Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

JUL 1 2 2012

Mr. Mark A. Satorius, Director
Office of Federal and State Materials
and Environmental Management Programs
U.S. Nuclear Regulatory Commission
11545 Rockville Pike, Mail Stop T8F5
Rockville, MD 20852-2738

Dear Mr. Satorius:

SUBJECT: Letter of Concern (Type IV) Regarding US Department of Energy Disposal Activities at the Savannah River Site Saltstone Disposal Facility (Your Letter dated April 30, 2012)

References: 1) Technical Evaluation Report for the 2009 Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site (Letter, Camper to Gilbertson dated 4/30/12)
2) Transmittal of Updated Saltstone Disposal Facility (SDF) Information Developed since August 2011 (Letter, Spears to Camper dated 6/13/12)

This letter provides additional information in response to the subject Letter of Concern related to disposal operations at the Savannah River Site Saltstone Disposal Facility (SDF) and the accompanying Technical Evaluation Report (Reference 1). The Department of Energy (DOE) is carefully considering the Nuclear Regulatory Commission (NRC) observations, and appreciates NRC's review of DOE's *Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site* dated October 2009 (SDF PA). Disposal operations are scheduled to resume in SDF later this fiscal year (FY), beginning with Saltstone Disposal Unit (SDU) 2 in August 2012. After filling SDU 2, operations in SDU 3 and 5 are anticipated to occur through FY 2015.

Enclosure 1 is an updated technetium-99 inventory projection for SDUs 2, 3, and 5. These projections reflect the current salt waste batching, treatment, and disposal plans for these three SDUs. Enclosure 1 indicates much lower technetium-99 inventories will be placed in SDUs 2, 3, and 5 than DOE previously assumed and evaluated in the SDF PA. Enclosure 2 provides sensitivity analyses based on Enclosure 1 projected inventory for SDUs 2, 3, and 5; as well as inventories in Vaults 1 and 4 for the SDF performance assessment sensitivity cases designated as Cases K and K1 utilizing the enhanced GoldSim model provided to NRC with Reference 2. These analyses, along with the SDF PA base case and other sensitivity analyses were performed by DOE, as part of DOE's performance assessment maintenance under DOE Manual 435.1-1, pursuant to DOE's Atomic Energy Act responsibilities. The May 22, 2012 DOE Transmittal letter for the Disposal Authorization Statement for the Savannah River Site Saltstone Disposal Facility (including its enclosure and attachments), was prepared as part of the Department's internal procedures consistent with DOE Manual 435.1-1 and is publicly available at the website location http://www.em.doe.gov/stakepages/wmdi_swd_orig.aspx?PAGEID=WMDI. DOE is submitting Enclosure 2 Cases K and K1, sensitivity analyses based on NRC's Technical Evaluation Report and Letter of Concern, irrespective of DOE's decision making process described in the Disposal Authorization Statement. DOE is confident that based on this information, the NRC, in coordination with the State of South Carolina, will conclude reasonable assurance that DOE's disposal operations at SDF through FY 2015 will be compliant with the public dose performance objective in 10 CFR Part 61.41, in accordance with Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005.

DOE will provide further information in response to the Technical Evaluation Report (Reference 1). The additional response, which DOE anticipates completing by the end of this month, will identify DOE's planned approach and path forward to fully address the Technical Evaluation Report and the subject Letter of Concern for all disposal actions planned at SDF beyond FY 2015. As explained in the May 22, 2012 Disposal Authorization Statement for the Savannah River Site Saltstone Disposal facility, DOE will not proceed with disposal operations in SDU 2 until after this latter transmittal.

DOE looks forward to continuing discussions with NRC pertaining to SDF operations and is scheduling a public meeting on August 6, 2012 in Aiken, SC. At this public meeting, DOE recommends detailed technical discussions between our staffs related to the information contained in Reference 2 and this transmittal.

If you have any questions regarding this letter, please call me at (803) 208-6072, Ms. Sherri Ross at (803) 208-6078, or Ms. Patricia Suggs at (803) 208-6804.

Sincerely,

Terrel J. Spears
Assistant Manager
Waste Disposition Project

WDPD-12-62

Enclosures:
1) Projected Tc-99 Inventory in SDU 2, 3, and 5
2) Sensitivity Analysis for Disposal Operations into SDF Vault 1, Vault 4, and SDUs 2, 3, and 5

cc:
Nishka Devaser, NRC (w/ Enclosures)
Shelly Wilson, SCDHEC (w/ Enclosures)

Enclosure 1

SRR-CWDA-2012-00095
Revision 1

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

July 2012

Prepared by: Savannah River Remediation LLC
Closure and Waste Disposal Authority
Aiken, SC 29808

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

APPROVALS

Author:

David R. Watkins
Closure and Waste Disposal Authority
Savannah River Remediation LLC

7/10/12
Date

Technical Review:

W. Ben Dean
Closure and Waste Disposal Authority
Savannah River Remediation LLC
Design Verification Method: Document Review

7/10/12
Date

Review:

Larry B. Romanowski
Closure and Waste Disposal Authority
Savannah River Remediation LLC

7/10/12
Date

Management Review:

Kent H. Rosenberger
Closure and Waste Disposal Authority
Savannah River Remediation LLC

7/10/2012
Date

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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 (2.67E+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 2.3E+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 2.4E+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 2.4E+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 2.5E+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 2.5E+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 2.5E+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.**

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	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	2.4E+04	9.1E-05	500	7.6E-05	38	2	2,800	240	22 %
		640	2.4E+04	9.1E-05	770	7.6E-05	59	3 and 5	770	59	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 and 5	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	3 and 5	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	3 and 5	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	3 and 5	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]

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	**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**	**2.4E+04**	**9.1E-05**	**140**	**7.0E-05**	**10**	2	**2,500**	**210**	**19 %**
		950	2.4E+04	9.1E-05	1,200	7.0E-05	84	3 and 5	1,200	84	4 %
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	2,600	180	8 %
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	3 and 5	4,000	280	13 %
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	3 and 5	5,300	380	18 %
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	3 and 5	**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	2,300	200	19%	2,400	200	19%
ARP/MCU B6	2	**2,800**	**240**	**22%**	**2,500**	**210**	**19%**
ARP/MCU B6	3 and 5	770	59	3%	1,200	84	4%
ARP/MCU B7	3 and 5	2,100	160	7%	2,600	180	8%
SWPF B1	3 and 5	3,400	260	12%	4,000	280	13%
SWPF B2	3 and 5	4,600	360	17%	5,300	380	18%
SWPF B3	3 and 5	5,800	460	21%	**5,500**	**390**	**18%**
SWPF B4	3 and 5	**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]

2.0 REFERENCES

LWO-LWP-2009-00023, *Saltstone Disposal Facility Saltstone Disposal Unit Need Date*, Savannah River Site, Aiken, SC, Rev. 3, June 8, 2011.

SRNL-L3100-2012-00062, *Results for the First Quarter 2012 Tank 50 WAC Slurry Sample: Tc-99,* Savannah River Site, Aiken, SC, May 1, 2012.

SRR-CWDA-2009-00017, *Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site,* Savannah River Site, Aiken, SC, Rev. 0, October 29, 2009.

SRR-LWP-2009-00001, *Liquid Waste System Plan,* Savannah River Site, Aiken, SC, Rev. 17, February 2012.

WDPD-12-49, Folk, J.L., *Disposal Authorization Statement for the Savannah River Site Saltstone Facility,* U.S. DOE Savannah River Office, Aiken, SC, May 22, 2012.

SRR-LWE-2012-00130, Campbell, S.E., *Estimated Technetium-99 Concentration for Salt Batches 6 and 7*, Savannah River Site, Aiken, SC, July 10, 2012.

X-ESR-H-00377, *Evaluation of ISDP Batch 5 Qualification Compliance to 512-S, DWPF, Tank Farm, and Saltstone Waste Acceptance Criteria,* Savannah River Site, Aiken, SC, Rev. 0, April 26, 2012.

X-ESR-S-00057, *Evaluation of Interim Salt Disposition Project (ISDP) Macrobatch Dilution Bases Experienced at Actinide Removal Process and Modular Caustic Side Solvent Extraction Unit (ARP/MCU),* Savannah River Site, Aiken, SC, Rev. 0, April 26, 2012.

Enclosure 2

SRR-CWDA-2012-00103
Revision 1

Sensitivity Analysis for Disposal Operations into Saltstone Disposal Facility Vault 1, Vault 4, and SDUs 2, 3 and 5

July 2012

Prepared by: Savannah River Remediation LLC
Closure and Waste Disposal Authority
Aiken, SC 29808

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

APPROVALS

Author:

Richard E. Sheppard
Closure and Waste Disposal Authority
Savannah River Remediation LLC

7/10/2012
Date

Technical Review:

Steven P. Hommel
Closure and Waste Disposal Authority
Savannah River Remediation LLC
Design Verification Method: Procedure S-4 ENG. 51

7/10/2012
Date

Management Review:

Kent H. Rosenberger
Closure and Waste Disposal Authority
Savannah River Remediation LLC

7/11/2012
Date

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ACRONYMS/ABBREVIATIONS

CFR	Code of Federal Regulations
DAS	Disposal Authorization Statement
MOP	Member of the Public
NRC	Nuclear Regulatory Commission
PA	Performance Assessment
RAI	Request for Additional Information
SDF	Saltstone Disposal Facility
SDU	Saltstone Disposal Unit
SRS	Savannah River Site
TER	Technical Evaluation Report

EXECUTIVE SUMMARY

As directed in the Disposal Authorization Statement (DAS) transmittal letter for the Savannah River Site (SRS) Saltstone Disposal Facility (SDF), dated May 22, 2012 (WDPD-12-49), a sensitivity analysis has been conducted to provide additional information on potential doses to a future member of the public (MOP) living near (i.e., 100 meters from) the closed SDF. This sensitivity analysis evaluates near-term disposal actions for SDF Vaults 1 and 4 and Saltstone Disposal Units (SDUs) 2, 3 and 5.

As specified in the subject transmittal letter this sensitivity analysis was based on:

1. The Case K model parameters presented in the response to the U.S. Nuclear Regulatory Commission (NRC) Request for Addition Information (RAI) PA-8 provided in SRR-CWDA-2011-00044, Rev. 1, and
2. The Tc-99 inventory in SDUs 2, 3 and 5 that reflects the expected Tc-99 concentration in salt solution to be processed during the filling of these six disposal cells. [SRR-CWDA-2012-00095]

Two sensitivity cases were evaluated. The first sensitivity case (SC-1) used the model parameters for Case K, except for inventory, presented in the response to RAI PA-8 provided in SRR-CWDA-2011-00044, Rev. 1. The inventories in this analysis for Vaults 1 and 4 were based on the current inventories, as provided in SRR-CWDA-2012-00002 (for Vault 1) and in SRR-CWDA-2012-00067 (for Vault 4), decayed to October 1, 2030. The inventories used for SDUs 2, 3, and 5 were consistent with the projected inventories described in the response to RAI PA-8, with the exception of Tc-99. For Tc-99, the projected inventories in each of the six disposal cells was 119 curies (22% of the 540 curies projected for each of these SDUs for Case K). These Tc-99 inventories for SDUs 2, 3 and 5 are conservative based on the information presented in SRR-CWDA-2012-00095. For this sensitivity case, the technetium distribution coefficient (K_d) values for cementitious materials were, as discussed in the response to RAI PA-8, 1,000 mL/g for saltstone and concrete in Reducing Region II, 10 mL/g for saltstone in Oxidizing Region II, and 0.8 mL/g for concrete in Oxidizing Region II.

The second sensitivity case (SC-2) used the same model parameters and inventory projections used in SC-1, except that the K_d values for technetium reflected the assumed values for Case K1 presented in the response to RAI SP-19, as provided in SRR-CWDA-2011-00044, Rev. 1. That is, 500 mL/g in Reducing Region II and 0.8 mL/g in Oxidizing Region II for both saltstone and concrete.

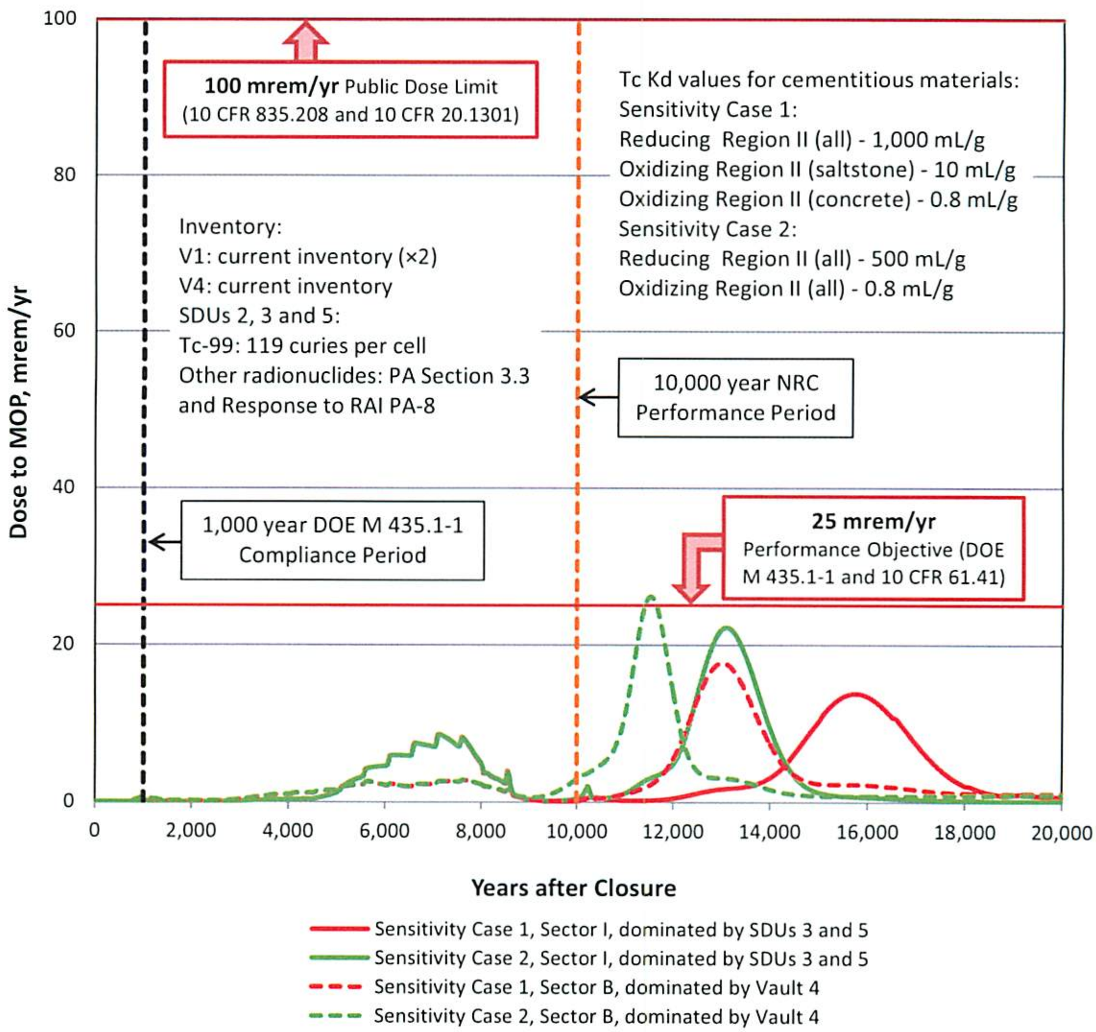
These sensitivity cases were evaluated using the SDF Stochastic Fate and Transport Model (version 3.002) developed for Case K, as described in SRR-CWDA-2011-00178. This GoldSim model tends to over-predict the peak calculated dose; thus reported peak dose results are expected to be lower if the aquifer concentrations are computed using PORFLOW (ACRi-2008). In addition, although the NRC has questions about modeling parameters for Case K and Case K1 in their Technical Evaluation Report (TER) specifically related to the treatment of technetium retention in the disposal cell floors (ML121020140), any changes that lead to an earlier peak dose timing from technetium would tend to decrease the magnitude of such peak.

Table ES-1 presents the peak dose to the MOP for both SC-1 and SC-2 within 1,000 years, 10,000 years, and 100,000 years after SDF closure. Figure ES-1 illustrates the dose profile to the MOP for SC-1 and SC-2 out to 20,000 years after SDF closure, for SDF Vaults 1 and 4 and SDUs 2, 3 and 5.

Table ES-1: Peak Dose to the MOP Using GoldSim Model v3.002

Time Period after Closure	Sensitivity Case 1	Sensitivity Case 2
0 - 1,000 Years	0.55 mrem/year (at 990 years)	0.57 mrem/year (at 1,000 years)
0 - 10,000 Years	8.7 mrem/year (at 7,120 years)	8.6 mrem/year (at 7,140 years)
0 - 100,000 Years	17 mrem/year (at 13,020 years)	26 mrem/year (at 11,540 years)

Figure ES-1: Dose to the MOP from Vaults 1 and 4 and SDUs 2, 3 and 5 Using GoldSim Model v3.002



1.0 INTRODUCTION

As directed in the DAS transmittal letter for the SRS SDF, dated May 22, 2012 (WDPD-12-49), a sensitivity analysis has been conducted to provide additional information on potential doses to a future MOP living near (i.e., 100 meters from) the closed SDF. This sensitivity analysis evaluates near-term disposal actions for SDF Vaults 1 and 4 and SDUs 2, 3 and 5.

As specified in the subject transmittal letter this sensitivity analysis was based on:

1. The Case K model parameters presented in the response to the U.S. Nuclear Regulatory Commission (NRC) Request for Addition Information (RAI) PA-8 provided in SRR-CWDA-2011-00044, Rev. 1, and
2. The Tc-99 inventory in SDUs 2, 3 and 5 that reflects the expected Tc-99 concentration in salt solution to be processed during the filling of these six disposal cells. [SRR-CWDA-2012-00095]

As described in more detail in the response to RAI PA-8, Case K was developed to provide additional information regarding the release of radionuclides when select barriers of concern were degraded simultaneously. In summary, the hydraulic properties of all cementitious material (saltstone and concrete) are degraded within 10,000 years after closure to reflect hydraulic properties associated with soil. The release of Tc-99 is based on an "average K_d" model that considers the growth of fractures within saltstone and concrete such that within 10,000 years after closure the spacing between fractures is ten centimeters. In this technetium release model the diffusion of oxygen starting at the surface of each fracture causes oxidation within the intact saltstone or concrete matrix and a time-dependent average K_d value is developed for saltstone and the concrete. This fracturing model was developed to address questions raised by the NRC regarding potential cracking in the saltstone and concrete. These are a few of the key parameters of Case K with all of the parameters described in detail in the response to RAI PA-8. [SRR-CWDA-2011-00044, Rev. 1]

In addition:

1. The dose pathway calculations have been updated to reflect an NRC TER comment on the leaching factor that impacts the uptake of radionuclides in vegetation. In the response to RAI B-3, provided in SRR-CWDA-2011-00044, Rev. 1, a soil buildup factor to account for the buildup of radionuclides in the soil from irrigation was developed that included a leaching factor. A comment by the NRC in the TER (ML121020140), Section 2.10.3.2 (page 145), was investigated. The investigation of the dose model verified that the fraction of time for irrigation (0.2 on an annual basis) was not included in the leaching factor. Not including this annual fraction for irrigation could dilute the buildup of radionuclides in the soil. This sensitivity analysis applies the fraction of time for irrigation to the soil buildup factor.

2. Two sensitivity cases were conducted to evaluate the impact of different distribution coefficients (K_d values) for technetium. The first sensitivity case, SC-1, used the K_d values presented in the Case K analysis presented in the response to RAI PA-8. The second sensitivity case, SC-2, used the K_d values associated with the evaluation identified as Case K1 in the response to RAI SP-19.

This sensitivity analysis was conducted using the updated SDF Stochastic Fate and Transport Model, version 3.002, described in SRR-CWDA-2011-00178, but modified to include a revised soil buildup factor used in the dose pathway calculations described above.

2.0 DESCRIPTION OF THE SENSITIVITY ANALYSIS

This sensitivity analysis utilizes the Case K model parameters presented in the response to RAI PA-8 as a starting point. The details of Case K were presented in the response to RAI PA-8 provided in SRR-CWDA-2011-00044, Rev. 1. Below is a brief summary of the pertinent assumptions of the Case K model modified for this sensitivity analysis, namely the inventory and the use of the SDF Stochastic Fate and Transport Model version 3.002.

2.1 Inventory

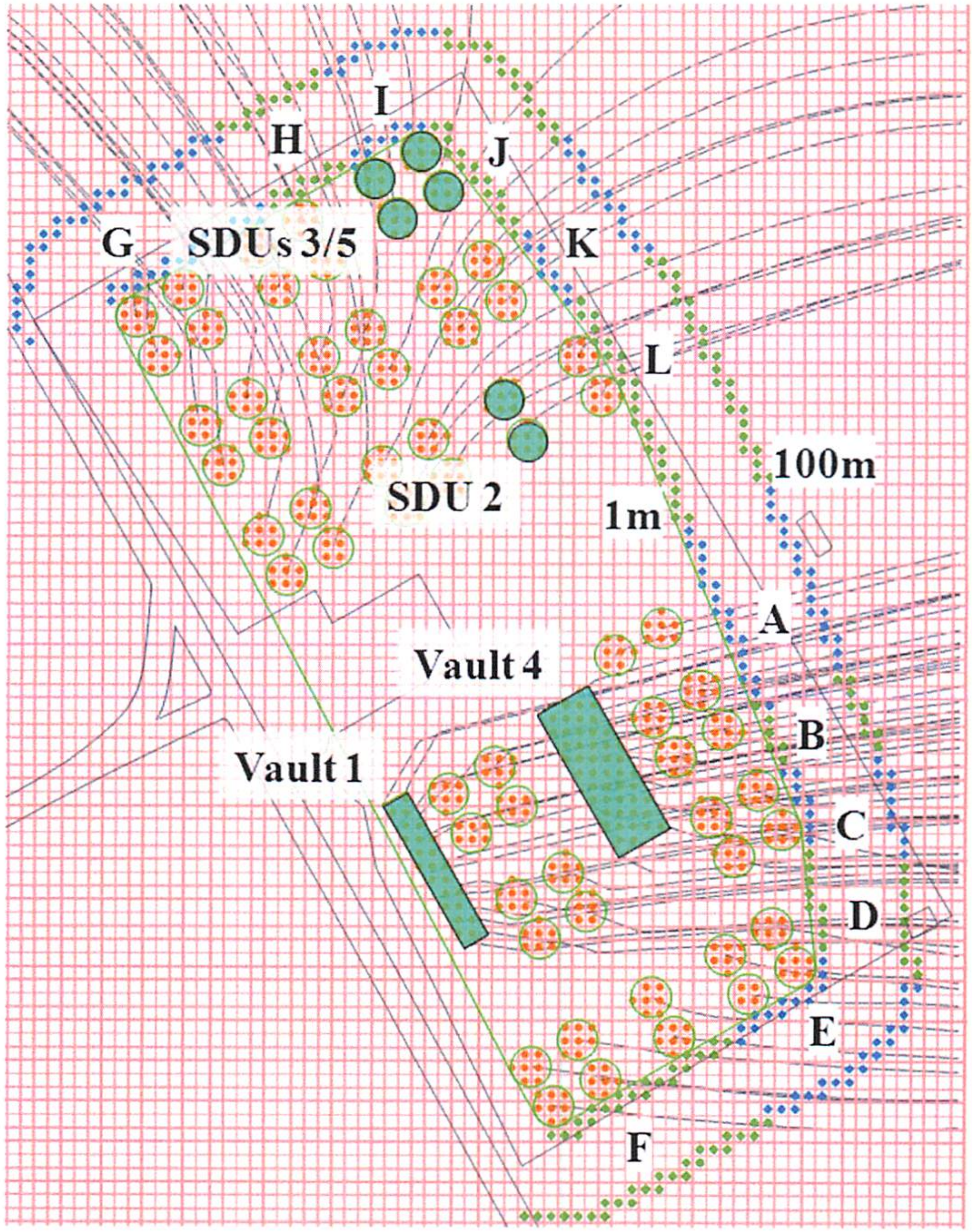
The radionuclide inventory reported in the SDF Performance Assessment (PA) (SRR-CWDA-2009-00017), and modified for Case K, as described in the response to RAI PA-8, was revised for this sensitivity analysis.

For Vaults 1 and 4 the current inventories, decayed to October 2030, were used rather than the projected inventories reported in SDF PA Tables 3.3-1 and 3.3-3. Note that for Vault 4 the inventories projected in SDF PA Table 3.3-3 was modified in Case K for Ra-226, Th-230, U-234, and Pu-238. The Vault 1 inventories, as of September 30, 2011, reported in SRR-CWDA-2012-00002, was increased by a factor of two to account for potential future additions. The Vault 4 inventories, as of March 31, 2012, was reported in SRR-CWDA-2012-00067.

For the SDUs, the projected inventories presented in SDF PA Table 3.3-5 and modified in Case K (1.3E-4 curie for Th-230 and 1.3E-5 curie for Ra-226) have not been changed except for the inventories of Tc-99. For Tc-99, an analysis was conducted to estimate the amount of Tc-99 that would be disposed in disposal cells 2A/B, 3A/B, and 5A/B, given the current salt waste batching strategy. [SRR-CWDA-2012-00095] Based on this analysis, the average Tc-99 inventory in the six disposal cells was estimated to be between 18% and 22% of the projected individual cell Tc-99 inventory of 540 curies reported in SDF PA Table 3.3-5. For this sensitivity analysis, each of the six disposal cells was assumed to contain 22% of the projected Tc-99 inventory reported in SDF PA Table 3.3-5 (540 curies), or 119 curies per disposal cell.

Figure 2.2-1 shows the location of Vaults 1 and 4, and SDUs 2, 3 and 5 with respect to the modeled sectors. The figure illustrates why Sector B is dominated by releases from Vault 4 and Sector I is dominated by releases from SDUs 3 and 5.

Figure 2.2-1: Location of SDF Disposal Units Evaluated in this Sensitivity Analysis



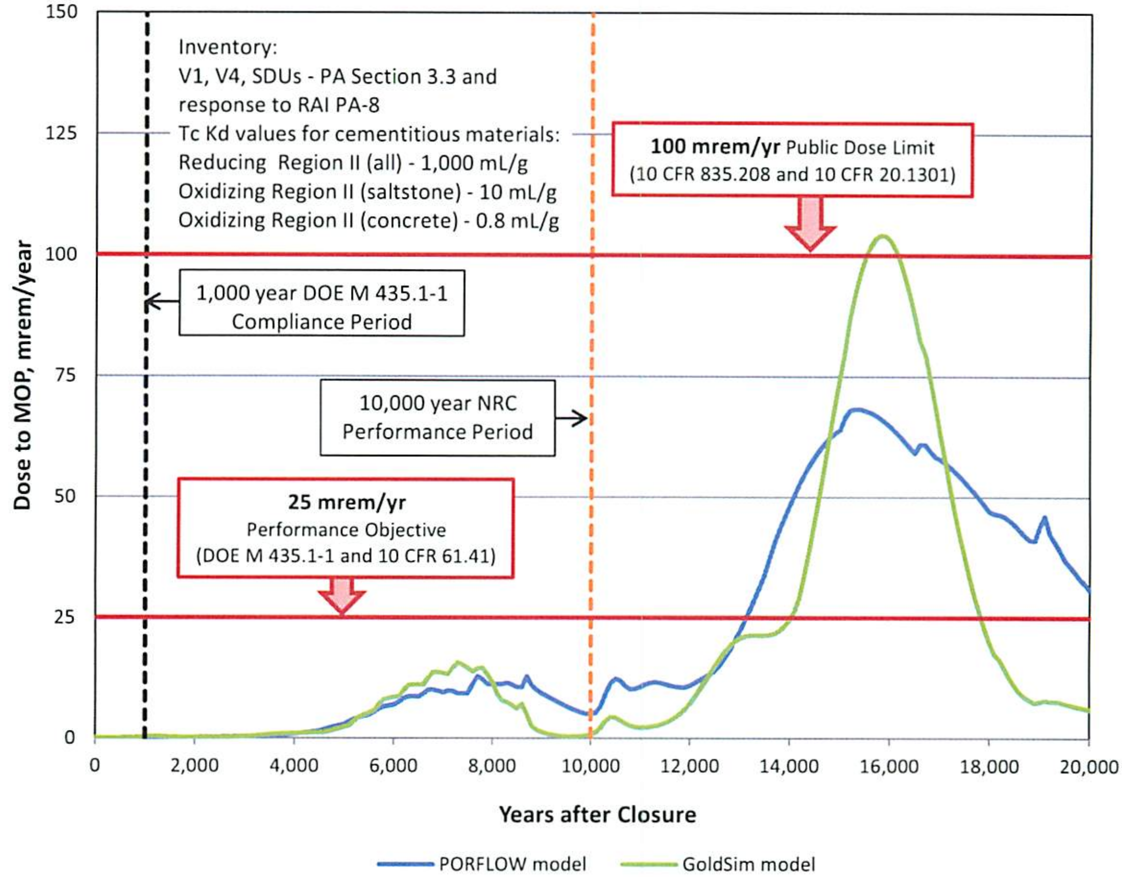
2.2 Use of SDF Stochastic Fate and Transport Model v3.002

To establish a baseline for SC-1, the Case K analysis results presented in the response to RAI PA-8, using the inventory discussed in the response to RAI PA-8, were updated using the GoldSim dose calculator (from the SDF Stochastic Fate and Transport Model v3.002) with the Case K aquifer concentrations computed using PORFLOW incorporating the soil buildup factor modification described in Section 1.0. The SDF Stochastic Fate and Transport Model v3.002 was also run with the inventory discussed in the response to RAI PA-8. These model runs provide a comparison between the two Case K models (PORFLOW versus GoldSim) for all disposal units. Table 2.2-1 presents the results from these two model runs. Figure 2.2-2 illustrates that the dose peaks are greater from the GoldSim model than from the PORFLOW model for a 20,000-year, post-closure period. Thus, the GoldSim transport model tends to over-predict the estimated peak dose to the MOP for SC-1.

Table 2.2-1: Peak Dose to MOP for Updated Case K

Model Used	Peak Dose in 1,000 Years	Peak Dose in 10,000 Years
PORFLOW	0.2 mrem/year @ Year 1,000	13 mrem/year @ Year 7,700
GoldSim	0.3 mrem/year @ Year 1,000	16 mrem/year @ Year 7,300

Figure 2.2-2: Comparison of the Case K Dose Results (PORFLOW versus GoldSim) Using Updated Dose Methodology

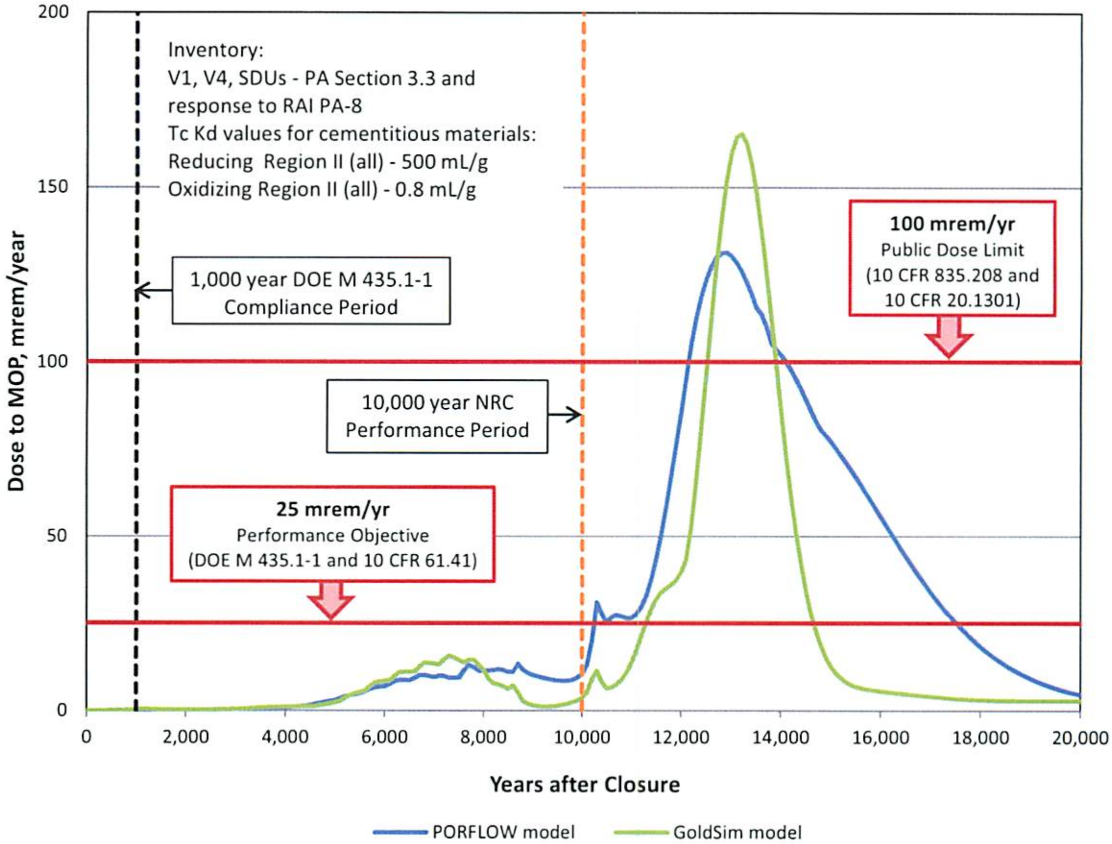


Similarly, to establish a baseline for SC-2, the Case K1 analysis results presented in the response to RAI SP-19, using the inventory discussed in the response to RAI PA-8, were updated using the GoldSim dose calculator (from the SDF Stochastic Fate and Transport Model v3.002) with Case K1 aquifer concentrations computed using PORFLOW. The SDF Stochastic Fate and Transport Model v3.002 was also run with the inventory discussed in the response to RAI PA-8. These model runs provide a comparison between the two Case K1 models (PORFLOW versus GoldSim). Table 2.2-2 presents the results from these two model runs. Figure 2.2-3 illustrates the differences between the two models. The dose peaks are greater from the GoldSim model than from the PORFLOW model for a 20,000-year, post-closure period. Thus, the GoldSim transport model would tend to over-predict the estimated peak dose to the MOP for SC-2.

Table 2.2-2: Peak Dose to MOP for Updated Case K1

Model Used	Peak Dose in 1,000 Years	Peak Dose in 10,000 Years
PORFLOW	0.2 mrem/year @ Year 1,000	14 mrem/year @ Year 8,700
GoldSim	0.3 mrem/year @ Year 1,000	16 mrem/year @ Year 7,300

Figure 2.2-3: Comparison of the Case K1 Dose Results (PORFLOW versus GoldSim) Using Updated Dose Methodology



3.0 SENSITIVITY ANALYSIS RESULTS

The SDF Stochastic Fate and Transport Model v3.002 (developed with GoldSim) is used to assess the impact to the MOP dose for sensitivity cases, SC-1 and SC-2. As discussed in Section 1.0, the use of the GoldSim model and treatment of technetium retention in the disposal cell floor tend to increase the modeled peak dose.

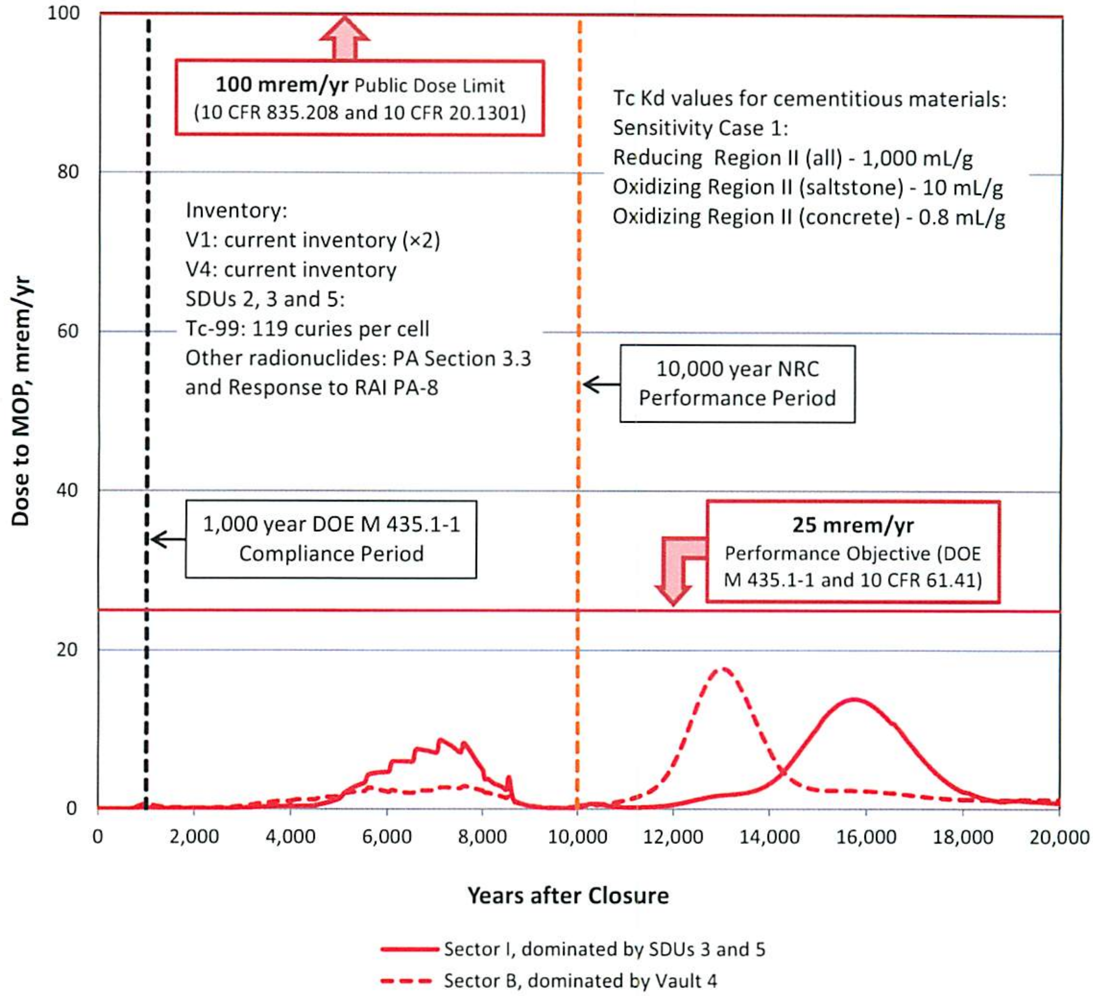
3.1 Sensitivity Case 1

Table 3.1-1 presents the peak dose to the MOP within a 1,000-year,10,000-year, and 100,000-year period after SDF closure for SC-1. As presented in Table 3.1-1, the estimated dose to the MOP does not exceed the performance objective. Figure 3.1-1 illustrates the dose to the MOP, for SC-1, in Sector B (dominated by the release from Vault 4) and Sector I (dominated by the release from SDUs 3 and 5). As indicated in Figure 3.1-1, the peak dose to the MOP based on the current inventory in Vaults 1 and 4 and the revised projected inventory in SDUs 2, 3 and 5 is less than the 25 mrem/year performance objective.

Table 3.1-1: Peak Dose to MOP for SC-1 (Vaults 1 and 4 and SDUs 2, 3 and 5 Only)

Time Period after Closure	Sensitivity Case 1
0 - 1,000 Years	0.55 mrem/year (at 990 years)
0 - 10,000 Years	8.7 mrem/year (at 7,120 years)
0 - 100,000 Years	17 mrem/year (at 13,020 years)

Figure 3.1-1: Dose to MOP for SC-1 Using GoldSim Model v3.002 (Vaults 1 and 4 and SDUs 2, 3 and 5 Only)



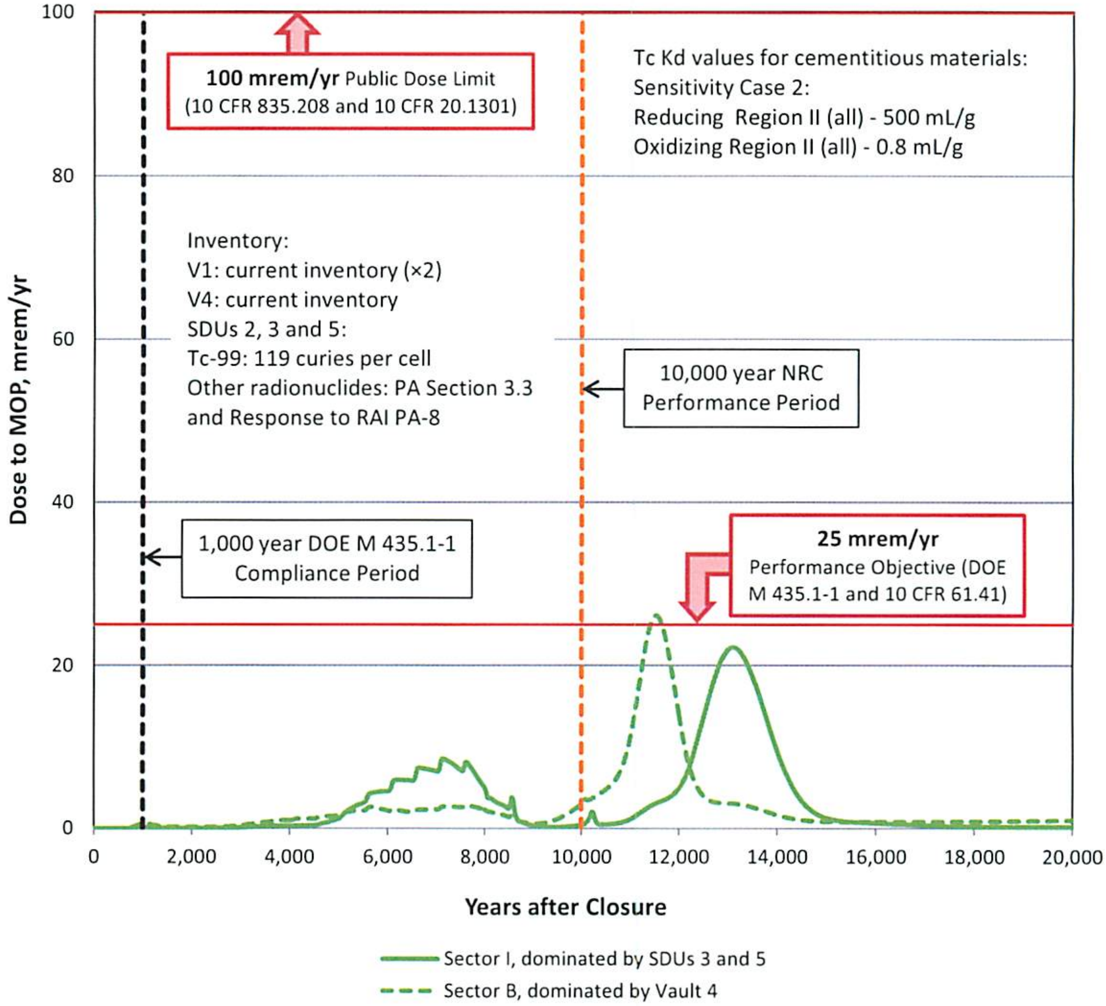
3.2 Sensitivity Case 2

Table 3.2-1 presents the peak dose to the MOP within a 1,000-year, 10,000-year, and 100,000-year period after SDF closure for SC-2. As presented in Table 3.2-1, the estimated dose to the MOP does not exceed the performance objective. Figure 3.2-1 illustrates the dose to the MOP, for SC-2, in Sector B (dominated by the release from Vault 4) and Sector I (dominated by the release from SDUs 3 and 5).

Table 3.2-1: Peak Dose to MOP for SC-2 (Vaults 1 and 4 and SDUs 2, 3 and 5 Only)

Time Period after Closure	Sensitivity Case 2
0 - 1,000 Years	0.57 mrem/year (at 1,000 years)
0 - 10,000 Years	8.6 mrem/year (at 7,140 years)
0 - 100,000 Years	26 mrem/year (at 11,540 years)

Figure 3.2-1: Dose to MOP for SC-2 Using GoldSim Model v3.002 (Vaults 1 and 4 and SDUs 2, 3 and 5 Only)



4.0 CONCLUSIONS

This sensitivity analysis illustrates that near-term disposal operations into SDF Vaults 1 and 4 and SDUs 2, 3 and 5 can be accomplished with reasonable assurance that the performance objective of 25 mrem/year to a MOP, from DOE M 435.1-1 and 10 CFR 61, will be met even with the conservative peak doses calculated using the GoldSim model and the treatment of technetium retention in the disposal cell floor. Subsequent research and development and modeling is expected to verify that the SDF, with all disposal units filled, will continue to meet the performance objectives.

5.0 REFERENCES

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SRR-CWDA-2012-00095, *Projected Technetium-99 Inventory in Saltstone Disposal Facility Units 2, 3, and 5,* Savannah River Site, Aiken, SC, Rev. 0, June 21, 2012.

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