SRNS-J2100-2009-00014
Revision 1

KEYWORDS:
Performance Assessment
Saltstone
UDQE
Inventory

RETENTION: PERMANENT

UNREVIEWED DISPOSAL QUESTION EVALUATION:

Evaluation of Updated Radionuclide Inventory in Saltstone Disposal Facility

Author

K. H. Rosenberger

June 2009

Savannah River Nuclear Solutions
Savannah River Site
Aiken, SC 29808

Prepared for U.S. Department of Energy Under
Contract No. DE-AC09-08SR22470

REVIEWS AND APPROVALS

Author

Kent H. Rosenberger 6/11/2009

K. H. Rosenberger, SRNS §3116 Documentation — Date

Reviews/Approval

M A Layton 6/11/09

M. A. Layton, Reviewer, SRNS §3116 Documentation — Date

L. B. Romanowski 6/11/09

L. B. Romanowski, Reviewer, WSRC Closure & Waste Disposal Authority — Date

S. A. Thomas 6/11/09

S. A. Thomas, Manager, SRNS §3116 Documentation — Date

L. B. Romanowski for V. G. Dickert per telecon 6/4/09

V. G. Dickert, Manager, WSRC Closure & Waste Disposal Authority — Date

Liquid Waste Operations Approval

Phillip Nash for David Sherburne per telecon 6/11/09

J. E. Occhipinti, Manager, WSRC Waste Solidification Engineering — Date

Robert Patten 6/11/09

E. Patten, FOSC Chairman, WSRC Saltstone Facility Manager — Date

Summary

As processing continues in the Saltstone Production Facility with subsequent disposal in the Saltstone Disposal Facility (SDF), the radionuclide concentrations in incoming feed solution are evaluated by routine sampling and analysis of material in Tank 50. Based on latest available information the radionuclide inventory for SDF vaults has been updated as of 3/31/2009 (information included as Attachment 1) [X-CLC-Z-00027] as well as near-term projections for disposal into Vault 4 [LWO-LWE-2009-00159]. The establishment of disposal limits in Vault 4 was made within the 2005 Special Analysis (SA) [WSRC-TR-2005-00074] as a supplement to the 1992 Performance Assessment (PA) [WSRC-RP-92-1360] and a projection of future disposal inventories was made in the Saltstone Performance Objectives Demonstration Document (PODD) [CBU-PIT-2005-00146]. While new information in the revised inventory calculation does not approach the disposal limits of the SA, it does challenge and in a few instances exceed the inventory projections made within the PODD for 12 radionuclides. None of these radionuclides are designated highly radioactive radionuclides (HRRs) in the *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site* [DOE-WD-2005-001]. In all cases, the revised inventory as of 3/31/2009 is less than five times the PODD projection for any individual radionuclide. For perspective, this analysis has evaluated the impact of increasing 12 radionuclides by up to 50 times the PODD projections, which provides at least one order of magnitude increase over the 3/31/2009 inventory for the 12 radionuclides evaluated [LWO-RIP-2009-00025]. While it is not expected that this 50 times inventory would actually be disposed of in Vault 4, such an evaluation does provide a level of assurance that the planned disposal activities will remain well within the applicable performance objectives. This analysis also evaluated the impact of the salt solution concentrations used in the new inventory calculations on the existing Vault 4 Unreviewed Disposal Question Evaluation (UDQE) on wall weeping. Through this quantitative analysis process, it has been demonstrated that the increased inventory for these 12 radionuclides for disposal in the SDF are within the bounds of the applicable waste disposal documentation (i.e., the PA, SA, PODD, Composite Analysis (CA) [WSRC-RP-97-311]). In addition, the revised salt solution concentrations have been reviewed versus the existing UDQE on Vault 4 weeping [SRS-REG-2007-00041]). The conclusion of these reviews is that no additional actions are required.

Introduction

The intent of this document is to provide an evaluation pursuant to DOE Manual 435.1-1 Chapter IV Section P.(4) to determine if new information for 12 radionuclide inventories in the SDF Vault 4 might impact the conclusions of the applicable waste disposal documentation (i.e., the approved PA, including applicable Special Analyses, the PODD, the CA and the UDQE that evaluated the impact of Vault 4 weeping) that performance objectives/measures are met. If they do impact the conclusions of the PA or CA, then, according to the DOE-issued Disposal Authorization Statement (DAS), the PA and CA would need to be updated as appropriate and DOE approval sought of the update (e.g., special analysis or revision of the PA or CA).

Description of the Discovery

As material characterization is conducted on the salt solution in Tank 50, comparisons are made between the new information and the existing limits in the SA, via the Waste Acceptance Criteria (WAC) [X-SD-Z-00001], and the projections in the PODD. A new Vault 4 inventory calculation has been issued and resulted in changes to the current inventory of many radionuclides [X-CLC-Z-00027]. Based on the recently revised inventory projections, no limits established by the SA are close to being challenged. The 3/31/2009 inventory for 12 radionuclides does challenge, and in a few instances exceed, the original inventory projections for Vault 4 made within the PODD. The inventory projections are not challenged for any designated HRRs.

Supporting Analysis

The revised radionuclide inventory established for Vault 4 as of 3/31/2009 [X-CLC-Z-00027] and the subsequent review [LWO-RIP-2009-00025] identified 12 radionuclides that are currently expected to approach or have already exceeded the inventory projections established during the development of the PODD. This revised inventory is based on the latest sampling results from the tank farm streams. It should be noted that none of these exceedances are greater than five times the original inventory projection in the PODD, an example of a factor that the Nuclear Regulatory Commission (NRC) in *U.S. Nuclear Regulatory Commission Plan for Monitoring the U.S. Department of Energy Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005* views as possibly warranting additional review to determine if the increases were significant to performance [ML071150165]. The 12 radionuclides addressed in this evaluation are Am-243, Ce-144, Cm-243, Cs-135, Nb-94, Ni-59, Pr-144, Pu-242, Th-230, U-232, U-233 and U-236. For perspective, this evaluation will determine the significance of an up to 50 times increase in the projected PODD inventories for these radionuclides, which provides at least one order of magnitude increase over the 3/31/2009 inventory [LWO-RIP-2009-00025]. The following evaluation addresses the potential impact of the increased inventory on the documents of concern.

1992 Performance Assessment / 2005 Special Analysis

The disposal limits established by the 1992 PA have been updated by the 2005 SA for Vault 4. The SA states "… a PA revision is not required and this SA serves to update the disposal limits for Vault 4." Therefore, the impacts of a 50 times increase in the PODD projections (Table 3-2 of CBU-PIT-2005-00146) for certain radionuclides have been determined by comparison to the disposal limits in Table 7.2 of the 2005 SA. The SA does not have an inventory limit for Ce/Pr-144 based upon its short half-life of 285 days. The margin column represents the additional magnitude that the inventory could be increased, even after the applied 50 times increase, before the SA limit is reached.

Evaluation of SA Limits

	50X PODD* (Ci)	SA limit** (Ci)	Margin***
Am-243	1.09E+00	3.00E+05	2.75E+05
Ce-144	3.14E+02	No limit	NA
Cm-243	1.34E+00	7.00E+09	5.22E+09
Cs-135	2.34E+02	8.10E+13	3.46E+11
Nb-94	2.11E-01	1.00E+03	4.74E+03
Ni-59	1.43E+02	2.50E+17	1.75E+15
Pr-144	3.14E+02	No limit	NA
Pu-242	9.05E+00	4.90E+10	5.41E+09
Th-230	1.77E+00	3.30E+02	1.86E+02
U-232	1.55E+00	9.00E+03	5.81E+03
U-233	1.11E+02	1.40E+04	1.26E+02
U-236	1.52E+01	3.20E+08	2.11E+07

* Inventory increased to 50 times the projection in Table 3-2 of the PODD (CBU-PIT-2005-00146).

** SA limit is most restrictive value of the all-pathways, resident intruder, groundwater, air or radon pathways from Table 7.2 of WSRC-TR-2005-00074.

*** Margin is SA limit divided by 50 times PODD projection.

The comparison indicates that the margin between the SA inventory limits and the 50 times increase in the PODD projections is greater than 100 for all of the 12 radionuclides and therefore there is no impact to the PA and SA.

Performance Objective Demonstration Document (PODD)

The PODD contained a projected inventory for the SDF based upon information available at that time. The projected inventory was used in the PODD to evaluate an all-pathways dose and chronic inadvertent intruder dose for comparison to performance objectives in Tables 4-19 and 5-4, respectively [CBU-PIT-2005-00146]. Since no credible scenario could be identified, there is no acute intruder scenario evaluated as discussed on page 44 of the PODD. The following tables present the impacts to the PODD calculations based upon a 50 times increase in the inventory projection for the 12 target radionuclides. The tables present the information directly from the PODD for all radionuclides (not just the 12 radionuclides) on the left side of the tables and the changes to the PODD tables as a result of the 50 times increase in the PODD projections on the right side of the tables. Since the inventory increases are only for 12 radionuclides, the changes to the PODD projections are indicated by shading in the tables. Of the 12 radionuclides,

only Ni-59 and Nb-94 have an all-pathways inventory limit based upon the modeling results. Of the 12 radionuclides, only Nb-94, Th-230, U-232, U-233, U-236, Pu-242, Am-243 and Cm-243 have an inadvertent intruder inventory limit based upon the modeling results. The remaining 12 radionuclides evaluated in the review have no SA limit per Table 7.2 of the SA for the exposure pathway evaluated.

All-Pathways Dose Per Year to Representative Member of the Public (Excluding Radon) Evaluation

	PODD Table 4-19				Revised Dose		
	SA Limit* (Ci)	PODD Inventory (Ci)	Fraction SA Limit	Dose** (mrem/yr)	Revised Inventory*** (Ci)	Fraction SA Limit	Dose** (mrem/yr)
H-3	1.30E+12	9.43E+03	7.25E-09	1.81E-07	9.43E+03	7.25E-09	1.81E-07
C-14	1.10E+08	5.20E+02	4.72E-06	1.18E-04	5.20E+02	4.72E-06	1.18E-04
Al-26	2.31E+10	2.35E+01	1.02E-09	2.54E-08	2.35E+01	1.02E-09	2.54E-08
Ni-59	1.58E+19	2.85E+00	1.81E-19	4.52E-18	1.43E+02	9.05E-18	2.26E-16
Se-79	1.02E+03	8.94E+01	8.77E-02	2.19E+00	8.94E+01	8.77E-02	2.19E+00
Sr-90	1.42E+17	7.43E+03	5.23E-14	1.31E-12	7.43E+03	5.23E-14	1.31E-12
Nb-94	6.98E+17	4.22E-03	6.05E-21	1.51E-19	2.11E-01	3.02E-19	7.56E-18
Tc-99	1.07E+17	3.31E+04	3.10E-13	7.74E-12	3.31E+04	3.10E-13	7.74E-12
Sn-126	2.92E+19	4.51E+02	1.54E-17	3.86E-16	4.51E+02	1.54E-17	3.86E-16
I-129	4.03E+03	1.80E+01	4.46E-03	1.12E-01	1.80E+01	4.46E-03	1.12E-01
Ra-226	3.84E+16	1.30E+01	3.39E-16	8.46E-15	1.30E+01	3.39E-16	8.46E-15
Np-237	8.93E+18	2.12E+00	2.37E-19	5.93E-18	2.12E+00	2.37E-19	5.93E-18
		Totals	**9.21E-02**	**2.30E+00**		**9.21E-02**	**2.30E+00**

Note: Shading indicates radionuclides evaluated in this document.

* SA limit based upon 25 mrem/yr performance objective.

** Dose is calculated by multiplying 25 mrem/yr by the fraction of the SA limit.

*** Inventory for Ni-59 and Nb-94 increased to 50 times the projection in Table 3-2 of the PODD (CBU-PIT-2005-00146).

Chronic Inadvertent Intruder Dose Evaluation

	PODD Table 5-4				Revised Dose		
	SA Limit* (Ci)	PODD Inventory (Ci)	Fraction SA Limit	Dose** (mrem/yr)	Revised Inventory*** (Ci)	Fraction SA Limit	Dose** (mrem/yr)
Na-22	7.80E+15	2.59E+02	3.32E-14	3.32E-12	2.59E+02	3.32E-14	3.32E-12
Al-26	1.61E+02	1.03E+00	6.40E-03	6.40E-01	1.03E+00	6.40E-03	6.40E-01
Co-60	5.75E+09	4.46E+01	7.76E-09	7.76E-07	4.46E+01	7.76E-09	7.76E-07
Nb-94	1.01E+03	1.02E-03	1.01E-06	1.01E-04	2.11E-01	2.09E-04	2.09E-02
Tc-99	3.66E+13	7.16E+02	1.95E-11	1.95E-09	7.16E+02	1.95E-11	1.95E-09
Sn-126	1.17E+03	9.56E+00	8.17E-03	8.17E-01	9.56E+00	8.17E-03	8.17E-01
Sb-125	1.41E+17	2.05E+02	1.45E-15	1.45E-13	2.05E+02	1.45E-15	1.45E-13
Cs-134	4.12E+19	2.40E+03	5.83E-17	5.83E-15	2.40E+03	5.83E-17	5.83E-15
Cs-137	5.99E+06	1.20E+06	2.00E-01	2.00E+01	1.20E+06	2.00E-01	2.00E+01
Eu-152	6.42E+06	1.48E+00	2.30E-07	2.30E-05	1.48E+00	2.30E-07	2.30E-05
Eu-154	1.15E+08	8.10E+01	7.04E-07	7.04E-05	8.10E+01	7.04E-07	7.04E-05
Eu-155	1.12E+19	1.72E+01	1.54E-18	1.54E-16	1.72E+01	1.54E-18	1.54E-16
Ra-226	4.21E+02	2.44E-01	5.80E-04	5.80E-02	2.44E-01	5.80E-04	5.80E-02
Ra-228	3.72E+08	6.41E-06	1.72E-14	1.72E-12	6.41E-06	1.72E-14	1.72E-12
Ac-227	8.78E+07	1.37E-06	1.56E-14	1.56E-12	1.37E-06	1.56E-14	1.56E-12
Th-229	8.61E+03	2.79E-03	3.24E-07	3.24E-05	2.79E-03	3.24E-07	3.24E-05
Th-230	3.29E+02	1.49E-03	4.53E-06	4.53E-04	1.77E+00	5.38E-03	5.38E-01
Th-232	1.56E+02	6.41E-06	4.11E-08	4.11E-06	6.41E-06	4.11E-08	4.11E-06
Pa-231	2.15E+04	3.80E-06	1.77E-10	1.77E-08	3.80E-06	1.77E-10	1.77E-08
U-232	9.00E+03	9.52E-03	1.06E-06	1.06E-04	1.55E+00	1.72E-04	1.72E-02
U-233	1.35E+04	9.82E-01	7.27E-05	7.27E-03	1.11E+02	8.22E-03	8.22E-01
U-234	4.48E+03	6.59E+00	1.47E-03	1.47E-01	6.59E+00	1.47E-03	1.47E-01
U-235	1.03E+05	7.41E-02	7.19E-07	7.19E-05	7.41E-02	7.19E-07	7.19E-05
U-236	3.17E+08	1.42E-01	4.48E-10	4.48E-08	1.52E+01	4.80E-08	4.80E-06
U-238	6.60E+04	1.61E-01	2.44E-06	2.44E-04	1.61E-01	2.44E-06	2.44E-04
Np-237	6.73E+04	5.76E-01	8.56E-06	8.56E-04	5.76E-01	8.56E-06	8.56E-04
Pu-238	1.27E+07	3.69E+03	2.91E-04	2.91E-02	3.69E+03	2.91E-04	2.91E-02
Pu-239	1.37E+10	3.36E+01	2.45E-09	2.45E-07	3.36E+01	2.45E-09	2.45E-07
Pu-240	2.96E+12	8.39E+00	2.83E-12	2.83E-10	8.39E+00	2.83E-12	2.83E-10
Pu-241	1.02E+10	1.72E+02	1.69E-08	1.69E-06	1.72E+02	1.69E-08	1.69E-06
Pu-242	4.91E+10	9.32E-03	1.90E-13	1.90E-11	9.05E+00	1.84E-10	1.84E-08
Pu-244	3.65E+03	9.38E-06	2.57E-09	2.57E-07	9.38E-06	2.57E-09	2.57E-07
Am-241	3.38E+08	1.44E+01	4.25E-08	4.25E-06	1.44E+01	4.25E-08	4.25E-06
Am-242m	9.83E+06	7.25E-03	7.38E-10	7.38E-08	7.25E-03	7.38E-10	7.38E-08
Am-243	2.96E+05	6.22E-03	2.10E-08	2.10E-06	1.09E+00	3.68E-06	3.68E-04
Cm-242	2.51E+09	6.21E-03	2.47E-12	2.47E-10	6.21E-03	2.47E-12	2.47E-10
Cm-243	7.00E+09	2.88E-03	4.11E-13	4.11E-11	1.34E+00	1.91E-10	1.91E-08
Cm-244	1.08E+15	3.16E+00	2.93E-15	2.93E-13	3.16E+00	2.93E-15	2.93E-13
Cm-245	8.42E+06	3.03E-04	3.60E-11	3.60E-09	3.03E-04	3.60E-11	3.60E-09
Cm-247	2.45E+04	5.55E-13	2.27E-17	2.27E-15	5.55E-13	2.27E-17	2.27E-15
Cm-248	4.64E+07	5.79E-13	1.25E-20	1.25E-18	5.79E-13	1.25E-20	1.25E-18
Bk-249	4.92E+07	4.23E-20	8.60E-28	8.60E-26	4.23E-20	8.60E-28	8.60E-26
Cf-249	1.27E+05	3.21E-12	2.53E-17	2.53E-15	3.21E-12	2.53E-17	2.53E-15
Cf-251	1.83E+06	2.47E-01	1.35E-07	1.35E-05	2.47E-01	1.35E-07	1.35E-05
Cf-252	6.31E+12	3.56E-15	5.64E-28	5.64E-26	3.56E-15	5.64E-28	5.64E-26
		Totals	**2.17E-01**	**2.17E+01**		**2.31E-01**	**2.31E+01**

Note: Shading indicates radionuclides evaluated in this document.
* SA limit based on DOE Order 435.1 100 mrem/yr performance objective.
** Dose is calculated by multiplying 100 mrem/yr by the fraction of the SA limit.
*** Inventory for Nb-94, Th-230, U-232, U-233, U-236, Pu-242, Am-243 and Cm-243 increased to 50 times the projection in Table 3-2 of the PODD (CBU-PIT-2005-00146).

The comparison indicates that, even with a 50x increase for the inventory of these 12 radionuclides, there is no change to the reported total all-pathways dose estimate in the PODD. For the chronic inadvertent intruder analysis, the 50x increase only results an increase of 1.6 mrem for the peak year dose, a 0.3% change relative to the 10 CFR Part 61 performance objective of 500 mrem/year. Based on this, there are no impacts on the PODD conclusions.

Composite Analysis (CA)

The CA contained a projected inventory for the SDF based upon information available at the time of CA development [WSRC-RP-97-311]. During the CA development, the inventory for the SDF underwent a screening process and the results were that all radionuclides from the SDF were screened out of further CA consideration. The projected inventory for the SDF for the radionuclides of concern would have to increase by greater than 10 orders of magnitude in order to influence the screening results of the CA. Therefore, there is no impact to the CA results.

Unreviewed Disposal Question Evaluation (UDQE) on Vault 4 weeping

A UDQE was previously performed to evaluate the impacts of Vault 4 weeping using information known at the time on salt solution radionuclide concentrations [SRS-REG-2007-00041]. The radionuclide concentrations from the most recent Tank 50 characterization results at that time were applied to a hypothetical 1000-liter spill from Vault 4. A screening dose was determined and compared to a 2.5 mrem screening threshold.

The new inventory calculation [X-CLC-Z-00027] contains additional concentrations for salt solution feed for several operational batches and, therefore, it is necessary to review this new concentration data against the previous weeping UDQE to ensure the conclusion that Vault 4 weeping has no dose impact is still valid. The following table contains a comparison of the weeping UDQE concentration to the maximum concentrations in, or derived from, X-CLC-Z-00027. The table further contains the assessment of impact to the screening dose versus the screening threshold. Column 1 shows the salt solution concentration used in the weeping UDQE [SRS-REG-2007-00041]. Column 2 shows the maximum concentration values from sample results or calculations in recently completed inventory calculations in X-CLC-Z-00027 or values projected for the next salt waste batch [LWO-LWE-2009-00159]. The maximum concentrations were determined on a radionuclide-by-radionuclide basis, taking the maximum concentration value found in any batch. Therefore, the individual concentration values may have been selected from different batches leading to a bounding overall concentration. Column 3 notes the source of the value in column two (sample, calculation based on process knowledge or next batch projection). Column 4 shows the ratio of the maximum concentration value to that used in the weeping UDQE and the ratios greater than one are highlighted. Column 5 contains the screening dose values determined in the weeping UDQE. Column 6 then presents the ratio (i.e., margin) of the 2.5 mrem screening threshold versus the screening dose values determined in the weeping UDQE as shown in column 5. Since dose is linear to concentration in the weeping UDQE, the ratio of concentration change can be compared to the ratio of the screening dose margin to determine the impact, if any, of the concentration changes. If the ratio of concentration change (column 4) is less than the margin (column 6) then there is no impact to the

conclusions of the weeping UDQE. This comparison, as shown in column 7, indicates that there is no impact to the conclusions of the weeping UDQE.

Evaluation of Vault 4 Weeping UDQE Impacts

	Weeping UDQE Concentration* (pCi/mL)	Calculation Maximum Value** (pCi/mL)	Note	Ratio Calc Max / UDQE	Weeping UDQE Screening Dose*** (mrem)	Margin to 2.5 mrem Screening Threshold****	Ratio Calc Exceed Margin to Threshold
H-3	1.24E+03	2.30E+03	1	1.85E+00	2.26E-04	1.11E+04	NO
C-14	1.35E+03	1.43E+03	3	1.06E+00	7.94E-03	3.15E+02	NO
Ni-63	7.86E+01	8.67E+02	1	1.10E+01	2.88E-06	8.68E+05	NO
Sr-90	6.90E+04	5.30E+05	1	7.68E+00	2.29E-02	1.09E+02	NO
Tc-99	1.84E+04	3.77E+04	3	2.05E+00	7.57E-02	3.30E+01	NO
I-129	3.86E+00	4.77E+01	3	1.24E+01	4.30E-03	5.81E+02	NO
Cs-137	3.72E+07	3.51E+07	3	9.44E-01	5.46E-07	4.58E+06	NO
Th-230	3.27E+03	5.31E+00	3	1.62E-03	1.34E-03	1.87E+03	NO
Th-232	1.70E-02	7.02E-02	3	4.13E+00	7.62E-09	3.28E+08	NO
U-232	4.41E-01	1.34E+00	1	3.04E+00	1.27E-06	1.97E+06	NO
U-233	4.69E+01	6.67E+00	3	1.42E-01	2.10E-05	1.19E+05	NO
U-234	1.38E+02	3.54E+01	3	2.57E-01	5.92E-05	4.22E+04	NO
U-235	2.45E-01	8.63E-01	1	3.52E+00	1.01E-07	2.48E+07	NO
U-236	6.37E+00	8.60E+00	1	1.35E+00	2.63E-06	9.51E+05	NO
U-238	3.19E+00	2.43E+00	3	7.62E-01	1.26E-06	1.98E+06	NO
Np-237	1.56E+01	3.16E+01	1	2.03E+00	3.89E-03	6.43E+02	NO
Pu-238	7.30E+04	6.78E+04	3	9.29E-01	4.03E-05	6.20E+04	NO
Pu-239	4.67E+03	8.86E+03	3	1.90E+00	7.58E-03	3.30E+02	NO
Pu-240	4.67E+03	5.06E+03	1	1.08E+00	7.58E-03	3.30E+02	NO
Pu-241	3.42E+03	4.12E+04	1	1.20E+01	1.07E-04	2.34E+04	NO
Pu-242	8.45E+01	1.20E+01	3	1.42E-01	1.32E-04	1.89E+04	NO
Pu-244	3.92E-01	5.58E-03	2	1.42E-02	6.11E-07	4.09E+06	NO
Am-241	9.44E+03	3.76E+03	3	3.98E-01	3.01E-03	8.31E+02	NO
Am-242m	5.07E+00	2.03E+00	1	4.00E-01	1.54E-06	1.62E+06	NO
Am-243	1.35E+02	2.39E+01	2	1.77E-01	4.31E-05	5.80E+04	NO
Cm-242	4.20E+00	1.72E+00	3	4.10E-01	8.04E-08	3.11E+07	NO
Cm-244	2.25E+04	4.46E+03	1	1.98E-01	4.31E-03	5.80E+02	NO
Cm-245	7.16E+01	1.31E-02	3	1.83E-04	2.40E-05	1.04E+05	NO

Note: Shading indicates ratio greater than 1.0.

* Concentration from Attachment 2 Table 1 of SRS-REG-2007-00041.

** Concentration represents maximum concentration value contained in X-CLC-Z-00027 or LWO-LWE-2009 00159.

Notes: 1) Maximum concentration contained in Tables 1, 2 and 3 of X-CLC-Z-00027 (i.e., sample result).
2) Maximum concentration calculated from Table 2 in Attachment 1 of X-CLC-Z-00027. Value for each radionuclide calculated by dividing total curies (Ci) for each batch by batch volume (gal) and converting to pCi/mL using the conversion factors 3785 mL/gal and 1E+12 pCi/Ci (i.e., process knowledge).
3) Concentration from last column of Table 1 in LWO-LWE-2009-00159.

*** Dose from Attachment 2 Table 3 (column SFgw) of SRS-REG-2007-00041 (decayed values for Cs-137, Sr-90 and Pu-238 used).

**** 2.5 mrem divided by UDQE screening dose.

Evaluation

To complete this UDQE, the following questions, which must be addressed in any UDQE, are answered with respect to the information concerning increased inventories for 12 radionuclides.

1a. *Is the proposed activity or new information outside the bounds of the approved PA/CA (e.g., does the proposed activity or new information involve a change to the basic disposal concept as described in the PA/CA such as critical inputs/assumptions or an increase in inventory analyzed in the CA)?*

NO. The PA/SA establishes disposal limits for the SDF and the increased inventory do not challenge the disposal limits. The inventory in the SDF was screened from further evaluation in the CA and the increased inventory does not change the screening results. The increased inventory does not impact the performance objective conclusions of the PODD.

1b. *Does the proposed activity or new information cause the PA/CA performance measures to be exceeded?*

NO. The increased inventory does not impact the conclusions regarding performance objectives/measures in the PA, SA, CA or PODD.

1c. *Would the radionuclide disposal limits in the approved PA need to be changed to implement the proposed activity?*

NO. The increased inventory does not impact the disposal limits determined via the SA.

1d. *Does the new information involve a change in the radionuclide disposal limits in the approved PA?*

NO. The increased inventory does not impact the disposal limits determined via the SA.

1e. *Does the proposed activity or new information involve a change to the DAS?*

NO. The increased inventory does not impact the disposal limits determined via the SA. Therefore, a change to the Disposal Authorization Statement is not required.

Conclusion

The 12 radionuclides addressed in this evaluation are Am-243, Ce-144, Cm-243, Cs-135, Nb-94, Ni-59, Pr-144, Pu-242, Th-230, U-232, U-233 and U-236. The conclusion of this evaluation is that a 50 times increase in the inventories for the 12 radionuclides does not impact the conclusions of the applicable waste disposal documentation (i.e., the PA, SA, PODD, or CA) and all performance objectives/measures are met. In addition, the use of the maximum salt solution concentrations from X-CLC-Z-00027 and LWO-LWE-2009-00159 do not impact the conclusions reached in the existing UDQE on Vault 4 weeping. Therefore, there are no changes required to the existing documents and no need to perform a new SA to further evaluate an increased inventory for the 12 radionuclides evaluated in this UDQE.

References

CBU-PIT-2005-00146, *Saltstone Performance Objective Demonstration Document (U)*, Revision 0, June 2005.

DOE Manual 435.1-1, *Radioactive Waste Management Manual*, Change 1, June 2001.

DOE-WD-2005-001, *Basis for Section 3116 Determination for Salt Waste Disposal at the Savannah River Site*, Revision 0, January 2006.

LWO-LWE-2009-00159, *Best Estimation of the Concentration of Radionuclides in a Tank 50 Influent Stream Aggregate*, Revision 0, June 2009.

LWO-RIP-2009-00025, *Evaluation of Saltstone Disposal Facility Radiological Inventory*, Revision 0, June 2009.

ML071150165, *U.S. Nuclear Regulatory Commission Plan for Monitoring the U.S. Department of Energy Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005*, May 3, 2007.

SRS-REG-2007-00041, *Unreviewed Disposal Question Evaluation: Evaluation of Liquid Weeping from Saltstone Vault 4 Exterior Walls*, Revision 1, April 2008.

WSRC-RP-92-1360, *Radiological Performance Assessment for the Z-Area Saltstone Disposal Facility*, Revision 0, December 1992.

WSRC-RP-97-311, *Composite Analysis E-Area Vaults and Saltstone Disposal Facilities*, Revision 0, September 1997.

WSRC-TR-2005-00074, *Special Analysis: Revision of Saltstone Vault 4 Disposal Limits (U)*, Revision 0, May 2005.

X-CLC-Z-00027, *Inventory Determination of PODD Radionuclides in Saltstone Vaults 1 and 4*, Revision 1, June 2009.

X-SD-Z-00001, *Waste Acceptance Criteria for Aqueous Waste Sent to the Z-Area Saltstone Production Facility (U)*, Revision 8, December 2008.

ATTACHMENT 1

3/31/2009 SDF Inventory Extracted from Table 4 of X-CLC-Z-00027

Radionuclide	Total (Ci)
H-3	5.45E+01
C-14	3.30E+00
Na-22	1.38E+01
Al-26	5.07E-02
Co-60	1.01E-01
Ni-59	4.81E-01
Ni-63	2.12E+00
Se-79	6.49E+00
Sr-90	2.01E+03
Y-90	2.01E+03
Nb-94	3.50E-03
Tc-99	2.35E+02
Ru-106	7.46E-01
Rh-106	7.46E-01
Sb-125	2.15E+02
Sb-126	1.67E-01
Sb-126m	1.19E+00
Te-125m	1.60E+02
Sn-126	1.56E+00
I-129	2.35E-01
Cs-134	1.36E+01
Cs-135	7.85E-01
Cs-137	9.22E+04
Ba-137m	8.72E+04
Ce-144	1.16E+00
Pr-144	1.16E+00
Pm-147	1.29E+01
Sm-151	8.81E+00
Eu-152	1.86E-02
Eu-154	3.30E+00
Eu-155	9.97E-01
Ra-226	5.35E+00
Ac-227	3.33E-07
Ra-228	1.45E-06
Th-229	4.30E-05
Th-230	1.41E-02
Pa-231	9.89E-07
Th-232	7.85E-05
Np-237	1.49E-01
U-232	1.54E-02
U-233	3.81E+00
U-234	3.83E+00
U-235	7.48E-02
U-236	1.09E-01
U-238	1.29E-01
Pu-238	1.55E+02
Pu-239	6.58E+00
Pu-240	1.12E+01
Pu-241	1.20E+02
Pu-242	1.09E-02
Pu-244	2.41E-05
Am-241	8.69E+00
Am-242m	1.08E-02
Am-243	1.05E-01
Cm-242	8.94E-03
Cm-243	7.36E-02
Cm-244	2.23E+01
Cm-245	6.15E-06
Cm-247	3.36E-15
Cm-248	3.51E-15
Bk-249	2.56E-22
Cf-249	1.94E-14
Cf-251	2.47E-01
Cf-252	2.15E-17

ATTACHMENT 2

Technical Review Package # USQ-SS-2009-00010 Revision 1

Technical Review Package
Content Sheet

TRP #: USQ-SS-2009-00010 Rev: 1

Technical Review Package Title

Approval of X-CLC-Z-00027, Rev. 1, Inventory Determination of PODD Radionuclides in Saltstone Vaults 1 and 4

Functional Classification: PS

Documents included in package

- ☐ **DATR**
- ☐ **DATR Summary**
- ☒ **USQS**
- ☐ **USQE**
- ☒ **CHAPS**
- ☐ **TSQS**
- ☐ **TSQE**

Other Documents Included (List)

The PA has no impacts to the trapped hydrogen program at Saltstone. Although the inventories reported in the calculation do not challenge the limits established in either the Saltstone Radiological Performance Assessment or the Vault 4 Special Analysis, this calculation will be used as an input to a UDQE (SRNS-J2100-2009-00014 Rev. 1) to determine if the conclusions of the PODD are impacted.

This TRP package was revised to reflect the UDQE document number and update the revision number of the calculation. The calculation was revised to correct the Title Block on the cover page.

CLASSIFICATION REVIEW

UNCLASSIFIED - Does Not Contain Unclassified Controlled Nuclear Information

DC/RO: N/A

Date: 06/11/2009

Guide:

UNREVIEWED SAFETY QUESTION PROCESS

USQ SCREENING - PART A (U)

Reference: Manual 11Q Procedure 1.05 *Nuclear Facility Unreviewed Safety Questions (U)*

USQ Number USQ-SS-2009-00010 **Rev.** 1 **Functional Classification** PS

Title: Approval of X-CLC-Z-00027, Rev. 1, Inventory Determination of PODD Radionuclides in Saltstone Vaults 1 and 4

DO NOT ENTER CLASSIFIED INFORMATION ON THIS FORM

Description of Proposed Activity* (or Discovery):

The PA involves the approval of X-CLC-Z-00027, Rev. 1, Inventory Determination of PODD Radionuclides in Saltstone Vaults 1 and 4. This document is an engineering calculation that uses the latest available sample results to determine current radionuclide inventory of 64 radionuclides that are listed in CBU-PIT-2005-00146, Saltstone Performance Objective Demonstration Document. This calculation adds the inventory for all processing performed from Dec. 2006 until 3/31/09.

*** Include intermediate configurations and impacts on other facilities which might result from the Proposed Activity.**

1 **Is the Proposed Activity a change to TSRs?** ☐ **Yes** ☒ **No**

Justification and References:

S-TSR-Z-00002, Rev. 6, October 2008, Saltstone Facility Technical Safety Requirements; There are no LCOs or TSRs whose implementation are impacted by the PA. The accounting of radionuclide inventory is not an impact to the Waste Acceptance Criteria program.

If "Yes", prior DOE approval through the TSR change process is required (see 11Q, 1.01), no further USQ screening or USQ Evaluation is required. If "No", continue with Screening.

2 **Does the Proposed Activity involve:**

a.	**Change to the facility as described in the Safety Basis?**	☐ **Yes**	☒ **No**
b.	**Change to the procedures as described in the Safety Basis?**	☐ **Yes**	☒ **No**
c.	**Test or experiment not described in the Safety Basis?**	☐ **Yes**	☒ **No**
d.	**Analytical errors, omissions or deficiencies in the Safety Basis?**	☐ **Yes**	☒ **No**

If question a, b, c or d is answered "Yes", justification below is not required, complete Blocks 3 and 4 and complete a USQ Evaluation.

Supporting Information:

References:

1] WSRC-SA-2003-00001, Rev. 6, October 2008, Saltstone Facility DSA Sections: 3.4.3, Table 3.6-6, Table 3.6-11
2] S-TSR-Z-00002, Rev. 6, October 2008, Saltstone Facility Technical Safety Requirements
3] SBD-CRF-Z-09001, Rev. 0, (1/16/09)
4] For config control: TRC-WD-2008-01123, TRC-WD-2008-00653, TRC-WD-2008-01028, TRC-SS-2009-00016

UNREVIEWED SAFETY QUESTION PROCESS

USQ SCREENING - PART A (U)

USQ Number USQ-SS-2009-00010 **Rev.** 1

2 - continued

Justification (Required if response to ALL Block 2 questions above are "No"):

a) There are no changes to the facility proposed or implemented by the PA. The PA is an engineering calculation that does not impact the design or operation of the facility. b) The PA does not impact procedures as described or implied by the DSA. There are no procedures that are modified or affected by the approval of this calculation. c) The PA is not a test or experiment as defined by 11Q. d) The PA does not address any analytical errors, omissions, or deficiencies in the DSA.

3 SCREENING ORIGINATOR

a. Is a USQE required? (If Yes, submit to EO for USQE.) ☐ **Yes** ☒ **No**

b. Does the PA require a change to the Safety Basis in accordance with 11Q? ☐ **Yes** ☒ **No**

(If Yes, forward a copy of the USQS to the SBRA)

Comments:

None.

STAUB, AARON VAUGHN — 6/11/2009

Signature from SPF **Date**

4 SCREENING REVIEWER

Is a USQE required? ☐ **Yes** ☒ **No**

Comments:

None.

Returned to SO for: IMPLEMENTATION OF PA

BEHELER, CHRISTOPHER HOWARD — 06/11/2009

Signature from SPF **Date**

Consolidated Hazard Analysis Process (CHAP) Screening

CHAP Screening No.	Rev No.	Functional Classification:	Building/Location	System
USQ-SS-2009-00010	1	PS	451004	

Title

Approval of X-CLC-Z-00027, Rev. 1, Inventory Determination of PODD Radionuclides in Saltstone Vaults 1 and 4

Brief Description of the Proposed Activity

The PA involves the approval of X-CLC-Z-00027, Rev. 1, Inventory Determination of PODD Radionuclides in Saltstone Vaults 1 and 4. This document is an engineering calculation that uses the latest available sample results to determine current radionuclide inventory of 64 radionuclides that are listed in CBU-PIT-2005-00146, Saltstone Performance Objective Demonstration Document. This calculation adds the inventory for all processing performed from Dec. 2006 until 3/31/09.

1. Is this a routine activity (i.e., an activity judged to be of sufficiently low risk from a process hazards perspective based on past experience, or is a routinely performed activity based on the facility/project schedule or other definitive facility/project document)? [Routine is defined as regular, repetitive, customary, normal operations; if routine activity is changed, check NO and continue.]

- [X] **Yes** — **If Yes, a CHA is NOT required. The activity should be controlled using AHA, RWP, operating procedures, and/or maintenance/test procedures. N/A remaining questions and obtain required signatures.**
- [ ] **No** — **If NO, continue...**

2. Is this work activity categorized as a complex, high risk activity per Manual 8Q, Procedure 122, and are the primary drivers process hazards? [Complex Activity - activity involving extensive interaction between Operations and other work groups, complex or numerous system alignment changes, complex communication or coordination, unusual hazards to personnel or equipment, or work performed in RBA where dose rate exceeds 100 mr/hr; High Risk - based on hazard categorization determination as part of AHA procedure.]

- [ ] **Yes** — **If YES, a CHA is required. N/A remaining questions and obtain required signatures.**
- [ ] **No** — **If NO, continue...**
- [X] **N/A** — **If NA, continue...**

3. Does the process change, proposed activity or modification only involve laboratory bench scale (small lab quantity) activities?

- [ ] **Yes** — **If Yes, a CHA is NOT required. The activity should be controlled using AHA, RWP, operating procedures, laboratory procedures, and/or Conduct of R&D Manual (SRNL). N/A remaining questions and obtain required signatures.**
- [ ] **No** — **If NO, continue...**
- [X] **N/A** — **If NA, continue...**

4. Does the process change, proposed activity or modification potentially increase workers, or co-located workers, exposure to EXISTING hazardous materials (chemical/radiological), or an EXISTING process unique energy source that has not been evaluated and documented? [Are there potentially new initiating events or are new controls potentially needed for existing hazards? Will there be an impact on existing controls or the functional classification of controls? If the answer to either or both of the foregoing questions is Yes, check Yes below. Refer to existing CHA hazard assessment table as necessary to answer this question.]

- [ ] **Yes** — **If YES, a CHA is required. The CHAP team and CHA activity should be tailored to the complexity of the operation and magnitude of the hazards**
- [ ] **No** — **If NO, continue...**
- [X] **N/A** — **If NA, continue...**

5. Does the process change, proposed activity or modification introduce any NEW hazardous materials (chemical/radiological), a NEW process unique energy source, or NEW equipment? [Refer to the existing CHA hazard assessment table as necessary to answer this question.]

- [ ] **Yes** — **If YES, a CHA is required. The CHAP team and CHA activity should be tailored to the complexity of the operation and magnitude of the hazards**
- [ ] **No** — **If NO, continue...**
- [X] **N/A** — **If NA, continue...**

6. Does the process change, proposed activity, or modification involve a change to existing process design and operating parameters (i.e. temperature, pressure, pH, specific gravity, liquid level, H_2 generation rate, flow rate, shielding, concentration, change from manual operation to DCS, etc.) that have not been evaluated and documented?

- [ ] **Yes** — **If Yes, a CHA is required**
- [ ] **No** — **If No, a CHA is NOT required**
- [X] **N/A** — **If N/A, a CHA is NOT required**

Reviewer Preparer	Date
STAUB, AARON VAUGHN	06/11/2009
Design Authority Engineer	**Date**
STAUB, AARON VAUGHN	06/11/2009
Regulatory/Safety Documentation Manager or Designee	**Date**
NORRIS, PHILLIP W	06/11/2009

Note: Preparer and Design Authority Engineer can be the same. If CHAP Screening is negative, Design Authority Manager may substitute for Regulatory Program/Safety Documentation Manager. If CHAP screening is positive, obtain Regulatory Program Manager/Safety Documentation approval.
*Numbers should be of the form: Brief Facility Designator-Year-Sequential Number (e.g., HTANK-2007-0001).
**This form is intended to address unmitigated process hazards for any system/unit operation, regardless of functional classification.