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FY 2006 Annual Review - Saltstone Disposal Facility (Z-Area) Performance Assessment (Covering the Performance Period FY 2006)

Authors

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FY2006 ANNUAL REVIEW
SALTSTONE DISPOSAL FACILITY (Z-AREA)
PERFORMANCE ASSESSMENT
(COVERING THE PERFORMANCE PERIOD FY 2006)

EXECUTIVE SUMMARY

The Z-Area Saltstone Disposal Facility (SDF) consists of two disposal units, Vaults 1 and 4, described in the Performance Assessment (PA) (WSRC 1992). The FY06 PA Annual Review concludes that both vaults contain much lower levels of radionuclides (curies) than that allowed by the PA. The PA controls established to govern waste operations and monitor disposal facility performance are determined to be adequate.

INTRODUCTION

The Saltstone facilities were originally permitted to receive wastewater from the In-Tank Precipitation (ITP) process. The ITP process was to remove specific radioisotopes from the salt solution arising from High Level Waste (HLW) tanks prior to treatment and disposal of the wastewater in Z-Area. The permits were subsequently modified to provide for the treatment of residues from the F- and H-Area Effluent Treatment Project (ETP). The ITP decontaminated salt solution contains chemicals, primarily sodium salts including relatively large amounts of nitrate and nitrite, and small amounts of radionuclides. Saltstone began processing radioactive waste in June 1990. Operations continued through August 1998. At that time, the facility was put in “lay-up” mode because of difficulties encountered with the ITP process. Subsequently it was decided that the ITP process was unacceptable and other processes considered. PA Annual Reviews were not performed during this lay-up period. In early 2002 efforts began to restart Saltstone to process and dispose of the residual ITP salt waste and ETF residues. At the same time, permitting activities were begun to authorize treatment and disposal of Savannah River Site (SRS) salt waste containing larger amounts of cesium than would have been in ITP salt waste. These larger amounts of cesium are still within the limits established by the PA baseline, and the chemical composition of this waste is not significantly different from the ITP decontaminated salt solution. In 2005, the facility received a permit modification from SCDHEC to treat and dispose of waste water from the processing of unirradiated fuel rods in the H-Canyon Facility. This low-activity waste stream is very similar to the waste received from the ETP.

SRS currently intends to process the salt waste to segregate the low-activity fraction by using a two-phase, three-part approach. The first phase (called interim Salt Processing) will involve two steps to treat the lower activity salt waste: (1) processing of a minimal amount of the lowest activity salt waste through a process involving Deliquification, Dissolution, and Adjustment (DDA) of the waste, and (2) processing of a minimal amount of additional waste with slightly higher activity levels using an Actinide Removal Process (ARP) and a Modular Caustic Side Solvent Extraction Unit (MCU), along with DDA. The second phase would involve the separation and processing of the majority of the salt waste using a much larger facility, the Salt Waste Processing Facility (SWPF).

The Saltstone Project is in the process of developing the design for the next generation of disposal units for the Saltstone Disposal Facility to accommodate these new waste streams. The new design must meet the performance requirements for low-level waste disposal set forth in DOE 435.1 and 10 CFR 61 as well as be cost effective. The design concept is that of a cylindrical, pre-cast, post-tensioned, reinforced concrete tank with nominal inside dimensions of 150 ft diameter and 20 ft height, based on commercial water tank technology. The projected layout of these new saltstone vaults would be in two or four-pack arrangements within the disposal site. The design concept also incorporates a diffusion barrier composed of a 100-mil high density polyethylene (HDPE) geomembrane and a geosynthetic clay liner (GCL) surrounding the tanks. Closure plans call for the addition of a multiple layer cover system, designed to minimize infiltration and intrusion over a 10,000 year period.

New Regulatory Strategy

In February 2005, U.S. Department of Energy (DOE) submitted the "Draft Section 3116 Determination, Salt Waste Disposal, Savannah River Site" for review by the U.S. Nuclear Regulatory Commission (NRC) to determine if there is reasonable assurance that these programs can meet the performance objectives of 10 CFR 61, Subpart C as required by the Ronald Reagan National Defense Authorization Act for FY 2005 (NDAA). The draft waste determination addresses salt waste that DOE proposes to remove from the high-level waste (HLW) tank farms, treat through the various processes described above, and dispose of on site in the Saltstone Disposal Facility. An integral part of this program is the performance assessment work on the Saltstone disposal facility. The original Saltstone Performance Assessment was completed in 1992. Since that time the processing and disposal facility has operated on an intermittent basis, and two small-scale performance assessment studies, called Special Analyses, have been completed. All three of these documents were reviewed by the Nuclear Regulatory Commission.

In May 2005 the NRC issued a Request for Additional Information (RAI). The responses were submitted to the NRC in July 2005. At the end of July, the NRC requested some further clarification, referred to as Action Items. There were also a number of public meetings at which the NRC reviewers asked questions and received replies. In December 2005 The NRC issued its Technical Evaluation Report (TER) (USNRC 2005) for the NRC review of the DOE's draft waste determination for salt waste disposal at the Savannah River Site. The TER contains the NRC staff's analysis which concludes that there is reasonable assurance that DOE's proposed salt waste management approach can meet the criteria in the NDAA provided certain assumptions made in DOE's analysis are verified via monitoring. These assumptions include the following general categories: wasteform and vault degradation, the effectiveness of infiltration and erosion controls, and estimation of radionuclide inventory. The specific assumptions and corresponding conclusions and recommendations are identified in the TER. The NRC's analysis was based on achieving performance objectives over a 10,000 year time frame. The text of the cover letter transmitting the review to DOE-HQ is:

Under Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), the Secretary of Energy, in consultation with the U.S. Nuclear Regulatory Commission (NRC), may determine that certain radioactive waste resulting from reprocessing of spent nuclear fuel is not high-level waste. By letter dated March 31, 2005, the U.S. Department of Energy (DOE) submitted the "Draft Section 3116 Determination, Salt Waste Disposal, Savannah River Site" to the NRC for review. The NRC staff has performed a technical review to determine whether there is reasonable assurance that applicable criteria of the NDAA can be met by the waste management approach proposed in DOE's draft Section 3116 waste determination. The NRC's assumptions, analysis, and conclusions are presented in the attached Technical Evaluation Report (TER).

Based on the information provided by DOE to the NRC in letters dated March 31, June 30, July 15, September 15, and September 30, 2005, the NRC staff has concluded that there is reasonable assurance that the applicable criteria of the NDAA can be met provided certain assumptions made in DOE's analyses are verified via monitoring. The assumptions described in Section 4.3.1 of the TER are important to demonstrating that the performance objectives in 10 CFR 61, Subpart C, can be met and fall into the following general categories: wasteform and vault degradation, the effectiveness of infiltration and erosion controls, and estimation of the radiological inventory. The NDAA requires NRC, in coordination with the State of South Carolina, to monitor disposal actions taken by DOE for the purpose of assessing compliance with the performance objectives of 10 CFR 61, Subpart C. Consequently, NRC requests that DOE develop proposed approaches that DOE will use to address the areas identified in Section 4.3.1. NRC will then, in coordination with the State, develop a program by which NRC will monitor DOE's implementation of the approaches.

It is important to note that the NRC's conclusions presented in this TER are based on the information provided by DOE. If, in the future, DOE determines it is necessary to revise its assumptions, analysis, design, or waste management approach and those changes are important to meeting the criteria of the NDAA, DOE should consult once again with NRC regarding the enclosed TER. The NRC looks forward to continuing to work cooperatively with DOE in implementing the Section 3116 requirements.

It is clear from the statements above that the NRC expects to continue to be involved with the Saltstone Disposal Facility. The Performance Assessment revision currently being developed is certain to be reviewed by the NRC since it involves a totally new design.

This annual review evaluates the adequacy of the original approved 1992 SDF PA and subsequent Special Analyses (SA) including those approved by DOE since the last Annual Review (WSRC 2006). The original PA, subsequent SAs, and special studies form the PA baseline. The review also verifies that low-level waste disposal operations through FY06 were conducted within the bounds of the PA baseline. Important factors considered in this review include waste receipts, results from monitoring, test & research programs, and the adequacy of controls derived from the PA baseline. The PA Annual Summary section is an overview of the adequacy of the PA baseline. A detailed evaluation of FY06 waste receipts and the resultant impact on the SDF is provided in the PA Annual Determination section. The results of monitoring, test & research and Special Analyses are also discussed in this section along with future work. The CA Annual Review is prepared in conjunction with the E-Area PA Annual Review and covers both the E-Area and Z-Area low-level waste disposal facilities and therefore is not included as a part of this review.

PA ANNUAL SUMMARY

SRS Low Level Waste (LLW) management is regulated under DOE Order 435.1 (USDOE 1999a). A Disposal Authorization Statement (DAS) was issued by the Department of Energy-Headquarters (DOE-HQ) on 9/28/99 authorizing continued operations of the SDF (USDOE 1999b). The DAS conditions of approval include requirements to prepare a closure plan and a monitoring plan complying with the Order, and to submit the plans to DOE for approval within one year of DAS issuance. The Monitoring Plan (Cook et al. 2000a) and the Closure Plan (Cook et al 2000b) were approved by DOE-SR and continue to be maintained through periodic updates.

Adequacy of PA

This PA Annual Review has shown that SDF operations conducted through FY2006 were well within the performance envelope analyzed in the PA baseline. Therefore, changes to the PA baseline assumptions and bases are not warranted. PA baseline controls have been established to govern waste operations and monitor disposal facility performance. The mechanisms to demonstrate that operations are within the bounds of the PA baseline are waste acceptance criteria, a running total inventory for each vault unit, periodic inspections of vault integrity and a comprehensive environmental monitoring program. These data are compared with the critical features, limits and predictions of the PA baseline to evaluate the past year's performance. The evaluation of performance since the last Annual Review leads to the following general conclusions:

- The inventory of radionuclides in Vaults 1 and 4 is well below that shown to be acceptable in the PA baseline.
- The vaults remain a barrier to contaminant migration.
- No releases to the subsurface environment have been detected.

Waste Receipts

During FY2006, there were no disposals and therefore no waste receipts during the period covered in the FY2006 annual review. The radionuclide inventories for Vault 1 and Vault 4 were updated to account for decay as a part of the FY2006 annual review.

Since the beginning of SDF operations in June 1990, 50% of the available volume of Vault 1 has been filled with waste and clean grout that contains only 0.3% of its allowable radionuclide inventory. Vault 4 is filled to 24.3% of capacity and contains only 0.1% of its allowable inventory including both Saltstone and naval fuels waste. These fractions are based on the 10,000 year time of compliance.

The radionuclide inventory limits calculated in the PA baseline are implemented in waste acceptance criteria (WAC). The radionuclide inventories are tracked as fractions of the individual radionuclide limits. The sum of these fractions for each disposal unit is controlled to less than or equal to one to ensure compliance with the PA baseline limits.

The sums-of-fractions of radionuclide inventories for both disposal units are less than 1 and well below the volume-filled fraction for each vault.

PA Monitoring

The results of environmental monitoring and vault inspections demonstrated that radionuclide migration from the vault disposal units is within acceptable concentrations as defined in the PA Monitoring Plan (Cook et al., 2000a)

PA R&D

Numerous research and development tasks related to the PA have been completed since the last Saltstone Annual Review (WSRC 2006).

There were no Special Analyses (SA) or Unreviewed Disposal Question (UDQ) Evaluations prepared in FY 2006.

Six Studies were completed in FY06 in support of the revision to the SDF PA. These studies included two geochemical studies one related to the precipitation of expansive sulfate-bearing phase that can potentially cause fracturing in saltstone (Denham, 2006) and another providing a geochemical data package for Performance Assessment calculations related to the SRS for disposal units including the SDF (Kaplan, 2006). A third study provided hydraulic property estimates for Performance Assessment calculations (Phifer et al, 2006). Three studies in support of the Vault 2 design were also carried out in FY06 including a study involving flow and transport analyses to verify performance objectives with the Vault 2 conceptual design, a study to estimate groundwater nitrate concentrations (Jones et al, 2006), and a study to verify the hydraulic properties of a geosynthetic clay liner (GCL) in contact with saltstone leachate (Dixon and Phifer, 2006).

Two PA Maintenance activities have been completed since the last Saltstone Annual Review (WSRC 2006). The Groundwater Monitoring Plan for the Z Area Saltstone Disposal Facility was revised and submitted to South Carolina Department of Health and Environmental Control (SCDHEC) in recognition of a number of changes that have been made in the salt processing program. The Radioactive Waste Management Database for the Closure Business Unit (CBU) Waste Solidification Project Saltstone (Z-Area) Facility has been updated (WSRC 2005).

Changes

During the last year efforts have been focused on developing the design for a new disposal unit and working with DOE-SR, DOE-HQ and the NRC to meet the requirements of the Section 3116 requirements.

The recent NDAA legislation establishes a new role for the NRC to consult with DOE on reassessing the classification of "high-level waste" for certain materials suitable for shallow land disposal in compliance with the criteria set forth in the law. One of those criteria is to ensure "compliance with the performance objectives set out in subpart C of part 61 of title 10, Code of Federal Regulations". As a result of this additional requirement, DOE has elected to adopt the NRC position of a 10,000 year time of compliance. In recognition of this change, this annual review of performance will be described in the context of 10,000-year derived radionuclide disposal limits. No other changes have been implemented as a result of the work listed above.

Recommended Changes

A number of PA-related improvements are under consideration for the Saltstone program, many of which are derived from the review by the NRC. The NRC staff enumerated eight factors that are important to assessing whether DOE disposal actions will be compliant with performance objectives of 10 CFR 61 (USNRC 2005). A table of these factors is attached (Attachment A).

The PA Monitoring Plan will be revised to incorporate the following changes: to revise sampling locations, to revise sampling frequency, and to remove biennial hydrocone sampling and nitrite sampling. Although biennial hydrocone sampling for nitrate is no longer required by SCDHEC, new wells have been installed in the vicinity of past hydrocone nitrate sampling locations, and these potential monitoring locations will be evaluated as a part of the PA Monitoring Plan Revision. Nitrate transport was evaluated in the PA and continues to be monitored at other sampling locations. In the past, nitrite transport was not evaluated in the PA. Nitrite levels monitored to date have been well below the MCL and, therefore, continued monitoring of nitrite is not warranted.

PA ANNUAL DETERMINATION

Effectiveness of PA Controls

Facility procedures for the operation of the Saltstone Production and Disposal Facilities for the period extending from June 1990 until October 2006 have been structured to meet Waste Acceptance Criteria (SRS Waste Acceptance Criteria Manual, Manual 1S) that were promulgated and approved in support of the original performance assessment (WSRC 1992). During this 15-year period, 4.1 million gallons of salt solution were processed through the production facility. Detailed production records are provided in Tables 1-3. No waste was processed in FY04, FY05, or FY06.

The purpose of this review is to establish that adequate controls are in place to ensure the SDF remains within the PA baseline. The stated performance objectives and requirements of the PA baseline (the performance measures that the controls are designed to meet) are listed below:

1. Dose to representative members of the public shall not exceed 25 mrem per year total effective dose equivalent (EDE) from all exposure pathways, excluding the dose from radon and its progeny in air.

2. Dose to representative members of the public via the air pathway shall not exceed 10 mrem per year total EDE, excluding the dose from radon and its progeny.

3. Release of radon shall be less than an average flux of 20 $pCi/m^2/s$ at the surface of the disposal facility. Alternatively, a limit of 0.5 pCi/L of air may be applied at the boundary of the facility.

This PA Annual Review has shown that SDF operations conducted through FY2006 were well within the performance envelope analyzed in the PA baseline. The adequacy of the PA baseline controls has been demonstrated by an evaluation of the inventory of radionuclides in Vaults 1 and 4 which is well below that shown to be acceptable in the PA baseline.

PA Waste Receipts

The approved SA (Cook et al, 2005) was used as a means to determine the allowable radionuclide concentrations and inventories in Vault 4. The allowable inventory for Vault 1 is assumed to be one-half that of Vault 4, since they are of similar construction, but Vault 1 has one-half the volumetric capacity of Vault 4.

Waste Receipts

The overall Saltstone production history is presented in Table 1. Tables 2 and 3 show the Saltstone production by cell for Vault 1 and Vault 4, respectively. An estimate of the capacity of each cell that has been used can be made by comparing the total salt solution processed in a cell to the design capacity of 1.1 million gallons per cell. To this must be added the space used in Vault 1 for clean grout used in testing and the cell in Vault 4 used entirely for disposal of Naval Fuels waste. These tables show that Vault 1 has 30.8% of its capacity (2.03 million gallons processed versus 6.6 million gallon capacity) used for salt solution. However, Vault 1 is currently at 50% of its volumetric capacity due to filling additional volume with clean grout during testing. Vault 4 has used 16.0% of its capacity (2.11 million gallons used versus 13.2 million gallons available) for disposal of salt solution, and an additional 8.3% of the volumetric capacity for disposal of the naval fuels waste. Therefore, Vault 4 is currently at 24.3% of its capacity.

Sum-of-Fractions

Tables 4 and 5 show the total inventory for each radionuclide disposed in Vaults 1 and 4, respectively. Each radionuclide inventory is compared to its respective SA derived disposal limit and the result is expressed as a fraction of the limit. The inventories used in this evaluation were determine by decaying the inventories in WSRC-2006-000568, Revision 0, 273 days (1/1/2006 to 9/30/2006) using Rad Chem© Version 2.0 software under software quality assurance plan, G-SQP-A-00006.

The total of these fractions is called the Sum-of-Fractions. The Sum-of-Fractions indicates how full the disposal facility is with regard to radionuclide activity. The Sum-of-Fractions for Vaults 1 and 4 are 3.46E-03 and 1.48E-03, respectively. These results are based on the 10,000-year derived radionuclide disposal limits.

Table 1 Saltstone Production History

Date	Salt Solution Gallons	Receiving Vault/Cell
Jun-90	27,990	1-A
Jul-90	73,510	1-A
Aug-90	75,010	1-A
Sep-90	70,150	1-A
Oct-90	63,540	1-A
Nov-90	75,880	1-A
Dec-90	74,980	1-A
Jan-91	62,020	1-A
Feb-91	17,460	1-A
Feb-91	32,550	1-B
Mar-91	49,990	1-B
Apr-91	52,290	1-B
May-91	75,837	1-B
Jun-91	43,470	1-B
Jul-91	33,642	1-B
Aug-91	42,340	1-B
Sep-91	27,280	1-B
Oct-91	28,798	1-B
Nov-91	28,524	1-B
Dec-91	18,629	1-B
Jan-92	10,430	1-B
Feb-92	8,700	1-B
Apr-92	10,310	1-B
Nov-92	15,750	1-B
Mar-93	11,220	1-B
Sep-93	1,050	1-B
Nov-93	5,770	1-B
Feb-94	32,720	1-B
Mar-94	115,570	1-C
Apr-94	8,524	1-C
May-94	12,000	1-B
Jun-94	12,000	1-B
Jul-94	26,050	1-C
Aug-94	680	1-B
Sep-94	47,744	1-C
Oct-94	2,470	1-C
Nov-94	25,540	1-C
Dec-94	72,020	1-C
Jan-95	12,000	1-C
Apr-95	10,870	1-C

Table 1 Saltstone Production History

Date	Salt Solution Gallons	Receiving Vault/Cell
Jul-95	7,000	1-C
Oct-95	20,318	1-C
Nov-95	16,860	1-C
Dec-95	190,956	1-C
Feb-96	21,170	1-C
Mar-96	84,120	1-C
Apr-96	30,220	1-C
May-96	29,680	1-C
Jun-96	61,390	1-C
Jul-96	56,330	1-C
Aug-96	36,360	1-C
Sep-96	60,370	1-C
Jan-97	24,760	4-G
Feb-97	54,790	4-G
Mar-97	12,540	4-G
Apr-97	45,820	4-G
May-97	53,700	4-G
Jun-97	20,760	4-G
Oct-97	9,920	4-G
Nov-97	3,070	4-G
Dec-97	1,740	4-G
Mar-98	16,310	4-G
Jun-98	95,610	4-G
Jul-98	208,990	4-G
Aug-98	3,670	4-G
Apr-02	45,590	4-G
May-02	63,340	4-G
Jun-02	3,980	4-G
Sep-02	150,920	4-G
Oct-02	31,680	4-G
Oct-02	334,880	4-C
Oct-02	171,950	4-I
Nov-02	82,640	4-C
Apr-03	147,980	4-C
May-03	113,542	4-C
May-03	375,847	4-I
Aug-03	16,624	4-E
Sep-03	17,331	4-E
Total	4,138,066	All cells

Table 2 Vault 1 Monthly Saltstone Production by Cell

Date	Salt Solution Gallons	Receiving Vault/Cell
Jun-90	27,990	1-A
Jul-90	73,510	1-A
Aug-90	75,010	1-A
Sep-90	70,150	1-A
Oct-90	63,540	1-A
Nov-90	75,880	1-A
Dec-90	74,980	1-A
Jan-91	62,020	1-A
Feb-91	17,460	1-A
Total 1-A	540,540	
Feb-91	32,550	1-B
Mar-91	49,990	1-B
Apr-91	52,290	1-B
May-91	75,837	1-B
Jun-91	43,470	1-B
Jul-91	33,642	1-B
Aug-91	42,340	1-B
Sep-91	27,280	1-B
Oct-91	28,798	1-B
Nov-91	28,524	1-B
Dec-91	18,629	1-B
Jan-92	10,430	1-B
Feb-92	8,700	1-B
Apr-92	10,310	1-B
Nov-92	15,750	1-B
Mar-93	11,220	1-B
Sep-93	1,050	1-B
Nov-93	5,770	1-B
Feb-94	32,720	1-B
May-94	12,000	1-B
Jun-94	12,000	1-B
Aug-94	680	1-B
Total 1-B	553,980	

Table 2 Vault 1 Monthly Saltstone Production by Cell

Date	Salt Solution Gallons	Receiving Vault/Cell
Mar-94	115,570	1-C
Apr-94	8,524	1-C
Jul-94	26,050	1-C
Sep-94	47,744	1-C
Oct-94	2,470	1-C
Nov-94	25,540	1-C
Dec-94	72,020	1-C
Jan-95	12,000	1-C
Apr-95	10,870	1-C
Jul-95	7,000	1-C
Oct-95	20,318	1-C
Nov-95	16,860	1-C
Dec-95	190,956	1-C
Feb-96	21,170	1-C
Mar-96	84,120	1-C
Apr-96	30,220	1-C
May-96	29,680	1-C
Jun-96	61,390	1-C
Jul-96	56,330	1-C
Aug-96	36,360	1-C
Sep-96	60,370	1-C
Total 1-C	935,562	

Table 3 Vault 4 Monthly Saltstone Production by Cell

Month/Year	Salt Solution Gallons	Receiving Vault/Cell
Oct-02	334,880	4-C
Nov-02	82,640	4-C
Apr-03	147,980	4-C
May-03	113,542	4-C
Total 4-C	679,042	
Aug-03	16,624	4-E
Sep-03	17,331	4-E
Total 4-E	33,955	
Jan-97	24,760	4-G
Feb-97	54,790	4-G
Mar-97	12,540	4-G
Apr-97	45,820	4-G
May-97	53,700	4-G
Jun-97	20,760	4-G
Oct-97	9,920	4-G
Nov-97	3,070	4-G
Dec-97	1,740	4-G
Mar-98	16,310	4-G
Jun-98	95,610	4-G
Jul-98	208,990	4-G
Aug-98	3,670	4-G
Apr-02	45,590	4-G
May-02	63,340	4-G
Jun-02	3,980	4-G
Sep-02	150,920	4-G
Oct-02	31,680	4-G
Total 4-G	847,190	
Oct-02	171,950	4-I
May-03	375,847	4-I
Total 4-I	547,797	

Table 4 Vault 1 Sum of Fractions.

Nuclide	Total Ci/vault 9/30/2006	10K Yr Limit Total Ci/vault	Fraction of 10K Yr Limit	1K Yr Limit Total Ci/vault	Fraction of 1K Year Limit
H-3	2.34E+01	2.75E+11	8.51E-11	2.75E+11	8.51E-11
C-14	1.28E+00	2.20E+07	5.82E-08	2.20E+07	5.82E-08
Co-57	NR	no limit	0.00E+00	no limit	0.00E+00
Ni-59	< 3.46E-02	1.25E+17	2.77E-19	no limit	0.00E+00
Co-60	1.93E-03	2.90E+09	6.66E-13	2.90E+09	6.66E-13
Ni-63	9.20E-01	no limit	0.00E+00	no limit	0.00E+00
Se-79	3.02E-01	5.00E+02	6.04E-04	2.40E+06	1.26E-07
Sr-90	1.23E-02	1.20E+16	1.02E-18	1.20E+16	1.02E-18
Nb-94	< 2.51E-03	5.00E+02	< 5.02E-06	5.00E+02	< 5.02E-06
Tc-99	1.08E+02	1.85E+13	5.84E-12	1.85E+13	5.84E-12
Ru-103	NR	no limit	0.00E+00	no limit	0.00E+00
Ru-106	1.72E-03	no limit	0.00E+00	no limit	0.00E+00
Sb-124	NR	no limit	0.00E+00	no limit	0.00E+00
Sb-125	6.49E+01	7.00E+16	9.27E-16	7.00E+16	9.27E-16
Sn-126	9.97E-01	6.00E+02	1.66E-03	6.00E+02	1.66E-03
I-129	1.12E-01	1.10E+02	1.02E-03	9.00E+06	1.24E-08
Ba-133	NR	no limit	0.00E+00	no limit	0.00E+00
Cs-134	NR	2.05E+19	0.00E+00	2.05E+19	0.00E+00
Cs-137	7.47E+00	3.00E+06	2.49E-06	3.00E+06	2.49E-06
Ce-141	NR	no limit	0.00E+00	no limit	0.00E+00
Pm-144	NR	no limit	0.00E+00	no limit	0.00E+00
Pm-146	NR	no limit	0.00E+00	no limit	0.00E+00
Sm-151	NR	no limit	0.00E+00	no limit	0.00E+00
Eu-152	*< 6.02E-03	3.20E+06	1.88E-09	3.20E+06	1.88E-09
Eu-154	< 1.62E-03	6.00E+07	< 2.70E-11	6.00E+07	< 2.70E-11
Eu-155	NR	5.50E+18	0.00E+00	5.50E+18	0.00E+00
U-232	NR	4.50E+03	0.00E+00	4.50E+03	0.00E+00
U-233	*+ 2.85E-01	7.00E+03	4.07E-05	4.45E+04	6.40E-06
U-234	*+ 2.85E-01	2.25E+03	1.27E-04	9.00E+04	3.17E-06
U-235	*# 3.17E-03	5.00E+04	6.34E-08	2.90E+05	1.09E-08
U-236	*# 3.17E-03	1.60E+08	1.98E-11	1.60E+09	1.98E-12
Np-237	< 4.49E-03	3.35E+04	< 1.34E-07	3.85E+04	< 1.17E-07
U-238	* 7.36E-03	3.30E+04	2.23E-07	4.00E+04	1.84E-07
Pu-238	* 9.42E-03	6.50E+06	1.45E-09	3.10E+08	3.04E-11
Pu-239	*§ 1.23E-02	7.00E+09	1.76E-12	1.50E+10	8.20E-13
Pu-240	*§ 1.23E-02	1.50E+12	8.20E-15	1.15E+14	1.07E-16
Pu-241	< 3.14E-02	5.00E+09	< 6.29E-12	7.50E+09	< 4.19E-12
Am-241	* 4.89E-04	1.70E+08	2.88E-12	2.40E+08	2.04E-12
Pu-242	* 9.03E-04	2.45E+10	3.69E-14	2.60E+11	3.47E-15
Am-242m		4.90E+06	0.00E+00	0.00E+00	0.00E+00
Am-243	NR	1.50E+05	0.00E+00	1.50E+05	0.00E+00
Cm-243	^ NR	3.50E+09	0.00E+00	3.50E+09	0.00E+00
Cm-244	^ NR	5.50E+14	0.00E+00	4.30E+16	0.00E+00

Table 4 Vault 1 Sum of Fractions.

Cf-251	NR	9.00E+05		0.00E+00	9.00E+05		0.00E+00
Sum of Fractions			<	3.46E-03		<	1.68E-03

NOTES: 1) All activity reported from WSRC-RP-2006-00568, revision 0 and these inventories were decayed 273 days using Rad Chem © Version 2.0 software (G-SQP-A-00006).

2) Activities listed as NR were not reported on applicable sample analyses.

3) Vault limits based on Cook et al. (2005), limits for Vault 1 were assumed to be half of the limit of Vault 4 based on volume.

4) * indicates a value calculated based on available data which was NR for one or more cells

5) + indicates inventory based on U-233/234 analysis results.

6) # indicates inventory based on U-235/236 analysis results.

7) § indicates inventory based on Pu-239/240 analysis results.

8) ^ indicates inventory based on Cm-243/244 analysis results.

Table 5 Vault 4 Sum of Fractions

Nuclide	Total Ci/vault 9/30/2006	10K Yr Limit Total Ci/vault	Fraction of 10K Yr Limit	1K Yr Limit Total Ci/vault	Fraction of 1K Yr Limit
H-3	2.52E+01	5.50E+11	4.58E-11	5.50E+11	4.58E-11
C-14	2.35E-01	4.40E+07	5.34E-09	4.40E+07	5.34E-09
Co-57	* 2.63E-05	no limit	0.00E+00	no limit	0.00E+00
Ni-59	< 9.09E-03	2.50E+17	3.64E-20	no limit	0.00E+00
Co-60	4.76E-03	5.80E+09	8.20E-13	5.80E+09	8.20E-13
Ni-63	< 5.90E-02	no limit	0.00E+00	no limit	0.00E+00
Se-79	2.57E-02	1.00E+03	2.57E-05	4.80E+06	5.35E-09
Sr-90	2.97E-01	2.40E+16	1.24E-17	2.40E+16	1.24E-17
Nb-94	< 9.91E-04	1.00E+03	< 9.91E-07	1.00E+03	< 9.91E-07
Tc-99	2.35E+01	3.70E+13	6.35E-13	3.70E+13	6.35E-13
Ru-103	* 5.68E-13	no limit	0.00E+00	no limit	0.00E+00
Ru-106	9.27E-04	no limit	0.00E+00	no limit	0.00E+00
Sb-124	* 2.30E-07	no limit	0.00E+00	no limit	0.00E+00
Sb-125	4.72E-01	1.40E+17	3.37E-18	1.40E+17	3.37E-18
Sn-126	5.66E-02	1.20E+03	4.72E-05	1.20E+03	4.72E-05
I-129	8.16E-02	2.20E+02	3.71E-04	1.80E+07	4.53E-09
Ba-133	NR	no limit	0.00E+00	no limit	0.00E+00
Cs-134	* 5.24E-03	4.10E+19	1.28E-22	4.10E+19	1.28E-22
Cs-137	1.57E+01	6.00E+06	2.62E-06	6.00E+06	2.62E-06
Ce-141	* 7.66E-07	no limit	0.00E+00	no limit	0.00E+00
Pm-144	* 1.10E-03	no limit	0.00E+00	no limit	0.00E+00
Pm-146	* 1.39E-04	no limit	0.00E+00	no limit	0.00E+00
Sm-151	*< 9.10E-04	no limit	0.00E+00	no limit	0.00E+00
Eu-152	*< 4.47E-03	6.40E+06	< 6.98E-10	6.40E+06	< 6.98E-10
Eu-154	< 7.27E-03	1.20E+08	< 6.06E-11	1.20E+08	< 6.06E-11
Eu-155	< 1.07E-03	1.10E+19	9.75E-23	1.10E+19	9.75E-23
U-232	* 9.28E-03	9.00E+03	1.03E-06	9.00E+03	1.03E-06
U-233	+ 3.52E+00	1.40E+04	2.51E-04	8.90E+04	3.96E-05
U-234	+ 3.52E+00	4.50E+03	7.82E-04	1.80E+05	1.96E-05
U-235	# 6.81E-02	1.00E+05	6.81E-07	5.80E+05	1.17E-07
U-236	# 6.81E-02	3.20E+08	2.13E-10	3.20E+09	2.13E-11
Np-237	4.87E-03	6.70E+04	7.27E-08	7.70E+04	6.32E-08
U-238	< 1.10E-01	6.60E+04	< 1.67E-06	8.00E+04	< 1.38E-06
Pu-238	6.63E-01	1.30E+07	5.10E-08	6.20E+08	1.07E-09
Pu-239	§ 1.33E-01	1.40E+10	9.50E-12	3.00E+10	4.43E-12
Pu-240	§ 1.33E-01	3.00E+12	4.43E-14	2.30E+14	5.78E-16
Pu-241	1.43E-02	1.00E+10	1.43E-12	1.50E+10	9.52E-13
Am-241	6.44E-02	3.40E+08	1.89E-10	4.80E+08	1.34E-10
Pu-242	< 8.03E-03	4.90E+10	1.64E-13	5.20E+11	1.54E-14
Am-242m		9.80E+06	0.00E+00	1.60E+07	0.00E+00
Am-243	* 1.30E-03	3.00E+05	4.33E-09	3.00E+05	4.33E-09
Cm-243	^ 7.54E-02	7.00E+09	1.08E-11	7.00E+09	1.08E-11
Cm-244	^ 7.46E-02	1.10E+15	6.78E-17	8.60E+16	8.68E-19

Table 5 Vault 4 Sum of Fractions

Cf-251	* 2.47E-01	1.80E+06		1.37E-07	1.80E+06	1.37E-07
Sum of Fractions			<	1.48E-03		< 1.13E-04

NOTES:

1) All activity reported from WSRC-RP-2006-00568, Revision 0 and these inventories were decayed 273 days using Rad Chem © Version. 2 software (G-SQP-A-00006).
2) Activities listed as NR were not reported on applicable sample analyses.
3) Vault limits based on Cook et al. (2005)
4) * indicates a value calculated based on available data which was NR for one or more cells
5) + indicates inventory based on U-233/234 analysis results.
6) # indicates inventory based on U-235/236 analysis results.
7) § indicates inventory based on Pu-239/240 analysis results
8) ^ indicates inventory based on Cm-243/244 analysis results.

Monitoring Results

The environmental monitoring and vault inspection programs were developed to be in conformance to the facility Performance Assessment. The monitoring data and evaluation are presented in this section.

Reason for Monitoring

Per the requirements in the Disposal Authorization Statement (DAS) issued for the SDF (USDOE 1999b), a monitoring plan was written, approved, and implemented within one year of issuance of the DAS (9/28/00) (Cook et al. 2000a). The monitoring plan requires an annual data review and evaluation. Following this annual data review and evaluation, any modifications to the monitoring plan that may be applicable will be noted and the plan updated as necessary.

Monitoring to be performed as part of the plan is intended to meet the requirements of USDOE Order 435.1 and its associated implementation manual and guide. These documents require disposal facilities to monitor for compliance with the conditions of the DAS. In particular, the following must be addressed:

- The site-specific performance assessment (PA) and composite analysis (CA) shall be used to determine the media, locations, radionuclides, and other substances to be monitored.

- The environmental monitoring program shall be designed to include measuring and evaluating releases, migration of radionuclides, disposal unit subsidence, and changes in disposal facility and disposal site parameters which may affect long-term performance.

- The environmental monitoring programs shall be capable of detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the PA performance objectives (USDOE 1999).

Monitoring Plan

Table 6 summarizes the monitoring that has been implemented to assess the SDF compliance with the performance objectives identified in the facility's PA (WSRC 1992) and SAs and included in the DAS.

Table 6 Summary Monitoring Table

Pathway/Relevant Feature	Media/ Inspection	Monitoring Location	Radionuclide/ Other Substance	Sampling Frequency	Sampling Method	Analytical Method	Minimum Detectable Activity/Method Detection Limit
Groundwater pathway	Groundwater	Well ZBG1 Well ZBG2	Gross alpha Nonvolatile beta Tritium Nitrate (as N) Nitrite (as N)	Twice per year	Well sampling	As designated in the groundwater protection management program (WSRC 1996)	As designated in the groundwater protection management program (WSRC 1996)
		Immediately down gradient of vaults (determined with SCDHEC concurrence prior to each sampling event)	Nitrate (as N)	Once every two years	Hydrocone technology	As designated in the groundwater protection management program (WSRC 1996)	As designated in the groundwater protection management program (WSRC 1996)
Vault integrity	Vault external/internal features (as appropriate)	Periphery of vaults 1 and 4	N/A	Quarterly	Visual	N/A	N/A
		Vault 4 Cell G	N/A	Annually	Video camera	N/A	N/A

NOTES: N/A Not applicable

Monitoring Data

The analytical results for monitoring wells ZBG-1 and ZBG-2 for the time period October 1, 2005 through September 30, 2006 are presented in Table 7.

Procedure 138-9-SSF-4001 is used to conduct monthly vault inspections. There were no findings of any significance in FY 2006.

No hydrocone sampling has been performed since 2000. Biennial hydrocone samples are no longer required by SCDHEC. Permanently installed monitoring wells are used instead. Nitrite sampling is no longer performed.

Data Evaluation

Data Evaluation vs. Action Levels

A comparison of the results from each monitoring well with the Maximum Contaminant Level (MCL) for each constituent is given in Table 8. All results are below the respective MCLs.

Data Evaluation vs. Performance Assessment Results

The Performance Assessment results indicate that no releases from the saltstone vaults are expected for over one thousand years. The analytical and vault inspection results to date do not contradict the model results.

Recommendations Based on Data Evaluation

The analytical results from the monitoring well samples seem to be quite constant. The sample collection and analysis frequency should be reduced to once per year.

Table 7 PA Monitoring Summary Table Monitoring Wells (ZBG1 and ZBG2)

Well	Collection Date	Result	Units	Analyte name
ZBG 1	2/28/2006	2.22	pCi/L	GROSS ALPHA
ZBG 1	2/28/2006	1.76	pCi/L	GROSS ALPHA
ZBG 1	7/12/2006	3.31	pCi/L	GROSS ALPHA
ZBG 2	2/28/2006	0.37	pCi/L	GROSS ALPHA
ZBG 2	7/13/2006	0.548	pCi/L	GROSS ALPHA
ZBG 1	2/28/2006	1.75	pCi/L	NONVOLATILE BETA
ZBG 1	2/28/2006	2.51	pCi/L	NONVOLATILE BETA
ZBG 1	7/12/2006	2.73	pCi/L	NONVOLATILE BETA
ZBG 2	2/28/2006	0.659	pCi/L	NONVOLATILE BETA
ZBG 2	7/13/2006	-0.371	pCi/L	NONVOLATILE BETA
ZBG 1	2/28/2006	3.9	pCi/mL	TRITIUM
ZBG 1	7/12/2006	3.4	pCi/mL	TRITIUM
ZBG 2	2/28/2006	2.75	pCi/mL	TRITIUM
ZBG 2	7/13/2006	2.85	pCi/mL	TRITIUM
ZBG 1	2/28/2006	1.94	mg/L	NITRATE-NITRITE AS NITROGEN
ZBG 1	7/12/2006	2	mg/L	NITRATE-NITRITE AS NITROGEN
ZBG 1	7/12/2006	2.03	mg/L	NITRATE-NITRITE AS NITROGEN
ZBG 2	2/28/2006	0.623	mg/L	NITRATE-NITRITE AS NITROGEN
ZBG 2	7/13/2006	0.487	mg/L	NITRATE-NITRITE AS NITROGEN

Table 8 Comparison of analytical results to MCLs

Well	Constituent	Mean	Maximum	MCL	Unit
ZBG-1	Gross alpha	2.43	3.31	15	pCi/L
ZBG-2	Gross alpha	0.459	0.548	15	pCi/L
ZBG-1	Nonvolatile beta	2.33	2.73	8*	pCi/L
ZBG-2	Nonvolatile beta	0.144	0.659	8*	pCi/L
ZBG-1	Tritium	3650	3900	20,000	pCi/L
ZBG-2	Tritium	2800	2850	20,000	pCi/L
ZBG-1	Nitrate-Nitrite as N	1.99	2.03	10**	mg/L
ZBG-2	Nitrate-Nitrite as N	0.555	0.623	10**	mg/L
ZBG-1	Nitrite as N	No data	No data	1	mg/L
ZBG-2	Nitrite as N	No data	No data	1	mg/L

* MCL for ^{90}Sr, the nonvolatile beta emitting radionuclide with the lowest MCL
** MCL for Nitrate

RESEARCH & DEVELOPMENT

Special Analyses and Evaluations

No Special Analyses or UDQ Evaluations were performed in FY06. A number of other PA-related tasks have been completed since the last Saltstone Annual Review (WSRC 2006). These tasks are described and tasks planned or underway in FY07 are briefly discussed below

Past Events

Special Analyses

<u>Program Plan for Revision of the Z-Area Saltstone Disposal Facility Performance Assessment (U)</u> (Cook, 2005). This program plan has been prepared to outline the general approach, scope, schedule and resources for the next PA revision. The plan briefly describes the task elements of the PA process. It discusses critical PA considerations in the development of conceptual models and interpretation of results. Applicable quality assurance (QA) requirements are identified and the methods for implementing QA for both software and documentation are described. The Program issues and risks are identified as well as mitigation of those risks. Finally, a preliminary program schedule has been developed and key deliverables identified.

UDQ Evaluations

No UDQ Evaluations were performed in FY 2006

Studies

<u>Confirmatory Analysis of Saltstone Vault 2 Conceptual Design</u>. The Saltstone Project recently prepared a conceptual design package for Saltstone Vault 2, Bldg. 451-002Z. The design concept is that of a cylindrical, pre-cast, post-tensioned, reinforced concrete tank with nominal inside dimensions of 150 ft diameter and 20 ft height, based on commercial water tank technology (American Water Works Association standard D-115). The Savannah River National Laboratory was asked to confirm that the conceptual design can meet DOE Order 435.1 performance objectives through a post-closure 10,000 year period of compliance, with proper selection of materials and vault dimensions. Structural and porous media flow and transport analyses indicate that an AWWA D-115 will meet performance objectives under a number of specified conditions. No report was issued for this study (Aleman, Sebastian E. Flach, Gregory P. Peregoy, William L. and Phifer, Mark A.).

<u>Thermodynamic and Mass Balance Analysis of Expansive Phase Precipitation in Saltstone</u> (Denham 2006) This report assesses the potential for future precipitation of expansive sulfate-bearing phases that can potentially cause fracturing in saltstone. It

examines the equilibrium case using The Geochemist's Workbench® reaction path model for a number of scenarios. The diffusion scenarios result in only minor precipitation, and no precipitation of ettringite. There are numerous factors that control how much ettringite precipitation cement can sustain before fracturing occurs. Nevertheless, only a small fraction of porosity is filled by precipitation at equilibrium. Slow migration of water through saltstone and the small amount of porosity filled by precipitating phases favor long-term structural survival of saltstone. This is but one theoretical approach for analyzing long-term behavior of saltstone, more sophisticated approaches can be taken as information on saltstone chemistry and mineralogy improves.

<u>Estimating Groundwater Nitrate Concentrations for Saltstone Vault 2 Industrial Solid Waste Landfill Permit (U)</u> (Jones et al, 2006). Estimates for groundwater nitrate concentrations expected from Saltstone Vault 2 are required for the Vault 2 Industrial Solid Waste Landfill Permit. This report presents vault design, vadose zone transport, and aquifer transport analyses for nitrate for a cylindrical tendon-type water tank design. The results show that nitrate released to groundwater from Vault 2 is not expected to result in groundwater concentrations above drinking water standards (10 ppm) at the groundwater monitoring point.

<u>Geochemical Data Package for Performance Assessment Calculations Related to the Savannah River Site</u> (Kaplan 2006). The objective of this document is to provide the geochemical values for Performance Assessment calculations. This document also provides the geochemical conceptual model, approach used for selecting the values, the justification for selecting data and the assumptions made to assure that the conceptual and numerical geochemical models are reasonably conservative. The geochemical parameters describe transport processes for 38 elements (>90 radioisotopes) potentially occurring within eight disposal units including those units in the E-Area Low Level Waste Disposal Facility and the Saltstone Facility.

<u>Geosynthetic Clay Liner (GCL) Compatibility with Saltstone Leachate</u> (Dixon and Phifer, 2006) The purpose of this task was to examine the effects of the Saltstone leachate on the hydraulic properties of a sodium bentonite GCL. The GCL is used in conjunction with a high density polyethylene (HDPE) geomembrane as a combined hydraulic/diffusional barrier to contaminant migration. The GCL primarily functions as a hydraulic barrier to plug tears that develop in the HDPE geomembrane over time. These studies demonstrate that the a GCL in contact with a simulated Saltstone pore fluid had an average saturated hydraulic conductivity below 1.0×10^{-7} which is the saturated hydraulic conductivity necessary for the GCL to maintain effective performance.

<u>Hydraulic Property Data Package for the E-Area and Z-Area Soils, Cementitious Materials, and Waste Zone</u> (Phifer et al, 2006). Hydraulic property estimates for the soils, the cementitious materials, and the wastezones associated with the E-Area and Z-Area low-level radioactive waste disposal units have been provided to support the Performance Assessments (PA) for the E-Area Low-Level Waste Facility (LLWF) and the Z-Area Saltstone Disposal Facility (SDF). Nominal or "best estimate" hydraulic property values for use in the deterministic modeling are provided along with representations of the hydraulic property value uncertainty for use sensitivity and

uncertainty modeling. The hydraulic properties provided for each of the EArea and Z-Area materials include porosity (η), dry bulk density (ρ_b), particle density (ρ_p), saturated hydraulic conductivity (K_{sat}), characteristic curves (suction head, saturation, and relative permeability), and effective diffusion coefficient (D_e). A representation of the uncertainty associated with each property, except for the characteristic curves, is provided for each material, except for the E-Area waste zones.

PA Maintenance.

Application for Revision of the Z-Area Industrial Solid Waste Landfill Permit. In July 2005 a series of revisions to the Z-Area Industrial Solid Waste Landfill Permit were completed and submitted to the South Carolina Department of Health and Environmental Control (SCDHEC) in recognition of a number of changes that have been made in the salt processing program. The groundwater monitoring plan required by SCDHEC was revised and incorporated into these revisions. SCDHEC did not approve this revision to the application in FY 2006.

WSRC Submittal of the Saltstone Radioactive Waste Management Basis (RWMB) for the Closure Business Unit/Waste Solidification Project/Saltstone (Z-Area) Facility (WSRC 2005). This RWMB revision adds the DOE-approved 2005 Special Analysis (SA) for Vault 4 and removes the Special Analysis completed in 2002.

Future Events

Special Analyses

SRNL is in the process of preparing a performance assessment revision for the Saltstone Disposal Facility which will incorporate a new salt waste processing plan and a new vault design. A number of significant changes have been implemented since the last PA revision resulting in a new design for future SDF disposal units. This revision will encompass the existing and planned disposal units, PA critical radionuclides and exposure pathways important to SDF performance. An integrated analysis of the overall facility layout, including all disposal units, will be performed to assess the impact of plume overlap on PA results. Finally, a rigorous treatment of uncertainty will be undertaken using probabilistic simulations. This analysis will be reviewed and approved by DOE-SR, DOE HQ and potentially the Nuclear Regulatory Commission (NRC).

Studies

A number of Studies are scheduled to start in FY2007. These studies are described briefly below.

<u>Fundamental Mechanisms of Saltstone and Vault Degradation</u>
Laboratory experiments will be conducted to provide insight into the fundamental mechanisms of saltstone and vault degradation. Reaction rate kinetics will be studied and the newly formed solid phase formed during the sulfate attack will be specified using spectroscopic and microscopic techniques. Presently, there is no mechanistic model to support assumptions about degradation of saltstone. Kinetic rate data will be provided for input values into models.

<u>Study Technetium Interaction with Reducing Saltstone</u>
The geochemistry describing the interaction of Tc with reducing grout/saltstone is extremely important to the PA. It is currently described as a solubility controlled process, however, other reactions may also be important. Additional work needs to be conducted to more completely describe this system of reactions, including the reduction and oxidation kinetics of Tc(IV) and Tc(VII) conversions, and the influence of dissolved oxygen (in groundwater) on sulfide and sulfate conversions. Additional measurements of K_{sp} values is also required to determine variability associated between Saltstone batches. Laboratory experiments will be conducted in glove boxes to determine the rate of Tc(IV) oxidation in slag-containing saltstone simulant. Reaction kinetics will be studied and the solid phase formed will be specified using spectroscopic (i.e. XANES, EXAFS) and microscopic techniques. The solubility of the precipitated phase will be measured. The uncertainty will be reduced by use of an actual measurement instead of a calculated value. Benefits include; 1) creating reaction rate kinetic terms that can be applied directly in reactive transport models, 2) defining the necessary conceptual model of reaction, including elemental composition and morphology of precipitate, and 3) providing a solubility value for Tc(IV) in saltstone that has a much smaller range of uncertainty than presently.

Evaluation of Geochemical Parameter (Kd and Ksp) Variability

At present, only an estimate as to radionuclide soption variability is available. Actual measured values are required. The variability associated with K_d and K_{sp} values must be measured to provide input into uncertainty calculations. Additionally, the distribution of the values must also be determined, for instance, are the values log-normally or normally distributed.

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Attachment A

Technical Evaluation Report Factors

	Section 4.3.1 Factors (p. 90-91)
Factor 1	The rate of waste oxidation and release of technetium from an oxidized layer of saltstone will be a key determinant of the future performance of the saltstone disposal facility and therefore whether 10 CFR 61.41 can be met. More realistic modeling will be important to achieving the performance objectives, and adequate model support is essential to providing the technical basis for the model results. It will be important to ensure that gas phase transport of oxygen through fractures will not significantly increase oxidation of technetium in the saltstone.
Factor 2	The extent of degradation that may influence the hydraulic isolation capabilities of the saltstone and vaults will be a key factor in assessing whether the SDF can meet 10 CFR 61.41. Degradation mechanisms that may result in the hydraulic conductivity of degraded saltstone and vault concrete being larger than 1 x 10-7 cm/s (1 x 10-1 ft/yr) need to be evaluated with multiple sources of information (e.g., modeling, analogs, experiments [especially field scale and long-term], expert elicitation) to ensure that they are unlikely to occur. It will be important to ensure that field-scale physical properties (e.g., hydraulic conductivity, effective diffusivity) of as-emplaced saltstone are not significantly different from the results of laboratory tests of smaller-scale samples performed to date. It will be important to perform additional laboratory measurements of hydraulic conductivity because the data being relied upon represent limited samples that had a small range of curing times. In addition, because there was a fairly significant amount of variability in the TCLP test results, if DOE deviates significantly from the nominal saltstone composition, DOE should perform additional tests for hydraulic conductivity and effective diffusivity that justify the parameter values used over the range of compositions.

	Section 4.3.1 Factors (p. 90-91)
Factor 3	Adequate model support is essential to assessing whether the saltstone disposal facility can meet 10 CFR 61.41. The model support for: (1) moisture flow through fractures in the concrete and saltstone located in the vadose zone, (2) realistic modeling of waste oxidation and release of technetium, (3) the extent and frequency of fractures in saltstone and vaults that will form over time, (4) the plugging rate of the lower drainage layer of the engineered cap, and (5) the long-term performance of the engineering cap as an infiltration barrier is key to confirming performance assessment results.
Factor 4	The erosion control design is important to ensuring that 10 CFR 61.42 can be met because it eliminates pathways and scenarios for intruder dose assessments. Implementation of an adequate design that does not deviate significantly from information submitted to the NRC in (WSRC, 2005a) and the associated references is important, or if it does deviate significantly that it is reviewed by NRC staff to ensure the revisions are consistent with long-term erosion control design principles.
Factor 5	The infiltration control design is important to ensuring that 10 CFR 61.41 can be met because the release of contaminants to the groundwater is predicted to be sensitive to the large reduction in infiltration provided by the infiltration control. It is important to ensure that the design can be implemented and will perform as designed.
Factor 6	Implementation of an adequate sampling plan is important to ensuring that 10 CFR 61.41 and 10 CFR 61.42 can be met. It is important to assess results of future sampling and confirm that current projections of the concentrations of highly radioactive radionuclides in treated salt waste (or grout) are greater than or equal to actual concentrations of highly radioactive radionuclides in treated salt waste (or grout).
Factor 7	To ensure that Tank 48 waste can be safely managed, future tests of the physical properties of samples that contain organic materials similar to Tank 48 waste will need to confirm that the properties of the wasteform made from this waste will provide for suitable wasteform performance such that the disposal system will be able to meet the performance objectives. The technical basis should, at a minimum, include tests for hydraulic conductivity and effective diffusivity.
Factor 8	Predicted removal efficiencies of highly radioactive radionuclides by each of the planned salt waste treatment processes are a key factor in determining the radiological inventory disposed of in saltstone. The inventory, in turn, is a important factor in the determination that 10 CFR 61.41 and 10 CFR 61.42 can be met.

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