance on release of materials under the RMMA program. • Revised the seven-step Data Quality Objectives (DQO) section to provide guidance to generators on applying the process with more understanding.
5	Section 2.0 – Updated scope statement to include: “This procedure applies to all generators (on-site and off-site) that present waste to the Solid Waste Management Facility (SWMF)…”. See procedure text.
6	Section 5.1 • Added new Step 2: “The generator will, where possible, prevent commingling of waste streams or waste types requiring different treatment technologies.” • Added new Step 3: “The generator will place sufficient consideration on the chemical aspects of the waste to be generated…”. See procedure text.
7 – 8	Section 5.2.1 • Revised second sentence of Step 1 to state: “Generators will provide notification to SWM of intent to ship…”. See procedure text. • Moved note originally above Step 5 to beginning of Section 5.9. • Added new Steps 3 – 7 to replace original Steps 3 – 8. See procedure text.
10	Section 5.2.3 • Added new Step 8: “For hazardous waste that has been lab packed, the waste characterization process…”. See procedure text. • Added new Step 10: “For LLW and TRU waste, a non-hazardous determination will be provided…”. See procedure text.
13	Section 5.3.1 • Revised first bullet in Step 1 by adding “in the course of its management…”. See procedure text. • Added new sentences to the third bullet in Step 2, which states: "Use of vendor data such as bulk density or specific gravity should be validated…”. See procedure text.
14	Section 5.3.2 • Revised Step 1 to state: “When PK is used for hazardous waste, documentation shall justify its use and applicability.” • Revised Step 2 to state: “Hazardous waste determinations, especially those that are determined by PK to be non-hazardous…”. See procedure text.

15 – 16	Section 5.3.3 • Revised Step 1 to state: "The success of the hazardous waste regulatory program depends, to a great extent, on generators…". See procedure text. • Added "(e.g., circuit boards)" as a new example in Step 2C.
16	Section 5.4.1 - Revised third sentence in Step 2 to state: "Environmental Monitoring Operations can provide many generator sampling services…". See procedure text.
23 – 24	Section 5.5.2 • Revised Step 1 to state: "The objective of the DQO process is to describe and document how a planning team can generate a plan…". See procedure text. • Revised last sentence in Step 2 to state: "The Environmental Monitoring Program Customer Technical Representative…". See procedure text. • Added new bulleted list to describe seven-step DQO process and removed table from Step 3. See procedure text.
24	Section 5.5.3 - Revised to state: "Database inventory management systems (e.g., WITS, Hazardous Mixed Waste Tracking [HMWT], CWTS)…". See procedure text.
25	Section 5.6.1 • Revised Step by 1 by adding sentence: "The LDRs attach to a hazardous waste at the point of generation." See procedure text. • Added new Step 3: "TRU mixed waste that is to be disposed at WIPP is exempt from having to comply with the treatment standards…". See procedure text.
26	Section 5.6.2 – Added new Step 1A with new bulleted list. See procedure text.
27	Section 5.6.5 • Replaced "Staging Area" with "Central Accumulation Area (CAA)" in title and throughout section. • Revised Step 1 to state: "A generator may treat hazardous waste in containers without a permit so long as the generator develops and follows a Waste Analysis Plan…" See procedure text. • Removed Step 2 and incorporated information into Step 1.
28 – 29	Section 5.7 • Converted first note into new Step 1. • Added "and permitted" to first sentence of Step 5. • Replaced "WCF" with "applicable characterization form" in Step 8.
29 – 30	Section 5.8.1 • Converted Step 3 of first note into new Step 1 of section. • Revised Step 4C to state: "When creating LLW packages in the applicable waste tracking application (e.g., WITS or CWTS)…". See procedure text.
30	Section 5.8.2 – Revised Step 2 to state: "When creating LLW packages in the applicable waste tracking application (e.g., WITS or CWTS)…". See procedure text.
33	Section 5.9.4 • Revised first sentence to state: "The waste tracking applications (e.g., WITS or CWTS) do not…". See procedure text. • Added new Step 4: "Cm-243 and Cm-244 are sometimes reported as Cm-243/244. Assign the activity to both Cm- 243 and U-244."
34	Section 5.9.5 – Added new note on section applicability to Attachment 8.7. See procedure text.

33 – 35	Section 5.9.6 – Added new Section 5.9.6, Radionuclide Reporting for TRU Waste. See procedure text.
39	Section 5.10.4 – Revised Step 2 to state: “The latest revision of the SRS-DTC computer program or SWM-approved equivalent program will be used…”. See procedure text.
53	Section 5.11.3 – Updated “MW streams” to “MW streams that will not be disposed within one year” throughout section.
53 – 56	Section 5.11.4 • Revised Step 2 by adding “if a hazardous waste that was listed in R.61-79 261.31-33 solely because it exhibits the characteristic of ignitability, corrosivity, and/or reactivity…”. See procedure text. • Revised Step 2 by adding “if a hazardous waste that was listed in R.61-79 261.31-33 solely because it exhibits the characteristic of ignitability, corrosivity, and/or reactivity…”. See procedure text. • Revised Step 3A, sub step 1 by adding “can be generated by any type of facility”. See procedure text. • Revised Step 3A, sub step 2 by adding “and is spent. If either of these conditions are not met, the waste is not F-listed”. See procedure text. • Added “SRS does not generate K-Listed wastes.” to Step 3B. • Revised Step 3C, sub step 1 by adding “unused commercial chemicals or products”. See procedure text. • Added “but not the U210 or D039” to Step 3C, sub step 4-A. • Revised Step 3C, sub step 4-C by adding “The P- and U- listing applies”. See procedure text.
57 – 58	Section 5.11.5 • Converted opening paragraph and first note into new Step 1 and Step 2. • Added new bullet to Step 3D: “DOT defines an oxidizer as…”. See procedure text. • Added new Steps 5A – 5H as new list of “specific criteria for defining Reactive Characteristic wastes:”. See procedure text. • Added “do not require extraction and” to Step 6C.
65	Section 5.14 – Revised Step 2 to state: “Database inventory management systems (e.g., WITS, HMWT, CWTS) may be used…”
71	Attachment 8.1 • Added new Step 3 to note starting section on Radioactive Determination Criteria: “Alternate Release Methodologies not described explicitly in Manual 5Q1.1, Procedure 517...”. See procedure text. • Added new first bullet to list on second page of attachment: “Released per Manual 5Q1.1, Procedure 517”.
75 – 80	Attachment 8.4 – Replaced “(as determined in Section 5.2.3 of 1S, 2.02)” with “(as determined in Manual 1S, Chapter 3, Attach. 8.1)” for Radioactive block in both examples. See procedure text.
85	Attachment 8.5 – Removed all notes and merged information to create one new table; updated table and attachment title.
86	Attachment 8.6 • Revised Step 1 of the first note to state: “Tables in the waste tracking applications (e.g., WITS or CWTS) are currently set up…”. See procedure text. • Replaced “WITS” with “waste tracking applications” in mid-page note.

87	Attachment 8.7 - Replaced “WITS” with “waste tracking applications (e.g., WITS or CWTS)” in Step 3 of note.
All	Updated to conform with current Site-level procedure template, including: terminology updates, correction of typos, punctuation, and step structure. Updated S/RIDs and other references

1.0 PURPOSE [S/RID 1, 2]

This chapter provides requirements associated with the development of suitable methodologies for characterization of waste packages and establishes the basis to ensure that all Low-Level Waste (LLW), Low-Level Liquid Waste (LLLW), Hazardous Waste (HW), Transuranic Waste (TRU), Mixed Waste (MW), and Polychlorinated Biphenyls Waste (PCBW) packages presented to Solid Waste Management (SWM) for treatment, storage, or disposal have been characterized by the generator to reasonably represent the physical, chemical and radiological contents of the waste package with sufficient accuracy to permit proper segregation, treatment, storage and disposal.

2.0 SCOPE

The provisions of this procedure apply to the Performing Entities at the Savannah River Site (SRS) and to subcontractors performing work for the Performing Entities when required by subcontract or applicable law.

This procedure applies to all generators (on-site and off-site) that present waste to the Solid Waste Management Facility (SWMF) for disposition.

The waste characterization process establishes the chemical and physical data to clearly identify radiological and hazardous characteristics. The waste is characterized using direct or indirect methods, and the characterization is documented in sufficient detail to ensure safe management and compliance with the waste acceptance criteria of the receiving Treatment, Storage, and Disposal (TSD) facility.

3.0 DEFINITIONS AND ABBREVIATIONS

Definitions and abbreviations applicable to this procedure are provided in Manual 1S, Glossary.

4.0 RESPONSIBILITIES

All responsibilities applicable to this chapter are provided in Section 4.0, Responsibilities, of Manual 1S, Chapter 1, in the master list outlining the roles and responsibilities associated with all SRS Radioactive Waste Requirements procedures.

5.0 REQUIREMENTS

5.1 Waste Characterization Considerations

1. Each LLW, LLLW, TRU Waste, HW, MW, or PCBW package presented for disposition under the SRS Waste Characterization Program will be characterized by the generator to represent the physical, chemical, and radiological contents of the waste package to ensure that it meets the Waste Acceptance Criteria (WAC) of the receiving TSD facility. A generator's characterization approach for each waste stream will consider:
   - The source and extent of contamination on the waste
   - The physical properties of the waste material and contamination

5.1 Waste Characterization Considerations, (cont.)
Step 1, (cont.)

- The radiological properties of the waste material and contamination
- The method of quantifying the radionuclide inventory
- The hazardous/chemical properties of the waste material and contamination
- The final disposition
- The sampling strategy
- The waste packaging
- The transportation mode needed.

2. The generator will, where possible, prevent commingling of waste streams or waste types requiring different treatment technologies.

3. The generator will place sufficient consideration on the chemical aspects of the waste to be generated during characterizing, segregating, packaging, storing, and disposing of waste to prevent unexpected chemical reactions from occurring. There have been several incidents throughout the complex where containers have over-pressurized and deformed (bulged) or lost their lids due to unforeseen chemical reactions within the waste. This is especially important when wastes are being mixed or composited within a container. Incompatibility, fill time, absorbent use, and other process changes should be considered.

   In order to efficiently analyze and characterize a waste stream, all requisite criteria and TSD required data should be evaluated when establishing a waste stream sampling and characterization strategy. SWM can provide technical assistance to the generator in the development of a characterization strategy. Environmental Compliance Authorities (ECAs) can also provide advice, assistance, and review of the waste stream characterization process, particularly from a hazardous constituent perspective. Process Knowledge (PK) used in whole, or as part of the characterization process, will be adequately documented, logically structured, and supported by defensible bases. Preplanning is important in those characterization processes that rely heavily on PK, and to ensure that Data Quality Objectives (DQOs) are met.

4. Resource Conservation Recovery Act (RCRA) and Hazardous and Toxic Substances Control Act (TSCA) regulated waste must be evaluated against radiological screening criteria as explained in Attachment 8.1, RMMA and Radiological Screening Criteria, including RCRA and TSCA waste that:

   A. Resided in a Radiological Material Management Area (RMMA), or

   B. Was generated within a RMMA, or

   C. Was generated from an unknown location, or

   D. Has a potential of containing Department of Energy (DOE) added radioactivity.

5.1 Waste Characterization Considerations, (cont.)

5. RCRA and TSCA waste stream radiological screenings may also be requested by SWM Engineering to support periodic assessment programs.

6. This procedure presents the framework within which generators will characterize their waste for disposition under Manual 1S, SRS Radioactive Waste Requirements.

5.2 Waste Characterization Requirements

5.2.1 Waste Characterization Requirements - General

1. Waste generated as a result of Comprehensive Environmental Response Compensation and Liability Act (CERCLA) cleanup actions can only be received by facilities specifically authorized by the United States Environmental Protection Agency (EPA) to receive such waste. Generators will provide notification to SWM of intent to ship waste from a CERCLA Removal Action site at least three weeks prior to the first shipment. SWM will request approval through the EPA Region IV office for the receipt of CERCLA waste. SWM will then notify the generator of approval to ship upon receiving EPA authorization.
2. Waste requiring treatment, storage and/or disposal at an off-site TSD facility must comply with the off-site TSD facility acceptance criteria. This may require additional sampling and/or documentation above that outlined in this manual. Contact Solid Waste Engineering (SWE) for guidance.
3. All radiological (i.e., LLW, TRU, MW and radiologically contaminated Polychlorinated Biphenyl [PCB]) characterization will be documented in an approved Engineering Calculation per Manual E7, Procedure 2.31, Engineering Calculations.
4. Generators of MW and radiologically contaminated PCB will follow the LLW radiological characterization criteria for the radiological portion of these waste types.
5. LLW stream characterization will be reported on OSR 29-82, Low-Level Waste Stream Characterization, or an SWM-approved equivalent.
6. TRU waste characterization will be reported on OSR 29-90, Transuranic Waste Container Characterization, or an SWM-approved equivalent.
7. HW, MW, and PCB characterization will be reported on OSR 29-47, Waste Characterization Form (WCF), and OSR 29-92, Characterization Process Report.

5.2.2 Alternative Evaluation Characterization

1. The requirements defined in this procedure represent best current practices. Alternative evaluations to characterize an individual waste stream or group of waste streams may be acceptable. These alternative methods will generally be described as engineering evaluations. Engineering evaluations will be prepared in compliance with Manual E7 requirements and may be used independently or in combination with an approved methodology.

2. The requirements for these evaluations are that the evaluation is:
   - Technically sound,
   - Appropriately rigorous,
   - Defensible, and
   - Properly documented.

3. The basis for a generator employing such alternatives will be submitted to SWM for review and approval with the waste stream characterization form.

5.2.3 Hazardous/Toxic Characterization Basis

1. A hazardous or toxic waste stream falls into one of these categories:
   - RCRA HW
   - TSCA/PCB
   - RCRA MW
   - Radioactive PCBW
   - Administrative Decision Waste.

   Waste may also be categorized as nonhazardous and/or nontoxic.

5.2.3 Hazardous/Toxic Characterization Basis, (cont.)

> **NOTE**
>
> For waste determined to be a non-hazardous waste, the current regulations do not require this documentation to be maintained. However, EPA recommends that generators also document their non-hazardous waste determinations, particularly in situations where the waste may display the attributes of a HW and where staff turnover may cause a worker to question the contents of a container. According to EPA, "inspectors have the existing authority to require a generator to perform a waste determination during an inspection to support their finding that the waste of concern is not a HW if no documentation exists."

2. The basis for the hazardous, toxic, non-hazardous and/or nontoxic determination requires documentation that is complete, defensible, and traceable to the waste stream or waste package. This documentation shall be referenceable and retrievable from records. For wastes that are also radiological (e.g., LLW, MW), the determination may be part of the E7 calculation for the radiological characterization of the waste or a separate E7 or equivalent type document pending it meets the requirements (e.g., Characterization Process Report [CPR]). (Reference Manual 3Q, Procedure 6.3, Hazardous Waste Determinations)

3. The rationale for the conclusions on characterization of a waste regarding the listing and characteristic criteria shall be documented. The regulatory agencies look for documentation that clearly demonstrates that the information relied upon in conducting such characterizations is sufficient to justify the conclusions; therefore, an explanation of the findings with regard to F-, K-, P-, U-listings and the characteristics of ignitability, corrosivity, reactivity, and toxicity must clearly be identified in the appropriate characterization documentation.

4. The summary determination of a waste's hazardous or toxic content will be documented on OSR 29-92 for waste streams determined to be HW/MW/PCBW (except radioactive PCBW that is acceptable for disposal in E-Area). The HW determination in conjunction with the radiological determination performed in Section 5.2.4 is used to identify MW.

5. The CPR provides a template for the methodical review of a waste stream against the waste type criteria (e.g., HW, MW). Examples of waste generation scenarios and completed CPRs are provided in Attachment 8.4, Characterization Process Report Examples.

6. The waste stream characterization is finalized by completing OSR 29-47 and OSR 29-99, Hazardous/Mixed/PCB Waste Manifest. These forms are required for waste streams determined to be HW/MW/PCBW (except radiological PCBW that is acceptable for disposal in E-Area). The WCF and manifest identify the waste type along with detailed physical, chemical, and radiological data necessary to meet TSD permit, processing, and handling requirements.

5.2.3 Hazardous/Toxic Characterization Basis, (cont.)

7. For Direct Shipments of non-radiological HW, the waste characterization process will be documented on OSR 29-92. Any data typically required for completion of OSR 29-47 and OSR 29-99 and deemed necessary by SWE will be included on or with the CPR. SWE/HMTR will determine necessary data based on offsite TSD and transportation requirements. Manual 1S, Chapter 6, RCRA, TSCA, Mixed and LLLW, further defines the requirements for Direct Shipments of HW/MW/PCB waste.

8. For HW that has been lab packed, the waste characterization process will be documented on OSR 29-105, Lab Pack Request, or equivalent. SWE/HMTR will determine necessary data based on offsite TSD and transportation requirements. Manual 1S, Chapter 6 further defines the requirements for lab packs of HW.

9. Routine RCRA/TSCA waste streams may be accommodated on a case-by-case basis once approved by SWE. Contact SWE to discuss establishing guidelines for routine waste streams.

10. For LLW and TRU waste, a non-hazardous determination will be provided with either the OSR 29-82 or the OSR 29-90, respectively. This determination shall be completed as outlined in Step 2 of this section.

5.2.4 Radionuclide Waste Stream Characterization

1. Waste stream radionuclide characterization is the process of:
   - Identifying the radionuclides of importance in a waste stream
   - Determining an algorithm for assigning a radioactive content to each waste package.

2. The radionuclides in a waste stream are specified in terms of a normalized radioactivity distribution, with the fractional abundance of each radionuclide given and the sum of all equal to one. The distribution gives the fractional abundance of each radionuclide present in the waste stream in significant quantity (i.e., it meets the requirements for inclusion).

3. The activity content algorithm determines the total activity in a waste package. The total activity times a radionuclide fractional abundance gives the reportable activity for the radionuclide.

4. The general process of waste characterization is described in the Attachment 8.2, Waste Stream Characterization Flow Chart. The specific methodology used to define radionuclide distribution and content is described in Section 5.10, Radionuclide Packaging Considerations.

5.2.5 Homogeneous Waste Stream Characterization

1. Homogeneous waste streams are those in which the radioactivity or chemical constituents are assumed to be uniformly distributed throughout their volume and mass. These can include:

5.2.5 Homogeneous Waste Stream Characterization, (cont.)
Step 1, (cont.)

- Non-metallic step off pad materials
- Ion exchange resins
- Contaminated soils
- Process metals
- Solidified liquids.

2. Where the relationship between the disposal container volume and the waste stream does not meet the requirements of Section 5.13.1, General, the actual waste volume must be quantified either through:
    - Periodic measurement
    - By using the waste weight and known density of the waste.

5.2.6 Heterogeneous Waste Stream Characterization

1. Heterogeneous waste streams are those in which the radioactivity or chemical constituents are known to not be uniformly distributed throughout their volume and mass. These can include:
    - Job control waste (JCW)
    - Cartridge filters
    - Contaminated wood, metals, concrete
    - Process equipment
    - Activated metals.
2. Where the relationship between the disposal container volume and the waste stream does not meet the requirements of Section 5.13.1 (e.g., large contaminated equipment where the equipment dimensional envelope exceeds three feet on any side), the actual waste volume must be quantified through either:
    - Periodic measurement
    - By measuring the waste weight and estimated composite density of the waste material (subject to verification during waste stream re-validation).

5.2.7 Large Contaminated Equipment Waste Stream Characterization

1. For these wastes (whether radiologically or chemically contaminated, or both) the waste volume is the estimated envelope volume (defined by external dimensions of the item) of the piece of equipment or machinery. (See Manual 1S, Chapter 4, Section 5.6, Contaminated Large Equipment Disposition [CLED] Approval Process.)
2. For large equipment that is also activated, use this section rather than Activated Metals section.

5.2.8 Activated Metals Waste Stream Characterization

For these wastes, the waste volume is the displaced volume and is determined by the waste weight, as per Section 5.13, Determining Waste Volumes and Masses.

5.2.9 Immobilized Waste Stream Characterization

1. When waste streams are immobilized with an inert material to enhance stability, the waste volume is the volume of the immobilized mass.

2. The waste weight is the weight of the waste stream plus the weight of the immobilization media.

5.2.10 Consolidated Waste Stream Characterization

1. Waste stream consolidation can be employed if it can be shown the resultant consolidated waste stream of two or more independent waste streams uses conservative isotopic qualification and quantification methods for TSD sensitive radionuclide contaminates.

2. Consult SWM Engineering when developing strategies to characterize a consolidation of waste streams.

5.2.11 Analysis Frequency Characterization (Hazardous/Mixed Waste Streams)

1. Hazardous and mixed waste streams generated at SRS must be evaluated at least annually to ensure that the characterization of the waste is accurate and up to date.

2. Generators shall inform SWE of any changes to the waste stream characteristics and shall modify the waste characterization as necessary.

5.3 Process Knowledge (PK)

5.3.1 Process Knowledge (PK) - General

> **NOTE**
>
> Sampling and analysis is the preferred method of characterization because it is easier to defend; however, some waste streams cannot be adequately characterized through use of sample and analysis techniques; in such cases, PK is appropriate and necessary.

1. PK may include a wide variety of information based on:
   - Ensuring the HW determination is made at its point of generation before any dilution, mixing or alteration, and at any time in the course of its management that it has, or may have, changed its properties as a result of exposure to the environment or other factors that may change the properties of the waste such that the RCRA classification of the waste may change
   - The physical, chemical, and radiological properties of the materials involved in the process that generates the waste materials
   - The effect of all aspects of the process on the materials
   - The associated process stream and product specifications.
2. Particular attention should be directed at possible chemical concentrating processes (e.g., evaporation, absorption, filtration, separation, settling). Examples of the types of information that have been used at SRS to characterize waste by PK are given below:
   - Process or quality control sample analyses
   - Analytical results from samples of simulated wastes
   - Procurement specifications, Safety Data Sheets (SDSs), and other vendor data. Use of vendor data such as bulk density or specific gravity should be validated prior to use in waste characterization calculations, particularly for mass-volume conversions. Validation may include weighing a known volume of the material.
   - Material balance calculations
   - Process flow sheets
   - Analytical results from similar processes elsewhere
   - Laboratory or pilot plant studies (e.g., treatability studies)
   - Engineering data on corrosion rates or material specifications
   - Previous characterizations of similar wastes
   - Administrative/procedural controls
   - Direct assay results
   - Technical reports

5.3.1 Process Knowledge (PK) - General, (cont.)
Step 2, (cont.)

- Documents and drawings specifying process areas and equipment
- Process equipment manuals
- Process stream or product specifications
- Documented mass balance information
- Procedures
- Documented living memory.

3. When PK is used for radionuclide waste, it will be prepared and approved in an engineering calculation in accordance with Manual E7, Procedure 2.31.

5.3.2 Hazardous Waste (HW) Process Knowledge (PK)

1. When PK is used for HW, documentation shall justify its use and applicability.

2. A generator is allowed by the South Carolina Hazardous Waste Management Requirement (SCHWMR) R.61-79.262.11(c-d) to use "knowledge of the hazard characteristic of the waste in light of the materials or the processes used" to make the HW determination. This approach is generally referred to as a PK determination.

3. HW determinations, especially those that are determined by PK to be non-hazardous, are always subject to challenge. Presumably, sampling establishes what is physically present in the waste. PK on the other hand, can only be used to justify that hazardous constituents are not likely to be present. In addition, sample results can also be challenged because of different interpretations of representative sampling, number of samples required or sample collection and analytical protocols. The generator must be prepared to defend a determination whichever method is used. Documentation of a nonhazardous determination is as important as a hazardous determination.

4. For Land Disposal Restrictions (LDR), EPA and South Carolina Department of Health and Environmental Compliance (SCDHEC) have stressed the need for accuracy in characterizing wastes. EPA/SW-846, Test Methods for Evaluation of Solid Waste: Physical/Chemical Methods, contains analytical and test methods recognized by EPA as being acceptable for testing under subtitle C of RCRA. Several of the SCHWMR regulations require that specific testing methods described in EPA/SW-846 be used in evaluating solid waste. It is important to understand that this does not always preclude a generator from using PK to make the HW determination. To illustrate, SCHWMR R.61-79.261.22 specifies that the pH of an aqueous solution should be determined by a pH meter using EPA/SW-846, Method 9040. Two points need to be made:

5.3.2 Hazardous Waste (HW) Process Knowledge (PK), (cont.)
Step 4, (cont.)

A. First, since a method is specified, a determination of pH using litmus paper is not a sufficient basis to conclude that the waste is not hazardous.

B. Second, the requirement to utilize EPA/SW-846, Method 9040 does not preclude the generator from characterizing the waste using PK as allowed by SCHWMR R.61-79.262.11(c-d). In that case, the litmus paper test serves as supporting data. In other cases, this option does not exist (e.g., compliance with certain LDR treatment standards must be demonstrated using the prescribed EPA/SW-846 methodology).

5.3.3 Process Knowledge (PK) Determinate Basis

1. The success of the HW regulatory program depends, to a great extent, on generators making an accurate HW determination. When characterizing a waste using PK and when documenting the methodology used to conduct the characterization, SCHWMR R.61-79.262.11(f) describes the type of records that must be maintained to support the determination. SRS experience with SCDHEC in such situations indicates that although PK is allowed it must be documented and defensible.

   A. Ensuring proper sufficiently accurate and detailed information about each waste stream and the process generating the waste is used when making waste determinations, and maintained in the facility's records per Manual 1B, 3.31. Such documentation must be maintained for at least three years and be readily available for audit by EPA and/or SCDHEC.

   B. For waste determined to be a HW, the Waste Generator and SWM must keep records onsite of any test results, waste analyses, or other documentation for at least 3 years from the date that the waste was last sent to onsite or offsite treatment, storage, or disposal. This time period extends automatically during the course of any unresolved enforcement action regarding the regulated activity or as requested by the SCDHEC.

2. As a general rule radionuclide and hazardous characterizations should be supported by reliable analytical data (process control, similar wastes) if possible.

   A. Claims that certain materials are excluded from a waste stream or that the makeup of a waste stream is known should be supported by procedures, work instructions, training programs or other controls.

   B. PK calculations will be peer-reviewed and documented.

      1) Sources of data should be clearly referenced and readily retrievable.

      2) Assumptions should be documented and supportable.

5.3.3 Process Knowledge (PK) Determinate Basis, (cont.)
Step 2, (cont.)

C. Wastes (e.g., circuit boards) should be evaluated for hazardous constituents that may be contained in materials of construction or alloys such as:

- Lead in brass or solder
- Corrosion products such as chromium from stainless steel
- PCBs in painted materials or electrical components
- Corrosion resistant coatings containing cadmium or other toxic metals.

5.4 Waste Sampling

5.4.1 Waste Sampling - General

1. The validity of sampling and analysis data is highly dependent upon a defensible sample and analysis plan. Defensible plans must encompass every aspect of the sampling process from collection of the sample to analysis and reporting of the analytical results. Often, the most underdeveloped aspect of a sampling plan is the sample collection techniques. Sophisticated and costly analytical methods coupled with a flawed collection process are of little value, particularly in the case of regulatory proceedings.

> **NOTE**
> Waste requiring treatment, storage and/or disposal at an off-site TSD facility must comply with the off-site TSD facility acceptance criteria. This may require additional sampling and/or documentation above that outlined in this manual. Contact SWE for guidance.

2. The burden of responsibility for ensuring a technically sound sampling and analysis plan rests with the waste generator. Generators should seek expert advice in the development and implementation of such plans. Environmental Monitoring Operations can provide many generator sampling services, including development of sample plans, collection activities, transportation, and reporting of results. Assistance can also be obtained through the Statistical Consulting Section of the Savannah River National Laboratory (SRNL). Depending upon the DQOs, measurement analysis can be performed at off-site labs contracted to SRS or on-site labs at SRNL.

3. In order to meet the LDR, EPA, and SCDHEC waste characterization requirements, the testing methods in EPA/SW-846 must be used for evaluating solid waste. This EPA Publication contains acceptable analytical test methods recognized by the EPA under subtitle C of RCRA.

5.4.1 Waste Sampling – General, (cont.)
Step 3, (cont.)

> **NOTE**
>
> PK can be used if it provides validated data equivalent to or better than approved EPA/SW -846 testing method requirements (Process or quality control sample analyses, Analytical results from samples of simulated wastes, etc.).

4. All analytical testing to make a HW determination must be performed by a state certified laboratory that is currently certified for the analytical procedure requested. SRS waste generators shall use the SRS Sample Management Group contracted laboratories or request approval from SWM for use of alternate laboratories for any sample analyses required of off-site laboratories.

5.4.2 Sample Collection

1. The objective of the sample collection process is the collection of a representative sample. A "representative sample" is defined as a sample of the whole (e.g., waste pile, lagoon, ground water) which can be expected to exhibit the average properties of the whole. Detailed collection and sampling strategies are provided in the EPA document EPA/SW-846. EPA/SW-846 protocols are not required for radioactive waste but should be considered to define reference methods during sample and analysis plan development.

2. Sample methodology and protocol defined by the generator will be documented in facility sample plans as appropriate. Sample and analysis plans should be submitted to SWM Engineering along with waste characterization documentation. Sample methods and techniques used shall ensure the following objectives are met:

    A. Representative samples or the collection of samples that are unbiased and exhibit average properties of the population sampled are achieved by segregating the containerized wastes into sub-waste streams and collecting samples using consistent and appropriate methodologies for the waste form. A sub-waste stream is generally comprised of a group of containers labeled with the same waste stream information. Sample collection information is identified in specific waste stream sampling and analysis plan.

    B. Sampling accuracy is achieved through randomized sampling of the waste within a given sub-waste stream. Randomized sampling minimizes bias in the sample selection process by giving each container or matrix an equal probability of being sampled. Randomized sampling is addressed in the waste stream specific sampling plan.

5.4.2 Sample Collection, (cont.)
Step 2, (cont.)

C. Sampling precision is achieved by increasing the number of samples to be collected, increasing the actual volume of the samples, or dividing a population into appropriate strata prior to sampling. Additional samples may be collected when sample collection is difficult. Lastly, when a waste stream is suspected or known to contain separate phases (i.e., solids and liquids), the number of samples required is calculated for each waste phase. During sample collection activities, a sample is collected from each waste phase from the randomly selected waste containers. The number of samples, matrix/phases sampled and container(s) sampled is addressed in the waste stream specific sampling plan.

D. The number of samples required to be collected will be calculated in accordance with statistical methods based on homogeneity of the media to be sampled. The number of samples is identified in the waste stream specific sample and analysis plan.

E. Ensure proper sample handling and transport protocols are followed per SRS site approved Sample Analysis Plans.

5.4.3 Sample Analysis

1. The objective of the sample analysis process is to ensure the sensitivity, precision, and bias of equipment and methods used provide for creditable results and are compliant with requirements for the waste acceptance criteria of the waste receiving facility.

2. Laboratory selection is vital to provide validated data quality. Waste generators will ensure that laboratories chosen for analysis of samples are capable of producing accurate results for their intended use. The laboratory will have the ability to perform the generator specified analysis in accordance with EPA or other standard protocols and methods that meet the Maximum Allowable Lower Limits of Detection (MALLDs) defined in Attachment 8.3, or reasonable justification shown to demonstrate why this sensitivity cannot be achieved based on waste stream composition. Generators will document this in a calculation per Manual E7, Procedure 2.31, for all radionuclide data. SWM will review the justification and approve if the impacts to TSD inventory are negligible.

3. Laboratories used to provide analytical results for radioactive and/or HW shall be:

- EPA or state certified
- DOE Consolidated Assessment Program (DOECAP) approved
- Compliant with Manual 1Q, Procedure 2-7, QA Program Requirements for Analytical Measurement Systems

5.4.3 Sample Analysis, (cont.)
Step 3, (cont.)

- Have an auditable laboratory quality assurance program based upon 10 Code of Federal Regulations (CFR) 830.122, Nuclear Safety Management and American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) NQA-1, Quality Assurance Requirements for Nuclear Facility Applications, and have an auditable measurement control program based upon applicable requirements contained in:
  - ANSI N15.41, Derivation of Measurement Control Programs - General Principles
  - ANSI N15.51, Measurement Control Programs in Nuclear Materials Analytical Chemistry Laboratory.

4. SRS waste generators shall use the SRS Sample Management Group contracted laboratories or request approval from SWM for use of alternate laboratories for any sample analyses required of off-site laboratories.

5. Development of sample analysis protocol will ensure analytical laboratory method selection is made based on the results needed and to achieve the detection level of the MALLD listed in Attachment 8.3. Method detection limits for radiological analyses are based upon ensuring compliance with the acceptance criteria for the treatment or disposal facility and are specified in the specific facility's waste acceptance criteria. Consideration should be given to the labs ability to meet the data quality objectives specified for waste potentially destined to an off-site treatment/disposal facility.

   A. Laboratory control sample(s) or matrix spike(s) should be analyzed with each batch of samples to verify that the precision and bias of the analytical process are within control limits. The results of the laboratory control sample(s) or matrix spike(s) are compared to control limits established for both precision and bias to determine usability of the data.

   B. When appropriate for the method, a method blank should be analyzed with each batch of samples processed to assess background levels in the laboratory. Established standard guidelines are followed to assess acceptability of the data based on the level of contamination in the blank.

   C. Duplicate samples are analyzed for comparability to ensure precision of the laboratory method(s) used.

   D. Established standard guidelines are followed to assess acceptability of the data and precision of the laboratory methods.

5.4.3 Sample Analysis, (cont.)

> **NOTE**
>
> Waste not meeting SRS disposal criteria may be acceptable for disposal at the Nevada National Security Site (NNSS). Analytical data used for characterization for the NNSS shall follow specific Data Validation criteria specified below. Contact SWM, SRS Cognizant Technical Function (CTF) for the NNSS or the SRS Waste Certification Official (WCO) for the NNSS for guidance.

6. Data Validation for the NNSS Waste Profile Development

   A. Validation criteria shall be developed using the DQO process and depend on the type(s) of data involved and the purpose for which the data are collected. The DQO process is covered in Section 5.5.2.

   B. Data shall be validated by technically qualified personnel who are independent of those performing the analyses.

   C. When sampling and analysis is used as a method of characterization, data validation shall be conducted on a portion of the data prior to use for characterization.

5.4.4 Sample Data Screening

1. The generator will screen the results from representative sample analysis. Reported sample data can be excluded from a waste stream's radionuclide content and distribution when any of the following reasons can be documented (justification to be provided in calculation per Manual E7, Procedure 2.31 or other characterization document):

   - No plausible production mechanism exists based on PK (e.g., a short half-life nuclide with no production mechanism should not exist in aged waste);
   - Non-PA radionuclides reported as below Lower Limit of Detection (LLD) values;
   - Non-PA radionuclides reported as positive by lab analyses with curie per package (Ci/Pkg) values less than Attachment 8.7's Ci/Pkg Threshold;
   - Radionuclides that are constituents of naturally occurring radioactive material (NORM) at background levels, i.e., there was no mechanism to concentrate these radionuclides (per WSRC-TR-2000-00128, Background Radioactivity in Savannah River Site (SRS) Soil). Examples are Potassium (K)-40, Lead (Pb)-212 (daughter of natural thorium), and Bismuth (Bi)-210 (daughter of natural uranium); and
   - Daughter radionuclides with Ci/Pkg values less than Attachment 8.7's Ci/Pkg Threshold regardless the presence of the parent radionuclide.

2. SWM will review the data screening justification and approve if the impacts to TSD inventory are negligible.

5.4.5 RCRA/TSCA Soils Sampling Radionuclide Release Requirements

> **NOTE**
>
> The following requirements are for release of RCRA and TSCA soils originating from RMMAs (basis documents: WSRC-TR-2000- 00128 and SWD-97-0011). Application of these criteria to non-RCRA and non-TSCA soils will be approved by SWM and DOE-Savannah River (DOE-SR).

1. One complete isotopic analysis will be conducted per waste stream on a representative sample of the waste stream. The results of this analysis will be compared to the Complete Isotopic Analysis Limits shown in Attachment 8.1.

2. A representative sample per container must be taken for gross alpha and gross nonvolatile beta and must be below the Gross Analysis Limits shown in Attachment 8.1.

3. If a gross alpha or gross nonvolatile beta limit is not met for a container, then a complete radioisotopic analysis must be completed for that container and results of that analysis compared against the Complete Isotopic Analysis Limits in Attachment 8.1.

4. For all waste streams greater than 1000 feet $(ft.)^3$ in total volume, a complete isotopic analysis must be completed for 1% of the containers within the waste stream. The results of this analysis will be compared to the Complete Isotopic Analysis Limits shown in Attachment 8.1.

5.4.6 Sampling Validation Exemption

> **NOTE**
>
> Sampling and analysis is the preferred method of characterization because it is easier to defend; however, some radioactive waste streams cannot be adequately characterized through use of sample and analysis techniques; in such cases, PK is appropriate and necessary. (See Section 5.3.4, PK Determinate Basis for RCRA/TSCA HW.)

PK only (without validation by sampling and analysis) may be used to determine the waste stream distribution when the following criteria are satisfied:

- Sampling cannot be performed due to As Low As Reasonably Achievable (ALARA) considerations
- The source of the contamination for the waste stream is a known input from a characterized waste stream (e.g., a laboratory which receives a sample from a facility process with a characterized stream can use this same waste stream to characterize the lab waste). However, controls must be in place to ensure that changes in original waste stream are identified to the facility (e.g., if the facility's waste stream changes, they must notify the lab so that the lab's waste stream can be revised).

5.5 Data Management

5.5.1 Data Management – General

The ultimate responsibility for data quality assurance on reported data resides with the waste generator to discover and correct inconsistencies and anomalies prior to providing to SWM.

1. Generators shall characterize waste with sufficient accuracy to:

   A. Determine the regulatory status of the waste materials and ensure both regulatory compliance and compliance with the treatment or disposal facility waste acceptance criteria.

   B. Determine the appropriate level of health and safety requirements for protection of site workers and the public during storage, transportation, treatment and disposal.

   C. Ensure the proper segregation, treatment, storage and disposal of the waste. While the waste generator is ultimately responsible for proper waste characterization, the intent of this procedure to define criteria and requirements to ensure waste characterization data supports safe and effective waste management. Specific data quality requirements are discussed based on the method of characterization.

2. General requirements include:

   A. Radiological characterization by PK or sample and analysis will be prepared and approved in an engineering calculation in accordance with Manual E7, Procedure 2.31.

   B. Verification of engineering calculation results are per Manual E7, Procedure 2.60, Technical Reviews.

   C. Radiological monitoring/survey equipment are properly calibrated per requirements in Manual 1Q, Procedure 12-3, Control and Calibration of Radiation Monitoring Equipment.

   D. Scales are properly maintained in accordance with Manual 1Q, Procedure 12-1, Control of Measuring and Test Equipment. Additional details on maintenance of scales are covered in Section 5.13.1, General.

3. Generators are also responsible for ensuring the above applicable requirements are met when provided by service organizations (e.g., Radiological Protection [RP], off-site labs).

4. A formal DQO process must be used for any waste identified for disposal at the NNSS, per Manual 3Q, Procedure 21.2, Data Quality Objectives Process. If DQOs are determined not to be required for NNSS waste, then the rationale shall be documented. The SRS WCO for NNSS or the SRS CTF for NNSS must be included in this process.

5.5.2 Data Quality Objectives (DQO)

1. The objective of the DQO process is to describe and document how a planning team can generate a plan to collect data of appropriate quality and quantity to meet the goals of the entire team. Interactions amongst a multidisciplinary team results in a clear understanding of the problem and problem-solving options available. Using this process can prevent the need for additional costly analysis, compliance risks, and additional human exposure to hazards. The steps of the DQO process as applicable can be documented in a summary in the waste sample plan completed by the ECA, Generator Certification Official (GCO) or CTF.

2. The decision for implementation is based on the TSD facility requirements and the generators project scope (e.g., the sampling of a single container would most likely not necessitate a DQO, unless it was required by the TSD or a unique waste procedure.) See Manual 3Q, Procedure 21.2 for a detailed explanation of the seven step DQO process. The Environmental Monitoring Program Customer Technical Representative can be contacted for development assistance.

3. The seven-step DQO process describes the sequential approach to achieve the structured characterization of sample analysis data, and is outlined below:

   - **STEP 1: State the Problem** – Provide a concise description of the problem that needs addressing through sample collection. Be sure to identify team members, hazards, resources, budget, and scheduling deadlines as applicable.
   - **STEP 2: Identify the Goal of the Study** – Be sure to reach out to other facility members that may have additional analytical data needs from that waste during your sample collection. Consider the potential for alternate outcomes and the need for additional sample locations and/or equipment. Clearly identify your key assumptions and areas that may require estimations. Look ahead for possible outcomes and be prepared for possible alternatives. If the sampling could result in multiple decisions, prioritize and organize your goals.
   - **STEP 3: Identify Information Inputs** – Identify what information is needed to meet your decisions or estimates you identified in Step 2. This is where the team selects appropriate sampling and analysis needs. Be sure to identify any regulatory compliance needs and/or site Shipping/H&S/radiological needs as applicable. Historical data may be used to aid in some of the decisions in Step 3.
   - **STEP 4**: **Define Boundaries of the Study** – What are some of the constraints associated with the sample and data collection? List any physical obstacles, scheduling issues, technology limitations, temporal changes, potential exposure scenarios, financial constraints, and identify hot spots if applicable. Since the sample unit has already been defined, this step discusses what may interfere with your data collection.

5.5.2 Data Quality Objectives (DQO), (cont.)
Step 3, (cont.)

- **STEP 5: Develop the Analytical Approach** – This step should identify the analytical approach needed to draw the conclusion. For example, if you have multiple data points, are you going to use the maximum, average, or statistics. The more complex parameters chosen require more complex data collection design. Statisticians may be needed for proper interpretation of larger data sets.
- **STEP 6: Specify Acceptance Criteria** – Identify any consequences of making incorrect decisions from this study and explain how you will manage uncertainties. Identify any errors such as sample collection and data measurement errors. Identify upfront what is the acceptable level of uncertainty (when the sampling strategy does not capture the extent of the variability in the population being investigated) Examples include sampling limitations and management of analytical data qualifiers. Discuss if errors will overestimate or underestimate analytical data and explain your tolerance limits for your decision errors. Discuss how your confidence level when managing your tolerance limits, and uncertainties.
- **STEP 7: Develop the Plan for Obtaining the Data** – Select and document the design that will yield data to achieve your acceptance criteria as identified in Steps 1 – 6. This is the Sample Plan that now can identify the “resource effective” design that meets all of your needs. Software tools are available such as Visual Sample Plan (VSP) to help with the development of a plan for this process. Be sure to include the number of samples, sample types, timing issues (such as scheduling or laboratory holding times), analytical methods, and any restrictions/alternatives as previously identified.

5.5.3 Data Base Systems

Database inventory management systems (e.g., Waste Tracking System [WITS], Hazardous Mixed Waste Tracking [HMWT], Consolidated Waste Tracking System [CWTS]) should be used to input, store, analyze, and generate reports where possible, in place of the corresponding forms unless otherwise specified by SWM.

5.5.4 Periodic Data Validation (Radioactive Waste Streams)

NOTE

Beryllium and elemental carbon waste streams do not require periodic validation

1. Hazardous and Mixed waste streams generated at SRS must be evaluated at least annually to ensure that the characterization of the waste is accurate per Section 5.11, Hazardous Waste (HW) Considerations.
2. Generators must perform a documented review of LLW Streams every two years to ensure the characterization data, waste stream information, and referenced procedures are current, unless changes requiring immediate notification occur. These reviews will typically be performed by sample and analysis and will be documented in an approved calculation per Manual E7, Procedure 2.31.

5.5.4 Periodic Data Validation (Radioactive Waste Streams), (cont.)

3. For LLW Streams with no changes in process or radionuclides after the two-year period, generators may document this by PK. Documentation of this review will be by the submittal of OSR 29-82 re-characterization to SWM for review and approval.

4. One-time only waste streams (i.e., limited term projects) and characterization-by-package waste streams do not require periodic validation. SWM requests generators to contact SWE after the use of the one-time only stream is complete so that the streams can be inactivated.

5. Generators will formally notify SWM of changes affecting the following:
   - Changes in process exceeding bounding assumptions (e.g., waste weight, contamination levels, default values, etc.)
   - Changes in process resulting in different waste streams (e.g., Job Control Waste [JCW], equipment) generated not previously evaluated
   - Changes in process affecting isotopic distribution of PA, TRU or fissile isotopes.

6. SWM will determine the impacts of the reported changes and will direct the waste generator in required waste characterization documentation revisions.

5.6 Land Disposal Restrictions (LDR)

5.6.1 Land Disposal Restrictions (LDR) - General

1. The LDR program requires that any HW destined for land disposal be treated to reduce the toxicity and/or mobility of its hazardous constituents.

2. The LDR regulations require that HW be treated using a specified technology or that it meet certain concentration (numerical) limits for hazardous chemical constituents prior to disposal (unless an exemption or variance has been obtained). The LDRs attach to a HW at the point of generation. In addition, Universal Treatment Standards (UTS) requirements apply to all characteristic (D-coded) wastes D001-D043. The LDRs additionally require the generator of all characteristically HW that will be land disposed to identify the Underlying Hazardous Constituents (UHCs) present so that they will be treated to the UTS. For F001-F005 and F039 listed wastes, the generator must identify which of the specifically regulated F001-F005 constituents are contained in the wastes. See Note under Section 5.11.5, Characteristic Waste.

3. TRU mixed waste that is to be disposed at the Waste Isolation Pilot Plant (WIPP) is exempt from having to comply with the treatment standards and is not subject to the land disposal restrictions outlined in 40 CFR Part 268, in accordance with the WIPP Land Withdrawal Act of 1992, as amended. TRU waste that is not eligible for disposal at WIPP, must comply with RCRA treatment and disposal requirements per the Federal Facility Compliance Act of 1992.

5.6.2 Point of LDR Determinations

1. EPA requires that LDR determinations be performed at the point of waste generation.

   A. LDRs attach to a HW at its point of generation. The waste must be evaluated to:

      - Assign proper waste code(s)
      - Determine treatment subcategory (e.g., D001 high total organic carbon [TOC] ignitable liquids)
      - Determine whether it is a wastewater or non-wastewater
      - Determine if there are any UHCs (applicable to Characteristic wastes only).

        a) UHCs must meet UTS requirements per 40 CFR 268.48.

5.6.3 Underlying Hazardous Constituents (UHC)

1. Characteristically hazardous D001 through D043 wastes that are to be land disposed must be treated such that all UHCs meet the UTS found in SCHWMR R.61-79.268.48. The requirements to cover all characteristically HW including the D004-D011 toxicity characteristic (TC) metal waste effective August 24, 1998. The requirements for treatment of underlying hazardous constituents do not apply to high-TOC ignitables that are incinerated. However, since generators are not aware if incineration will be chosen, based upon other prohibitive constituents or TSD operational factors, UHCs should be identified regardless. The application of this requirement is illustrated by examples in Attachment 8.4.

2. In order to meet the treatment standards for UHC, TSDs must be aware of any UHCs present in the waste. A waste generator is obligated to identify those UHCs that are "reasonably expected to be present" in a HW stream. The determination of "reasonably expected to be present" may be based on PK of the raw materials used, the process and potential reaction products, or the results of a one- time analysis for the entire list of UTS hazardous constituents that may be present in the untreated HW. The EPA believes it is not necessary to routinely monitor waste streams for all UHCs.

5.6.4 Heavy Metal Waste Treatment Prohibition

In the Phase III LDR rule, EPA defined an "inorganic metal-bearing waste" as one for which EPA has established treatment standards for metal hazardous constituents and which do not otherwise contain significant organic or cyanide content, [SCHWMR R.61-79.268.2(j)]. EPA has determined that the eight TC metal wastes (D004- D011) meet the definition and the prohibition of dilution by combustion applies to these wastes [SCHWMR R.61-79.268.3(c)]. These waste codes cannot be incinerated or substituted as fuel in a Boiler or Industrial Furnace (BIF) or in a HW incinerator unless, at the point of generation or after any treatment (such as cyanide destruction), they meet one or more of the following criteria:

5.6.4 Heavy Metal Waste Treatment Prohibition, (cont.)

1. The waste contains hazardous organic constituents or cyanides at levels exceeding the constituent-specific UTS.

2. The waste is an organic, debris-like material (such as wood, paper, plastic or cloth) that is contaminated with inorganic, metal-bearing HW.

3. The waste at point of generation has reasonable heating value such as greater than or equal to 5,000 Btu/lb.

4. The waste is co-generated with other wastes for which combustion is a specified treatment standard.

5. The waste is subject to a federal and/or state provision that requires a reduction of organics (including biological agents).

6. The waste contains greater than 1% TOC.

5.6.5 Central Accumulation Area (CAA) Waste Treatment

1. A generator may treat HW in containers without a permit so long as the generator develops and follows a Waste Analysis Plan and the treatment is conducted in a CCA. The waste cannot be land disposed unless it has met all applicable LDR treatment standards. Treatment must be for the purpose of fully meeting the LDR Treatment Standards. A Waste Analysis Plan is required and must be kept on file for review by the regulator, if requested. Prior to conducting any treatment, contact the RCRA SME for guidance.

2. A Waste Analysis Plan that describes the treatment performed must be kept on file for review by the regulator, if requested. Prior to land disposal, the waste must be treated to meet UTS for any UHCs reasonably expected to be present in the waste.

5.6.6 Identifying Appropriate Treatment Standards

1. HW treatment standards are separated into two categories:
   - **Wastewater** - Defined as a waste containing less than 1% by weight TOC and less than 1% by weight total suspended solids (TSS).
   - **Non-wastewater** - Defined as any waste that does not meet the definition of wastewater.

2. A generator must determine if a waste is a wastewater or non-wastewater to determine the appropriate treatment standard.

5.7 Treatment, Storage, and Disposal (TSD) Prerequisites

1. Waste requiring treatment, storage and/or disposal at an off-site TSD facility must comply with the off-site TSD facility acceptance criteria. This may require additional sampling and/or documentation above that outlined in this manual. SWE shall be contacted for guidance.

2. Each facility that expects to receive some form of radioactive or HW must be properly permitted for the specific physical and chemical characteristics of the waste or wastes for which it is authorized, as indicated below:

3. Facilities designated for the treatment, storage, or disposal of LLW or TRU operate under the authority of the DOE.

4. LLW facilities are not authorized to receive, treat, store, or dispose of HW, MW, or most categories of PCBW.

5. A facility must be specifically authorized and permitted by SCDHEC or EPA to receive, treat, store, or dispose of HW or MW. On-site non-commercial facilities that store PCBW are not required to be permitted by EPA. However, they must comply with specific standards set forth in the regulations or in an applicable EPA approved document. With limited exceptions for certain non-liquid PCB wastes, commercial treatment, storage, and disposal facilities must be permitted by EPA to receive PCB wastes. TSCA requires many forms of PCB wastes to be disposed at a TSCA-permitted incinerator or chemical waste landfill. The permits for these facilities specify the physical and chemical characteristics of the waste for which they are authorized.

6. In order to meet permit and operating needs, some TSD facilities require information beyond that necessary to characterize the waste as hazardous, radioactive, or PCB waste. LDR may also dictate the need for certain waste characterization data to allow for future treatment or disposal.

7. Data needed for acceptance of waste at a TSD is specified in:
   - Manual 1S, Chapter 5, Low-Level Waste; Chapter 7, Transuranic Waste; or Chapter 6, RCRA, TSCA, Mixed and LLLW
   - OSR 29-82, Low-Level Waste Stream Characterization
   - OSR 29-47, Waste Characterization Form (WCF)
   - OSR 29-90, TRU Waste Container Characterization
   - OSR 29-93, Uniform Low-Level Radioactive Waste Manifest
   - OSR 29-99, Hazardous/Mixed/PCB Waste Manifest.

5.7 Treatment, Storage, and Disposal (TSD) Prerequisites, (cont.)

8. While the applicable characterization form and waste manifest capture the bulk of the characterization data, they are not all inclusive. The generator must ensure that the waste does not include items/material prohibited by the TSD's Waste Acceptance Criteria.

5.8 Radiological Modifier Special Considerations

5.8.1 Beryllium and Elemental Carbon

NOTE

1. These requirements are only applicable to generators using beryllium or elemental carbon in the process or as a waste component.
2. Elemental Carbon is those materials containing pure carbon in its elemental form that could credibly be considered either a special neutron reflector or moderator (e.g., graphite or diamond).
3. Naturally occurring beryllium in SRS soil is exempted from this requirement.

1. Due to increased fissile gram loading in Slit Trench and Component-in-Grout segments, generators of LLW destined for disposal in any E-Area location will evaluate for the presence of beryllium and/or elemental carbon in or associated with the waste. The fissile inventory limits for LLW facilities are dependent on the presence of beryllium and elemental carbon. As such, the generator will report the grams (quantities greater than or equal to one gram) of beryllium or elemental carbon in a waste package by the RAD Weight calculation method in the applicable waste tracking application (e.g., WITS or CWTS) as directed by SWM.

2. All waste packages containing any quantity of beryllium must comply with Manual 4Q, Procedure 209, Chronic Beryllium Disease Prevention Program, labeling requirements. A comment should be included on the waste package documentation that supports the IH beryllium label.

3. LLW waste packages containing less than one gram of beryllium and elemental carbon are exempt from reporting in characterization documentation.

4. The following is guidance for reporting beryllium and elemental carbon quantities greater than or equal to one gram in LLW:

    A. Beryllium in LLW will be reported on a separate Waste Stream Characterization Form. Generators will select RAD Weight as the Valid Calculation Method, designating the beryllium as "Be-1" and report 100 Ci%.

    B. Elemental carbon in LLW will be reported on a separate Waste Stream Characterization Form. Generators will select RAD Weight as the Valid Calculation Method, designating elemental carbon as "C-1" and report 100 Ci%.

5.8.1 Beryllium and Elemental Carbon, (cont.)
Step 3, (cont.)

C. When creating LLW packages in the applicable waste tracking application (e.g., WITS or CWTS), the generator will:

- Create a separate waste cut for the beryllium or elemental carbon portion
- Select the appropriate waste stream
- Enter RAD as the Calculation Method
- Leave the default value of zero for Activity
- Enter the gram quantity equal to the amount of either beryllium or elemental carbon in the waste into the RAD Weight field.

5. The following guidance is for reporting beryllium and elemental carbon in Mixed Waste:

A. The concentrations of beryllium and elemental carbon, if present, must be provided in the Chemical Constituents section of OSR 29-47.

B. The total quantities (in grams) for beryllium and elemental carbon do not need to be reported.

6. TRU waste packages containing less than one gram of beryllium are exempt from reporting in characterization documentation. For TRU waste packages containing greater than or equal to one gram of beryllium, the beryllium quantity shall be specified on the OSR 29-90. Elemental carbon is not required to be reported at any levels for TRU waste packages.

5.8.2 Attached Lead

NOTE

Per agreement with SCDHEC, a waste form/equipment with attached lead can only be disposed of in Slit Trench, Component-In-Grout Trenches or E-Area Vault Waste if it provides radiation shielding or functions as a counterweight during transportation, handling or disposal.

1. Lead in LLW destined for disposal in either the Slit Trench, Component-In-Grout Trenches or E-Area Vault Waste will be reported on a separate WCF. Generators will select RAD Weight as the Valid Calculation Method, designate the Lead as "Pb-1" and report 100 Ci%.

2. When creating LLW packages in the applicable waste tracking application (e.g., WITS or CWTS), the generator will:

- Create a separate waste cut for the lead
- Select the appropriate waste stream

5.8.2 Attached Lead, (cont.)
Step 2, (cont.)

- Enter RAD as the Calculation Method
- Leave the default value of zero for Activity
- Enter the gram quantity equal to the amount of Lead in the waste into the RAD Weight field.

5.9 Radionuclide Considerations

NOTE

The requirements for LLW are to be used if the subject waste stream can be either LLW or TRU, depending on activity levels.

5.9.1 Potential Radionuclides

1. The radionuclides that must be considered as potentially present in all SRS LLW waste streams are:

   A. Those identified as Performance Assessment (PA) radionuclides identified for a specific TSD. The following eight PA isotopes shall specifically be reported: H-3, C-14, Sr-90, Tc-99, I-129, U-234, U-235, and Np-237.

   B. If an isotope is greater than 1% of total Curie distribution it must be reported.

   C. If an isotope is determined to be less than 1% of the initial radiological distribution and does not have to be reported for PA/DSA concerns (it is less than the reporting threshold values in Attachment 8.7, LLW Radionuclide Package Reporting Thresholds), it may still need to be reported for transportation purposes.

      - Transportation and Packaging requires the reporting of any significant isotope to enable the categorization of the radioactive material content in terms of A1/A2 Curie values for determining radioactive material types [e.g., limited quantity, low specific activity (LSA), Type A and Type B] and associated packaging.
      - The OSAs and OTRs provide for onsite transfer of radioactive materials in a manner that is equivalent to that provided by the DOT/NRC regulations. OSAs and OTRs provide radionuclide, fissile gram and wattage limits as well as transportation control and communication requirements. Compliance with the OSA and OTR radionuclide, FGE and wattage limits requires a comprehensive listing of the isotopes and curies of the material to be transferred.

5.9.1 Potential Radionuclides, (cont.)
Step 1, (cont.)

D. Those that are expected be present in the waste stream based on the nuclide generation process at the time the waste stream is characterized (daughters are to be included) in quantities that may challenge waste package reporting thresholds that are identified in Attachment 8.7 or do not meet the radionuclide exclusion criteria in Section 5.9.2, Radionuclide Exclusion Basis.

E. Detectable transuranics (those that contribute to TRU) and fissile radionuclides. (See Attachment 8.5, TRU and Fissile Isotopes Table) (See Section 5.9.2 note on Radionuclide Exclusion Basis on MALLD).

2. The generator should report on OSR 29-47 only those radionuclides that are actually in the MW (those identified through analysis as greater than minimum detectable levels [>MDA]). This standard is established based upon the needs of the treatment facility and existing transportation limitations. It is not expected for generators to obtain long-count analyses in order to identify those radionuclides believed or suspected to be present in the waste at very low concentration. Radionuclides at such low levels (i.e., 1.0E+00 pCi/g) do not adversely impact current treatment facility WAC or licensing requirements, and generally do not pose a concern from a transportation perspective.

5.9.2 Radionuclide Exclusion Basis

1. A radionuclide can be assumed to be not present and/or not significant for the purpose of waste stream characterization if any one of the following conditions is demonstrated and documented:

A. There is no reason to expect the radionuclide to be present in the waste stream, i.e., no plausible production mechanism.

NOTE

The MALLDs listed in Attachment 8.3 are provided as a guide for laboratory selection. If the laboratory cannot provide a LLD at or below the MALLD, a better analysis technique or better laboratory should be considered. In the event there are legitimate limitations on what the laboratory can achieve due to waste stream specific considerations, these limitations must be documented as part of the characterization.

B. For PA radionuclides, PK can show that the radionuclide could not be present in the waste stream at concentrations more than two orders of magnitude below the radionuclide Maximum Allowable Lower Limit of Detection (MALLD) concentration in µCi/cc or µCi/g shown in Attachment 8.3. Iodine-129 is an exception to this rule. For Iodine-129, PK must show that the radionuclide could not be present in the waste stream at a concentration above 1.0E-10 µCi/cc or 1.0E-10 µCi/g.

5.9.2 Radionuclide Exclusion Basis, (cont.)
Step 1, (cont.)

C. For a non-PA radionuclide, PK which includes consideration of the radionuclide shows that it is not present in the waste stream or if present has a concentration below the MALLD concentration shown in Attachment 8.3.

2. The list of considered radionuclides remaining after application of the above exclusionary criteria will provide the basis for initial radionuclide content and distribution in a waste stream. Screening of quantitative representative sample data and other criteria defined in this section will provide the basis for determining the final radionuclide content and distribution used for characterization of a waste stream.

5.9.3 Radionuclide Reporting of LLW Stream PA Below LLD

1. If PK shows that a PA radionuclide cannot be excluded, PA radionuclides that are less than LLD will be assigned a value 0.1 times the LLD value (except for Iodine-129) for the PA radionuclide.

2. Iodine-129 that is less than LLD in the sample will be reported using one of the following methods:

A. If PK shows that I-129 is not concentrated by the waste process, calculate the I-129 value by multiplying the reported Cs-137 value, whether Cs-137 is measured or reported LLD, by 9.00E-07 which is two times I-129/Cs-137 ratio in Table 4 of EPD-CTG-94-0006 - Fission Limits for Fission Product Ratios.

B. If PK shows the waste process concentrates the I-129, calculate the I-129 value by multiplying its LLD value by 0.1.

5.9.4 Reporting LLW Radionuclides Combined on Sample Output

The waste tracking applications (e.g., WITS or CWTS) do not allow for reporting of combined activities of two or more isotopes, which may be reported as such in sample results. If available and documented, PK may be used to distribute the activity accordingly; otherwise, generators will report combined radionudides on sample output using the following method:

1. Pu-239 and Pu-240 are sometimes reported as Pu-239/240. Assign the activity to both Pu-239 and Pu-240.

2. U-233 and U-234 are sometimes reported as U-233/234. Assign the activity to both U-233 and U-234.

3. U-235 and U-236 are sometimes reported as U-235/236. Assign all activity as U-235.

4. Cm-243 and Cm-244 are sometimes reported as Cm-243/244. Assign the activity to both Cm-243 and Cm-244.

5.9.5 Common Daughter Radionuclide Relationships

NOTE

The information provided in Attachment 8.7 does not apply to TRU waste and MW.

All daughter radionuclides will be considered to be in the proper proportion to the parent radionuclide. When the amount of any daughter radionuclide is <Ci/Pkg threshold in Attachment 8.7 and < 1% of the total Ci (curie) distribution, the daughter radionuclide may be excluded from the final distribution. Common daughter radionuclides at SRS and their relationship to the parent are:

- Barium (Ba)-137m - report at 0.946 of Cs-137
- Protactinium (Pa)-234m - report at 1.00 of U-238
- Thorium (Th)-234 - report at 1.00 of U-238
- Pa-233 - report at 1.00 of Neptunium (Np)-237
- Th-231 - report at 1.00 of U-235
- Yttrium (Y)-90 - report at 1.00 of Strontium-90.

5.9.6 Radionuclide Reporting for TRU Waste

1. TRU generators will report the radiological characterization on the OSR 29-90 using one of the following reporting methods:

   A. Standard Distribution Method enables the user to enter the mass or activity values along with uncertainty values directly on the form by radionuclide. The OSR 29-90 segregates radionuclides into two groups. The upper section provides mass (grams) entry fields for radionuclides that are predominantly TRU and/or fissile. The lower section provides activity (Ci) entry for a group designated as “Other Radionuclides.” The other radionuclide section does not provide a separate field for uncertainty. When performing the standard method on the OSR 29-90, TRU generators will include the uncertainty in the total activity (Ci) value entered.

   B. Scaled Distribution Method enables the user to select the TRU radiological waste stream Ci% distribution applicable to the TRU waste container. The user must then select the radionuclide and enter the measurement quantity and uncertainty value used to scale to the other radionuclides in the waste stream distribution. Use of this method prohibits the user from making direct radionuclide property entries on the OSR 29-90. The Scaled Waste Stream must be developed by the generator and approved by SWM prior to being available for selection on the OSR 29-90. The Scaled Waste Stream is a fixed radionuclide waste stream Ci% distribution that may be used for more than one TRU waste container.

5.9.6 Radionuclide Reporting for TRU Waste, (cont.)

2. TRU waste generators will evaluate the presence in the waste stream, through PK and SWM-approved radionuclide analytical techniques (e.g., Direct Assay [DA]), of the TRU and fissile radionuclides listed on Attachment 8.5. This evaluation is used to identify and report the TRU and fissile radionuclides detectable by analytical technique and to exclude the radionuclides that either are not present in the waste stream or are at activity levels expected through PK or are reported by the analytical technique to be below the lower limit of detection (LLD). The evaluation must also address the Total Measurement Uncertainty (TMU) ensuring a high level of confidence the reported values are conservative with respect to the actual content of the TRU waste container. See criteria for TMU in Section 5.10.5.

3. For TRU waste, additional reporting guidance applies to twelve radionuclides.

   A. These nuclides are:

      1) Americium (Am)-241

      2) Plutonium (Pu)-238, Pu-239, Pu-240, Pu-241, Pu-242

      3) Uranium (U)-233, U-234, U-235, U-238

      4) Strontium (Sr)-90

      5) Cesium (Cs)-137

   B. TRU waste generators shall report the twelve radionuclides on OSR 29-90 based on the following criteria:

      1) The quantity and uncertainty of a detectable radionuclide present in the distribution either by direct entry on the form using the standard method or by Ci% ratio to another radionuclide by using the scaled method. Sr-90 and Cs-137 do not have fields for entry of an uncertainty value. For these fields, the entry will be a total, including the uncertainty.

      2) For any radionuclide known to be present in the TRU radiological characterization but at levels documented below the LLD based on PK or by the analytical technique, a value of zero directly entered using the standard method or a Ci% of zero in the radiological waste stream characterization distribution for use by the scaled method.

      3) For any radionuclide the documented PK evaluation and analytical technique indicates the radionuclide is less than (<) LLD in the waste stream characterization, the radionuclide may be excluded from reporting.

5.9.6 Radionuclide Reporting for TRU Waste, (cont.)

4. TRU waste generators will report on OSR 29-90 any other non-TRU or non-fissile radionuclides with activity level greater than (>) 1 Ci% of the final TRU waste container. If the radionuclide is not specified on the OSR 29-90, report the radionuclide under the appropriate decay category of Other Alpha (α) or Other Beta/Gamma (β/γ) based on the primary decay mode of the radionuclide. List any radionuclide in the comment field that has the activity reported in the decay category fields of the OSR 29-90, as appropriate.

5. For any TRU waste container not confirmed containing greater than (>) 100 nCi/g TRU radionuclides, TRU waste generators will also document the waste stream characterization following the LLW radionuclide reporting criteria, with emphasis on reporting the LLW PA radionuclides.

5.10 Radionuclide Package Activity Considerations

5.10.1 Radionuclide Package Activity Considerations - General

1. The last step in the LLW, TRU, and MW characterization process estimates the radionuclide content of a waste package. Several different methods can be employed, and their application depends on the predominant radionuclides within a waste stream and the physical form of the waste materials. This section presents the methods to be used to determine waste content and the criteria for their application under Manual 1S.

2. The following requirements are independent of the method used to quantify the radioactivity within a waste package:

   A. **Radionuclide Content and Distribution** - the predominant radionuclide content and distribution of the waste stream must have been determined using the process defined in Section 5.2.4, Radionuclide Waste Stream Characterization.

   B. **Disposal Container** - the waste stream must be packaged in one of the SRS approved disposal containers (approval of a non-standard container can be obtained through submittal of OSR 29-57, Container Approval Request).

   C. **Alternate Methodologies** - the methods described in this section apply to most SRS waste packages but do not preclude the use of other characterization methods as provided for in Section 5.2.2, Alternative Evaluation Characterization.

5.10.2 Activation Modeling

Activation analysis employs computer programs to calculate the activities of radionuclides produced in metals as a result of exposure to neutron fluxes. The use of such computer programs does not, however, provide a basis for quantifying the absolute radionuclide content in metals.

1. Applicability

   Activation analysis applies only to metal components exposed to neutron fluxes.

2. Radionuclides Excluded

   All radionuclides that are not produced from neutron activation of the base metal constituents (including trace contaminants) can be excluded from the waste stream radionuclide content. This method can be used only if surface contamination (which can include fission products and transuranics) is negligible with respect to waste stream characterization. See criteria for radionuclide exclusion in Section 5.9.1, Potential Radionuclides, and Section 5.9.2, Radionuclide Exclusion Basis.

3. Method

   The following methodology relies on the use of the ANISN and ORIGEN2 computer programs for neutron transport and activation analysis, respectively. Other computer programs that perform the same types of calculations can also be used at the discretion of the generator:

   A. Determine the initial elemental material composition for the component(s) of interest. The material composition should include all elements present, including trace impurities such as niobium and cobalt. Materials data can be obtained from actual component specifications or generic composition data either from NUREG/CR-3474 - Long-Lived Activation Products in Reactor Materials or ASTM standards.

   B. Calculate the neutron flux levels and energy spectra at the locations of interest using the ANISN discrete ordinates neutron transport program. ANISN input parameters include detailed physical characteristics as well as materials data.

   C. Perform activation calculations using the ORIGEN2 computer code. Activation calculations inputs include materials inputs and flux results from above and the irradiation history for the component(s) of interest.

   D. Scaling factor relationships are determined based on the ratio of hard to detect radionuclides relative to gamma emitting nuclides like Co-60 from the ORIGEN2 results.

5.10.3 Direct Sample Measurement

This method relies on the measurement of the activity in a representative sample or samples to characterize a bulk quantity of material with volumetric contamination. Sample characterization makes use of gamma rays of selected energies from a contaminating radionuclide, or measurement of alpha or beta radiation to quantify radionuclides. Analytical methods include use of spectroscopy, liquid scintillation counting, and radiochemistry. If multiple radionuclides are present in the contamination, the radionuclide scaling factors must be determined and used to quantify non-measured radionuclide activities from the activity of the measured radionuclide(s).

1. Applicability

   A. This method may be used if all of the following conditions are satisfied:

      1) A sampling and analysis plan is developed to provide for random representative sampling.

      2) The generator has demonstrated through periodic analysis of representative waste stream samples or currently validated PK, that the waste stream contains radionuclides that are measurable with sufficient sensitivity to ensure that the WAC will not be exceeded.

      3) The generator has determined the radionuclide distribution of the contaminating radionuclides. This can be done by laboratory analysis of samples from the waste stream, if appropriate, or from the material being characterized. If the considered radionuclides are directly measured, the distribution does not need to be known in advance.

      4) The samples for direct measurement quantification are obtained from batches of the waste stream that are representative of the waste materials to be packaged.

2. Method

   A. The direct measured sample data values in activity per gram (g) or activity per cubic centimeter (cc) will be multiplied by the waste weight (grams) or the waste volume (cc) as appropriate to quantify the directly measured activity.

   B. The total activity in a waste package will be determined by dividing the directly-measured activity(ies) by the fraction of the radionuclide activity distribution for the waste stream attributed to those directly-measured radionuclides which will be documented in a calculation per Manual E7, Procedure 2.31.

5.10.4 Dose-to-Curie Conversion

This method relies on the measurement of gamma emitting radionuclides from the waste package.

1. Applicability

   This method may be employed if the following conditions are satisfied:

   A. A typical waste package or waste cut emits gamma radiation with a dose rate at least 15 μrem/hr above background at contact (5 cm) if a Bicron Micro-Rem Model LE instrument (or equivalent) is used.

   B. The generator has defined the radionuclide distribution per the requirements of this procedure.

   C. The waste stream has sufficient gamma emitting radionuclides in concentrations that ensure scaled isotopes are conservatively accounted for in any package including those with measured dose rates below 15 μRem/hr at contact.

2. Method

   The latest revision of the SRS-DTC computer program or an SWM-approved equivalent program will be used to calculate DTC conversion factors for each generator's waste package with generator input parameters (waste geometry, dimensions, type, weight, shielding thickness - type, detector location, and radionuclides) as defined in the operating procedures for this computer program. For routine SRS waste streams this is normally accomplished by means of Tables accessed by the waste tracking application program which are maintained by SWM. Tables currently set up in the waste tracking application are based on the list shown in Attachment 8.6, Dose-to-Curie Standards Tables.

3. Dose Rates

   Dose rates to be used for DTC will be taken in accordance with the requirements below unless technical justification is provided to and approved by SWM:

   A. Dose rates will be taken on packages using a standard geometry.

   B. A Bicron® Micro-Rem Model LE or SWM-approved equivalent instrument will be used.

   C. If the dose reading exceeds the capability of the Bicron® Micro-Rem, a Portable Ion Chamber instrument may be used provided the waste is contaminated primarily with a high-energy gamma emitting radionuclide such as Cs-137, Ba- 137m or Co-60.

   D. If a Portable Ion Chamber instrument is used on waste with other than Cs-137, Ba-137m or Co-60 contamination, contact Solid Waste for evaluation.

5.10.4 Dose-to-Curie Conversion, (cont.)
Step 3, (cont.)

E. Radiological monitoring equipment used to obtain dose rates will be controlled and calibrated per Manual 1Q, Procedure 12-3.

F. The background radiation levels in the immediate area will be obtained prior to the measurement of package dose rates. These background levels should be as low as reasonably achievable and should be subtracted from the readings measured from the package. No background-corrected reading less than the default value of the instrument (15 µrem/hr for background readings up to 50 µrem/hr and 20 µrem/hr for backgrounds from 50 to 200 µrem/hr) will be used.

G. For far-field readings (i.e., three or five feet) a minimum of four radiation level readings will be obtained at equal distances from the package surface with such measurements taken at mid height of the container on:

- Four box sides
- Four drum/cylinder quadrants
- Two vertical sides (only on skid pans).

H. When contact readings are used, the surface area of the accessible sides must be surveyed (e.g., four sides of a B-25, six sides of a 21-inch box, or the entire side area of a drum or drum liner), and the highest reading per side used. For 21-inch or smaller box, midpoint readings may normally be used.

I. The radiation level value used to quantify waste package content will be the highest of the readings taken less the background radiation level.

J. Special conditions may be imposed by SWM on the use of this method depending on the form and isotopic distribution (e.g., only incidental metal allowed). These will be notated on OSR 29-82.

4. Physical Form

Physical characteristics will comply with the following requirements:

A. The generator will consider the impact of non-homogeneity of physical form.

B. Void spaces in the waste will be minimized to the extent reasonable.

C. Metal content in the waste will be evaluated to determine how the variation in the metal content affects the DTC calculation. The generator must show that the effect on the DTC calculation of variations in the metal content is not significant (i.e., within a factor of 2), or the generator must implement controls for metals in the waste stream.

5.10.4 Dose-to-Curie Conversion, (cont.)

5. Validation

   A. Validation requirements on the radiological distribution are given in Section 5.5.4, Periodic Data Validation.

   B. Depending on the radionuclides affected, changes to the radionuclide distribution can have significant impact to accuracy in activity reporting when performing DTC. During (Periodic) validation of waste streams, generators will evaluate impacts to DTC and document the results in a calculation per Manual E7, Procedure 2.31 and submit the results along with the characterization documents to be reviewed and approved by SWM as part of the validation.

5.10.5 Direct Assay

1. Direct assay is an option for waste containing certain radioisotopes that emit measurable gamma radiation of sufficient energy and intensity. Certain fission products, and some uranium and transuranic isotopes can be measured by this method.

2. Direct assay makes use of highly efficient detectors, energy discrimination, and a longer count time than is used with field instruments and provides a much more accurate measure of radionuclide content than field instruments can provide. In order for direct assay to provide the best results, the generator will maintain the system in an area with as low as reasonably achievable background radiation levels.

3. Direct assay may be used as the sole method of determining the presence and quantity of radionuclides (especially for TRU wastes). This must be supported by detailed and accurate PK.

4. Applicability

   The following conditions will be met to apply this method:

   A. The typical waste package contains at least one radionuclide in sufficient concentration that it can be accurately quantified through the use of an appropriate assay device (e.g., Canberra Q2).

   B. The generator has defined the radioisotope distribution per the requirements of this procedure.

5. Method

   Each package is directly measured using the assay device and maintaining proper measurement control as defined below in Measurement Control. The total activity of the contaminating radionuclides is determined by dividing the directly measured radionuclide activity by the fraction of activity from that nuclide in the activity distribution. The activities of all other radionuclides are obtained by multiplying their respective activity fractions (from the distribution) by the total activity.

5.10.5 Direct Assay, (cont.)

6. Measurement Control

Direct assay measurements are valid only after a technical review has validated the measurement data and the measurement system and has ensured that the following attributes have been met:

A. The non-destructive assay measurement system used for the measurement is capable of detecting the desired material attributes for which it is reporting and that the measurement method is qualified for its intended use.

B. The non-destructive assay measurement system used for the measurement is maintained under a site level recognized measurement control program (Manual 1Q, Procedure 2-7, QA Program Requirements for Analytical Measurement Systems).

C. Measurement control limits for the non-destructive assay instrument are established and the methodology for calculating the control limits is documented (Manual 14Q, Procedure 3.06, Nondestructive Assay Measurement Control).

D. The non-destructive assay measurement system is calibrated and has a documented calibration program which is in alignment with guidance given in one of more of the following:

1) ASTM C1133-03 - Test Method for Nondestructive Assay of Special Nuclear Material in Low- Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning

2) ASTM C1207-03 - Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting

3) ASTM C1500-02 - Test Method for Nondestructive Assay of Plutonium by Passive Neutron Multiplicity Counting.

E. The reported measurement value includes the Total Measurement Uncertainty/Expanded Uncertainty, and this Uncertainty has been documented and undergone a peer review. The Total Measurement Uncertainty/Expanded Uncertainty should be in alignment with guidance given in one or more of the following:

1) ASTM C1133-03

2) ASTM C1215-92 - Guide for Preparing and Interpreting Precision and Bias Statements in Test Method Standards Used in the Nuclear Industry

5.10.5 Direct Assay, (cont.)
Step 6E, (cont.)

3) ANSI N15.36 - Nondestructive Assay Measurement Control and Assurance

4) International Atomic Energy Agency (IAEA)-TECDOC-1537 - Strategy and Methodology for Radioactive Waste Characterization.

F. The requirement is to provide a high level of confidence that the reported values are conservative with respect to the actual isotopic content. As required by WSRC-SA-22, Savannah River Site Solid Waste Management Facility Documented Safety Analysis, the measurement and required result shall ensure a 95 percent confidence level or a two-standard deviation (2 sigma) is applied to the assay value.

7. Validation

Scaling factors (the ratio of non-detectable to detectable radionuclides) will be reviewed at the frequency established based on Section 5.5.4, Periodic Data Validation.

5.10.6 Smear-to-Curie Conversion for Non-Equipment Waste

This characterization method relies on posted room or area contamination levels and the weight of the waste to reasonably upper bound the waste package radionuclide content. This method may also use smears of the actual waste, surveys of the waste or surveys from the area(s) where the waste is generated. Room contamination postings, smear results, or surveys are generally given in disintegrations per minute per 100 cm2 (dpm/100 cm2). This method applies to job control and laboratory waste typically of low to medium density that has been contaminated by incidental contact with contaminated surfaces.

> **NOTE**
>
> Smear-to-curie is invalid for waste from decontamination activities and waste contaminated by contact with radioactive material in the gaseous or liquid phase that could act to concentrate the activity or result in skewed distributions except as specifically justified by appropriate technical documentation.

1. Applicability

This method can be used for contaminated non-equipment waste when the following conditions are satisfied:

A. Waste contamination must be surface contamination.

B. The impact of non-homogeneity has been considered.

5.10.6 Smear-to-Curie Conversion for Non-Equipment Waste, (cont.)
Step 1, (cont.)

C. The transfer mechanism must be by means of contact with solids.

2. Method

The determination of the assigned content of a waste package will be as follows:

A. Total Activity - the following algorithm will be used to estimate the total waste package activity:

$$\mathbf{A = [S \times W \times K \times T \times P] / [Da \times F \times E]}$$

Where:
A = Total activity in Ci

S = Room posting, smear, or survey activity in dpm/100 cm^2 (e.g., for a room posted or a smear counted at 10,000 dpm/100 cm^2, then S = 10,000)

W = Net weight of waste in lbs

K = Constant conversion factor, 2.04E-9 (Ci-mg-100 cm^2/cm^2-dpm-lb) (e.g., 4.50E-13 Ci/dpm x 453.6 gm/lb x 1E3 mg/g x 1E-2 100cm^2/cm^2)

T = 1 for one-sided contamination, 2 for two-sided contamination

P = Fraction of contamination level "S" (room posting or waste smear) that is present on the waste

Da = Areal density of waste in mg/cm^2

F = Fraction of radionuclide distribution detected on the smear used to characterize (post) the area (i.e., alpha smears from a stream of which alpha activity is 11% of the total activity would have F = 0.11)

E = Smear efficiency (fraction of removable contamination that is transferred to a smear).

B. Individual Radionuclide Activities - Total Activity "A above" in the following algorithm is used to determine the activity "R(i)" to assign to an individual radionuclide in a waste package:

$$\mathbf{R(i) = A \times FA(i)}$$

Where:

A = Total activity in Ci

R(i) = Assigned activity in Ci of the ith radionuclide

5.10.6 Smear-to-Curie Conversion for Non-Equipment Waste, (cont.)
Step 2B, (cont.)

FA(i) = Fractional activity of the ith radionuclide in waste stream being characterized.

C. Assume all waste is uniformly contaminated on one side (T=1) unless evidence can be presented to demonstrate that contamination of both sides is routinely expected.

D. Use one of the following two methods to obtain the smear value "S" used in this calculation.

1) The first method is to use the area posting or survey for the location where the waste was generated (see Step 3 below.)

2) The second method is to take smear samples or surveys from the actual waste as it is prepared for disposal [(see Step 4 below, (T=1)].

E. Determine the average value of the areal density appropriate to the waste stream by means of an actual study of the waste stream or use an appropriately conservative value (e.g., 6-mil plastic at 12 mg/cm^2). Average areal density is the average weight per unit surface area (mg/cm^2) of the waste.

3. Use of Area Posting for Smear Value

When room or area postings are used, the following conditions are required:

A. The contamination level of the area expected to be most representative of the waste or a conservative posting will be used in the activity calculation.

B. If necessary, the generator will perform a waste contamination survey to determine the fraction of the posted contamination level actually transferred to the waste {"P" in the equation in Step 2 above [P = Fraction of contamination level "S" (room posting or waste smear) that is present on the waste]}. This entails a survey with a hand-held alpha scintillation counter of a suitable sample of typical waste items to determine how much of the waste is actually contaminated and to what level it is contaminated relative to the posting. Analysis of the results of this study will determine a factor "P" (< 1) that reduces the total activity assigned to facility waste but will afford a high level of confidence that the calculated activity still bounds the actual activity.

5.10.6 Smear-to-Curie Conversion for Non-Equipment Waste, (cont.)

4. Use of Waste Smear or Survey Results

   When waste is characterized by smear analysis or survey, the following requirements must be met:

   A. The area smeared or surveyed must be 100 cm^2 or for smaller pieces of waste, the contamination results are normalized to 100 cm^2.

   B. The best reasonably available measurement method will be used to read the smears (liquid scintillation for tritium) or perform the waste survey (e.g., alpha scintillation counter for waste surveys).

   C. A representative portion of the waste must be smeared or surveyed.

   D. Radiological monitoring equipment used to obtain smear or survey results will be controlled and calibrated per Manual 1Q, Procedure 12-3.

5. Determining Waste Stream Specific Areal Density

   A waste stream specific areal density survey may be done as follows:

   A. Randomly select a representative number of waste containers for areal density analysis, THEN

   B. Determine the total surface area of all waste items in each container. Obtain waste weight and calculate the areal density by dividing the waste weight by the total surface area to get the areal density (mg/cm^2) of the waste in each container. Average the results from the sample containers to determine the waste stream specific areal density, <u>OR</u>

   C. Perform the next four steps as listed:

      1) Separate all the waste by material category (e.g., Kraft paper, rubber shoe covers, 6-mil plastic)

      2) Determine weight-to-surface-area ratio (areal density, mg/cm^2) of each material

      3) Determine the fraction of the waste stream by weight of each material

5.10.6 Smear-to-Curie Conversion for Non-Equipment Waste, (cont.)
Step 5C, (cont.)

4) Determine the weighted average areal density ($Da_{(Wgt\ avg)}$) for the waste stream calculating the inverse of the sum of each material weight fraction divided by the areal density for each material.

$$\mathbf{Da_{(Wgt\ Avg)}} = \frac{\mathbf{1}}{\sum \mathbf{X_i} / \mathbf{Da_i}}$$

Where:

X_i = Material Weight Fraction

Da_i = Areal Density of Material

6. Validation

In addition to the validation of waste stream distribution discussed in Section 5.5.4, Periodic Data Validation, the Smear-to-Curie methodology requires validation of the following:

A. Changes to contamination fraction "F" due to changes in radionuclide distribution and will be evaluated during periodic validation or whenever they occur according to Section 5.5.4.

B. Changes to the calculated specific areal density (as opposed to a conservative value) will be validated as part of the periodic validation.

5.10.7 Smear-to-Curie Conversion for Contaminated Equipment Items

To determine the radionuclide content of a waste equipment item, this characterization method relies on areal smear data or survey data from contamination on the equipment, and an estimate of the contaminated surface area.

1. Applicability

This method can be used for surface-contaminated equipment when all of the following conditions are met:

A. The equipment is surface contaminated.

B. The radionuclide distribution has been determined per Section 5.2.4, Waste Stream Radionuclide Characterization.

C. The contaminated surface area (external and internal) of the equipment can be reasonably estimated.

5.10.7 Smear-to-Curie Conversion for Contaminated Equipment Items, (cont.)
Step 1, (cont.)

D. Radiological monitoring equipment used to obtain smear or survey results will be controlled and calibrated per Manual 1Q, Procedure 12-3.

2. Method

Estimates of contaminated equipment activity will employ the following methods:

A. Total Activity - The following algorithm will be used to estimate the total activity:

A(e) = [S x A x K] / [F x E]

Where:
A(e) = Assigned total equipment activity in Ci

S = Smear data in dpm/100 cm2 (i.e., a smear or survey result of 10,000 dpm/100 cm2 would yield S = 10,000)

A = Estimated contaminated surface area (cm2)

K = Constant conversion factor: 4.5E-15 Ci-100 cm^2/dpm-cm^2
(e.g., 4.50E-13 Ci/dpm x 1E-2 100 cm^2/cm^2)

E = Smear efficiency (fraction of measured contamination to total contamination - for smears, E = 0.1 is typical, and for survey data, E = 1)

F = Fraction of activity distribution being measured (i.e., alpha activity to total activity ratio if alpha activity is measured).

B. Radionuclide Activity - The following algorithm will be used to estimate the individual radionuclide activities of contaminated equipment:

R(i) = A(e) x FA(i)

Where:
R(i) = Activity in Ci of the ith radionuclide

A(e) = Total activity on the equipment item in Ci

FA(i) = Activity fraction of the ith radionuclide in the waste stream from which the item comes.

5.10.8 Materials Accountability

This method relies on the premise that a given quantity and concentration of radioactive material is known to either be contained in waste or may be inferred from measurement of the difference between the quantity of radioactive material entering and exiting the process that generates the waste. Typical applications include sealed sources, wetted tritium waste, radiotracer spike additions, Special Nuclear Material (SNM), and byproduct materials.

1. Applicability

   The following conditions will be met to apply this method:

   A. For sealed sources, radiotracer spike additions, SNM, and byproduct material, the quantities of radioactivity in the waste must be documented in records which can be referenced.

   B. For processes where influent and effluent radioactivity will be measured to determine the quantity in the waste, the process generating the waste stream must produce relatively constant concentrations of radionuclides in known quantities of waste.

2. Methods

   Materials accountability methods include:

   A. For sources and other waste streams with known quantities of radioactivity as of a certain date, the activity can be determined by decay correction.

   B. For waste streams from processes where influent and effluent radioactivity concentrations are known and relatively constant, the activity of the waste resulting from the processing can be determined by applying the following algorithm for each radionuclide or constituent (e.g., enriched uranium, weapons-grade plutonium):

$$\mathbf{A_m = K \times Q\ (Inf - Eff)}$$

Where:

Am = Activity of each radionuclide or constituent; K = Unit-conversion constant

Q = Quantity of material processed during time interval when waste was generated in gallons, cubic feet, or lbs

Inf = Known process influent radionuclide or constituent concentration (i.e., µCi/cc or µCi/g)

Eff = Known process effluent radionuclide or constituent (i.e. µCi/cc or µCi/g).

5.10.8 Materials Accountability, (cont.)
Step 2, (cont.)

C. When "Am" is a constituent (e.g., enriched uranium or weapons grade plutonium), the activity for each radionuclide in the constituent is calculated by multiplying the total activity (Am) by the known fractional abundance for the radionuclide.

D. For example, although the accountability of enriched uranium is by grams of Uranium-235, there are other nuclides in the enriched uranium radionuclide distribution that may be significant for characterization and would be quantified by multiplying the enriched uranium total activity by the known fractional abundance for each radionuclide.

E. For waste streams where either the gross or radionuclide-specific concentration(s) (i.e., µCi/cc or µCi/g) are known, the gross package activity is the gross concentration multiplied by the waste weight or volume and the package radionuclide activity is the radionuclide-specific concentration multiplied by the waste weight or volume, as appropriate.

5.10.9 Radioactive Sources

1. Sources containing transuranic alpha-emitting nuclides with half-lives greater than 20 years must be evaluated against the TRU limit of 100 nCi/g, using only the weight of the source and the components and shielding integral to the source. If the source is determined to be TRU then it may not, for any reason, be considered incidental to the waste stream.

2. Radioactive sources may be considered as incidental to the waste stream if:

   A. The radionuclide is normally part of the waste stream.

   B. The radionuclide activity is less than 1 µCi.

   C. The radionuclide is not listed as a Performance Assessment (PA) in Section 5.9.1, Step 1A.

   D. The source will not challenge the LLW package reporting thresholds per Attachment 8.7.

3. If these criteria cannot be met, then the source(s) must be characterized as a separate waste stream and its radionuclide activity included with the waste package. Characterization will be done by using the original known activity for each source and decay correcting that value.

4. It is recommended that disposal of a large number of sources be done by means of a separate waste stream regardless of activity levels.

5.10.10 Scaling Factors

Methods employed to define radionuclide content and distribution will also be used to calculate scaling factors. Scaling factors define the relationships between readily detectable radionuclides and other radionuclides. These scaling factor relationships can be used for a waste stream until periodic re-validation is completed as defined in the Periodic Validation section. Typically scaling factors are ratios of one easily detectable radionuclide.

5.11 Hazardous Waste (HW) Considerations

5.11.1 Hazardous Waste (HW) Considerations - General

> **NOTE**
>
> Information on Toxic Substance Control Act (TSCA) wastes such as PCBs is provided in Section 5.12, Polychlorinated Biphenyl (PCB) Toxic Waste Considerations.

1. Certified waste programs direct the identification and quantification of the radionuclides contained in LLW, TRU, and MW. These programs also include provisions that limit the creation of MW by restricting or controlling the commingling of radioactive and HW. While HW characterizations are not specifically required for certified LLW streams, it is the responsibility of the generator to ensure that HW is excluded from LLW and that MW and HW are properly characterized to allow for treatment, storage, and disposal.

2. Information provided in this section summarizes many regulatory requirements applicable to the characterization criteria for HW and is not intended as a substitute for the full text of the regulations. Additional characterization guidance can be found in Manual 3Q, Procedure 6.3. The generator ECA can provide assistance in determining specific regulatory requirements.

3. HW which:

   - Resided in a RMMA
   - Was generated within a RMMA
   - Generated from an unknown location
   - Has a potential of containing DOE-added radioactivity.

   Must be evaluated against radiological screening criteria as explained in Attachment 8.1. HW stream radiological screenings may also be requested by SWM Engineering to support periodic assessment programs. HW that contains DOE-added radioactivity must be managed as Mixed Waste (Section 5.11.3, Radiological/Hazardous - Mixed Waste).

4. Only personnel who have successfully completed and maintained the training requirements of ZOBITM07, Radioactive Material Management Area, or equivalent, can evaluate and certify that HW was not generated in or did not reside in an RMMA. This certification is documented on OSR 29-47.

5.11.2 Resource Conservation Recovery Act (RCRA) Hazardous Waste (HW)

1. RCRA and SCHWMR defines HW as a solid waste or combination of solid wastes which, because of its quantity, concentration, physical, or chemical characteristics, may cause or contribute to serious illness or pose a substantial threat to human health and the environment.

2. Solid waste is broadly defined as any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility, and other material that is discarded or intended for discard, including solid, semi-solid, liquid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural and community activities. There are a number of exclusions and exemptions that should be evaluated in determining when a waste is subject to management as a HW.

3. A solid waste is a HW if it is a "listed" waste, as described in Section 5.11.4, or possesses any one of the four characteristics of a HW (i.e., Ignitability, Corrosivity, Reactivity, and Toxicity).

4. These wastes may cause or contribute to an increase in mortality and serious illness or pose a hazard to human health or the environment. The EPA is responsible for establishing regulations governing the "cradle-to-grave" management of HW. SCDHEC has been delegated authority to regulate the management of HW in South Carolina.

5. SCHWMR R.61-79 requires the generator of a solid waste to "determine if a waste is a hazardous waste" (R.61 - 79.262.11). To accomplish this, the generator must first determine if the solid waste is excluded from regulation under R.61-79.261.4. The generator must then determine if the solid waste is listed as a HW in Subpart D of R.61-79.261. The generator is also required to determine if the solid waste is characteristically hazardous under Subpart C of R.61-79.261. The generator may accomplish this by testing the waste or by applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used (R.61-79.262.11[c-d]) (i.e., characterization by PK).

5.11.3 Radionuclide/Hazardous - Mixed Waste (MW)

1. Waste that meets the previously described criteria as both radioactive and hazardous is designated as a MW. The characterization requirements for the radioactive component of MW are described in Section 5.2.4, Radiological Waste Stream Characterization. The analysis and characterization frequency requirements for the hazardous component of mixed waste are described in this section. Heat generation from the radioactive component of this type of waste must be taken into consideration when evaluating handling, packaging, storage, and interactive effects on the hazardous component of the waste.

5.11.3 Radionuclide/Hazardous - Mixed Waste (MW), (cont.)

2. The SRNS-TR-2008-00101 - SRS Site Treatment Plan (STP) identifies specific treatment requirements for all MW streams that will not be disposed within one year. MW with different treatment requirements must be segregated prior to transfer to SWM to preclude the need for and cost associated with post generation segregation. Within 30 days of discovery, SRS is required to notify SCDHEC in writing of new on-site generated MW streams that will not be disposed within one year. Therefore, to ensure compliance with this requirement, a generator of a MW stream that will not be disposed within one year and is not currently identified in the STP should immediately notify Environmental Compliance (EC). The TSD acceptance criteria for MW are specifically addressed in Manual 1S, Chapter 6.

5.11.4 Listed Wastes

1. A solid waste is a listed waste if it meets the listing criteria contained in Subpart D of SCHWMR R.61-79.261; otherwise known as the F-, K-, P-, and U-lists. It is important to understand that a determination that a waste is or is not RCRA listed can only be made based on knowledge of the chemicals contained in the waste and the history of how those chemicals were used. For example, the spent solvent listings (F001, F002, F004, F005) cover only those solvents that are used for their solvent properties and have a before use concentration of 10% or greater. Analysis of samples of the waste that demonstrate that there are listed constituents present is not adequate evidence to conclude that the waste is listed. Likewise, the absence of listed constituents in representative samples is not sufficient evidence to conclude that a waste is not listed.

2. Waste characterized solely as LLW or TRU cannot include any listed waste codes defined by the lists below. By application of the RCRA "mixture rule" (R.61-79.261.3[a]), if any amount (there are no "de minimis" quantities) of these listed wastes are mixed with LLW or TRU, the entire waste volume is regulated as mixed waste. There are, however, certain exclusions that apply to "empty" containers that have previously held listed waste or listed commercial chemical products. Exclusion is also provided if a HW that was listed in R.61-79 261.31-33 solely because it exhibits the characteristic of ignitability, corrosivity, and/or reactivity (e.g., the 29 ICR-only wastes) is mixed with a solid waste. The resulting mixture would be considered hazardous unless it does not exhibit a characteristic. One of the most commonly encountered ICR-only wastes is F003 Non-halogenated spent solvent which is listed only because of ignitability. Once again, generators are strongly encouraged to consult their Environmental Compliance Authorities on the applicability of these exclusions.

3. There are three basic types of listed waste as described below.

   A. F-listed Waste

      1) F-listed wastes (SCHWMR R.61-79.261.31) are from non-specific sources (they can be generated by any type of facility). The F-listing includes spent solvents, heavy metal and cyanide wastes, dioxin wastes, wood preserving wastes, petroleum refining sludges, and multi-source leachates. The most common F-listed wastes encountered at SRS are F001-F005 spent solvents.

5.11.4 Listed Wastes, (cont.)
Step 3A, (cont.)

2) In evaluating a waste containing or contaminated with a solvent on the F-List, the generator must first determine if the solvent was used for its solvent properties and is spent. If either of these conditions are not met, the waste is not F-listed. Then, to determine the listing criteria, the before-use concentration of the solvent or combination of solvents must be greater than 10% by volume. The presence of one of these chemicals is not sufficient reason to classify the waste as listed. Therefore, the history of the solvent usage must be evaluated with sufficient detail to determine if the listing criteria are or are not met.

3) The following examples are included to assist in the "listing" characterization of spent solvent wastes:

- The combined before use solvent concentration of F001, F002, F004 or F005 constituents must be 10% or greater by volume
- The 10% rule does not apply to F003 solvents. In general, a solvent must be 100% F003 or a mixture of F003 and 10% or more of the solvents covered in F001, F002, F004 and F005 to meet the F003 listing criteria. This can be an important factor in minimizing the generation of solvent wastes
- Wastes that are listed solely because they exhibit a characteristic may "lose" the listing if they are mixed with another solid waste and the mixture no longer exhibits that characteristic. F003 waste listed solely because it is ignitable when physically or chemically altered (mixed with another solid waste) such that the mixture no longer meets the definition of ignitable is no longer F003 listed. This must be part of the normal process that is generating the waste (e.g., you cannot intentionally dilute to remove the ignitability and then not treat it as F003)
- Soil that is contaminated with spilled F003 must be managed as F003 even if the soil has no liquids present and does not exhibit the characteristic of ignitability
- F001 - F005 chemicals that are used as reactants or ingredients in the production of a commercial product such as solvent paint are not regulated as spent solvents;
- F001-F005 chemicals present in the aqueous phase of a solvent extraction process are not considered spent solvents;

5.11.4 Listed Wastes, (cont.)
Step 3A, (cont.)

- Residues of F-listed waste remaining in RCRA empty containers (including laboratory glassware) that have previously held F-listed waste are no longer subject to RCRA. (See SCHWMR R.61-79.261.7);
- Metal parts that have been cleaned with F-list solvents are not F-listed wastes if the parts are discarded after cleaning.

B. K-listed Wastes

K-listed wastes (SCHWMR R.61-79.261.32) are waste from specific industrial processes. If the waste being characterized was not produced by one of the listed processes, no additional evaluation for K-listing is required. SRS does not generate K-Listed wastes.

C. P- and U-Listed Wastes

1) P- and U-listed wastes are unused commercial chemicals or products, off-specification commercial chemical products, or manufacturing chemical intermediates of those chemicals listed in SCHWMR R.61-79.261.33(e) and 261.33(f). With the exception of the residues in a container (see SCHWMR R.61-79.261.7) that has held a P- or U-listed chemical; the criteria for the RCRA characterization of these materials are identical.

2) Any residue, contaminated soil, water, or other debris resulting from a spill or cleanup of a spill of a P- or U-listed material must also be managed as P- or U-listed waste.

3) The mere presence of one of these chemicals is not sufficient reason to classify the waste as listed. The use of the chemicals should be evaluated in sufficient depth to determine if the listing criteria are met. Since many chemicals have multiple names, EPA publishes the List of Lists which can assist with the use of SCHWMR R 61-79.261.33(e). It can be located at http://www.epa.gov/epcra/consolidated-list-lists.

4) The following examples are presented to illustrate some factors that are important in characterizing P- and U-listed waste:

a) P- and U-listed chemicals that are used prior to discard do not meet the listing criteria. [e.g., tetrachloroethylene is a U-listed chemical (U210). It is also a F002 solvent and is identified in SCHWMR R.61-79.261.24 for toxicity (D039). When used for its solvent properties and discarded, the spent solvent would carry the F002 waste code, but not the U210 or D039. See note under Section 5.11.5, Characteristic Waste.

5.11.4 Listed Wastes, (cont.)
Step 3C, (cont.)

b) P- and U-listings apply only to the pure form of the chemical or where the P- or U-listed chemical is the sole active ingredient. Therefore, if two or more P- or U-listed chemicals are combined, as in a prepared laboratory reagent that is later discarded without first being used, the combination would not carry the P- or U-listing.

c) The P- and U-listing applies whether or not the chemical was purchased in a diluted form or diluted by the user prior to discard so long as the listed chemical is the sole principle active ingredient.

d) Residues from a spill of a P- or U-listed chemical carry the P- or U-listing.

5.11.5 Characteristic Waste

1. A solid waste that exhibits one or more of the following four characteristics is a HW. These characteristics are summarized below; however, to determine if one of these characteristics is applicable to their wastes, generators should refer to cited sections of the regulations.

2. Listed Waste (F, K, P and U) which is also characteristic waste in accordance with Subpart C of SCHWMR R.61-79.261 must be evaluated to determine if the treatment standards for the listed waste includes a treatment standard for the constituent that causes the waste to be characteristic. If the treatment standard for the listed waste does not address the characteristic constituent, the waste must carry both the listed code and the characteristic code per SCHWMR R.61-79.268.9(b).

3. Ignitability [SCHWMR R.61-79.261.21]

   A solid waste exhibits the characteristic of ignitability if it is any of the following:

   A. Liquid, other than an aqueous solution containing less than 24% alcohol by volume, with a flash point less than 60°C (140°F).

   B. Not a liquid and is capable under standard temperature and pressure of causing fire through friction, absorption of moisture, or spontaneous chemical changes **and**, when ignited, burns so vigorously **and** persistently that it creates a hazard.

   C. An ignitable compressed gas as defined by the Department of Transportation (DOT) regulations 49 CFR 173.300 - Hazardous Materials Definitions.

5.11.5 Characteristic Waste, (cont.)
Step 1, (cont.)

D. Any oxidizer as defined by DOT regulations 49 CFR 173.127 - Class 5, Division 5.1 and 5.2 - Definition and Assignment of Packing Groups.

- DOT defines an oxidizer as "…a material that **may, generally** by yielding oxygen, cause or enhance the combustion of other materials." Examples of oxidizers that are hazardous for ignitability include, but are not limited to: chlorates, permanganates, organic peroxides, inorganic peroxides and nitrate compounds.

4. Corrosivity [SCHWMR R.61-79.261.22]

A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste is either of the following:

A. Aqueous and has a pH less than or equal to 2.0 or greater than or equal to 12.5.

B. A liquid that corrodes steel at a rate greater than 6.35 mm (0.250 inch) per year at a temperature of 55°C (130°F).

5. Reactivity [SCHWMR R.61-79.261.23]

The reactivity characteristic generally describes those wastes that are unstable and readily undergo violent change without detonating and when mixed with water, react violently, form explosive mixtures, or generate toxic gases, vapors or fumes in sufficient quantities to present a danger to human health or the environment. Certain cyanide or sulfide bearing wastes are also considered reactive. Generators should consult with their ECAs regarding the characterization of a waste as reactive.

There are 8 specific criteria for defining Reactive Characteristic wastes:

A. Normally unstable and readily undergoes violent change without detonating.

B. Reacts violently with water.

C. Forms potentially explosive mixtures with water.

D. When mixed with water, it generates toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.

E. Cyanide- or sulfide-bearing waste which, *when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.

* EPA has rescinded their guidance document and has agreed that this could happen with any pH

5.11.5 Characteristic Waste, (cont.)
Step 3, (cont.)

F. Capable of detonation or explosive reaction if it is subjected to a strong initiating source or if heated under confinement.

G. Readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

H. Is considered a Forbidden Explosive, or a Class A or Class B Explosive.

6. Toxicity [SCHWMR R.61-79.261.24]

A. The toxicity characteristic leaching procedure (TCLP) is used to evaluate a waste for the toxicity characteristic. If the TCLP extract from a representative sample of the waste contains any of the constituents in concentrations equal to or greater than those listed in Table 1 of SCHWMR R.61-79.261.24, the waste is a HW.

B. As an alternative to performing the TCLP for solids, the generator may elect to analyze a sample of the waste to determine the total concentration of the Table 1 constituents. If the total concentration of each constituent when divided by twenty does not equal or exceed the Table 1 concentrations, the waste can conservatively be characterized as non-hazardous. If it exceeds the Table 1 concentrations, then the waste is characterized as hazardous unless additional TCLP analysis shows otherwise.

C. Totals analysis for liquids containing < 0.5% filterable solids do not require extraction and can be compared directly to regulatory levels.

5.12 Polychlorinated Biphenyl (PCB) Toxic Waste Considerations

5.12.1 Toxic Substance Control Act (TSCA) - PCB Waste

Regulations issued pursuant to TSCA govern the disposal of wastes that contain PCBs. The applicable regulations are contained in 40 CFR 761, Polychlorinated Biphenyls (PCB) Manufacturing, Processing. The EPA retains regulatory authority for implementation of the regulations. The primary intent of the TSCA and its regulations is to drive all PCBs to disposal. Per TSCA regulations, no items containing detectable levels of PCBs may be used or distributed in commerce (e.g., re-sold, re-used, or recycled for other uses) unless specifically authorized in the regulation.

5.12.2 Polychlorinated Biphenyl (PCB) Toxic Waste Considerations - General

1. PCBs are a family of synthetic chlorinated aromatic hydrocarbon compounds. The most common commercial mixtures manufactured in the United States are referred to as Aroclor® (e.g., Aroclor® 1016, Aroclor® 1254, Aroclor® 1260, and several others). With the exception of Aroclor® 1016 which has a chlorine content of approximately 41%, the last two digits of the Aroclor® number denote the percentage to which the particular compound is chlorinated.

5.12.2 Polychlorinated Biphenyl (PCB) Toxic Waste Considerations - General, (cont.)

2. PCBs are thermally stable and resistant to degradation, oxidation, acids, bases and other chemical agents. They are soluble in oils, most organic solvents, and lipids. They are only slightly soluble in water. PCBs possess excellent dielectric properties, which along with their chemical stability and fire resistance properties led to their widespread use in transformers, capacitors and other electrical equipment. Other common uses included hydraulic fluids, heat transfer fluids, carbonless copy paper, gas pipeline liquids, paints, air compressor liquids, plasticizers, and caulking.

3. Information provided in this section summarizes many regulatory requirements applicable to the characterization criteria for PCB wastes and is not intended as a substitute for the full text of the regulations. Additional characterization information can be found in guidance documents published on the Environmental Compliance (EC) Home Page.

4. It should be noted that certain non-liquid PCB and radioactive wastes may be disposed at the E-Area Low Level Radioactive Waste Disposal Facilities. Manual 1S, Chapter 5 should be consulted.

5.12.3 PCB Waste Considerations

1. PCB-containing wastes are subject to the TSCA storage and disposal regulations based on their PCB concentrations, the form in which the PCBs are present, how the PCBs were used, and the manner in which the PCB wastes were generated.

> **NOTE**
>
> Anti-dilution does not apply to lab samples and associated residues, if managed in accordance with TSCA requirements. The TSCA SME can be contacted for guidance if in question.

2. TSCA prohibits the dilution of PCBs in order to avoid any part of the PCB regulations unless a specific exception applies. When PCBs are added to a previously PCB-free item or material, the entire item or mixture is then considered to contain PCBs at the same concentration as the PCB materials added to the item.

   A. If two PCB-containing substances are combined, the resulting mixture must be considered to contain PCBs at the highest concentration level of the two original substances. For example, if PCB oil containing 100 ppm is spilled, all of the substances the oil contacts (soil, spill pillows, kitty litter, protective clothing, etc.) are considered to contain 100 ppm PCBs.

   B. If a substance containing 20 ppm PCBs is mixed with a substance containing 1000 ppm PCBs, the entire substance is considered to contain 1000 ppm PCBs. Similarly, if paint on the surface of an item (e.g., equipment, a wall, etc.) contains PCBs at 50 ppm, then the entire item is considered to contain PCBs at 50 ppm (the mass of the item is not relevant in determining its PCB status).

5.12.4 PCB Determination Concentrations

1. PCBs can be found in liquid, non-liquid and multi-phasic (combination of liquid and non-liquid) forms. In order to determine the PCB concentration of waste, specific regulatory criteria must be applied based on the waste form.

2. TSCA regulations require PCB concentrations to be determined on a weight-per-weight basis (e.g., milligrams per kilogram). For liquids, concentrations may be determined on a weight-per-volume basis (e.g., milligrams per liter) if the density of the liquid is also reported; however, it is preferred that PCB concentrations in liquids also be reported on a weight-per-weight basis.

   A. PCB concentrations for non-liquid materials must be determined on a dry-weight basis.

   B. PCB concentrations for liquid materials must be determined on a wet-weight basis.

      1) Liquids containing more than 0.5 percent non-dissolved material must be analyzed as multi-phasic mixtures.

      2) In order to determine the PCB concentration for multi-phasic mixtures, the phases must be separated before chemical analysis. The PCB concentration of each separated phase (liquid and non-liquid) must then be analyzed. The highest PCB concentration measured in any of the separated phases applies to the entire mixture, and the entire mixture is regulated for disposal based on that concentration (another example of the "anti-dilution" rule). An exception is allowed for multi-phasic PCB Remediation wastes which may be separated and disposed based on the PCB concentration in each separated phase.

3. Items which have been contaminated with liquid PCBs but have no free-flowing liquids remaining, are characterized by use of the EPA "standard wipe test" which is defined in 40 CFR 761.123, Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Subpart G_PCB Spill Cleanup Policy - Definitions. The test measures surface PCB contamination.

4. TSCA regulations include exceptions to the anti-dilution rule for some remediation/cleanup wastes and certain laboratory and decontamination wastes. Generators should contact their Environmental Compliance Authorities for assistance.

5.12.5 Regulatory Thresholds Based on PCB Concentration and Waste Type

1. In general, wastes are regulated for disposal under TSCA if they contain certain concentrations of PCBs or have been in contact with regulated concentrations of PCBs as described in the following:

5.12.5 Regulatory Thresholds Based on PCB Concentration and Waste Type, (cont.)
Step 1, (cont.)

A. **Non-Aqueous Liquids** - Containing 50 ppm or more PCBs.

B. **Items with surface PCB contamination but no free-flowing liquids** - Items with surface PCB levels that exceed 10 µg/100 cm2 but are less than 100 µg/100 cm^2 are regulated for disposal in the same manner as items that contain at least 50 ppm PCBs but less than 500 ppm PCBs. Items with surface PCB concentrations of 100 µg/100 cm^2 or higher are regulated for disposal in the same manner as are items that contain 500 ppm PCBs.

C. **Non-Liquids with PCBs as an integral part of the item (e.g., dried paint or coatings)** - Items that contain 50 ppm or more PCBs in the PCB source material. TSCA regulations allow non-liquid PCBs that are eligible for land disposal to be presumed (declared) to contain PCBs at a concentration of 500 ppm or more PCBs in lieu of sampling. The ECA or EC PCB SME can be contacted for assistance as needed.

D. **Aqueous Liquids** - Aqueous liquids containing greater than or equal to 0.5 µg/L PCBs [i.e., greater than 0.5 parts per billion (ppb)] are regulated for disposal. Liquids with greater than or equal to 3 µg/L PCB (i.e., greater than or equal to 3 ppb) cannot be discharged to a treatment works or to navigable waters unless the discharge is in accordance with a PCB discharge limit included in a permit issued under purview of the Clean Water Act (CWA). Liquids with less than or equal to 0.5 ppb PCBs are not subject to TSCA regulation.

Discharge of PCBs at any concentration to navigable waters must comply with applicable CWA requirements, which generally are much stricter than the TSCA limits stated above.

E. **Remediation/Cleanup Waste** - includes PCB-containing environmental media and/or structures such as:

- Soil, gravel, sediments, etc.
- Investigation-derived wastes (IDW)
- Other wastes associated with waste site or spill cleanup, such as personal protective equipment, job control waste
- Buildings or other man-made structures contaminated by liquid PCBs:
  - Materials disposed (i.e., spilled onto or disposed onto the ground or other surface) prior to April 18, 1978 that are currently at concentrations of 50 ppm PCBs or more are regulated by TSCA

5.12.5 Regulatory Thresholds Based on PCB Concentration and Waste Type, (cont.)
Step 1E, (cont.)

– Materials currently at any concentration or volume of PCBs that were disposed beginning April 18, 1978, and where the original concentration of PCBs was equal to or greater than 500 ppm are regulated under TSCA

– Materials currently at any concentration or volume of PCBs that were disposed beginning July 2, 1979, and where the original concentration of PCBs was equal to or greater than 50 ppm are regulated under TSCA

– Materials currently at any concentration or volume of PCBs from a source not authorized for use under the PCB regulations are regulated under TSCA.

2. All wastes associated with a fresh PCB spill (less than 72 hours old) are regulated based on the PCB concentration of the spilled material.

   Disposal facility requirements for remediation and cleanup wastes vary based on the PCB levels and physical form of the waste. Generators are urged to contact their ECAs or EC for assistance with categorizing remediation wastes.

5.12.6 Electrical Equipment

1. Prior to disposal, the PCB concentration of fluids in electrical equipment must be established. This may be done by sampling. Alternatively, the concentration may be established by using the original PCB concentration as certified by the manufacturer and servicing records that document the PCB concentration of all fluids used in servicing the equipment during its lifetime.

2. Fluorescent light ballasts may contain PCBs in either the small capacitor within the ballast or in the potting material that holds together the internal parts. Ballasts that were manufactured in the United States between July 1978 and July 1998 were required to bear a label stating "no PCBs"; ballasts that have such labels may be managed as non-TSCA. Ballasts that do not have a label stating "no PCBs" must be managed as TSCA waste unless the generator can document (e.g., manufacturer's certification) that they do not contain PCBs.

3. PCB small capacitors are capacitors that contain less than three pounds of dielectric fluid. Leaking small capacitors must be managed as TSCA waste including adherence to the TSCA 30-day limit on temporary storage. Non-leaking small capacitors are not subject to TSCA storage and disposal regulations. However, company policy requires that they be disposed at a TSCA-permitted facility. Non-leaking small capacitors are not subject to the 30-day temporary storage limit.

4. Generators are encouraged to consult their facility ECAs or EC for assistance in characterizing wastes that potentially contain PCBs.

5.12.7 Paints, Coatings and Other Non-Liquid PCB Items

PCBs were included in certain paint formulations and other products to provide specific properties such as waterproofing, chemical resistance, heat resistance, etc. Routine testing of painted surfaces and other solids is not required by TSCA. Testing should be done only if PCBs are suspected to be present. For assistance in determining whether dried paints and other solids (i.e., caulking, rubber, or plastic items) may have contained PCBs, generators should contact their ECAs for the most recent EC guidance document on this subject. That guidance includes a checklist to assist in determining whether an item potentially may contain regulated levels of PCBs. Since this guidance document is subject to frequent revision as information and relevant requirements evolve, it has not been incorporated into this procedure.

5.12.8 PCB Bulk Product Waste

1. PCB Bulk Product Waste is waste derived from manufactured products containing PCBs in a non-liquid state at any concentration at or above 50 ppm. It includes items such as:
   - Debris from demolition of buildings with surfaces painted or coated with PCBs
   - Plastics (e.g., plastic insulation from wire or cable)
   - Molded rubber parts
   - Caulking
   - Sound deadening insulation
   - Felt or fabric products such as gaskets
   - Other non-liquid items.
2. TSCA regulations include special provisions for storage and disposal of large volumes of PCB bulk product waste such as demolition debris. Generators should work closely with their ECAs, EC, and SWM if they anticipate generating PCB bulk product wastes.

5.12.9 Analysis of PCB Waste

1. TSCA regulations require that PCB wastes be analyzed via gas chromatography. Any gas chromatographic method that is appropriate for the material being analyzed may be used. The following are examples of different types of acceptable methods:
   - EPA/SW-846, Method 608, Organochlorine Pesticides and PCBs
   - EPA/SW-846, Method 8082, Polychlorinated Biphenyls (PCBs) by Capillary Column Gas Chromatography
   - ASTM D-4059 - Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography.
2. The TSCA regulations provide specific sampling protocols that must be used in certain instances. Protocols are provided for verification of waste site/spill site cleanup, for characterization of remediation wastes, and for disposal of certain bulk product wastes.

5.13 Waste Volumes and Masses Determination

To quantify and document the amounts of radioactive, hazardous, and PCB waste dispositioned under Manual 1S and to calculate concentrations, both the volume and weight of the waste within each disposal container may be required. Approved methods for determining waste volumes and weights are defined below. Alternate methods for determining waste volumes and weights may be used with SWE concurrence.

5.13.1 General

1. The weight or mass of the waste can be determined by subtracting the weight of the disposal container (tare weight) from the gross weight of the waste package. The weight or mass of the waste can also be determined by summing the weight of individually weighed waste packages or cuts. The waste weight is to be used when determining radionuclide activity or chemical concentration per unit weight. Scales used for waste weight determination will be maintained in accordance with Manual 1Q, Procedure 12-1, Control of Measuring and Test Equipment. Measurement and test equipment (M&TE) is not required for LLW scales where large differences in weight do not significantly impact quantification accuracy (typically for Dose-to-Curie methodology) and specifically, any measurement where a measurement difference of 10% would result in a radionuclide quantification difference of less than 2%. In such cases, some method (e.g., check weights) will be used to insure less than 10% error.

2. Waste volumes can be the same as the disposal container volume provided:

   A. A thin walled (less than 0.75-inch thick) disposal container is used, and the actual waste volume is within 10 percent of the container empty volume. [Ten percent refers to "free board" as opposed to void space (i.e., the container is full).]

   B. If waste is compacted, the waste volume is, by definition, the container volume. This waste volume is to be used when determining radionuclide activity or chemical concentration per unit volume.

3. Standard container volumes are listed in the table below

Container	Actual Volume (ft^3)
B-25	90.0
B-12	45.0
55-gallon drum	7.4
Skid Pan	162.0
20-foot intermodal (i.e., Sealand)	1173.0
40-foot intermodal (i.e., Sealand)	2394.0

5.14 Administrative Controls

1. The waste characterization process will be documented.

   A. For HW/MW/PCB, characterization will be documented on OSR 29-92, OSR 29-47, and OSR 29-99.

   B. For radiological waste, characterization method and data will be documented in an approved Manual E7 calculation per Procedure 2.31.

   C. For LLW and PCB LLW acceptable for disposal in E-Area, characterization will be documented on OSR 29-82 and OSR 29-93, Uniform Low-Level Radioactive Waste Manifest, as required by Manual 1S, Chapter 5. The nonhazardous and/or PCB characterization of the LLW and PCB LLW may be documented as part of the E7 calculation for the radiological characterization of the waste, as a separate E7 calculation or as an equivalent type document. (Reference Manual 3Q, Procedure 6.3)

   D. TRU characterization will be documented on OSR 29-90.

2. Database inventory management systems (e.g., WITS, HMWT, CWTS) may be used to input, store, analyze, and generate reports in place of some forms. If available, WITS or HMW Reports shall be used in place of the corresponding forms unless otherwise specified by SWM.

6.0 REFERENCES

These requirement documents are located in Manual 1S – References, as well as repeated in this chapter; in addition, S/RIDS and Commitments applicable to each chapter will be listed below.

1B, 3.31, Records Management

1S, SRS Radioactive Waste Requirements

1S, Chapter 1, Waste Management Requirements

1S, Chapter 4, General Waste Requirements

1S, Chapter 5, Low-Level Waste

1S, Chapter 6, RCRA, TSCA, Mixed and LLLW

1S, Chapter 7, Transuranic Waste

1S, Glossary

1Q, 2-7, QA Program Requirements for Analytical Measurement Systems

1Q, 12-1, Control of Measuring and Test Equipment

6.0 REFERENCES, (cont.)

1Q, 12-3, Control and Calibration of Radiation Monitoring Equipment

3Q, 6.3, Hazardous Waste Determination

3Q, 21.2, Data Quality Objectives Process

4Q, 209, Chronic Beryllium Disease Prevention Program

5Q1.1, 517, Radiological Release of Material

14Q, 3.06, Nondestructive Assay Measurement Control

E7, 2.31, Engineering Calculations

E7, 2.60, Technical Reviews

E7, Conduct of Engineering

10 Code of Federal Regulations (CFR) 173.300, Hazardous Materials Definitions

10 CFR 830.122, Nuclear Safety Management, Quality Assurance Criteria

40 CFR, 260-282, Resource Conservation and Recovery Act, Subtitle C

40 CFR, 750-761, Toxic Substance Control Act

American Society for Testing and Materials (ASTM) C113-03, Test Method for Nondestructive Assay of Special Nuclear Material in Low-Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning

ASTM C1207-03, Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting

ASTM C1500-02, Test Method for Nondestructive Assay of Plutonium by Passive Neutron Multiplicity Counting

ASTM C1215-92, Guide for Preparing and Interpreting Precision and Bias Statements in Test Method Standards Used in the Nuclear Industry

ASTM D-4059, Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME) NQA-1, Quality Assurance Requirements for Nuclear Facility Applications

ANSI N15.41, Derivation of Measurement Control Programs - General Principles

6.0 REFERENCES, (cont.)

ANSI N15.51, Measurement Control Programs in Nuclear Materials Analytical Chemistry Laboratory

DOE Order 458.1, Radiation Protection of the Public and the Environment

DOE Survey Manual, Appendix B

Eastern Environmental Radiation Facility (EERF) Radiochemistry Procedures Manual

Environmental Protection Agency (EPA)/SW-846, Method 608, Organochlorine Pesticides and PCBs

EPA/SW-846, Method 8082, Polychlorinated Biphenyls (PCBs) by Capillary Column Gas Chromatography

EPA/SW-846, Method 9040, pH in Liquid

EPA/SW-846, Test Methods for Evaluation of Solid Waste: Physical/Chemical Methods

Environmental Radiation Ambient Monitoring (ERAM) System Manual

International Atomic Energy Agency (IAEA)-TECDOC-1537, Strategy and Methodology for Radioactive Waste Characterization

NUREG/CR-3474, Long-Lived Activation Products in Reactor Materials

South Carolina Hazardous Waste Management Regulations (SCHWMR)

SCHWMR R.61-79.261, Identification and Listing of Hazardous Waste

SCHWMR R.61-79.262, Standards Applicable to Generators of Hazardous Waste

SCHWMR R.61-79.268, Land Disposal Restrictions

SRNS-TR-2008-00101, SRS Site Treatment Plan (STP)

SWD-97-0011, W. S. Kelly to Mr. Noll, “Establishment of Naturally Occurring Radioactive Material (NORM) Levels in Savannah River Site (SRS) Soils (U),” Feb 20, 1997

WSRC-SA-22, Savannah River Site Solid Waste Facility Documented Safety Analysis

WSRC-TR-94-0388, Release Program for Wastes Potentially Contaminated with U.S. Department of Energy Radioactivity

[S/RID 1] Standards/Requirements Identification Document, DOE O 435.1, Radioactive Waste Management

[S/RID 2] DOE M 435.1-1, Radioactive Waste Management Manual

7.0 RECORDS

Records generated as a result of implementing this procedure are maintained in accordance with Manual 1B, Procedure 3.31.

OSR 29-47	Waste Characterization Form (WCF)
OSR 29-57	Container Approval Request
OSR 29-82	Low-Level Waste Stream Characterization
OSR 29-90	Transuranic Waste Container Characterization
OSR 29-92	Characterization Process Report
OSR 29-93	Uniform Low-Level Radioactive Waste Manifest
OSR 29-99	Hazardous/Mixed/PCB Waste Manifest
OSR 29-105	Lab Pack Request

7.1 Forms

OSR 29-47	Waste Characterization Form (WCF)
OSR 29-57	Container Approval Request
OSR 29-82	Low-Level Waste Stream Characterization
OSR 29-90	Transuranic Waste Container Characterization
OSR 29-92	Characterization Process Report
OSR 29-93	Uniform Low-Level Radioactive Waste Manifest
OSR 29-99	Hazardous/Mixed/PCB Waste Manifest
OSR 29-105	Lab Pack Request

8.0 ATTACHMENTS

Attachment 8.1	RMMA and Radiological Screening Criteria
Attachment 8.2	Waste Stream Characterization Flow Chart
Attachment 8.3	Maximum Allowable Lower Limits of Detection
Attachment 8.4	Characterization Process Report Examples
Attachment 8.5	TRU and Fissile Isotopes Table

8.0 ATTACHMENTS, (cont.)

Attachment 8.6	Dose-to-Curie Standards Tables
Attachment 8.7	LLW Radionuclide Package Reporting Thresholds

ATTACHMENT 8.1
RMMA and Radiological Screening Criteria
Page 1 of 3

Radioactive Materials Management Areas (RMMA)

NOTE

Radiological screening of Radiological Buffer Area (RBA) or Radiological Material Area (RMA) waste is only required if it meets one of the following criteria:

1. The waste has been attached in a permanent or temporary manner (e.g., signs, floor tile, concrete, or paint fragments) or, any items, equipment, or material that could be considered part of a facility.
2. The waste consists of articles that can accumulate radioactivity (e.g., mop heads or solvent rags or floor sweepings).

An RMMA is an area in which the potential exists for contamination due to the presence of unencapsulated or unconfined radioactive material or an area that is exposed to beams or other sources of particles (neutrons, protons, etc.) capable of causing activation. As a minimum, any of the following areas, singularly or in combination, constitute a RMMA:

- Contamination areas (CA) and high contamination areas (HCA)
- Airborne radioactivity areas (ARA)
- Radiation areas (RA), high radiation areas (HRA), and very high radiation areas (VHRA) that can cause activation
- Radiological Buffer Areas (RBA) (except those established solely for a radiation field that cannot cause activation) and all areas they encompass (See note)
- Radioactive Material Areas (RMA) (See note)
- Soil Contamination Areas (SCA) and the surrounding area that is greater than twice the background reading
- Underground Radioactive Material Areas (URMA) that have undergone operations to expose radionuclides (e.g., excavation)

NOTE

Environmental restoration sites have been identified by SRS.

- The area inside the Occupational Safety and Health Act (OSHA) physical control (e.g., fence) that is established for an environmental restoration activity where radioactive material is present (See note above)
- Any other area where unconfined radioactivity is present (e.g., environmental laboratory).

ATTACHMENT 8.1
RMMA and Radiological Screening Criteria
Page 2 of 3

Radioactive Determination Criteria

NOTE

1. Materials containing commercially added radioactivity (e.g., exit sign, smoke detector, etc.) which have not been contaminated with DOE added radioactivity are considered non-radioactive for purposes of off-site shipments, but still must meet the receiving facility's limits.
2. If the below radiological limits are not met, then specific radionuclide content and distribution must be obtained and provided in the Radionuclide Analytical Data section of OSR 29-47.

Alternate Release Methodologies not described explicitly in Manual 5Q1.1, Procedure 517, Radiological Release of Material, must be approved by SWE and DOE.

Radiological screening can only be performed with instruments and/or laboratory facilities approved by SWM. Non-Hazardous waste less than or equal to the surface and volume release criteria in Manual 5Q1.1, Procedure 517, Radiological Release of Material, can be declared non-radioactive.

HW can be declared non-radioactive provided the following criteria are met:

- Released per Manual 5Q1.1, Procedure 517
- The waste must not contain any known DOE radionuclides (e.g., spikes or tracers)
- If the waste contains isotopes with half-lives less than 65 days, they must have decayed at least 10 half-lives
- If the waste has potential for internal contamination, and screening results of a representative sample are either less than the instrument Lower Limit of Detection (LLD) or indistinguishable from a virgin (or non-RMMA) sample
- Where waste volumes are radiologically screened, the qualifying instrument used has a maximum LLD of:
  - Less than 120 dpm/ml or dpm/g for alpha;
  - Less than 240 dpm/ml or dpm/g for beta/gamma;
  - Less than 240 dpm/ml or dpm/g for tritium
- For SRS soils, screening results indicating non-radioactive waste are:

  Gross Analysis Limits:

  - Less than 21.0 pCi/g gross alpha
  - Less than 22.0 pCi/g gross nonvolatile beta

ATTACHMENT 8.1
RMMA and Radiological Screening Criteria
Page 3 of 3

Radioactive Determination Criteria, (cont.)

Complete Isotopic Analysis Limits:

– Less than LLD for all man-made isotopes (except Cs-137);

– < 0.37 pCi/g Cs-137 (for undisturbed soils between 0-1 foot in depth);

– Less than 0.17 pCi/g Cs-137 (for disturbed soils or soils greater than 1 foot in depth);

– Compare results to values in Appendix C of WSRC-TR-2000-00128.

Results will meet applicable State and EPA NORM regulations and radium/thorium values must meet DOE Order 458.1, Radiation Protection of the Public and the Environment.

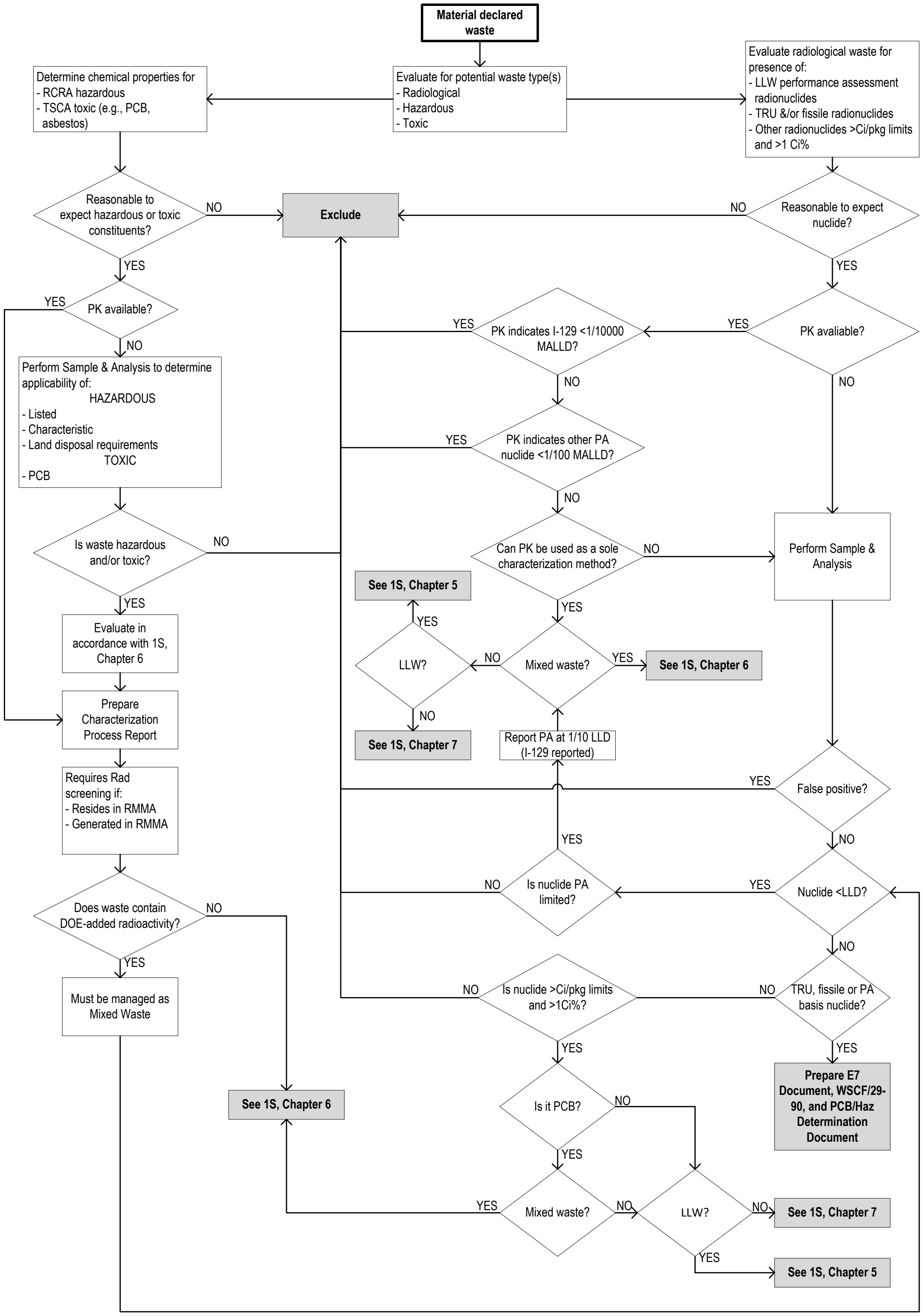
Representative Sampling for Radiological Screening

A representative sample of the waste will be obtained in accordance with one or more of the following methods:

- DOE Survey Manual, Appendix D
- Environmental Radiation Ambient Monitoring (ERAM) System Manual
- EPA's Eastern Environmental Radiation Facility (EERF) Radiochemistry Procedures Manual guidance
- EPA/SW-846 - Test Methods For Evaluation of Solid Waste Physical/Chemical Methods.

Recommended solutions for sampling issues can be obtained from DOE's Environmental Measurements Laboratory (EML) in Long Island, New York, or EPA's Environmental Monitoring Systems Laboratory (EMSL) in Las Vegas, Nevada. More specific direction can be obtained from WSRC-TR-94-0388, Release Program for Wastes Potentially Contaminated with U.S. Department of Energy Radioactivity.

ATTACHMENT 8.2
Waste Stream Characterization Flow Chart
Page 1 of 1



ATTACHMENT 8.3
Maximum Allowable Lower Limits of Detection
Page 1 of 1

NOTE

These MALLDs are provided as a guide for laboratory selection.

Radioisotope	Maximum Allowable Lower Limit of Detection (μCi/cc or μCi/g)	Maximum Allowable Lower Limit of Detection (μCi/smear)
H-3	1.00E-04	2.00E-03
C-14	1.00E-05	2.00E-05
Ni-59	1.00E-04	2.00E-04
Co-60	1.00E-04	2.00E-07
Ni-63	1.00E-04	N/A
Sr-90	1.00E-04	3.00E-06
Tc-99	1.00E-06	6.00E-05
I-129	1.00E-06	7.00E-05
Cs-137	1.00E-05	2.00E-07
U-233	1.00E-06	2.00E-06
U-234	1.00E-06	2.00E-06
U-235	1.00E-06	2.00E-06
U-236	1.00E-06	2.00E-06
Np-237	1.00E-06	6.00E-03
U-238	1.00E-06	2.00E-06
Pu-238	1.00E-06	5.00E-04
Pu-239	1.00E-06	5.00E-04
Pu-240	1.00E-06	5.00E-04
Pu-241	1.00E-05	1.00E-02
Am-241	1.00E-05	2.00E-04
Pu-242	1.00E-06	5.00E-04
Cm-242	1.00E-06	N/A
Other TRU and/or Fissile*	1.00E-06	2.00E-06

(*e.g., Cf-251, Cm-246)

ATTACHMENT 8.4
Characterization Process Report Examples
Page 1 of 100

EXAMPLE #1

Characterization Process Report

Waste Stream **HLW98015** | **ID No.**

Origin of Waste: Laboratory Facility Building, 772-1F, clean process lab

Physical Description of Waste:
The waste is a heterogeneous mixture of plastic bags, wipes, protective clothing, filters, small resin columns, and glassware from the analysis of process control samples. The waste does not contain free liquids and was transferred directly from the waste bag to the present 55- gallon storage drum.

Process or Activity that Generated Waste:

Analysis of non-radioactive process control samples used F-listed solvents (tetrachloroethylene and methyl alcohol) for their solvent properties. The before use concentrations of the solvents was greater than 10%. Acids and chromate solutions were used in sample preparation.

Liquids were disposed via laboratory drains or collected in separate satellite areas in accordance with Laboratory Procedure # F-772-PS-1211.

Characterization Method: (check all applicable)
X Process Knowledge △ Sampling and Analysis

RCRA Regulated Materials Reasonably expected to be Present:
- Tetrachloroethylene
- Chromium compounds
- Methyl alcohol

Radioactive (as determined in Manual 1S, Chapter. 3, Attach 8.1) △ Yes X No

Detailed Waste Evaluations:
X Listed △ Ignitability △ Corrosivity
Reactivity X Toxicity X Underlying Hazardous Constituents
PCBs

Procedure/Documents used in Characterization:
1. CRC Handbook of Chemistry and Physics, 46th Edition
2. 2/14/98 memorandum from Mary Smith (Laboratory Supervisor) to Chris Jones (Environmental Compliance Authority) attached.
3. 2/27/98 memorandum from Terry Carpender (Process Operations Manager) to Chris Jones (Environmental Compliance Authority) attached.
4. Laboratory procedure (221-LAB-STD12) on glassware

ATTACHMENT 8.4
Characterization Process Report Examples
Page 2 of 100

EXAMPLE #1

Characterization Bases: HLW98015

1. The TCLP preparation procedure directs the depositing of a 0.1Kg sample of the waste into 2.0 liters of acetic acid. If the concentration of a waste constituent (solid material) is known (mg/kg), the constituent can conservatively be assumed to completely (100%) leach and a TCLP value determined using the following equation. [Constituent conc. Mg/kg] X [0.1 Kg/2 L] = conservative TLCP conc. in mg/L. (Reference #1)
2. The following information was obtained from the laboratory supervisor.(Reference 3):
   a. Waste package contains discarded materials from the analysis of 800 to 1,000 samples.
   b. Any excess sample was returned to the sample originator
   c. The sample was dissolved in 500 ml solution of sulfuric acid and potassium dichromate. The solution was neutralized with NaOH.
   d. After neutralization the dissolved sample was passed through a resin column to remove the chromium.
   e. 100 ml of the prepared sample was combined with 100 ml of a solution of Tetrachloroethylene (50%) and methyl alcohol (50%) prior to filtration.
   f. Tetrachloroethylene and methyl alcohol could be present in the waste from material absorbed on wipes or filters
   g. A totally saturated filter will hold 5 ml of solution. However, much of the Tetrachloroethylene-alcohol solution evaporates and they appear to be dry when they are bagged for transfer to the waste container.
   h. For characterization purposes the filters were assumed to be 50% saturated. It was assumed that this amount would include any traces of Tetrachloroethylene absorbed in wipes.
   i. The total weight of a used resin column is approximately 1 kg.
   j. Resin columns are replaced after 500 samples.
   k. 5 mg of elemental chromium (from the chromate solution) was used in each procedure
   l. The net weight of the waste contained in a 55-gallon drum is 250 pounds (114 kg)
   m. The samples that were analyzed were not listed waste and contained no hazardous constituents that would cause the sample and analysis residues to be RCRA hazardous.

ATTACHMENT 8.4
Characterization Process Report Examples
Page 3 of 100

EXAMPLE #1

Methodology: **HLW98015**
Listed Waste

Laboratory glassware is known to have contained spent solvents. However, laboratory procedures (Reference 5) require that glassware (beakers, pipettes) be rinsed prior to discarding. EPA has determined that laboratory glassware that has contained a HW is analogous to containers that have previously contained HW. When empty, as defined by SCHWM R.61- 79.261.7, such containers are not considered HW. By rinsing the beaker or pipette and disposing of the rinsate as a listed waste, the glassware has been rendered empty and therefore the presence of glassware does not cause the waste to be listed HW.

Kim-wipes and filters that were used in the analytical procedure contain F002/F003 spent solvents. Discarded protective clothing contaminated with spent solvents must also be managed as listed waste. EPA has said that protective clothing contaminated with a listed waste becomes a listed waste.

The Methyl Alcohol is listed (F003) solely because it is ignitable. While Kim-wipes and filters are contaminated with F003 spent solvent, the combined waste no longer meets the definition of ignitable and is therefore no longer (F003) listed. However, the waste is still subject to the land disposal restrictions.

This waste meets the listing criteria for an F002 spent solvent as defined in SCHWMR R.61-79.261.31 because of the presence of listed waste on filters and Kim-wipes.

ATTACHMENT 8.4
Characterization Process Report Examples
Page 4 of 100

EXAMPLE #1

Corrosivity

The waste is not a liquid and therefore does not possess the characteristic of corrosivity as defined by SCHWMR R.61-79.261.22

Reactivity

This waste contains stable solids such as plastic bags, wipes, protective clothing, filters, small resin columns and chemically contaminated glassware from the analysis of process control samples. The waste materials are contaminated by small quantities of Tetrachloroethylene, methyl alcohol and chromium.

The waste is not reactive as defined by SCHWMR R.61-79.261.23

Toxicity

Tetrachloroethylene and chromium (Cr) are both toxic materials. Their TCLP toxicity limits are 0.7 and 5.0 mg/l (or ppm), respectively.

Determine if the waste is RCRA hazardous for Cr

Total amount of Cr on each resin column = (500 samples) X (5 mg/sample) = 2,500 mg

Assume that the waste contains two spent resin columns

Total concentration of Cr in the waste = (2,500 mg/column) X (2 columns) ÷ 114 kg = 44 mg/kg

Calculated concentration in TCLP extract = 44 mg/kg X 0.05 Kg/L = 2.2 mg/L

Therefore this waste is not hazardous for Cr as defined by SCHWMR R.61-79.261.24

Determine if the waste is RCRA hazardous for TCE

Total amount of Tetrachloroethylene on each filter = (5ml) X (density of Tetrachloroethylene) X (Saturation Fraction) X (Volume Fraction Tetrachloroethylene)

= (5ml) X (1.6 g/ml) X (0.5) X (0.5) = 2.02 g/filter

Total Tetrachloroethylene in Waste = (2.02 g/filter) X (1000 filters) = 2.02E3 grams

Total Concentration (mg/kg) of Tetrachloroethylene in Waste = 2.02E3 g X E3 mg/g ÷ 1.14E2 kg = 1.77E4 mg/kg

Calculated concentration in TCLP extract = 1.77E4 X 0.05 Kg/L = 890 mg/L

The waste is hazardous for TCE SCHWMR R.61-79.261.24

ATTACHMENT 8.4
Characterization Process Report Examples
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EXAMPLE #1

Underlying Hazardous Constituents The waste stream has been identified as hazardous for toxicity, code D039. As required by 268.7, the underlying hazardous constituents list (268.48 Table UHC) was reviewed for constituents that could reasonably be expected to be present in the waste stream. The laboratory supervisor and operations manager of the facility originating the sample were asked if any of the chemicals on the UHC table were used in the process/analysis or reasonably expected to be present. Safety Data Sheets (SDS) and vendor data for the analytical chemicals, filters, and resin columns were compared against the UHC table. Of all the listed UHC, only chromium was identified as reasonably expected to be present. Process knowledge as used in this section is adequate to establish the value as 2.2 mg/L Cr. Using the non-wastewater UTS standard of 0.86 mg/L Cr, and process knowledge, it was determined that the waste is restricted from land disposal.			
Characterization Summary: The waste is characterized as F-listed waste F-002, exhibiting the characteristic of Toxicity D039 and restricted from land disposal for chromium.			
Mixed Waste Inventory Report Number (as applicable) NA			
Completed by: (Print Name)	**Title**	**Signature**	**Date**
Cognizant Technical Function: (Print Name)		**Signature**	**Date**
Environmental Coordinator: (Print Name)		**Signature**	**Date**

Example #1 provides insight into determining the HW content of a heterogeneous waste stream and the importance of waste segregation. The entire waste package (250 lb.) must be managed as hazardous because of the introduction of less than nine pounds of Tetrachloroethylene and Methyl alcohol contaminated filter paper and wipes. Conversely, the calculated TCLP concentration for chromium falls below the regulatory limit because of the introduction of extraneous waste. Also note that in the UHC determination, PK was used. However, had sampling and analysis been used in this case, specific test methods would be required. Several RCRA regulations require specific test methods as described in the January 13, 1995 Federal Register.

ATTACHMENT 8.4
Characterization Process Report Examples
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EXAMPLE #2

Characterization Process Report

Waste Stream PCD99007 | **ID No.**

Origin of Waste:
Construction Division Paint Shop 725-N, waste paint and solvent from 1999.

Physical Description of Waste:
The waste is a homogeneous (with proper mixing) liquid collection of solvent based Glidden (Glid-Guard) alkyd industrial enamel paint remnants and paint solvent.

Process or Activity that Generated Waste:
Paint remaining after the completion of various construction paint jobs is returned to stock for reuse. Periodically, the paint stock is reviewed to determine what paint is no longer needed or useful. Paint that is deemed unusable is collected and composited in a 55-gallon drum. Only those paints that are stocked and used by the paint shop end up in the drum. Methyl Ethyl Ketone (MEK) is used for cleanup during the painting process. While lacquer thinner was used in the past as a cleaning solvent, it is not believed to be present in this waste. The used solvent is collected at the end of each job, returned to the paint shop and deposited into the same 55- gallon drum as the waste paint. While the possible paints and solvent present in the drum are known, the specific paints/solvent and quantity of each is unknown.

Characterization Method: (check all that apply)
X Process Knowledge X Sampling and Analysis

RCRA Regulatory Substances Reasonably Expected to be Present:

Benzene	Ethyl Benzene	Methyl Ethyl Ketone
Zinc	Phthalic Anhydride	Toluene
Acetone	Barium	

Radioactive (as determined in Manual 1S, Chapter. 3, Attach. 8.1) △ Yes X No

Detailed Waste Evaluations:
X Listed X Ignitability ☐Corrosivity
☐Reactivity X Toxicity X Underlying Hazardous Constituents
☐PCBs

Procedure/Documents used in Characterization:
1. 3/3/98 memorandum from Pamela Lane (Paint Shop Supervisor) to Sherri Thomas (Environmental Compliance Authority), attached
2. 3/22/98 Facsimile from Glidden paint company, du Pont Inc., and Dunn Edwards Corp. to Sherri Thomas (Environmental Compliance Authority), attached
3. Glidden SDS SRS #1811.01, 1814.01, 1815.01, 1817.01, 1820.01, 3140.01, 04181.01, 1819.03, 1813.01, 1829.03, 4490.02, 1818.01, 10078.02, du Pont SDS SRS # 17501.00, and Dunn Edwards SDS SRS # 21973.00, attached
4. General Engineering Laboratory report, attached
5. Sampling Plan NAR-BSP-9002

ATTACHMENT 8.4
Characterization Process Report Examples
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EXAMPLE #2

Characterization Bases: **Waste Stream ID No. PCD99007**

1. The following information was obtained from the Paint Shop Supervisor. (Reference 1)
   a. All paints deposited into the drum were Glid-Guard Alkyd Enamel paint/primers/tints.
   b. All paints/primers/tints deposited into the drum were in liquid form with any included solids no larger than the 1/2 inch end opening of the funnel used to fill the drum.
   c. All paints/primers/tints deposited into the drum were from the paint shop stock which was last purged 6 months prior.
   d. The deposited paints/primers/tints and solvent could include any of those with listed SDSs (reference 3) on the first page of this report. The SDS for lacquer thinner was included to verify its absence.
   e. All deposited paints/primers/tints are comprised of high percentages of solids suspended in solvent combinations significantly greater than 1% (ref. SDS)
   f. The quantity of each paint/primer/tint type deposited was not recorded.
   g. MEK was used as the cleaning agent in the painting process.
   h. Only the identified Glidden paints could be contaminates to the used cleaning solvent.
   i. The drum is 90% full and weighs 665 lbs (302 kg)
2. The following information was obtained from a Glidden paint company representative. (Reference 2)
   a. The chemicals listed on the SDS for each of the paint colors includes all chemicals used in a production of that color.
   b. The SDSs provide the range of wt% for each of the paint components. The percentage of each chemical may be altered slightly but the maximum amount will not exceed that listed on the SDS.
   c. There are no known contaminates to the industrial grade chemicals listed on the SDS.
   d. In between color batches, the mixing tanks are washed with a hydro-treated light distillate. After clean-out, a tank heal of up to 1% of petroleum distillate can exist. This added petroleum distillate is factored into the mixture of the next batch of paint.
3. The following information was obtained from du Pont and Dunn Edwards company representatives. (Reference 2)
   a. The chemicals listed on the SDS/SDS for each of the paint solvents includes all chemicals used in production of that material and the correct percentages.
   b. There are no known contaminates to the industrial grade chemicals listed on the SDS.

ATTACHMENT 8.4
Characterization Process Report Examples
Page 8 of 100

EXAMPLE #2

Methodology: **Waste Stream ID No. PCD99007**

Listed Waste

While all the paints/primers/tints contain benzene, it is used in the manufacture of the paint product, not as a solvent. The paint waste does not originate from a non-specific source as identified in the F listings and is therefore not a F-listed waste.

The paint/primer/tint waste does not originate from a specific source as identified in the K listings and is therefore not a K-listed waste.

The paint/primer/tint waste is not a commercial chemical product or chemical manufacturing intermediate as identified in the P or U listings and is therefore not a P or U-listed waste.

However, MEK was used for its solvent properties in the clean-up process. Lacquer thinner includes acetone (28%) and toluene (20%) as ingredients and MEK is 100% methyl ethyl ketone. Since all three chemicals are > 10% by volume in their original form, used for their solvent properties, and appear on the F-list, their presence in the 55-gallon drum would make the drum contents F003 and/or F005 listed. Since MEK is suspected as being present and lacquer thinner should not be present, the drum contents were sampled. The results are presented below:

Chemical	Sample Result
Methyl ethyl ketone	10,756 mg/kg
Acetone	none detected
Toluene	none detected

The sample results indicate the presence of MEK but not lacquer thinner. Therefore the waste is determined to be F005 listed as defined in SCHWM R.61-79.261.31-33

Ignitability

The paint is a liquid and using the flash point specified on the various SDSs, the flash point of the mixture is between 24°F and 106°F. The flash point of the waste is below 140°F, making the paint hazardous because of its characteristic of ignitability as defined in SCHWM R.61-79.261.21

Corrosivity

The pH of non-aqueous liquids cannot be determined by direct measurement with a pH meter. A non-aqueous liquid is corrosive if it corrodes steel at a rate greater than 6.3 mm (0.250 inch) per year {SCHWR R.61-261.22(a)(2)}. However, it is known that steel is little affected by organic chemicals and many storage tanks for solvents and similar chemicals are fabricated from steel. (Perry's Chemical Engineers' Handbook, 4th Edition, page 23-7) For example the corrosion rate of steel by benzene is less than 0.02 inch per year (Perry page 23-21). Therefore, the waste is not corrosive as described in SCHWM R.61-79.261.22.

ATTACHMENT 8.4
Characterization Process Report Examples
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EXAMPLE #2

Reactivity
The waste contains a collection of stable enamel paints which does not contain cyanides or sulfides. Therefore the waste is not reactive as described in SCHWM R.61-79.261.23

Toxicity

The SDS for all paints/primers/tint specifies a benzene content of between 0.01 to 0.1 wt. % (100 - 1000 mg/kg). Glidden paint company representatives specified that the actual benzene content is normally 0.04% and should never exceed 0.1%. MEK is 100% methyl ethyl ketone. Benzene, barium, and methyl ethyl ketone are on the toxicity characteristic list. However, the quantity of paint/primer/tint vs. solvent was unknown so a TCLP was run on the drum. The results of toxicity characteristic materials are presented below (reference 4):

Chemical	Sample Result	Regulatory level
Benzene	**412 mg/L**	0.5 mg/L
Barium	none detected	100 mg/L
Methyl ethyl ketone	**10,756 mg/L**	200 mg/L

Since the regulatory limits are exceeded, the waste is hazardous for benzene D018 and methyl ethyl ketone D035 as defined in SCHWM R.61-79.261.24

Underlying Hazardous Constituents
The waste paint is hazardous for ignitability D001, but because it is in the high TOC ignitable sub-category, this by itself does not require a determination of the underlying hazardous constituents.

The waste paint is hazardous for benzene toxicity D018 and methyl ethyl ketone toxicity D035, which requires a determination of underlying hazardous constituents.
Using the SDS and information provided by Glidden, du Pont, and Dunn Edwards company, the waste paint could reasonably be expected to include the underlying hazardous constituents of acetone, barium, benzene, ethyl benzene, methyl ethyl ketone, naphthalene, phthalic anhydride, toluene, and zinc. Samples for these chemicals provided the following results (reference 4):

Chemical	Sample Result	Non-wastewater Standard
acetone	none detected	160.0 mg/kg
barium	none detected	7.6 mg/kg
ethyl benzene	none detected	10.0 mg/kg
naphthalene	2.4 mg/kg	5.6 mg/kg
phthalic anhydride	**152.0 mg/kg**	28.0 mg/kg
toluene	none detected	10.0 mg/kg
zinc	1.5 mg/kg	5.3 mg/kg

Representative samples of the above chemicals were analyzed in accordance with the sampling plan (reference 5) and compared against the universal treatment standards table. Using the non-wastewater standards, it was determined that the waste is restricted from land disposal because of the presence of phthalic anhydride.

ATTACHMENT 8.4
Characterization Process Report Examples
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EXAMPLE #2

PCBs: The paints/solvents are from after July 1982, therefore, no PCBs are present in the paints			
Characterization Summary: The waste paint is hazardous because of the characteristic of ignitability (D001) benzene toxicity (D018), and methyl ethyl ketone (D035/F005). The waste is also restricted from land disposal because of the underlying hazardous constituents of phthalic anhydride.			
Mixed Waste Inventory Report Number (as applicable) NA			
Completed by: (Print Name)	**Title**	**Signature**	**Date**
Cognizant Technical Function: (Print Name)	**Title**	**Signature**	**Date**
Environmental Coordinator: (Print Name)	**Signature**		**Date**

<u>Example #2</u> provides insight into the importance of collecting historical information on waste. Once the waste was mixed into a homogeneous form, sampling was used to indicate that lacquer thinner was not present in the waste. Exclusion of the F003 listing associated with lacquer thinner that was used as a solvent in the cleanup process is therefore logical given that it was not believed to be present. However, if lacquer thinner was suspected as being present, the waste should be listed as F003 even if it was not detected via sampling. Refer to the section on listings for more information. The facility should implement actions to more fully document the contents of future waste paint/primer/tint/solvent drums to prevent a reoccurrence of this problem

ATTACHMENT 8.5
TRU and Fissile Isotopes Table
Page 1 of 1

TRU and Fissile Isotopes

Nuclide	Fissile	TRU
U-233	Yes	No
U-235	Yes	No
Np-237	No	Yes
Pu-238	No	Yes
Pu-239	Yes	Yes
Pu-240	No	Yes
Pu-241	Yes	No
Pu-242	No	Yes
Am-241	No	Yes
Am-242m	Yes	Yes
Pu-244	No	Yes
Am-243	No	Yes
Cm-243	Yes	Yes
Cm-245	Yes	Yes
Cm-246	No	Yes
Cm-247	Yes	Yes
Cm-248	No	Yes
Cm-250	No	Yes
Bk-247	No	Yes
Cf-249	Yes	Yes
Cf-251	Yes	Yes

ATTACHMENT 8.6
Dose-to-Curie Standards Tables

NOTE

1. Tables in the waste tracking applications (e.g., WITS or CWTS) are currently set up with these parameters. Additions to the tables in the waste tracking applications may be made via WSCFs without updating this Table. This Table will be updated periodically.
2. Includes 12- and 14-gauge B-25s
3. This is same as contact (sensing element assumed to be 5 cm from end).
4. Set up for F/H Area Laboratory cell waste

TABLE 1 - Standard Distances and Locations for DTC Dose Rate Measurements (1)

Dose Rate Measurement Position			
Container Type	**Distance from Surface, ft**	**Location**	**Type of Waste**
All B-25's (2)	5	Midpoint, four sides	Job Control Waste
B-12	5	Midpoint, four sides	Job Control Waste
B-12	5	Midpoint, four sides	Soil/Rubble
21-inch Cardboard Box	3	Midpoint, four sides	Job Control Waste
21-inch Cardboard Box	0.164 (5 cm)(3)	All sides/Top/Bottom	Job Control Waste
55-gallon drum	3	Four quadrants	Job Control Waste
55-gallon drum liner	0.164 (5 cm)(3)	Side	Job Control Waste
2-Gallon Plastic Pail(4)	0.164 (5 cm)(3)	Top	Job Control Waste
Skip Pan, 6 yd	5	Two long sides	Soil/Rubble

NOTE

If taking a dose rate measurement at a distance other than that specified in Table 1, the correction factors in Table 2 must be used for entry into waste tracking applications.

Example: Measured a B-25 at 5 ft and no measured dose rate was detected above background. Measured the B-25 at 5 cm (0.164 ft) and obtained a dose rate of 50 μrem/hr. Background was 20 μrem/hr. The dose rate for waste tracking application entry is: 0.11 x (50-20) = 3.3 μrem/hr

TABLE 2 - Dose Rate Correction Factors

Distance from Container Surface						
Container Type	**0.164 ft**	**1.0 ft**	**2.0 ft**	**3.0 ft**	**4.0 ft**	**5.0 ft**
21-inch Box	0.059	0.20	0.49	1.0	----	----
B-12	0.086	0.18	0.31	0.49	0.71	1.0
B-25	0.11	0.20	0.34	0.52	0.73	1.0
55-Gal Drum	0.087	0.25	0.56	1.0	----	----

ATTACHMENT 8.7
Radionuclide Package Reporting Thresholds
Page 1 of 3

NOTE

1. The LLW Radionuclide Packaging Reporting Thresholds are not to be used for PA, TRU, or fissile nuclides.
2. The Isotopes reported in the two following tables are in alphabetic order. Tables can be read by starting with the top left column in each table progressing to the bottom of the column in that table, then repeating the process for each successive column in that table.
3. (*) Isotope does not exist in waste tracking applications (e.g., WITS or CWTS) (If reporting required, isotope and its Trigger Limit must be entered into waste tracking applications.)
4. Package Reduction Factors are set at 1% (0.01) for rare PA Trigger isotopes and non- PA (TSR only) isotopes, and set at 0.01% (0.0001) for more common SRS PA and TSR isotopes.

ATTACHMENT 8.7
Radionuclide Package Reporting Thresholds
Page 2 of 3

ISOTOPE	Reporting Threshold, Ci/Pkg	ISOTOPE	Reporting Threshold, Ci/Pkg	ISOTOPE	Reporting Threshold, Ci/Pkg	ISOTOPE	Reporting Threshold, Ci/Pkg
AC225	5.30E-01	BK249	2.10E-01	CS135	3.20E-05	I124*	1.60E-05
AC227	7.80E-04	BR74*	1.70E-02	CS136	1.00E+01	I125*	2.60E-06
AC228	1.00E+01	BR74M*	1.40E-02	CS137	3.30E-01	I126*	2.40E-06
AG108	1.00E+01	BR75*	1.10E-02	ES253	9.90E-03	I128*	6.00E-01
AG108M	1.00E-03	BR76*	1.60E-03	EU150	1.00E+01	I129	9.20E-09
AG109M	1.00E+01	BR77*	2.10E-03	EU150B	1.00E+01	I130*	1.90E-03
AG110	1.00E+01	BR80*	8.90E-01	EU152	1.30E-00	I131	4.70E-06
AG110M	1.00E+01	BR80M*	8.30E-02	EU154	1.00E+01	I132*	1.10E-02
AG112	1.00E+01	BR82*	5.80E-04	EU155	1.00E+01	I132M*	2.10E-02
AL26	8.00E-09	BR83*	5.50E-01	F18*	3.20E-02	I133	6.00E-04
AM237	1.00E+01	BR84*	3.70E-02	FE55	1.00E+01	I134*	2.00E-02
AM241	4.50E-03	C11*	8.90E-02	FE59	1.00E+01	I135*	5.30E-03
AM242	1.00E+01	C14	2.50E-05	FE60	1.10E-06	IN113M	1.00E+01
AM242M	1.00E-02	CA41	3.70E-06	FR221	9.90E-03	IN114	1.00E+01
AM243	9.10E-04	CA45	1.00E+01	GD148	9.90E-03	IN114M	1.00E+01
AR37*	1.00E+01	CD109	1.00E+01	GD152	1.70E-06	IN115	2.30E-06
AR39	1.00E+01	CD113	6.10E-07	GE66*	1.10E-02	IR192	1.00E+01
AR41*	8.90E-02	CD113M	3.10E-00	GE67*	6.00E-02	IR192M	3.60E-02
AS69*	7.40E-02	CD115M	1.00E+01	GE68	1.00E-05	K40	1.40E-05
AS70*	1.30E-02	CE134	1.00E+01	GE69*	1.80E-03	KR74*	4.20E-02
AS71*	1.20E-03	CE139	1.00E+01	GE71*	1.20E-02	KR76*	2.00E-03
AS72*	1.10E-03	CE141	1.00E+01	GE75*	4.90E-01	KR77*	4.90E-02
AS73*	4.30E-04	CE144	1.00E+01	GE77*	4.70E-03	KR79*	4.30E-01
AS74*	9.50E-05	CF249	5.20E-04	GE78*	3.10E-02	KR81*	1.00E+01
AS76*	2.10E-03	CF250	9.80E-03	H3	2.00E-04	KR83M*	1.00E+01
AS77*	6.30E-03	CF251	2.50E-03	HF172	1.00E+01	KR85	1.00E+01
AS78*	2.80E-02	CF252	5.70E-02	HF175	1.00E+01	KR85M*	6.60E-01
AT207*	8.30E-03	CL36	4.70E-06	HF178M	1.00E+01	KR87*	1.30E-01
AT211*	5.50E-04	CL38*	4.00E-02	HF181	1.00E+01	KR88*	2.50E-02
AT216*	1.00E+01	CL39*	3.50E-02	HF182	6.50E-06	LA137	2.50E-03
AT217	9.90E-03	CM241	4.60E-02	HG193*	4.30E-02	LA138	1.50E-04
AT218*	6.00E-00	CM242	3.00E-01	HG193M*	4.90E-03	LA140	1.00E+01
BA133	1.00E+01	CM243	9.80E-03	HG194	2.40E-07	LA141	1.00E+01
BA137M	1.00E+01	CM244	9.80E-03	HG195*	2.20E-02	LU174	1.00E+01
BA140	1.00E+01	CM245	4.80E-04	HG195M*	1.90E-03	LU176	7.90E-06
BE10	2.60E-05	CM246	6.30E-05	HG197*	3.60E-03	MN53	3.00E-04
BE7	1.00E+01	CM247	7.80E-04	HG197M*	4.40E-03	MN54	1.00E+01
BI207	4.90E-02	CM248	2.20E-04	HG199M*	2.40E-01	MO93	1.90E-05
BI210	1.00E+01	CM250	9.10E-04	HG203	7.40E-05	MO99	1.00E+01
BI210M	1.20E-06	CO57	1.00E+01	HO166M	6.60E-04	N13*	1.40E-01
BI211	9.90E-03	CO58	1.00E+01	I120*	1.30E-02	NA22	1.10E-00
BI212	1.00E+01	CO60	1.00E+01	I120M*	9.50E-03	NB93M	1.00E+01
BI213	1.00E+01	CR51	1.00E+01	I121*	2.60E-02	NB94	9.00E-06
BI214	1.00E+01	CS134	1.00E+01	I122*	4.00E-01	NB95	1.00E+01
BK247	9.80E-05	CS134M	1.00E+01	I123	1.70E-02	NB95M	1.00E+01

ATTACHMENT 8.7
Radionuclide Package Reporting Thresholds
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ISOTOPE	Reporting Threshold, Ci/Pkg	ISOTOPE	Reporting Threshold, Ci/Pkg	ISOTOPE	Reporting Threshold, Ci/Pkg	ISOTOPE	Reporting Threshold, Ci/Pkg
ND147	1.00E+01	PU244	1.50E-03	SE73M*	8.30E-02	TH234	1.00E+01
NI57	1.00E+01	RA224	1.80E-00	SE75	4.30E-02	TI44	5.50E-09
NI59	4.10E-04	RA225	6.80E-01	SE77M *	1.00E+01	TL204	1.00E+01
NI63	1.00E+01	RA226	1.30E-06	SE79	7.50E-02	TL208	1.00E+01
NP236	1.00E+01	RA228	1.00E+01	SE81*	2.30E-00	TL209	1.00E+01
NP236A	4.20E-09	RB86	1.00E+01	SE81M*	5.10E-01	TM170	1.00E+01
NP237	2.20E-06	RB87	8.00E-06	SE83*	3.40E-02	TM171	1.00E+01
NP239	1.00E+01	RE186M	1.00E-06	SI32	3.00E-05	U230	9.90E-03
O15*	1.00E-00	RE187	4.40E-04	SM146	1.30E-06	U231	1.00E+01
OS194	1.00E+01	RH101	1.00E+01	SM147	1.50E-06	U232	6.70E-03
P30*	7.00E-01	RH102	1.00E+01	SM151	1.00E+01	U233	2.60E-02
P32*	1.80E-05	RH102M	1.00E+01	SN110*	1.00E-02	U233D	2.60E-02
P33*	1.40E-04	RH103M	1.00E+01	SN111*	7.80E-02	U234	7.60E-04
PA230	1.00E+01	RH106	1.00E+01	SN113	2.50E-01	U235	2.30E-05
PA231	9.70E-08	RN220	9.80E-03	SN117M*	2.20E-04	U235D	2.30E-05
PA233	1.00E+01	RN222	1.00E+01	SN119M	5.70E-01	U236	9.80E-03
PA234	1.00E+01	RU103	1.00E+01	SN121	3.10E-00	U237	1.00E+01
PA234M	1.00E+01	RU106	1.20E-00	SN121M	8.90E-02	U238	3.10E-02
PB202	5.80E-06	RU97	1.00E+01	SN123	4.70E-00	V49	7.40E-05
PB205	1.50E-04	S35	1.10E-00	SN123M*	3.30E-01	W181	1.00E+01
PB209	1.00E+01	SB115*	7.00E-01	SN125*	6.30E-05	W185	1.00E+01
PB210	2.20E-01	SB116*	1.80E-05	SN126	2.00E-04	W187	1.00E+01
PB212	1.00E+01	SB116M*	1.40E-04	SN127	7.80E-03	W188	1.00E+01
PB214	1.00E+01	SB117*	7.00E-01	SN128*	2.10E-02	XE120*	3.90E-02
PD107	4.90E-02	SB118M*	1.80E-05	SR85	1.00E+01	XE121*	3.80E-02
PM144	1.00E+01	SB119*	1.40E-04	SR85M	1.00E+01	XE122*	4.30E-03
PM145	1.00E+01	SB120A*	7.00E-01	SR89	1.00E+01	XE123*	7.40E-02
PM146	1.00E+01	SB120B*	1.80E-05	SR90	7.10E-03	XE125*	2.30E-04
PM147	1.00E+01	SB122*	1.40E-04	SR91	1.00E+01	XE127*	4.00E-01
PO210	6.20E-02	SB124	3.00E-02	TA180	3.50E-05	XE129M*	4.60E-00
PO212	9.80E-03	SB124M*	1.30E-00	TA182	1.00E+01	XE131M	1.00E+01
PO213	9.90E-03	SB124N*	8.30E-02	TB157	1.00E+01	XE133	3.10E-00
PO214	9.90E-03	SB125	9.20E-03	TB158	1.00E+01	XE133M*	3.60E-00
PO216	9.80E-03	SB126	6.30E-05	TC93M	1.00E+01	XE135*	4.40E-01
PO218	9.90E-03	SB126M	5.10E-02	TC97	1.40E-06	XE135M*	3.60E-01
PR144	1.00E+01	SB127*	3.60E-04	TC98	5.70E-08	XE138*	6.00E-02
PR144M	1.00E+01	SB128A*	6.60E-02	TC99	1.30E-05	Y90	1.00E+01
PT193	1.00E+01	SB128B*	2.50E-03	TE123	4.10E-05	Y91	1.00E+01
PU236	9.90E-03	SB129*	8.90E-03	TE123M	1.00E+01	Y91M	1.00E+01
PU237	2.60E-02	SB130 *	1.90E-02	TE125M	1.00E+01	ZN65	1.00E+01
PU238	1.10E-02	SB131 *	2.30E-03	TH228	1.60E-02	ZR93	1.60E-05
PU239	1.00E-02	SC46	1.00E+01	TH229	2.40E-03	ZR95	1.00E+01
PU240	9.80E-03	SC48	1.00E+01	TH230	3.60E-06		
PU241	1.30E-01	SE70 *	1.90E-02	TH231	1.00E+01		
PU242	9.80E-03	SE73	8.30E-03	TH232	1.80E-04		

Appendix E. 10 CFR 61.55

§ 61.53 Environmental monitoring.

(a) At the time a license application is submitted, the applicant shall have conducted a preoperational monitoring program to provide basic environmental data on the disposal site characteristics. The applicant shall obtain information about the ecology, meteorology, climate, hydrology, geology, geochemistry, and seismology of the disposal site. For those characteristics that are subject to seasonal variation, data must cover at least a twelve month period.

(b) The licensee must have plans for taking corrective measures if migration of radionuclides would indicate that the performance objectives of subpart C may not be met.

(c) During the land disposal facility site construction and operation, the licensee shall maintain a monitoring program. Measurements and observations must be made and recorded to provide data to evaluate the potential health and environmental impacts during both the construction and the operation of the facility and to enable the evaluation of long-term effects and the need for mitigative measures. The monitoring system must be capable of providing early warning of releases of radionuclides from the disposal site before they leave the site boundary.

(d) After the disposal site is closed, the licensee responsible for post-operational surveillance of the disposal site shall maintain a monitoring system based on the operating history and the closure and stabilization of the disposal site. The monitoring system must be capable of providing early warning of releases of radionuclides from the disposal site before they leave the site boundary.

§ 61.54 Alternative requirements for design and operations.

The Commission may, upon request or on its own initiative, authorize provisions other than those set forth in §§ 61.51 through 61.53 for the segregation and disposal of waste and for the design and operation of a land disposal facility on a specific basis, if it finds reasonable assurance of compliance with the performance objectives of subpart C of this part.

§ 61.55 Waste classification.

(a) Classification of waste for near surface disposal. (1) *Considerations.* Determination of the classification of radioactive waste involves two considerations. First, consideration must be given to the concentration of long-lived radionuclides (and their shorter-lived precursors) whose potential hazard will persist long after such precautions as institutional controls, improved waste form, and deeper disposal have ceased to be effective. These precautions delay the time when long-lived radionuclides could cause exposures. In addition, the magnitude of the potential dose is limited by the concentration and availability of the radionuclide at the time of exposure. Second, consideration must be given to the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effective.

(2) *Classes of waste.* (i) Class A waste is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in § 61.56(a). If Class A waste also meets the stability requirements set forth in § 61.56(b), it is not necessary to segregate the waste for disposal.

(ii) Class B waste is waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in § 61.56.

(iii) Class C waste is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in § 61.56.

(iv) Waste that is not generally acceptable for near-surface disposal is waste for which form and disposal methods must be different, and in general more stringent, than those specified for Class C waste. In the absence of specific requirements in this part, such waste must be disposed of in a geologic repository as defined in part 60 or 63 of this chapter unless proposals for disposal of such waste in a disposal site licensed pursuant to this part are approved by the Commission.

(3) Classification determined by long-lived radionuclides. If radioactive waste contains only radionuclides listed in Table 1, classification shall be determined as follows:

(i) If the concentration does not exceed 0.1 times the value in Table 1, the waste is Class A.

(ii) If the concentration exceeds 0.1 times the value in Table 1 but does not exceed the value in Table 1, the waste is Class C.

(iii) If the concentration exceeds the value in Table 1, the waste is not generally acceptable for near-surface disposal.

(iv) For wastes containing mixtures of radionuclides listed in Table 1, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section.

TABLE 1

Radionuclide	Concentration curies per cubic meter
C–14	8
C–14 in activated metal	80
Ni–59 in activated metal	220
Nb–94 in activated metal	0.2
Tc–99	3
I–129	0.08
Alpha emitting transuranic nuclides with half-life greater than 5 years	[1] 100
Pu–241	[1] 3,500
Cm–242	[1] 20,000

[1] Units are nanocuries per gram.

(4) Classification determined by short-lived radionuclides. If radioactive waste does not contain any of the radionuclides listed in Table 1, classification shall be determined based on the concentrations shown in Table 2. However, as specified in paragraph (a)(6) of this section, if radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A.

(i) If the concentration does not exceed the value in Column 1, the waste is Class A.

(ii) If the concentration exceeds the value in Column 1, but does not exceed the value in Column 2, the waste is Class B.

(iii) If the concentration exceeds the value in Column 2, but does not exceed the value in Column 3, the waste is Class C.

(iv) If the concentration exceeds the value in Column 3, the waste is not generally acceptable for near-surface disposal.

(v) For wastes containing mixtures of the nuclides listed in Table 2, the total concentration shall be determined by the sum of fractions rule described in paragraph (a)(7) of this section.

TABLE 2

Radionuclide	Concentration, curies per cubic meter		
	Col. 1	Col. 2	Col. 3
Total of all nuclides with less than 5 year half-life	700	([1])	([1])
H–3	40	([1])	([1])
Co–60	700	([1])	([1])
Ni–63	3.5	70	700
Ni–63 in activated metal	35	700	7000
Sr–90	0.04	150	7000
Cs–137	1	44	4600

[1] There are no limits established for these radionuclides in Class B or C wastes. Practical considerations such as the effects of external radiation and internal heat generation on transportation, handling, and disposal will limit the concentrations for these wastes. These wastes shall be Class B unless the concentrations of other nuclides in Table 2 determine the waste to be Class C independent of these nuclides.

(5) Classification determined by both long- and short-lived radionuclides. If radioactive waste contains a mixture of radionuclides, some of which are listed in Table 1, and some of which are listed in Table 2, classification shall be determined as follows:

(i) If the concentration of a nuclide listed in Table 1 does not exceed 0.1 times the value listed in Table 1, the class shall be that determined by the concentration of nuclides listed in Table 2.

(ii) If the concentration of a nuclide listed in Table 1 exceeds 0.1 times the value listed in Table 1 but does not exceed the value in Table 1, the waste shall be Class C, provided the concentration of nuclides listed in Table 2 does not exceed the value shown in Column 3 of Table 2.

(6) Classification of wastes with radionuclides other than those listed in Tables 1 and 2. If radioactive waste does not contain any nuclides listed in either Table 1 or 2, it is Class A.

(7) The sum of the fractions rule for mixtures of radionuclides. For determining classification for waste that contains a mixture of radionuclides, it is necessary to determine the sum of fractions by dividing each nuclide's concentration by the appropriate limit and adding the resulting values. The appropriate limits must all be taken from the same column of the same table. The sum of the fractions for the column must be less than 1.0 if the waste class is to be determined by that column. Example: A waste contains Sr-90 in a concentration of 50 Ci/m^3 and Cs-137 in a concentration of 22 Ci/m^3. Since the concentrations both exceed the values in Column 1, Table 2, they must be compared to Column 2 values. For Sr-90 fraction 50/150=0.33; for Cs-137 fraction, 22/44=0.5; the sum of the fractions=0.83. Since the sum is less than 1.0, the waste is Class B.

(8) *Determination of concentrations in wastes.* The concentration of a radionuclide may be determined by indirect methods such as use of scaling factors which relate the inferred concentration of one radionuclide to another that is measured, or radionuclide material accountability, if there is reasonable assurance that the indirect methods can be correlated with actual measurements. The concentration of a radionuclide may be averaged over the volume of the waste, or weight of the waste if the units are expressed as nanocuries per gram.

[47 FR 57463, Dec. 27, 1982, as amended at 54 FR 22583, May 25, 1989; 66 FR 55792, Nov. 2, 2001]

§ 61.56 Waste characteristics.

(a) The following requirements are minimum requirements for all classes of waste and are intended to facilitate handling at the disposal site and provide protection of health and safety of personnel at the disposal site.

(1) Waste must not be packaged for disposal in cardboard or fiberboard boxes.

(2) Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.

(3) Solid waste containing liquid shall contain as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1% of the volume.

(4) Waste must not be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

(5) Waste must not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does not apply to radioactive gaseous waste packaged in accordance with paragraph (a)(7) of this section.

(6) Waste must not be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be nonflammable.

(7) Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20°C. Total activity must not exceed 100 curies per container.

(8) Waste containing hazardous, biological, pathogenic, or infectious material must be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.

(b) The requirements in this section are intended to provide stability of the waste. Stability is intended to ensure that the waste does not structurally degrade and affect overall stability of the site through slumping, collapse, or other failure of the disposal unit and thereby lead to water infiltration. Stability is also a factor in limiting exposure to an inadvertent intruder, since it provides a recognizable and nondispersible waste.

(1) Waste must have structural stability. A structurally stable waste form will generally maintain its physical dimensions and its form, under the expected disposal conditions such as weight of overburden and compaction equipment, the presence of moisture, and microbial activity, and internal factors such as radiation effects and chemical changes. Structural stability can be provided by the waste form itself, processing the waste to a stable form, or placing the waste in a disposal container or structure that provides stability after disposal.

(2) Notwithstanding the provisions in § 61.56(a) (2) and (3), liquid wastes, or

Appendix F. Compliance Crosswalk to WCS FWF WAC

WCS FWF Generator Handbook Requirement		SRS Contaminated Process Equipment Compliance Statement		
		Meets WCS FWF Requirement?		
Requirement (Handbook Section)	Description	Yes	No	Supporting Statement
License Volume and Curie Limit (5.2.1)	Federal LLW volumes shall not exceed a total of 26,000,000 ft^3 of waste with a total decay corrected quantity of radioactivity not to exceed 5,600,000 Ci and, of the total volume, 8,100,000 ft^3 can be containerized waste with a total quantity of radioactivity of containerized waste not to exceed 5,500,000 Ci.	✓		Disposal of the SRS contaminated process equipment is within the license volume and curie limits.
Chelating Agents (5.2.2)	Limited to 8 percent by weight for each waste stream (e.g., profile).	✓		No chelating agents in stabilized SRS contaminated process equipment.
Free Liquids (5.2.3)	Must not exceed 1 percent of the volume in containerized waste.	✓		SRS contaminated process equipment does not contain free liquids.
Void Space/Head Space (5.2.4)	Must be reduced to the extent practicable; LLW can have no more than 15 percent void space/headspace. MLLW can have no more than 10% void space.	✓		Stabilized LLW container packages will have less than 15 percent void space. MLLW will have no more than 10% void space.
Void Filling/Solidification Agent (5.2.5)	Void filling/solidification agents are required to be non-biodegradable. Two examples are vermiculite and concrete.	✓		Non-biodegradable grout and stabilizing foam would be used to fill void space.
Waste Packaging (5.2.6)	Each package or container shall only contain one approved profiled waste stream; Packages should weigh 10,000 lbs. or less unless special arrangements have been made; Drums exceeding 1,000 lbs. must be palletized and banded unless alternate arrangements are made with WCS; All containers transported on public roads to WCS are required to meet the applicable requirements of the Texas Department of State Health Services (DSHS) and USDOT regulations (49 CFR) Cardboard, fiberboard, and wood boxes are prohibited; Except for bulk waste in reusable containers and large components, waste packages must fit into a Modular Concrete Canister (MCC). WCS has two	✓		Waste container will only include SRS contaminated process equipment as an approved profiled waste stream. SRS contaminated process equipment is considered a large component as defined under TCEQ RML, Attachment C, Section 2.0, because the containers are too large to fit into a modular concrete canister in the WCS FWF disposal cell and, therefore, require disposal under a Large Component Disposal Plan pursuant to TCEQ RML, Attachment C, Section 10.3.and will be disposed of in accordance with Large

WCS FWF Generator Handbook Requirement		SRS Contaminated Process Equipment Compliance Statement		
		Meets WCS FWF Requirement?		
Requirement (Handbook Section)	Description	Yes	No	Supporting Statement
	standard types of MCCs: Cylindrical: 6’ 8” D x 9’ 2” H (internal dimension); Rectangular: 9’ 6” L x 7’ 8” W x 9’ 2” H.			Component Disposal Plan submitted to TCEQ for evaluation and approval prior to receipt of waste shipments.
Waste Class (5.2.7)	The FWF is authorized to receive containerized Class A, Class B, and Class C (as defined in 30 TAC §336.362) LLRW and LLMW, and bulk Class A LLRW and LLMW in reusable packages with a dose rate of <100 mrem/hr. at 30 cm.	✓		SRS contaminated process equipment disposal containers do not exceed Class C limits. Dose rates for large packages may be >100 mrem/hr.
Waste Stability Requirements (5.2.9)	The MCC disposal structure provided by WCS will provide the stability required for radioactive waste in accordance with 10 CFR 10 CFR §61; therefore, the waste or the waste form as shipped to WCS is not required to meet stability requirements; All Class B, C, and HCD Class A waste will be placed in an MCC.	✓		SRS contaminated process equipment will be disposed of in accordance with a Large Component Disposal Plan, prepared by WCS for evaluation and approval by TCEQ. The waste containers will be placed on the floor of the WCS FWF on a reinforced concrete pad, resting on top of the existing concrete barrier, at the WCS FWF disposal cell at a depth up to 120 ft. (37 m). A 2-ft. thick minimum reinforced concrete barrier will be placed on the sides and top of the containers.
Prohibited Waste Types (5.2.11)	Waste streams not specifically authorized by the license or with physical, chemical, and radiological characteristics not evaluated in the license application • Waste of international origin [THSC §401.207(0)] • Greater than Class C waste • Naturally occurring radioactive material (NORM) waste including oil & gas NORM • Byproduct material waste [11.e(2)] • High-level radioactive waste • Uranium hexafluoride • Waste capable of generating toxic gases, vapors, or fumes (excluding radioactive gases)	✓		Waste does not contain any prohibited waste types. SRS contaminated process equipment meeting the HLW interpretation for management as non-HLW would be declared non-HLW by DOE prior to shipment to WCS FWF.

WCS FWF Generator Handbook Requirement		SRS Contaminated Process Equipment Compliance Statement		
		Meets WCS FWF Requirement?		
Requirement (Handbook Section)	Description	Yes	No	Supporting Statement
	• Waste readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures or of explosive reaction with water • Waste containing transuranic nuclides in concentrations greater than 100 nCi/g • Municipal solid waste • Liquid waste that is not stabilized or not solidified • Explosive materials • Pyrophoric material that has not been properly stabilized Putrescible waste • LLMW containing RCRA codes F020, F021, F022, F023, F026, and F027 (Dioxins and Furans) • Waste that is NOT considered Federal Waste.			