

Enclosure 1

**Projected Technetium-99 Inventory in Saltstone Disposal Facility
Units 2, 3, and 5**

July 2012

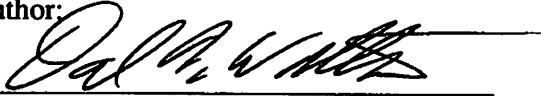
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Prepared for U.S. Department of Energy Under Contract No. DE-AC09-09SR22505

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ACRONYMS/ABBREVIATIONS

ARP	Actinide Removal Process
DSS	Decontaminated Salt Solution
DWPF	Defense Waste Processing Facility
LTAD	Low Temperature Aluminum Dissolution
MCU	Modular Caustic Side Solvent Extraction Unit
SB	Sludge Batch
SDF	Saltstone Disposal Facility
SDU	Saltstone Disposal Unit
SWPF	Salt Waste Processing Facility

1.0 INTRODUCTION

As requested in the letter from J.L. Folk to L.D. Olson, *Disposal Authorization Statement for the Savannah River Site Saltstone Facility* [WDPD-12-49], a projected inventory of Tc-99 in Saltstone Disposal Units (SDUs) 2, 3, and 5 was prepared. This estimate is based on input from multiple sources including the Liquid Waste System Plan, Revision 17. [SRR-LWP-2009-00001] The estimate evaluates two scenarios based on Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit (ARP/MCU) dilution ratios and grout to decontaminated salt solution (DSS) ratios to provide a potential range of Tc-99 curies in the SDU cells. The ARP/MCU dilution ratios ranged from 20-30 % and the grout to DSS ratios ranged from 1.6 to 1.76.

The estimate is based on both current and proposed batches for ARP/MCU and future batches processed at the Salt Waste Processing Facility (SWPF) as presented in Revision 17 of the Liquid Waste System Plan. Table 1 contains estimated Tc-99 curie inventory based on an ARP/MCU dilution ratio of 20 % and a grout to DSS ratio of 1.6. Table 2 contains estimated Tc-99 curie inventory based on an ARP/MCU dilution ratio of 30 % and a grout to DSS ratio of 1.76. These combinations provide a minimum and maximum estimate for projected Tc-99 inventory.

1.1 SDU DSS Capacity

SDU 2 is composed of two cells, A and B. At a grout to DSS ratio of 1.76, SDU 2 can accept a cumulative DSS volume of 2,580,000 gallons. [LWO-LWP-2009-00023, Rev. 3] At a grout to DSS ratio of 1.6, SDU 2 can accept a cumulative DSS volume of 2,840,000 gallons.

SDUs 3 and 5 are each composed of two cells, A and B, for a total of four cells. At a grout to DSS ratio of 1.76, SDUs 3 and 5 combined can accept a total DSS volume of 5,440,000 gallons. [LWO-LWP-2009-00023, Rev. 3] At a grout to DSS ratio of 1.6, SDUs 3 and 5 combined can accept a total DSS volume of 5,980,000 gallons.

1.2 SDU Performance Assessment Tc-99 Inventory

In the Saltstone Disposal Facility (SDF) Performance Assessment, SRR-CWDA-2009-00017, each future disposal cell in the SDF is assumed to contain 540 curies of Tc-99.

1.3 Batches

The proposed batch pre-treatment volumes presented below for ARP/MCU and SWPF are based on the Liquid Waste System Plan, Rev 17. [SRR-LWP-2009-00001]

Batch ARP/MCU B4 is currently staged in Tank 50 and is composed of salt solution from Tanks 25 and 41, Evaporator 2H concentrated liquor, and recycle from the Defense Waste Processing Facility (DWPF) stored in Tank 24. The concentration of Tc-99 ($2.67\text{E}+04$ pCi/mL) utilized in this evaluation is based on Tank 50 sample results presented in SRNL-L3100-2012-00062. Batch ARP/MCU B4 requires no ARP/MCU dilution ratio as it has been processed and is staged in Tank 50 as DSS with a volume of 1,100,000 gallons. This volume is based on an approximate Tank 50 level collected on May 1, 2012. All of Batch ARP/MCU B4 is scheduled for disposal in SDU 2, reflected in Tables 1 and 2.

The remaining batches have not undergone pre-treatment through ARP/MCU. Batch ARP/MCU B5 is currently staged in Tank 49 and estimated to have a pre-treatment volume of 1,030,000 gallons and based on sample results, a Tc-99 concentration of $2.3\text{E}+04$ pCi/mL. [X-ESR-H-00377]. This batch is composed of salt solution from Tank 41 (temporarily stored in Tank 23), Evaporator 2H concentrated liquor, sludge batch (SB)6 Low Temperature Aluminum Dissolution (LTAD) leachate in Tank 8, and DWPF recycle from in Tank 22. All of the pre-treatment volume from Batch ARP/MCU B5 is scheduled for disposal in SDU 2, reflected in Tables 1 and 2.

The remaining batches have not been built/staged at this time. Batch ARP/MCU B6 is estimated to have a pre-treatment volume of 1,060,000 gallons and a Tc-99 concentration of $2.4\text{E}+04$ pCi/mL. [SRR-LWE-2012-00130] This batch would be composed of Tank 41 and Tank 10 salt solution stored in Tank 23, Evaporator 2H concentrated liquor, SB6/SB5 LTAD leachate from Tank 8, and DWPF recycle stored in Tank 22. Based on Table 1, the cumulative volume of DSS allowable for SDU 2 will be reached when 420,000 gallons of pre-treatment volume from ARP/MCU B6 have been placed in the cells. The remaining 640,000 gallons would be scheduled for disposal in SDUs 3 and 5. Based on Table 2, the cumulative volume of DSS allowable for SDU 2 will be reached when 110,000 gallons of pre-treatment volume from ARP/MCU B6 has been placed in the cells. The remaining 950,000 gallons would be scheduled for disposal in SDUs 3 and 5.

Batch ARP/MCU B7 is estimated to have a pre-treatment volume of 1,050,000 gallons and a Tc-99 concentration of $2.4\text{E}+04$ pCi/mL. [SRR-LWE-2012-00130] This batch would be composed of Tank 41 and Tank 10 salt solution stored in Tank 23, Evaporator 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8, and DWPF recycle stored in Tank 22. All of the pre-treatment volume from Batch ARP/MCU B7 is scheduled for disposal in SDUs 3 and 5, reflected in Tables 1 and 2.

The following four batches (SWPF B1, SWPF B2, SWPF B3, SWPF B4) are shown in Revision 17 of the Liquid Waste System Plan to be treated at SWPF. For the purposes of this inventory projection, it is assumed these batches would be treated by ARP/MCU, not SWPF. Therefore, the Tc-99 concentration for these batches is assumed to be similar to that of previous ARP/MCU batches. Batch SWPF B1 is estimated to have a pre-treatment volume of 1,050,000 gallons and a Tc-99 concentration of $2.5\text{E}+04$ pCi/mL. This batch would be composed of Tank 41 and Tank 10 salt solution stored in Tank 23, Evaporator 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8, and DWPF recycle stored in Tank 22. All of the volume from Batch SWPF B1 is scheduled for disposal in SDUs 3 and 5, reflected in Tables 1 and 2.

Batch SWPF B2 is estimated to have a pre-treatment volume of 1,000,000 gallons and a Tc-99 concentration of $2.5\text{E}+04$ pCi/mL. This batch would be composed of Tank 24 supernate, Evaporator 3H concentrated liquor, and Tank 13 supernate containing Tank 14 and 15 salt dissolution. All of the volume from Batch SWPF B2 is scheduled for disposal in SDUs 3 and 5, reflected in Tables 1 and 2.

Batch SWPF B3 is estimated to have a pre-treatment volume of 1,000,000 gallons and a Tc-99 concentration of $2.5\text{E}+04$ pCi/mL. This batch would be composed of Tank 23 supernate (containing Tank 9 and 10 salt solution), Tank 13 supernate, and Tank 33 supernate stored in Tank 8. Based on Table 1, all of the DSS from Batch SWPF B3 would be sent for disposal in

SDUs 3 and 5. However, per Table 2, only 140,000 gallons of pre-treatment volume would be required to reach the combined DSS capacity for SDUs 3 and 5, based on the grout to DSS ratio.

As presented in Table 1, additional pre-treatment volume would be required from Batch SWPF B4 to reach the combined DSS capacity for SDUs 3 and 5, based on the grout to DSS ratio. Batch SWPF B4 is estimated to have a pre-treatment volume of 1,000,000 gallons and a Tc-99 concentration of 2.5E+04 pCi/mL. However, only 240,000 gallons of pre-treatment volume would be required to reach the combined DSS capacity for SDUs 3 and 5. The remaining pre-treatment volume from SWPF B4 would be sent to the next available SDU. Batch SWPF B4 would be composed of Tank 23 supernate containing Tank 38 salt solution and Tank 25 supernate/interstitial liquid/salt solution and Tank 33 supernate stored in Tank 8.

1.4 Summary of Projected Technetium-99 Inventory

Table 3 presents a summary of the projected Tc-99 inventory in SDUs 2, 3, and 5. As described in Section 1.2, the SDF Performance Assessment assumes each future disposal cell contains 540 curies of Tc-99.

The projected Tc-99 inventory in SDU 2, based on ARP/MCU dilution ratio of 20 % and a grout to DSS ratio of 1.6, would be approximately **240 curies (approximately 120 curies per cell) or 22 % of the SDF PA inventory estimate of 540 curies per cell**. The projected Tc-99 inventory in SDU 2, based on ARP/MCU dilution ratio of 30 % and a grout to DSS ratio of 1.76, would be approximately **210 curies (approximately 105 curies per cell) or 19 % of the SDF PA inventory estimate of 540 curies per cell**.

The projected Tc-99 inventory in SDUs 3 and 5, based on ARP/MCU dilution ratio of 20 % and a grout to DSS ratio of 1.6, would be approximately **470 curies (approximately 117 curies per cell) or 22 % of the SDF PA inventory estimate of 540 curies per cell**. The projected Tc-99 inventory in SDUs 3 and 5, based on ARP/MCU dilution ratio of 30 % and a grout to DSS ratio of 1.76, would be approximately **390 curies (approximately 98 curies per cell) or 18 % of the SDF PA inventory estimate of 540 curies per cell**.

**Projected Technetium-99 Inventory in
Saltstone Disposal Facility Units 2, 3, and 5**

**SRR-CWDA-2012-00095
Revision 1
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Table 1: Projected Tc-99 Curies to Saltstone Disposal Facility, ARP/MCU Dilution Ratio = 20%, Grout to DSS Ratio 1.6

Batch ¹	Content ¹	Pre-Treat Volume ¹ (kgal)	Pre-Treat. Tc-99 Conc. ² (pCi/mL)	Pre-Treat. Tc-99 Conc. (Ci/gal)	DSS Volume ³ (kgal)	DSS Tc-99 Conc. ³ (Ci/gal)	Projected Curies to SDU	SDU	SDU DSS Cumm. Volume ⁴ (kgal)	SDU Cumm. Curies	% Cumm. SDF PA Inventory (1080 per SDU) ⁵
ARP/MCU B4 (Tank 50 Current) (SRNL-L3100-2012-00062)	Tank 25/41 salt solution stored in Tank 23; 2H concentrated liquor; and DWPF recycle in Tank 24	N/A	2.67E+04	1.0E-04	1,100	1.0E-04	110	2	1,100	110	10 %
ARP/MCU B5 (X-ESR-H-00377)	Tank 41 salt solution stored in Tank 23; 2H concentrated liquor, SB6 LTAD leachate in Tank 8; and DWPF recycle in Tank 22	1,030	2.3E+04	8.7E-05	1,200	7.3E-05	88		2,300	200	19 %
ARP/MCU B6 (SRR-LWE-2012-00130)	Tank 41 & Tank 10 salt solution stored in Tank 23; 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8; and DWPF recycle in Tank 22	420 640	2.4E+04 2.4E+04	9.1E-05 9.1E-05	500 770	7.6E-05 7.6E-05	38 59		2,800 770	240 59	22 % 3 %
ARP/MCU B7 (SRR-LWE-2012-00130)	Tank 41 & Tank 10 salt solution stored in Tank 23; 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8; and DWPF recycle in Tank 22	1,050	2.4E+04	9.1E-05	1,300	7.6E-05	99	3 and 5	2,100	160	7 %
SWPF B1 (similar to ARP/MCU batches)	Tank 41 & Tank 10 salt solution stored in Tank 23; 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8 and DWPF recycle in Tank 22	1,050	2.5E+04	9.5E-05	1,300	7.9E-05	100		3,400	260	12 %
SWPF B2 (similar to ARP/MCU batches)	Tank 24 supernate (contained 3H concentrated liquor and Tank 13 supernate) and Tank 13 supernate (contained Tank 14 & 15 salt dissolution).	1,000	2.5E+04	9.5E-05	1,200	7.9E-05	95		4,600	360	17 %
SWPF B3 (similar to ARP/MCU batches)	Tank 23 supernate (contained Tank 9 and 10 salt solution and Tank 13 supernate) Tank 33 supernate stored in Tank 8	1,000	2.5E+04	9.5E-05	1,200	7.9E-05	95		5,800	460	21 %
SWPF B4 (similar to ARP/MCU batches)	Tank 23 supernate (contained Tank 38 salt solution and Tank 25 supernate/IL/salt solution) and Tank 33 supernate stored in Tank 8.	140	2.5E+04	9.5E-05	170	7.9E-05	13		6,000	470	22 %

- (1) Batch information shown from System Plan Rev. 17. [SRR-LWP-2009-00001] Based on anticipated SWPF start date, listed SWPF batches likely to be ARP/MCU batches and source tanks may differ from those shown. Tc-99 concentrations for SWPF batches are assumed to be similar to other ARP/MCU batches.
- (2) Tc-99 Concentration value from source listed in first column
- (3) Decontaminated Salt Solution (DSS) volumes based on ARP/MCU dilution factor of 20 %. [X-ESR-S-00057] No decontamination factor assumed for Tc-99. ARP/MCU B4: Volume = Approximate Tank 50 Volume 5/1/2012; Tc-99 conc. per SRNL-L3100-2012-00062, no dilution adjustment necessary.
- (4) Allowable DSS volume for SDU 2 (2-cells total) = 2,580,000 gallons. DSS volume for SDUs 3 and 5 combined (4-cells total) = 5,440,000 gallons. Grout to DSS ratio of 1.76 assumed. [LWO-LWP-2009-00023, R3] At Grout to DSS ratio of 1.6: SDU 2 = 2,840,000 gallons, SDU 3 and 5 combined = 5,980,000 gallons.
- (5) SDF Performance Assessment: Tc-99 curies per future disposal cell (FDC) = 540. Therefore, SDU 2 (2-cells) = 1,080 curies, SDUs 3 and 5 combined (4-cells) = 2,160 curies. [SRR-CWDA-2009-00017]

**Projected Technetium-99 Inventory in
Saltstone Disposal Facility Units 2, 3, and 5**

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Table 2: Projected Tc-99 Curies to Saltstone Disposal Facility, ARP/MCU Dilution Ratio = 30%, Grout to DSS Ratio 1.76

Batch ¹	Content ¹	Pre-Treat Volume ¹ (kgal)	Pre-Treat. Tc-99 Conc. ² (pCi/mL)	Pre-Treat. Tc-99 Conc. (Ci/gal)	DSS Volume ³ (kgal)	DSS Tc-99 Conc. ³ (Ci/gal)	Projected Curies to SDU	SDU	SDU DSS Cumm. Volume ⁴ (kgal)	SDU Cumm. Curies	% Cumm. SDF PA Inventory (1080 per SDU) ⁵
ARP/MCU B4 (Tank 50 Current) (SRNL-L3100-2012-00062)	Tank 25/41 salt solution stored in Tank 23; 2H concentrated liquor; and DWPF recycle in Tank 24	N/A	2.67E+04	1.0E-04	1,100	1.0E-04	110	2	1,100	110	10 %
ARP/MCU B5 (X-ESR-H-00377)	Tank 41 salt solution stored in Tank 23; 2H concentrated liquor, SB6 LTAD leachate in Tank 8; and DWPF recycle in Tank 22	1030	2.3E+04	8.7E-05	1,300	6.7E-05	87		2,400	200	19 %
ARP/MCU B6 (SRR-LWE-2012-00130)	Tank 41 & Tank 10 salt solution stored in Tank 23; 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8; and DWPF recycle in Tank 22	110 950	2.4E+04 2.4E+04	9.1E-05 9.1E-05	140 1,200	7.0E-05 7.0E-05	10 84		2,500	210	19 %
ARP/MCU B7 (SRR-LWE-2012-00130)	Tank 41 & Tank 10 salt solution stored in Tank 23; 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8; and DWPF recycle in Tank 22	1050	2.4E+04	9.1E-05	1,400	7.0E-05	98	3 and 5	1,200	84	4 %
SWPF B1 (similar to ARP/MCU batches)	Tank 41 & Tank 10 salt solution stored in Tank 23; 2H concentrated liquor, SB6/SB5 LTAD leachate in Tank 8 and DWPF recycle in Tank 22	1050	2.5E+04	9.5E-05	1,400	7.3E-05	100		2,600	180	8 %
SWPF B2 (similar to ARP/MCU batches)	Tank 24 supernate (contained 3H concentrated liquor and Tank 13 supernate) and Tank 13 supernate (contained Tank 14 & 15 salt dissolution).	1000	2.5E+04	9.5E-05	1,300	7.3E-05	95		4,000	280	13 %
SWPF B3 (similar to ARP/MCU batches)	Tank 23 supernate (contained Tank 9 and 10 salt solution and Tank 13 supernate) Tank 33 supernate stored in Tank 8	140	2.5E+04	9.5E-05	180	7.3E-05	13		5,300	380	18 %
									5,500	390	18 %

(1) Batch information shown from System Plan Rev. 17. [SRR-LWP-2009-00001] Based on anticipated SWPF start date, listed SWPF batches likely to be ARP/MCU batches and source tanks may differ from those shown. Tc-99 concentrations for SWPF batches are assumed to be similar to other ARP/MCU batches.

(2) Tc-99 Concentration value from source listed in first column

(3) Decontaminated Salt Solution (DSS) volumes based on ARP/MCU dilution factor of 30 %. [X-ESR-S-00057] No decontamination factor assumed for Tc-99. ARP/MCU B4: Volume = Approximate Tank 50 Volume 5/1/2012; Tc-99 conc. per SRNL-L3100-2012-00062, no dilution adjustment necessary.

(4) Allowable DSS volume for SDU 2 (2-cells total) = 2,580,000 gallons. DSS volume for SDUs 3 and 5 combined (4-cells total) = 5,440,000 gallons. Grout to DSS ratio of 1.76 assumed. (LWO-LWP-2009-00023, R3) At Grout to DSS ratio of 1.6: SDU 2 = 2,840,000 gallons, SDUs 3 and 5 combined = 5,980,000 gallons.

(5) SDF Performance Assessment: Tc-99 curies per future disposal cell (FDC) = 540, Therefore, SDU 2 (2-cells) = 1,080 curies, SDUs 3 and 5 combined (4-cells) = 2,160 curies. [SRR-CWDA-2009-00017]

Table 3: Summary of Projected Tc-99 Curies to SDUs 2, 3, and 5

Batch ¹	SDU	ARP/MCU Dilution Ratio = 20 %, Grout to DSS Ratio 1.6			ARP/MCU Dilution Ratio = 30 %, Grout to DSS Ratio 1.76		
		SDU DSS Cumulative Volume ² (kgal)	SDU Cumulative Curies	% Cumulative SDF PA Inventory (1080 per SDU) ³	SDU DSS Cumulative Volume ² (kgal)	SDU Cumulative Curies	% Cumulative SDF PA Inventory (1080 per SDU) ³
ARP/MCU B4 (Tank 50 Current)	2	1,100	110	10%	1,100	110	10%
ARP/MCU B5		2,300	200	19%	2,400	200	19%
ARP/MCU B6		2,800	240	22%	2,500	210	19%
ARP/MCU B7	3 and 5	770	59	3%	1,200	84	4%
SWPF B1		2,100	160	7%	2,600	180	8%
SWPF B2		3,400	260	12%	4,000	280	13%
SWPF B3		4,600	360	17%	5,300	380	18%
SWPF B4		5,800	460	21%	5,500	390	18%
		6,000	470	22%	N/A	N/A	N/A

- (1) Batch information shown from System Plan Rev. 17. [SRR-LWP-2009-00001] Based on anticipated SWPF start date, listed SWPF batches likely to be ARP/MCU batches and source tanks may differ from those shown. Tc-99 concentrations for SWPF batches are assumed to be similar to other ARP/MCU batches.
- (2) Allowable DSS volume for SDU 2 (2-cells total) = 2,580,000 gallons. DSS volume for SDU 3 and 5 combined (4-cells total) = 5,440,000 gallons. Grout to DSS ratio of 1.76 assumed. [LWO-LWP-2009-00023, R3] At Grout to DSS ratio of 1.6: SDU 2 = 2,840,000 gallons, SDUs 3 and 5 combined = 5,980,000 gallons.
- (3) SDF Performance Assessment: Tc-99 curies per future disposal cell (FDC) = 540, Therefore, SDU 2 (2-cells) = 1,080 curies, SDUs 3 and 5 combined (4-cells) = 2,160 curies. [SRR-CWDA-2009-00017]

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