

G-CLC-A-00234  
July 8, 2010

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## Table of Contents

Table of Contents.....	2
Introduction .....	3
Inputs and Assumptions.....	3
Analytical Methods and Computations.....	3
Results .....	4
Activity Calculations – Absorbed Liquids and JCW Waste Cut.....	4
Total Waste Container Activity .....	4
LLW WAC Compliance .....	5
HC2 SOF Contribution .....	5
Open Items.....	6
Conclusion.....	6
References .....	6
Attachments.....	6
Attachment 1: Radioactive Material Disposition Request, February 22, 2010.....	7
Attachment 2: Assay Results #10024 – Klapper Canyon Waste Cut.....	8
Attachment 3: Activity Calculations.....	12
Attachment 4: Waste Container (Minimum Mass) LLW Test Package – WITS Input.....	14
Attachment 5: Waste Container (Minimum Mass) LLW Test Package – WITS Limit Checks .....	17
Attachment 6: HC2 SOF Calculation.....	21

## Introduction

The purpose of this Engineering Calculation is to quantify the radiological activity for a waste cut containing absorbed liquids and job control waste (JCW) from canyon-related R&D activities that will be added to a waste container filled with "SRNLJCW" LLW [Ref. 1]. This activity will be used for characterization of this waste container. The objective is to transfer the resulting waste container to SWM for disposal. The information submitted on the Radioactive Material Disposition Request (RMDR), as well as provided by the assay file for this waste cut, was used to characterize this combined waste cut for disposal.

This calculation is comprised of the following sections:

- Inputs and Assumptions
- Analytical Methods and Computations
- Results
- Open Items
- Conclusion
- References
- Attachments

## Inputs and Assumptions

The following input data and assumptions (IA) are used to perform this calculation:

- IA.1. The waste cut was generated by canyon-related R&D activities in 773-A Lab C-075/077/079 (see Attachment 1). The waste cut includes 1.5L neutralized nitric acid and 2L of tributyl phosphate (TBP) that have been absorbed on NoChar 610, NoChar 660, and Oil-Dry, as well as various JCW (e.g., glassware, paper, plastics).
- IA.2. Per L7.13 Procedure 005 [Ref. 2], all waste cuts designated as "Canyon" waste are assayed to ensure they do not exceed the TRU waste threshold. The assay results for this waste cut, which was assayed with other Canyon waste cuts, is used to determine the TRU waste concentration (see Attachment 2).
- IA.3. Per the SRNL Waste Certification Plan [Ref. 3], assay values reported as detection level values are not used to provide TRU concentration verification. Only detected TRU radionuclides are used to verify the TRU concentration for TRU waste.
- IA.4. Low-Level Waste Acceptance Criteria (LLW WAC) are provided in 1S WAC 3.17 [Ref. 4]. LLW WAC compliance is demonstrated through input of test waste cuts into the Waste Information Tracking System (WITS) and the resulting calculations performed by WITS, as recommended by 1S WAC 3.17 [Ref. 4].
- IA.5. This waste cut will be added to a B-25 filled with routine "SRNLJCW" LLW, which was characterized by G-CLC-A-00152 [Ref. 5]. The activity assigned to the "SRNLJCW" portion of the waste cut is  $5.50 \text{ E } -03 \text{ Ci}$  [Ref. 5]. The minimum mass for a B-25 filled with "SRNLJCW" LLW is 151 kg [Ref. 5]. The combined activity and minimum mass are used to demonstrate WAC compliance for this waste container. The actual waste mass will be determined at the time that the container is closed and accepted by the GCO.
- IA.6. If any other non-"SRNLJCW" waste cuts (i.e., "00524" LLW stream or other LLW stream cuts) are planned to be added to the B-25 that contains this waste cut, additional LLW WAC compliance tests may be performed to ensure overall container compliance. These waste cut additions would be made to allow for waste management operational efficiency. This calculation will not be revised since the total activity attributed to this waste cut will not be affected by these additions.
- IA.7. To ensure the 778-A Waste Pad inventory remains below the Hazard Category 2 (HC2) threshold, the HC2 sum-of-fractions (SOF) contribution from this waste cut is calculated using the HC2 thresholds per DOE-STD-1027-92 [Ref. 6].

## Analytical Methods and Computations

The following steps are used to perform this calculation. The equations used for each step (as applicable) are provided in the Results section below.

1. Determine the activity (Ci) per radionuclide for the absorbed liquids and JCW waste cut based on assay data (see IA.1 – IA.3).

2. Determine the total activity (Ci) per radionuclide for the waste container (see IA.5).
3. Determine compliance with LLW WAC [Ref. 4] for the waste container (see IA.4 – IA.6).
4. Determine the HC2 SOF contribution for the waste container (see IA.7).

## Results

### *Activity Calculations – Absorbed Liquids and JCW Waste Cut*

The absorbed liquids and JCW waste cut was generated under the “Canyon” waste stream (see IA.1). As required by SRNL procedures, this waste cut was assayed to determine the TRU concentration (see IA.2). The assay results for this waste cut (combined with other Canyon waste cuts) are provided in Attachment 2. The TRU concentration was calculated using Equation 1; these calculations are provided in Attachment 3A.

$$TRU = \frac{\sum A_r}{M} \quad \text{Equation (1)}$$

where TRU = TRU concentration (nCi/g)  
 $A_T$  = Activity for TRU Isotope, T (nCi); see Attachment 3A  
 M = Waste Mass (g), per assay results; see Attachment 3A

As noted in IA.3, detection level values (i.e., not detected above the detection level; shown as “<” values) are not used to verify the TRU concentration. Per the assay results (see Attachment 2), Pu-238 and Pu-240 were reported as detection level values. If these detection level values are included, the TRU concentration is 134 nCi/g, which exceeds the allowable concentration for LLW. If these detection level values are not included, the TRU concentration is 95 nCi/g, which is below the verified concentration for TRU waste. Therefore, this waste cut, as assayed, was not acceptable as routine “SRNLJCW” LLW or as verified TRU waste.

The assay results provide both measured radionuclides (e.g., Cs-137a, where the “a” designates an actual value) and scaled radionuclides (see Attachment 2). The scaled radionuclides are either included in the “SRNLJCW” distribution, were screened out of the “SRNLJCW” distribution due to low content (e.g., U-238), or can be determined using more recent plutonium isotope scalors [Ref. 7]. Therefore, only the assayed nuclides are included to represent the absorbed liquids and JCW waste cut. The plutonium isotopes (i.e., Pu-240, Pu-241 and Pu-242) were scaled to Pu-239 using the G-CLC-A-00089 scaling factors [Ref. 7]. These calculations are provided in Attachment 3B.

### *Total Waste Container Activity*

The Absorbed Liquids and JCW waste cut will be added to a B-25 containing “SRNLJCW” (see IA.5). The total activity for the waste container was calculated based on the activity of the waste cut (see Attachment 3A and 3B) and the activity for the “SRNLJCW” B-25 (see IA.5), using Equations 2 and 3. These calculations are provided in Attachment 3C.

$$A_i = A_A + A_R \quad \text{Equation (2)}$$

$$A = \sum A_i \quad \text{Equation (3)}$$

where  $A_i$  = Total Activity for radionuclide, i (Ci)  
 $A_A$  = Absorbed Liquids and JCW Waste Cut Activity for radionuclide, i (Ci); see Attachment 3A & 3B  
 $A_R$  = Routine “SRNLJCW” Activity for radionuclide, i (Ci); Ref. 5  
 A = Total Activity for B-25 Waste Container (Ci)

After the total activity was calculated, the non-PA, non-TRU, and non-fissile nuclides that were less than 1Ci% were removed from further consideration, as allowed by 1S WAC 2.02 [Ref. 8]. This analysis resulted in the removal of Cm-244, Co-60, and Y-90. The remaining activities represent the combined Absorbed Liquids and JCW Waste Cut and the routine “SRNLJCW” in a B-25 waste container; these values are presented in Table 1. See Attachment 3C for this calculation.

**Table 1. Waste Container Radionuclide and Total Activities**

<b>Nuclide</b>	<b>Ci</b>
Am-241	1.42E-03
Am-243	2.24E-06
Ba-137m	8.12E-04
C-14	8.90E-07
Cs-137	8.58E-04
H-3	3.01E-04
I-129	4.86E-10
Np-237	6.05E-06
Pu-238	2.11E-03
Pu-239	7.25E-03
Pu-240	1.52E-03
Pu-241	1.76E-02
Pu-242	1.20E-07
Sr-90	2.26E-04
Tc-99	1.24E-05
U-233	2.84E-06
U-234	3.01E-06
U-235	1.59E-07
<b>TOTAL</b>	<b>3.21E-02</b>

Note that the TRU concentration for this waste container, using Equation 1 and the minimum waste mass (i.e., 151 kg, see IA.5), is 82 nCi/g, which is acceptable for disposal as LLW.

### ***LLW WAC Compliance***

Per 1S WAC 3.17 [Ref. 4], the recommended method to demonstrate compliance with WAC requirements is to enter a test package into WITS (see IA.4). Therefore, a test package was created that contained one waste cut to represent the combination of the Absorbed Liquids and JCW Waste Cut with the routine “SRNLJCW” LLW. This combined waste cut used the “00524” LLW stream, the nuclide activities shown in Table 1, and the minimum waste container mass (see IA.5). The container used for this test package was a B-25 (see IA.5). The WITS input as well as the results (i.e., limit checks) for this test package are provided in Attachments 4 and 5, respectively.

As seen by the limit checks in Attachment 5, a B-25 that contains the Absorbed Liquids and JCW Waste Cut along with routine “SRNLJCW” LLW is acceptable for disposal in the Engineered Trench (ET). Other disposal locations may also be acceptable but were not specifically tested in WITS because the SWM operational preference is the ET. No PA isotope limits, TRU waste limits, or U-235 fissile gram equivalent (FGE) limits were exceeded.

### ***HC2 SOF Contribution***

The 778-A Waste Pad is designated as a Hazard Category 3 (HC3) Facility; therefore, the total radiological inventory on the 778-A Waste Pad can not exceed the Hazard Category 2 (HC2) threshold [Ref. 6]. Although the historical contribution from LLW to the HC2 SOF is known to be low compared to the contribution from TRU waste, since this waste container is being managed as a non-routine LLW cut, its HC2 SOF contribution was checked to ensure it will not impact the current inventory control strategy for the 778-A Waste Pad. The following equation is used to calculate the HC2 SOF.

$$SOF = \sum \frac{A_i}{L_i} \quad \text{Equation (4)}$$

where  $A_i$  = Activity for radionuclide, i (Ci); see Table 1  
 $L_i$  = HC2 Activity Threshold Limit (Ci) for radionuclide, i [Ref. 6]  
 SOF = HC2 Sum of Fractions

These calculations are provided in Attachment 6 and indicate the HSC2 SOF for this waste cut is 4.6E-04. The HC2 SOF for the 778-A Waste Pad is not allowed to exceed a value of 1 to remain as a HC3 Facility [Ref. 6]. Due to the insignificant impact on HC2 SOF from this waste cut, its HC2 SOF contribution does not impact the inventory control strategy for the 778-A Waste Pad.

## Open Items

There are no Open Items related to this calculation.

## Conclusion

The activity attributed to the waste container that contains the Absorbed Liquids and JCW Waste Cut along with “SRNLJCW” LLW has been provided in Table 1 and should be used for input into WITS using the “00524” LLW stream. The total waste mass for this container will be determined by the GCO once the container is full and accepted [see IA.5].

The total activity for the waste container meets 1S WAC 3.17 requirements for disposal as LLW. The specific waste container chosen for this waste cut will be determined by the SRNL LLW GCO to allow for operational flexibility.

For the chosen disposal container, if additional characterized non-“SRNLJCW” waste cuts are placed into the same container for disposal, a WITS check should be performed prior to placing the additional cuts into the container to ensure no WAC limits are exceeded.

Lastly, this waste cut does not impact the HC3 inventory controls used for the 778-A Waste Pad.

## References

1. Crawford, K. C., SRNL-L8300-2010-0029, “RMDR Disposition FY10-20 (Klapper / Crowder Absorbed TBP and JCW) – Preliminary”, Revision 0, June 23, 2010.
2. SRNL Manual L7.13, Procedure 005, “Quantifying, Manifesting, and Verifying Low-Level Radioactive Waste Packages”, Revision 24, May 3, 2010.
3. Crawford, K. C., TSD-AEC-96-1114, “SRNL Waste Certification Plan”, Revision 9, January 5, 2010.
4. SRS Manual 1S, WAC 3.17, “Low-Level Radioactive Waste Acceptance Criteria”, Revision 11, January 15, 2009.
5. K. C. Crawford, “SRNL Routine Low-Level Waste Consolidation”, G-CLC-A-00152, Revision 0, June 28, 2006.
6. US Department of Energy, “Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports”, DOE-STD-1027-92, Change Notice No. 1, September 1997.
7. K. C. Crawford, “SRNL Transuranic Waste Spreadsheets”, G-CLC-A-00089, Revision 4, December 29, 2009.
8. SRS Manual 1S, WAC 2.02, “Low Level, Hazardous, TRU, Mixed, and PCB Waste Characterization Requirements”, Revision 12, October 31, 2008.

## Attachments

1. Radioactive Material Disposition Request, February 22, 2010
2. Assay Results #10024 – Klapper Canyon Waste Cut
3. Activity Calculations
4. Waste Container (Minimum Mass) LLW Test Package – WITS Input
5. Waste Container (Minimum Mass) LLW Test Package – WITS Limit Checks
6. HC2 SOF Calculation

**Attachment 1: Radioactive Material Disposition Request, February 22, 2010**

**Radioactive Material Disposition Request/  
Potential Waste Characterization Changes**

**INSTRUCTIONS:** Complete Section I for Radioactive Material Disposition Request and/or Section II for Potential Waste Characterization Changes, then submit your request to the GCO or CTF. E&WMG will document the disposition of the request separately.

Name: Mark Crowder Date: 02/22/10

Work Group: E&CPTP Phone No.: 51110 Pager: 10778

**SECTION I – RADIOACTIVE MATERIAL DISPOSITION REQUEST**

Description of Material: 1.5 liter neutralized HNO<sub>3</sub> and 2 liter of tributyl phosphate absorbed on Nochar 610 and 660 and oil-dri, glassware, paper, plastics,

Type and condition material is in: Solid waste

Location of material: Lab C075/077/079

Quantity of material: .one 45 cubic foot bag weighing approximately 26 lbs

Any special handling concerns:

Does this material pose any personal hazards? NO

If YES, please describe

**SECTION II – POTENTIAL WASTE CHARACTERIZATION CHANGES**

Will an upcoming material and/or activity have the potential to change the existing solid radioactive waste characterization as described in the Waste Certification Plan?

*For Example:* Will the activity involve handling different samples that are not normally used in the lab/area?  YES  NO

If YES, please describe the activity and the new samples/materials used:



**Attachment 2: Assay Results #10024 – Klapper Canyon Waste Cut**

**Attachment 2, Page 1 of 4**

Report for 06152010R-03

6/15/2010 10:28:56 AM

Page 1

SRTC SWAF  
NDA 2000 Assay Report

\*\*\*\*\* Sample Information \*\*\*\*\*

Sample ID: 06152010R-03 Count Sequence Number: 10024  
Operator: SRSDOMAIN\Z2219  
Assay Start: 6/15/2010 10:18:49 AM  
Description 1: CANYON-SUPPORT  
Description 2:  
Location: C-154/159  
Comment: SPECIAL WASTE CUT ADDED MORE WT. KLAPPER  
Matrix Type: Not Used  
Container Type: 55-Gallon Drum  
Weight: Gross: 103.0 kg Net: 80.7 kg  
Container: Volume: 208.0 l Full: 100.0 %  
Density: 0.390 kg /l

Analysis Parameters

Channels: 4096 Conversion Gain: 4096  
Energy Calibration: 6/9/10 4:07:40 PM  
Response Calibration: 1/15/10 11:18:08 AM  
Energy Tolerance: 1.00 keV  
Nuclide confid threshold: 0.30  
Nuclide Library:  
C:\GENIE2K\CAMFILES\CANYON.NLB  
Background File:  
C:\Canberra\nda2k\Data\00010020\_CNTR0001\_DCAT0001\_PROC000Y.CNF

Summed Non-Segmented Results

File Name:  
C:\Canberra\nda2k\Data\00010024\_CNTR0001\_DCAT0001\_PROC000Y.CNF

Background File:  
C:\Canberra\nda2k\Data\00010020\_CNTR0001\_DCAT0001\_PROC000Y.CNF

Acquisition Start: 6/15/2010 10:18:49 AM  
Elapsed Live Time: 600.00 sec Elapsed Real Time: 603.62 sec

Attachment 2, Page 2 of 4

Report for: 06152010R-03

6/15/10 10:28:57 AM

Page 2

Peak Analysis Report

Sample ID: 06152010R-03  
Peak Analysis Performed on: 6/15/10 10:28:55 AM  
Peak Analysis From Channel: 80  
Peak Analysis To Channel: 4096

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	147-	156	151.92	59.63	3.73E+004	466.13	4.90E+003
2	223-	232	227.64	86.56	9.40E+002	210.08	2.87E+003
M 3	240-	278	244.67	92.61	6.84E+002	105.88	3.01E+003
m 4	240-	278	250.90	94.83	1.95E+003	129.72	2.96E+003
m 5	240-	278	261.63	98.64	4.07E+003	160.43	3.12E+003
m 6	240-	278	268.48	101.08	2.87E+002	91.15	3.04E+003
m 7	240-	278	274.51	103.22	7.76E+002	105.04	2.73E+003
M 8	292-	311	297.02	111.23	1.25E+003	130.48	3.13E+003
m 9	292-	311	307.16	114.84	5.29E+002	106.22	2.98E+003
M 10	334-	352	337.26	125.54	1.70E+002	74.67	1.71E+003
m 11	334-	352	348.17	129.42	1.71E+003	119.05	1.94E+003
12	503-	512	506.85	185.86	2.84E+002	124.55	1.34E+003
M 13	551-	574	556.79	203.62	2.09E+002	55.99	9.66E+002
m 14	551-	574	569.35	208.08	4.35E+002	67.01	8.99E+002
15	742-	753	748.25	271.71	1.26E+002	93.01	6.77E+002
16	822-	834	828.50	300.26	1.51E+003	120.55	6.70E+002
17	855-	867	861.59	312.03	8.55E+003	198.46	4.09E+002
18	914-	925	920.41	332.95	1.64E+002	56.52	2.11E+002
M 19	936-	959	941.97	340.62	8.84E+002	65.34	1.60E+002
m 20	936-	959	954.62	345.12	1.56E+002	30.98	1.39E+002
M 21	1033-	1057	1039.36	375.26	5.24E+002	52.10	1.37E+002
m 22	1033-	1057	1053.64	380.34	5.02E+001	26.03	1.71E+002
M 23	1082-	1111	1089.25	393.00	1.35E+002	26.88	6.38E+001
m 24	1082-	1111	1104.85	398.55	2.67E+002	36.60	8.38E+001
M 25	1141-	1160	1147.83	413.84	3.68E+002	41.98	6.67E+001
m 26	1141-	1160	1153.57	415.88	3.29E+002	39.38	5.97E+001
27	1249-	1260	1254.24	451.69	3.17E+001	29.92	6.33E+001
28	2133-	2146	2139.47	766.60	7.00E+001	24.28	2.80E+001
29	2793-	2805	2798.84	1001.20	1.20E+002	25.84	1.78E+001

M = First peak in a multiplet region  
m = Other peak in a multiplet region  
F = Fitted singlet

Errors quoted at 2.000 sigma

~~U238~~  
P239  
Am241  
U235 ~  
~~Np237~~

Attachment 2, Page 3 of 4

Report for: 06152010R-03

6/15/10 10:28:57 AM

Page 3

Nuclide Peak Analysis Results

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (nCi)	Activity Uncertainty
C-14	0.000	??????????	??????		
TC-99	0.000	??????????	??????		
U-234	0.000	??????????	??????		
U-235a	0.750	143.76	10.96		
		185.71*	57.20	7.12E+001	3.13E+001
U-238	0.000	??????????	??????		
PU-239a	0.997	129.30*	0.01	4.79E+006	4.21E+005
		375.05*	0.00	7.61E+006	7.85E+005
		413.71*	0.00	6.12E+006	7.21E+005
AM-241a	0.999	59.54*	35.90	7.97E+005	5.85E+004
		99.00*	0.02	6.81E+006	5.62E+005
		103.00*	0.02	1.17E+006	1.77E+005
		125.00*	0.00	7.92E+005	3.49E+005
PU-241	0.000	??????????	??????		

Unidentified Peaks

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty
2	86.56	1.5664E+000	22.35
M 3	92.61	1.1405E+000	15.47
m 4	94.83	3.2569E+000	6.64
m 6	101.08	4.7809E-001	31.78
M 8	111.23	2.0837E+000	10.44
m 9	114.84	8.8116E-001	20.09
M 13	203.62	3.4903E-001	26.74
m 14	208.08	7.2466E-001	15.41
15	271.71	2.1009E-001	73.79
16	300.26	2.5092E+000	8.01
17	312.03	1.4242E+001	2.32
18	332.95	2.7409E-001	34.37
M 19	340.62	1.4734E+000	7.39
m 20	345.12	2.5990E-001	19.87
m 22	380.34	8.3630E-002	51.87
M 23	393.00	2.2477E-001	19.93
m 24	398.55	4.4553E-001	13.69
m 26	415.88	5.4911E-001	11.95
27	451.69	5.2836E-002	94.39
28	766.60	1.1667E-001	34.68
29	1001.20	2.0033E-001	21.50

Errors quoted at: 2.00 sigma



**Attachment 3: Activity Calculations**

**Attachment 3, Page 1 of 2**

**A. Assay Results – Summary**

<b>Assay File</b>	10024
<b>Description</b>	Klapper JCW + Canyon
<b>Waste Mass (kg)</b>	80.7
<b>Nuclide</b>	<b>nCi</b>
Co-60	< 6.77E+00
Cs-137	< 1.54E+01
U-235	7.12E+01
Pu-238	< 1.84E+06
Pu-239	6.80E+06
Pu-240	< 1.25E+06
Am-241	8.88E+05
<b>TOTAL</b>	<b>1.08E+07</b>
<b>TOTAL (w/o DL)</b>	<b>7.69E+06</b>
<b>TRU nCi/g</b>	<b>134</b>
<b>TRU nCi/g (w/o DL)</b>	<b>95</b>

**Notes:**

1. The above table shows measured nuclides only. No scaled nuclides are included; see assay file in Attachments 2 for scaled and measured nuclides.
2. Detection Level (DL) values are shown as “<” values.
3. TRU concentration (nCi/g) is calculated using the TRU nuclides (i.e., Pu-238, Pu-239, Pu-240, and Am-241) and waste mass, per Equation 1.

**B. Scaled Pu Isotopes**

<b>Nuclide</b>	<b>Assay nCi</b>	<b>Scaled nCi [Ref. 7]</b>	<b>Notes</b>
Pu-240	1.25E+06	1.52E+06	Use scaled value (higher than assay DL)
Pu-241		1.60E+07	Use scaled value (more recent scaling factor than assay library)
Pu-242		1.20E+02	Use scaled value (no scaling factor in assay library)

**C. Total Waste Container Activity**

<b>Nuclide</b>	<b>Absorbed Liquids + Canyon JCW – Ci (see Att 3A &amp; 3B)</b>	<b>SRNLJCW B25 – Ci [Ref. 5]</b>	<b>Total Ci</b>	<b>Ci%</b>	<b>Revised Total Ci</b>
H-3	0	3.01E-04	3.01E-04	0.93%	3.01E-04
C-14	0	8.90E-07	8.90E-07	0.0027%	8.90E-07
Co-60	6.77E-09	0	6.77E-09	0.000021%	
Tc-99	0	1.24E-05	1.24E-05	0.038%	1.24E-05
I-129	0	4.86E-10	4.86E-10	0.0000015%	4.86E-10
Ba-137m	0	8.12E-04	8.12E-04	2.50%	8.12E-04
Cs-137	1.54E-08	8.58E-04	8.58E-04	2.64%	8.58E-04
U-234	0	3.01E-06	3.01E-06	0.009%	3.01E-06
U-235	7.12E-08	8.82E-08	1.59E-07	0.00049%	1.59E-07
Pu-238	1.84E-03	2.74E-04	2.11E-03	6.50%	2.11E-03
Pu-239	6.80E-03	4.50E-04	7.25E-03	22.28%	7.25E-03
Pu-240	1.52E-03	0	1.52E-03	4.68%	1.52E-03
Am-241	8.88E-04	5.30E-04	1.42E-03	4.36%	1.42E-03

**Attachment 3, Page 2 of 2**

**C. Total Waste Container Activity (continued)**

<b>Nuclide</b>	<b>Absorbed Liquids + Canyon JCW – Ci (see Att 3A &amp; 3B)</b>	<b>SRNLJCW B25 – Ci [Ref. 5]</b>	<b>Total Ci</b>	<b>Ci%</b>	<b>Revised Total Ci</b>
Pu-241	1.60E-02	1.59E-03	1.76E-02	54.00%	1.76E-02
Pu-242	1.20E-07	0	1.20E-07	0.00037%	1.20E-07
Am-243	0	2.24E-06	2.24E-06	0.0069%	2.24E-06
Cm-244	0	2.10E-04	2.10E-04	0.65%	
Np-237	0	6.05E-06	6.05E-06	0.019%	6.05E-06
Sr-90	0	2.26E-04	2.26E-04	0.69%	2.26E-04
U-233	0	2.84E-06	2.84E-06	0.0087%	2.84E-06
Y-90	0	2.26E-04	2.26E-04	0.69%	
<b>TOTAL</b>	<b>2.70E-02</b>	<b>5.50E-03</b>	<b>3.25E-02</b>	<b>100.00%</b>	<b>3.21E-02</b>

**Attachment 4: Waste Container (Minimum Mass) LLW Test Package – WITS Input**

**Attachment 4, Page 1 of 3**

**Waste Package Data Report**

**For: ABSORBJCW**

6/28/2010 10:16:32 AM

Username: L0482 Date/Time: 6/28/2010 10:13:40 AM

This package is tracked in WITS as: **LLW** (Note: Some TRU waste at EATRU is tracked in WITS as LLW)

The TRU isotope concentration is low enough to classify this as Low Level Waste.

**General Info:**

Package Activity (ci)	Certification Date	Parent Container
3.2125E-02		
Dose Rate (mrihr)	Limit Deviation Number	

**Weight Info:**

Gross Weight (kg)	Gross Weight (lb)
434.50	957.90
Waste Weight (kg)	Waste Weight (lb)
151.00	332.90

**Container Info:**

Container Type Code	Description		
733	B-25 (YELLOW) 625#		
Pkg Tare Weight (kg)	Pkg Tare Weight (lb)	Container Type Tare Weight (kg)	Container Type Tare Weight (lb)
283.50	625.00	283.50	625.00
Cntnr Vol (m3)	Cntnr Vol (ft3)	Volume % Full	Waste Vol (m3)
2.5500	90.0519	100.00	2.5500

Generator Limit Check Facility	Generator Limit Check Location
EAV	ETRENCH2

**Shipment History:**

Shipment ID	Date Shipped	Date Received	Sender	Receiver
-------------	--------------	---------------	--------	----------

<b>Fissile Gram Equivalent (U235):</b>	<b>TRU Isotope Conc. (nci/g):</b>	<b>LLW Pu239 Equivalent Activity (ci) (PEC):</b>	<b>Fissile Gram Equivalent (Pu239):</b>	<b>Heat Load:</b>	<b>TRU Pu239 Equivalent Activity (ci) (PEC):</b>	<b>Pu239 Dose Equivalent Curies (DEC):</b>
2.6266E-01	8.1513E+01	1.2503E-02	1.6288E-01	1.3473E-03 (BTU/Hr) 3.9485E-04 (Watts)	1.2464E-02	1.2226E-02
These calculations based on LLW Program definitions.			<b>TRU Alpha Act (ci):</b>		These calculations based on TRU Program definitions.	
			1.2308E-02			

**Waste Streams:**

Stream ID	Version	Description
00524-LLW	2	ROUTINE WASTE FROM SRTC LABS

**Current Owner:**

773-A SRNL
------------

**Current Location\*:** \*(of overpack, if applicable)

Facility	Location	Unit
SRNL		
X:	Y:	Z:

**Inside Packages:** IP Count: 0

**Nuclide Contents:**

Nuclide	Activity (ci)
AM 241	1.420000E-03
AM 243	2.240000E-06
BA 137 M	8.120000E-04
C 14	8.900000E-07
CS 137	8.580000E-04
H 3	3.010000E-04
I 129	4.860000E-10

Attachment 4, Page 2 of 3

**Waste Package Data Report For: ABSORBJCW**

Nuclide	Activity (ci)
NP 237	6.050000E-06
PU 238	2.110000E-03
PU 239	7.250000E-03
PU 240	1.520000E-03
PU 241	1.760000E-02
PU 242	1.200000E-07
SR 90	2.260000E-04
TC 99	1.240000E-05
U 233	2.840000E-06
U 234	3.010000E-06
U 235	1.590000E-07
	3.2125E-02

**Waste Package Storage Location History:**

Date/Time of Movement*	Facility	Location	Unit
6/24/2010 3:50:53 PM	SRNL	None	None

*\*Note: This report only provides location history data gathered since implementation of WITS v3.0 on 10/1/97. Records indicating 10/1/97 may reflect package was placed in that location at any time prior to 10/1/97. Movements between facilities that do not correspond to a shipment record in the Shipment History section may be due to "Admin" shipments. Admin shipments are typically manipulations of WITS data only and DO NOT represent actual movements of the package. For inside packages this section does not show movements of the overpack.*

**Waste Cuts:**

Cut ID	Description	Waste Stream	Version	Calc Method	Date In	Contamination Level (DPM/100cm2)	Cut Wt (kg)	Activity (ci)
1	Absorbed + JCW + Routine	00524-LLW	2	CHAR BY PACK	6/24/2010	NA	151.00	3.2125E-02



**Attachment 4, Page 3 of 3**

**Waste Package Data Report For: ABSORBJCW**

<i>Characterization By Package Isotope Activities:</i>					
Cut ID	Waste Stream ID	Version	Isotope		Activity (ci)
1	00524-LLW	2	AM	241	1.4200E-03
			AM	243	2.2400E-06
			BA	137 M	8.1200E-04
			C	14	8.9000E-07
			CS	137	8.5800E-04
			H	3	3.0100E-04
			I	129	4.8600E-10
			NP	237	6.0500E-06
			PU	238	2.1100E-03
			PU	239	7.2500E-03
			PU	240	1.5200E-03
			PU	241	1.7600E-02
			PU	242	1.2000E-07
			SR	90	2.2600E-04
			TC	99	1.2400E-05
			U	233	2.8400E-06
			U	234	3.0100E-06
			U	235	1.5900E-07
<b>Total Activity (ci):</b>					<b>3.2125E-02</b>

**Attachment 5: Waste Container (Minimum Mass) LLW Test Package – WITS Limit Checks**  
**Attachment 5, Page 1 of 4**

**Generator Limit Check Report for the Destination Facility**

Manifest Number							Destination Facility	Destination Location
Package Number		Deviation Number						
ABSORBJCW							EAV	ETRENCH2
Limit ID	Limit Amount	Inventory Contribution	Package Contribution	LA - (IC + PC)	Limit Units	Limit Description	PASSED/ FAILED	
62176	5.0000E+01	0.0000E+00	2.6266E-01	4.9737E+01	CI	ET- 50 FGE PACKAGE LIMIT		
62177	1.0000E-04	0.0000E+00	8.1513E-05	1.8487E-05	CI/KG	ENGINEERED TRENCH - TRU PACKAGE		
62205	1.5000E+01	0.0000E+00	1.8966E-01	1.4810E+01	CI	DOT 15-GRAM FISSILE - ETRENCH		
64126	1.0000E-02	0.0000E+00	1.6669E-06	9.9983E-03	CI/M3	MAY BE GTCC / WIR - IF FAILED CALL HLWD LEAD		
64127	9.9000E-01	0.0000E+00	8.4893E-01	1.4107E-01	CI/KG	MAY BE GTCC / WIR - IF FAILED CALL HLWD LEAD		
64128	1.0000E+00	0.0000E+00	8.6431E-08	1.0000E+00	CI/M3	MAY BE GTCC / WIR - IF FAILED CALL HLWD LEAD		
65794	4.0000E+00	0.0000E+00	1.2503E-02	3.9875E+00	CI	ET2 Package Limit- 4 PEC		
66314	5.0000E-02	0.0000E+00	1.6149E-04	4.9839E-02	CI	5% Pkg Screening ETXPA-BG1- If Failed Call SWE		
66315	5.0000E-02	0.0000E+00	1.9742E-04	4.9803E-02	CI	5% Pkg Screening ETXPA-BG2- If Failed Call SWE		
66316	5.0000E-02	0.0000E+00	4.3547E-06	4.9996E-02	CI	5% Pkg Screening ETXPA-BG3- If Failed Call SWE		

**Attachment 5, Page 2 of 4**

Limit ID	Limit Amount	Inventory Contribution	Package Contribution	LA - (IC + PC)	Limit Units	Limit Description	PASSED/ FAILED
66317	5.0000E-02	0.0000E+00	3.4489E-05	4.9966E-02	CI	5% Pkg Screening ETXPA-Alpha1- If Failed Call SWE	
66318	5.0000E-02	0.0000E+00	2.8370E-05	4.9972E-02	CI	5% Pkg Screening ETXPA-Alpha2- If Failed Call SWE	
66319	5.0000E-02	0.0000E+00	2.4775E-05	4.9975E-02	CI	5% Pkg Screening ETXPA-Alpha3- If Failed Call SWE	
66320	5.0000E-02	0.0000E+00	1.0053E-08	5.0000E-02	CI	5% Pkg Screening ETXPA-Radium1- If Failed Call SWE	
66321	5.0000E-02	0.0000E+00	3.0227E-08	5.0000E-02	CI	5% Pkg Screening ETXPA-Radium2- If Failed Call SWE	
66322	5.0000E-02	0.0000E+00	3.3358E-08	5.0000E-02	CI	5% Pkg Screening ETXPA-Radium3- If Failed Call SWE	
66323	5.0000E-02	0.0000E+00	1.6452E-14	5.0000E-02	CI	5% Pkg Screening ETXPA-Uranium- If Failed Call SWE	
66324	5.0000E-02	0.0000E+00	9.3270E-05	4.9907E-02	CI	5% Pkg Screening ETXPA-API- If Failed Call SWE	
66325	5.0000E-02	0.0000E+00	1.1003E-04	4.9890E-02	CI	5% Pkg Screening ETXPA-AP2- If Failed Call SWE	
66326	5.0000E-02	0.0000E+00	9.1453E-05	4.9909E-02	CI	5% Pkg Screening ETXPA-AP3- If Failed Call SWE	
66327	5.0000E-02	0.0000E+00	7.8404E-08	5.0000E-02	CI	5% Pkg Screening ETXPA-Res- If Failed Call SWE	
66328	5.0000E-02	0.0000E+00	8.1085E-06	4.9992E-02	CI	5% Pkg Screening ETXPA-Drill- If Failed Call SWE	

**Attachment 5, Page 3 of 4**

Limit ID	Limit Amount	Inventory Contribution	Package Contribution	LA - (IC + PC)	Limit Units	Limit Description	PASSED/ FAILED
66329	5.0000E-02	0.0000E+00	3.0952E-11	5.0000E-02	CI	5% Pkg Screening ETXPA-Air- If Failed Call SWE	
66330	5.0000E-02	0.0000E+00	2.9311E-15	5.0000E-02	CI	5% Pkg Screening ETXPA-Radon- If Failed Call SWE	
66348	5.0000E-03	0.0000E+00	1.6149E-04	4.8385E-03	CI	0.5% Pkg Screening ETXPA-BG1- If Failed Call SWE	
66349	5.0000E-03	0.0000E+00	1.9742E-04	4.8026E-03	CI	0.5% Pkg Screening ETXPA-BG2- If Failed Call SWE	
66350	5.0000E-03	0.0000E+00	4.3547E-06	4.9956E-03	CI	0.5% Pkg Screening ETXPA-BG3- If Failed Call SWE	
66351	5.0000E-03	0.0000E+00	3.4489E-05	4.9655E-03	CI	0.5% Pkg Screening ETXPA-Alpha1- If Failed Call SW	
66352	5.0000E-03	0.0000E+00	2.8370E-05	4.9716E-03	CI	0.5% Pkg Screening ETXPA-Alpha2- If Failed Call SW	
66353	5.0000E-03	0.0000E+00	2.4775E-05	4.9752E-03	CI	0.5% Pkg Screening ETXPA-Alpha3- If Failed Call SW	
66354	5.0000E-03	0.0000E+00	1.0053E-08	5.0000E-03	CI	0.5% Pkg Screening ETXPA-Radium1- If Failed Call S	
66355	5.0000E-03	0.0000E+00	3.0227E-08	5.0000E-03	CI	0.5% Pkg Screening ETXPA-Radium2- If Failed Call S	
66356	5.0000E-03	0.0000E+00	3.3358E-08	5.0000E-03	CI	0.5% Pkg Screening ETXPA-Radium3- If Failed Call S	
66357	5.0000E-03	0.0000E+00	1.6452E-14	5.0000E-03	CI	0.5% Pkg Screening ETXPA-Uranium- If Failed Call S	

**Attachment 5, Page 4 of 4**

Limit ID	Limit Amount	Inventory Contribution	Package Contribution	LA - (IC + PC)	Limit Units	Limit Description	PASSED/ FAILED
66358	5.0000E-03	0.0000E+00	9.3270E-05	4.9067E-03	CI	0.5% Pkg Screening ETXPA-AP1- If Failed Call SWE	
66359	5.0000E-03	0.0000E+00	1.1003E-04	4.8900E-03	CI	0.5% Pkg Screening ETXPA-AP2- If Failed Call SWE	
66360	5.0000E-03	0.0000E+00	9.1453E-05	4.9085E-03	CI	0.5% Pkg Screening ETXPA-AP3- If Failed Call SWE	
66361	5.0000E-03	0.0000E+00	7.8404E-08	4.9999E-03	CI	0.5% Pkg Screening ETXPA-Res- If Failed Call SWE	
66362	5.0000E-03	0.0000E+00	8.1085E-06	4.9919E-03	CI	0.5% Pkg Screening ETXPA-Drill- If Failed Call SWE	
66363	5.0000E-03	0.0000E+00	3.0952E-11	5.0000E-03	CI	0.5% Pkg Screening ETXPA-Air- If Failed Call SWE	
66364	5.0000E-03	0.0000E+00	2.9311E-15	5.0000E-03	CI	0.5% Pkg Screening ETXPA-Radon- If Failed Call SWE	

6/28/2010 10:14:11 AM

4 of total 4

**Note:** The convention used by WITS is to indicate “Failed” Limits only; no information in the “Passed/Failed” column indicates the package passes the Limit.

**Attachment 6: HC2 SOF Calculation**

<b>Nuclide</b>	<b>Revised Total Ci (see Attach 3C)</b>	<b>HC 2 Threshold (Ci) [Ref. 6]</b>	<b>Waste Container HC2 SOF</b>
H-3	3.01E-04	3.0E+05	1.00E-09
C-14	8.90E-07	1.4E+06	6.36E-13
Tc-99	1.24E-05	3.8E+06	3.27E-12
I-129	4.86E-10	1.0E+03	4.86E-13
Ba-137m	8.12E-04	1.0E+03	8.12E-07
Cs-137	8.58E-04	8.9E+04	9.64E-09
U-234	3.01E-06	2.2E+02	1.37E-08
U-235	1.59E-07	1.5E-03	1.04E-04
Pu-238	2.11E-03	6.2E+01	3.41E-05
Pu-239	7.25E-03	2.8E+01	2.56E-04
Pu-240	1.52E-03	5.5E+01	2.77E-05
Am-241	1.42E-03	5.5E+01	2.58E-05
Pu-241	1.76E-02	2.9E+03	6.06E-06
Pu-242	1.20E-07	5.5E+01	2.18E-09
Am-243	2.24E-06	5.5E+01	4.07E-08
Np-237	6.05E-06	5.8E+01	1.04E-07
Sr-90	2.26E-04	2.2E+04	1.03E-08
U-233	2.84E-06	4.9E+00	5.81E-07
<b>TOTAL</b>	<b>3.21E-02</b>		<b>4.55E-04</b>