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2013 Annual Summary Report for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada National Security Site, Nye County, Nevada

Review of the Performance Assessments and Composite Analyses

March 2014

Prepared by

National Security Technologies, LLC
Las Vegas, Nevada

Prepared for

U.S. Department of Energy,
National Nuclear Security Administration
Nevada Field Office
Under Contract Number
DE-AC52-06NA25946

DISCLAIMER

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EXECUTIVE SUMMARY

The *Maintenance Plan for the Performance Assessments and Composite Analyses for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site* (National Security Technologies, LLC 2007a) requires an annual review to assess the adequacy of the performance assessments (PAs) and composite analyses (CAs), with the results submitted to the U.S. Department of Energy (DOE) Office of Environmental Management. The Disposal Authorization Statements for the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) also require that such reviews be made and that secondary or minor unresolved issues be tracked and addressed as part of the maintenance plan (DOE 1999a, 2000).

The U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office performed an annual review of the Area 3 and Area 5 RWMS PAs and CAs for fiscal year (FY) 2013. This annual summary report presents data and conclusions from the FY 2013 review, and determines the adequacy of the PAs and CAs. Operational factors (e.g., waste forms and containers, facility design, and waste receipts), closure plans, monitoring results, and research and development (R&D) activities were reviewed to determine the adequacy of the PAs. Likewise, the environmental restoration activities at the Nevada National Security Site (NNSS) relevant to the sources of residual radioactive material that are considered in the CAs, the land-use planning, and the results of the environmental monitoring and R&D activities were reviewed to determine the adequacy of the CAs.

Important developments in FY 2013 include the following:

- Development of a new Area 5 RWMS closure inventory estimate based on disposals through FY 2013
- Evaluation of new or revised waste streams by special analysis
- Development of version 4.115 of the Area 5 RWMS GoldSim PA/CA model

The Area 3 RWMS has been in inactive status since July 1, 2006, with the last shipment received in April 2006. The FY 2013 review of operations, facility design, closure plans, monitoring results, and R&D results for the Area 3 RWMS indicates no changes that would impact PA validity. The conclusion of the annual review is that all performance objectives can be met and the Area 3 RWMS PA remains valid. There is no need to the revise the Area 3 RWMS PA.

Review of Area 5 RWMS operations, design, closure plans, monitoring results, and R&D activities indicates that no significant changes have occurred. The FY 2013 PA results, generated with the Area 5 RWMS v4.115 GoldSim PA model, indicate that there continues to be a reasonable expectation of meeting all performance objectives. The results and conclusions of the Area 5 RWMS PA are judged valid, and there is no need to the revise the PA.

A review of changes potentially impacting the CAs indicates that no significant changes occurred in FY 2013. The continuing adequacy of the CAs was evaluated with the new models, and no significant changes that would alter the CAs results or conclusions were found. The revision of the Area 3 RWMS CA, which will include the Yucca Flat Underground Test Area

(Corrective Action Unit [CAU] 97) source term, is scheduled for FY 2024, following the completion of the Corrective Action Decision Document/Corrective Action Plan in FY 2015. Inclusion of the Frenchman Flat Underground Test Area (CAU 98) results in the Area 5 RWMS CA is scheduled for FY 2016, pending the completion of the CAU 98 Closure Report in FY 2015.

Near-term R&D efforts will focus on continuing development of the PA, CA, and inventory models for the Area 3 and Area 5 RWMS.

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

ac	acre
Am	americium
BN	Bechtel Nevada
Bq	becquerel
Bq m^{-2} s^{-1}	becquerel per square meter per second
CA	composite analysis
CADD	Corrective Action Decision Document
CAIP	Corrective Action Investigation Plan
CAP	Corrective Action Plan
CAS	Corrective Action Site
CAU	Corrective Action Unit
CEUSP	Consolidated Edison Uranium Solidification Project
CFR	Code of Federal Regulations
Ci	curie
COCs	contaminants of concern
COPCs	contaminants of potential concern
CR	Closure Report
CY	calendar year
DAS	Disposal Authorization Statement
DOE	U.S. Department of Energy
DU	depleted uranium
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ET	evapotranspirative
FEPs	features, events, and processes
FFACO	*Federal Facility Agreement and Consent Order*
ft	foot
ft^3	cubic foot
FY	fiscal year
GCD	Greater Confinement Disposal
GMX	Gadget, Mechanics, and Explosives
GZ	ground zero
^3H	tritium
LFRG	Low-Level Waste Disposal Facility Federal Review Group
LHS	Latin hypercube sampling
LLW	low-level waste
LLWMU	Low-Level Waste Management Unit

ACRONYMS, ABBREVIATIONS AND SYMBOLS (continued)

m	meter
m^3	cubic meter
MFP	mixed fission products
mSv	millisievert
NDEP	Nevada Division of Environmental Protection
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
PA	performance assessment
Pb	lead
PSM	potential source material
Pu	plutonium
R&D	research and development
Ra	radium
RaDU	radium disposal unit
RCRA	Resource Conservation and Recovery Act
RIDP	Radionuclide Inventory and Distribution Program
Rn	radon
RTG	radioisotope thermoelectric generator
RWAP	Radioactive Waste Acceptance Program
RWMS	Radioactive Waste Management Site
SLB	shallow land burial
Sr	strontium
TBD	to be determined
TBq	terabecquerel
Tc	technetium
TED	total effective dose
Th	thorium
TLD	thermoluminescent dosimeter
TRU	transuranic
U	uranium
UDQ	unreviewed disposal question
UGTA	Underground Test Area
UR	use restriction
WAC	waste acceptance criteria

1.0 INTRODUCTION

This report summarizes the results and conclusions of an annual review of the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) performance assessments (PAs) and composite analyses (CAs). The Area 3 and Area 5 RWMSs were issued Disposal Authorization Statements (DASs) in accordance with U.S. Department of Energy Order DOE O 435.1 "Radioactive Waste Management" (U.S. Department of Energy [DOE] 2001). The Area 3 RWMS and Area 5 RWMS DASs (DOE 1999a, 2000) require preparation of an annual summary report and a determination of the continuing adequacy of the PAs and CAs. The requirement to prepare an annual summary report is implemented in the Maintenance Plan for the PAs and CAs (National Security Technologies, LLC [NSTec] 2007a). The annual summary report is submitted to the DOE Office of Environmental Management for review and approval.

The annual review summarizes changes in site operations, facility design, site monitoring, research and development (R&D), PA/CA models, and planning documents that may impact the validity of the PA and CA. The impact of changes and new information on the adequacy of the PA and CA is evaluated by answering three key questions:

1. Does the annual summary information indicate that changes to the PA or CA are required?
2. Does the annual summary information indicate that the conclusions of the PA and CA remain valid?
3. Does the annual summary information indicate that facility performance will remain within the U.S. Department of Energy Manual DOE M 435.1-1, "Radioactive Waste Management" (DOE 1999b) PA performance objectives, CA performance goals, and any conditions in the facility DAS?

This report follows the format in U.S. Department of Energy Guide DOE G 435.1-4, "Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analysis" (DOE 1999c) and presents the annual summary for the PAs in Section 2.0 and the CAs in Section 3.0. The annual summary for the PAs includes the following:

- Section 2.1 summarizes changes in waste disposal operations and includes new estimates of the closure inventories derived from the actual disposals through fiscal year (FY) 2013.
- Section 2.2 summarizes changes related to facility design and environmental monitoring.
- Section 2.3 summarizes closure plans and land use plans.
- Section 2.4 summarizes R&D activities conducted under the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) Closure and Monitoring Plans for the Area 3 and Area 5 RWMSs (NSTec 2007b, 2008a).
- Section 2.5 is a summary of changes, including proposed and discovered changes, in facility design, operation, future plans, the monitoring plan, R&D activities, and the maintenance program.

- Section 2.6 answers the key review questions addressing the continuing validity of the PA.

Section 3.0 presents the annual summary for the CAs emphasizing changes not addressed in the PA annual summary. The annual summary for the CAs includes the following:

- Section 3.1 presents an assessment of activities at the Nevada National Security Site (NNSS) that would impact the sources of residual radioactive material considered in the CAs.
- Section 3.2 summarizes R&D results for FY 2013.
- Section 3.3 updates the status of sources of residual radioactive material interacting with the Area 3 and Area 5 RWMSs.
- Section 3.4 summarizes changes in monitoring plans, R&D activities, and the maintenance program that occurred since the CAs were prepared.
- Section 3.4.3.1 updates the CA results using the FY 2013 inventories and models.
- Section 3.5 answers the key review questions regarding the continuing validity of the CA.

Appendix A is a self evaluation using the Low-Level Waste Disposal Facility Federal Review Group (LFRG) annual summary checklist.

1.1 STATUS OF DISPOSAL AUTHORIZATION STATEMENT CONDITIONS

The Area 3 RWMS PA and CA were issued in a single document (Shott et al. 2001). The Area 3 RWMS was issued a DAS on October 20, 1999 (DOE 1999a). The Area 3 RWMS DAS contained one PA condition and two CA conditions (Tables 1 and 2). All DAS conditions were resolved with the PA/CA document revision (Shott et al. 2001).

Table 1. Status of the Area 3 RWMS DAS PA Conditions

Condition	Status
"Provide to LFRG, within eight months of the date of issuance of this disposal authorization statement, a revision to the performance assessment that includes resolution of the following secondary issues: 1) Lack of justification for excluding particular exposure scenarios based on exhumed waste, 2) Inadequate justification for omission of surface water, 3) Lack of sensitivity analysis regarding the assumed 250 years of institutional control, 4) Need for clarification of the Resource Conservation and Recovery Act (RCRA)/CERCLA regulatory involvement, if any, in low-level waste disposal at Area 3, 5) Need for clarification of the location of the point of maximum exposure, 6) Need for better explanation of the borehole and field data within the framework of the no-recharge conceptual model."	A revised Area 3 RWMS PA/CA was issued in December 2001 (Shott et al. 2001). The DAS conditions were closed in 2002 (DOE 2002a).

Table 2. Status of the Area 3 RWMS DAS CA Conditions

Condition	Status
"Provide to LFRG, within eight months of the date of issuance of this disposal authorization statement, a revision to the composite analysis that includes qualitative assessment including an options analysis of the effect of groundwater contamination resulting from underground nuclear testing. Before any portion of the Nevada Test Site is considered for a reduction in institutional control, Nevada Operations Office will have quantified the potential dose from the underground testing residues and taken measures to mitigate the dose, as appropriate."	A revised Area 3 RWMS PA/CA was issued in December 2001 (Shott et al. 2001). The DAS conditions were closed in 2002 (DOE 2002a).
"Resolution of the following secondary issues identified in the review of the composite analysis: Need for a better explanation of the borehole and field data within the framework of the no-recharge conceptual model."	A revised Area 3 RWMS PA/CA was issued in December 2001 (Shott et al. 2001). The DAS conditions were closed in 2002 (DOE 2002a).

The Area 5 RWMS PA documentation consists of the original DOE O 435.1 low-level waste (LLW) PA (Shott et al. 1998) and supporting addenda (Bechtel Nevada [BN] 2001a, 2006). The Area 5 RWMS CA was issued as a single document (BN 2001b) and has a single addendum (BN 2001c).

In addition to the LLW PA, a PA was prepared and approved to meet the requirements of Title 40 Code of Federal Regulations (CFR) Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Waste" (CFR 1994). The 40 CFR 191 PA was prepared for transuranic (TRU) waste disposed in Greater Confinement Disposal (GCD) boreholes at the Area 5 RWMS (Cochran et al. 2001).

The Area 5 RWMS DAS was issued on December 5, 2000 (DOE 2000). The PA and CA each had two conditions (Tables 3 and 4). All DAS conditions were closed on May 23, 2002.

Table 3. Status of the Area 5 RWMS DAS PA Conditions

Condition	Status
"The specific radionuclide concentration or inventory limits shall be imposed on Pit 6 to ensure that performance objectives will not be exceeded. A quantitative dose estimate shall be calculated using the reduced inventory to determine compliance with the performance objective."	An addendum to the Area 5 RWMS PA was issued in November 2001 (BN 2001a). The DAS conditions were closed in 2002 (DOE 2002b). Pit 6 was closed in FY 2011.
"The closure plan shall require a closure cap thickness of at least 4 meters as stated in Section 5.1 of the 1998 PA to ensure that performance objectives for the agricultural scenario will not be exceeded. A quantitative dose estimate shall be calculated using the 4 meter cap to demonstrate compliance with the performance objectives."	An addendum to the Area 5 RWMS PA was issued in November 2001 (BN 2001a). The DAS conditions were closed in 2002 (DOE 2002b).

Table 4. Status of the Area 5 RWMS DAS CA Conditions

Condition	Status
"The CA for the RWMS shall either be revised or an addendum issued within one year of the date of the issuance of this DAS to incorporate the Supplemental Information. The revised CA or addendum shall be submitted to the LFRG. Nevada Operations Office shall address all secondary issues and issues identified in Appendix B of the Review Team Report through the maintenance program."	An addendum to the Area 5 RWMS CA was issued in November 2001 (BN 2001c). The DAS conditions were closed in 2002 (DOE 2002b).
"Consistent with the site's Land-Use Plan and the conditions identified in the Area 3 DAS before any portion of the Nevada Test Site is considered for a reduction in institutional controls, Nevada Operations Office will have quantified the potential dose from the underground testing residues."	An addendum to the Area 5 RWMS CA was issued in November 2001 (BN 2001c). The DAS conditions were closed in 2002 (DOE 2002b).

1.2 TRACKING OF SECONDARY ISSUES

The Maintenance Plan (NSTec 2007a) addresses resolution of secondary issues identified in the LFRG review reports for the Area 3 and Area 5 RWMS PAs and CAs. Table 5 lists the secondary issues that were tracked and resolved through the maintenance program. The resolution for each issue is included in the third column of Table 5. All secondary issues are currently resolved.

Table 5. Secondary Issues Identified in the LFRG Review Reports for the Area 3 and Area 5 RWMS PAs and CAs

Identified Issue	Source Document for Issue	Resolution
An engineered barrier will be added, and the assurance requirements of 40 CFR 191 must be met for the GCD boreholes.	GCD PA	The GCD assurance requirements, including installation of an engineered barrier, will be met at the time of final closure of the Area 5 RWMS in FY 2028.
Inconsistencies exist between conceptual models for the Area 5 RWMS PA and CA, the Area 3 RWMS PA and CA, and the GCD PA.	Area 5 RWMS PA, Area 5 RWMS CA, Area 3 RWMS PA/CA, GCD PA	The continuous development of PA and CA models using the GoldSim software system has systematically eliminated inconsistencies. This work will continue to be described in annual summary reports.
Conduct site monitoring and site characterization studies, as required, to increase confidence in the results of the PAs.	Area 3 RWMS PA/CA	Monitoring programs at both Area 3 and Area 5 RWMSs are ongoing; data are being incorporated into the GoldSim models to increase confidence in the PA results.

Table 5. Secondary Issues Identified in the LFRG Review Reports for the Area 3 and Area 5 RWMS PAs and CAs (continued)

Identified Issue	Source Document for Issue	Resolution
The maintenance program must include periodic assessment of changes in potentially interacting sources (Underground Test Areas [UGTAs], industrial sites) and impacts on the CAs.	Area 5 RWMS CA, Area 3 RWMS PA/CA	All interacting sources are being closed under the *Federal Facility Agreement and Consent Order* (FFACO) process. FFACO documents are reviewed as part of the annual review process. Site characterization data and corrective actions are compared with CA assumptions.
The maintenance program must include periodic assessment of changes in land-use restrictions and impacts on the CAs.	Area 5 RWMS CA, Area 3 RWMS PA/CA	Changes in land-use restrictions are reviewed annually through the maintenance program, and results are presented in the annual summary reports.
Monitoring systems need to be deployed and data gathered and evaluated to distinguish between interacting sources at the Area 3 RWMS.	Area 3 RWMS PA/CA	The monitoring systems deployed at the disposal facilities are described in the site closure plans (NSTec 2007b, 2008a). Monitoring results are evaluated in the annual summary reports.

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2.0 PERFORMANCE ASSESSMENT REVIEW

The PA maintenance plan requires an annual review of waste operations including evaluation of waste forms, waste containers, facility design, waste acceptance criteria (WAC), closure design, and waste inventory. Changes in waste inventory, facility design, WAC, environmental monitoring, institutional controls, and closure design occurring during FY 2013 are noted and described below. The impacts of these changes are assessed in Section 2.5.

2.1 WASTE DISPOSAL OPERATIONS

2.1.1 Waste Forms and Containers

The Area 3 and Area 5 RWMS PAs do not explicitly model the effects of waste forms and containers on the near-field release of radionuclides. Radionuclides are assumed to be fully available for release and transport at site closure. These assumptions continue to apply for waste disposed at the Area 3 and Area 5 RWMSs through FY 2013.

2.1.2 Waste Receipts

The Area 3 and Area 5 RWMS PAs analyze waste inventories that are estimated as the sum of known past disposals and estimated future disposals. The closure inventory estimate changes over time as records of past disposals are revised, waste received does not match forecasts, or future waste forecasts change. Closure inventory uncertainty is dominated by uncertainty in future disposals. Sources of uncertainty that are unique to future disposals include approval of new waste generators, acceptance of new waste streams, and disposal of wastes at alternative disposal sites. The FY 2013 closure inventory estimates for the Area 3 and Area 5 RWMS are summarized below.

2.1.2.1 New or Revised Waste Streams

Each new or revised waste stream is evaluated by the Radioactive Waste Acceptance Program (RWAP) for its conformance with WAC and potential impacts on the PA. Each new or revised waste stream is considered a potential unreviewed disposal question (UDQ). These potential UDQs enter the UDQ process to identify significant changes that impact the PA, CA, DAS, or Radioactive Waste Management Basis. The UDQ process for new or revised waste streams includes a comparison of waste concentrations with the WAC action levels using a sum of fractions calculation. Waste streams with a sum of fractions greater than one or with a potential to cause changes to operations or the Radioactive Waste Management Basis are classified as positive UDQs. Positive UDQs are usually resolved by preparation, review, and approval of a special analysis.

Special analyses for inventory changes are performed by adding the additional inventory to the Area 5 RWMS PA model and determining if all performance objectives can be met. Occasionally, waste streams may present issues other than inventory changes that require a special analysis. If the special analysis shows that all performance objectives can be met, the waste stream is recommended for approval.

Three special analyses were performed for new or revised waste streams in FY 2013 (Table 6). All of the special analyses involved radionuclides that exceeded WAC action levels. The special analyses indicated that all performance objectives could be met with the addition of the waste streams to the site inventory.

Table 6. Waste Streams Evaluated by Special Analysis in FY 2013

Waste Stream	Description	Issues	Result
DRTK000000050, Rev. 0	Consolidated Edison Uranium Solidification Project (CEUSP) Waste	^{232}U, ^{230}Th, ^{233}U, ^{234}U, and ^{229}Th Inventory	Accepted
PERMC00000004, Rev. 0	Classified Stabilized Low-Level Waste	^{99}Tc Inventory	Accepted
NEID09INLCLLW, Rev. 6	Idaho National Laboratory Routinely Generated Contact Handled Low-Level Waste	^{3}H, ^{60}Co, ^{90}Sr, and ^{137}Cs Inventory	Accepted

The CEUSP Waste, DRTK00000050, consists of 403 stainless steel canisters partially filled with ceramic-like monoliths of uranium oxide (U_3O_8) highly enriched in naturally occurring uranium-235 (^{235}U) and man-made ^{233}U. The CEUSP Waste required a PA special analysis because the concentrations of thorium-229 (^{229}Th), ^{230}Th, ^{232}U, ^{233}U, and ^{234}U exceeded their NNSS WAC action levels. The unique characteristics of the CEUSP Waste generated stakeholder interest and questions. In response to stakeholder questions, the CEUSP Waste special analysis evaluated the long-term performance of the waste. Analysis of long-term performance included evaluations of climate change, institutional controls, site features, and PA model results for 10,000 and 60,000 years.

Addition of the CEUSP Waste to the Area 5 RWMS inventory slightly increased the results for all PA results (NSTec 2013a). PA model results provide a reasonable expectation of meeting all performance objectives for 1,000 years. Evaluations of long-term performance indicate the disposal of the CEUSP Waste is protective of human health and the environment for up to 60,000 years. The peak all-pathways dose from the CEUSP Waste occurs at approximately 48,000 years. Disposal of the CEUSP waste was found to meet all NNSS WAC requirements and DOE Manual 435.1-1 performance objectives.

2.1.2.2 FY 2013 Closure Inventory Estimate for the Area 3 RWMS

The Area 3 RWMS was placed in inactive status July 1, 2006, by closing active disposal units with operational covers and suspending waste disposal operations. Although the site remains available for future disposal of large volume bulk waste streams, no waste streams are currently designated for the Area 3 RWMS. The current inventory estimate assumes no future waste disposals.

The FY 2013 inventory is unchanged from the FY 2011 inventory, which was estimated with the Area 3 Inventory model, version 2.016. The model sums past disposals and inventory revisions probabilistically. Probability distributions representing uncertainty in annual activity disposed are sampled each FY during operations. Radioactive decay and ingrowth during the operational

period are explicitly included in the model. The estimated closure inventories are well fit by a lognormal distribution and described by the geometric mean and standard deviation estimated by the sample moments (Table 7). The estimated inventories are decayed until the assumed date of closure on October 1, 2025.

Table 7. FY 2013 Estimate of the Area 3 RWMS Inventory Disposed before September 26, 1988 (Estimates are calculated from 500 Latin hypercube sampling [LHS] realizations and decayed to October 1, 2025)

Nuclide	U-3ax/bl		U-3ah/at	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
H-3	1.3E+14	3.13	7.7E+11	2.17
C-14	1.0E+11	3.13	1.1E+08	2.88
Al-26	4.0E+06	3.16	4.3E+03	2.90
Cl-36	2.2E+10	3.27	2.4E+07	2.91
Ar-39	1.0E+11	3.16	1.1E+08	2.98
K-40	6.0E+09	3.07	6.7E+06	2.65
Ca-41	1.6E+11	3.07	1.7E+08	3.08
Co-60	1.2E+10	3.20	*Negligible*	--
Ni-59	4.2E+09	3.13	4.5E+06	2.83
Ni-63	3.4E+11	3.19	4.0E+08	2.85
Kr-85	6.4E+10	3.10	1.3E+08	2.67
Sr-90	5.2E+12	3.08	7.8E+09	2.53
Zr-93	5.7E+08	3.08	6.3E+05	2.67
Nb-93m	7.4E+10	3.31	1.2E+08	2.91
Nb-94	1.4E+11	3.26	1.5E+08	3.01
Tc-99	1.4E+10	2.45	1.0E+10	3.81
Pd-107	2.5E+07	3.08	2.8E+04	2.68
Cd-113m	6.4E+10	3.17	1.1E+08	2.94
Sn-121m	1.4E+12	3.18	1.7E+09	2.93
Sn-126	2.5E+08	3.08	2.7E+05	2.66
I-129	1.3E+07	3.08	1.4E+04	2.66
Cs-135	4.4E+08	3.07	4.9E+05	2.66
Cs-137	7.2E+12	3.06	1.0E+10	2.61
Sm-151	5.5E+11	3.07	6.5E+08	2.66
Eu-150	2.0E+11	3.38	2.3E+08	3.59
Eu-152	4.9E+11	3.25	8.8E+08	3.02
Eu-154	8.8E+10	3.26	2.0E+08	3.17
Ho-166m	5.4E+09	3.17	5.9E+06	2.92
Pb-210	4.0E+11	4.07	1.1E+05	2.19
Ra-226	5.5E+11	4.07	3.6E+05	2.19
Ra-228	1.4E+09	2.71	4.8E+05	2.66

Table 7. FY 2013 Estimate of the Area 3 RWMS Inventory Disposed before September 26, 1988 (Estimates are calculated from 500 Latin hypercube sampling [LHS] realizations and decayed to October 1, 2025) (continued)

Nuclide	U-3ax/bl		U-3ah/at	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Ac-227	1.3E+06	2.20	1.7E+06	2.22
Th-228	8.3E+09	2.85	7.8E+06	2.87
Th-229	1.5E+07	3.05	1.4E+04	2.62
Th-230	3.6E+07	2.04	4.4E+07	2.19
Th-232	1.5E+09	2.71	4.9E+05	2.66
Pa-231	3.0E+06	2.21	4.2E+06	2.22
U-232	5.9E+09	3.24	7.0E+06	2.91
U-233	3.5E+09	3.07	3.9E+06	2.60
U-234	9.3E+10	2.13	1.3E+11	2.19
U-235	3.6E+09	2.22	5.3E+09	2.22
U-236	2.5E+09	2.82	2.4E+09	2.84
U-238	4.3E+10	2.31	1.1E+11	2.55
Np-237	5.3E+08	2.46	2.3E+08	2.40
Pu-238	2.0E+11	3.08	1.8E+10	2.61
Pu-239	1.2E+12	3.05	2.3E+09	2.17
Pu-240	3.1E+11	3.05	5.8E+08	2.11
Pu-241	4.6E+11	3.09	1.6E+09	2.02
Pu-242	1.2E+08	3.07	1.6E+05	2.31
Am-241	3.8E+11	3.03	7.0E+08	2.07
Am-243	5.2E+07	3.12	5.7E+04	2.69
Cm-244	9.2E+09	3.10	1.5E+07	2.66
Total	**1.5E+14**		**1.1E+12**	

Negligible – Inventory less than 37 becquerels (Bq)

Pre-1988 waste is disposed in U-3ax/bl and U-3ah/at, with 80% of the volume and 99% of the activity disposed in U-3ax/bl. The total pre-1988 inventory as of October 1, 2025, consists of approximately 1.5×10^2 TBq (4.1×10^3 Ci) in 2.3×10^5 cubic meters (m^3) (8.1×10^6 cubic feet [ft^3]) of waste.

The post-1988 waste is disposed in U-3ah/at and U-3bh. The post-1988 inventory consists of approximately 1.2×10^3 TBq (3.4×10^4 Ci) in 3.3×10^5 m^3 (1.2×10^7 ft^3) of waste. On an activity basis, the inventory is predominantly tritium (^3H) (Table 8).

Table 8. FY 2013 Estimate of the Area 3 RWMS Inventory Disposed after September 26, 1988 (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2025)

Nuclide	U-3ah/at		U-3bh	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
H-3	7.5E+15	2.06	4.5E+15	2.15
C-14	9.8E+10	1.76	3.0E+07	2.11
Al-26	9.5E+04	2.40	*Negligible*	--
Cl-36	6.1E+08	2.29	*Negligible*	--
Ar-39	2.6E+09	2.50	*Negligible*	--
Ar-42	4.4E+08	2.01	2.4E+08	2.49
K-40	2.6E+09	1.82	7.1E+08	2.58
Ca-41	4.0E+09	2.39	*Negligible*	--
Ti-44	1.2E+10	2.04	5.6E+09	2.61
Co-60	3.6E+09	1.79	2.4E+09	1.89
Ni-59	9.4E+08	2.31	1.7E+08	2.06
Ni-63	2.1E+11	1.77	7.5E+09	1.97
Se-79	2.5E+07	2.13	*Negligible*	--
Kr-85	3.6E+09	2.13	*Negligible*	--
Sr-90	3.1E+14	2.75	4.4E+10	1.94
Zr-93	1.4E+07	2.28	*Negligible*	--
Nb-93m	2.8E+09	2.42	*Negligible*	--
Nb-94	3.4E+09	2.56	1.8E+08	2.10
Tc-99	2.0E+12	1.90	7.7E+10	1.98
Pd-107	6.2E+05	2.28	*Negligible*	--
Cd-113m	2.7E+09	2.41	*Negligible*	--
Sn-121m	3.7E+10	2.42	*Negligible*	--
Sn-126	5.8E+08	2.15	9.1E+05	2.66
I-129	4.7E+08	2.03	2.4E+08	2.63
Cs-135	1.1E+07	2.29	*Negligible*	--
Cs-137	1.7E+14	1.96	4.9E+10	1.75
Ba-133	5.0E+09	1.99	1.6E+09	2.73
Sm-151	1.5E+10	2.28	1.2E+06	2.23
Eu-150	6.1E+09	2.76	*Negligible*	--
Eu-152	3.9E+10	1.87	1.3E+09	2.42
Eu-154	8.6E+09	1.99	1.6E+08	2.04
Ho-166m	1.3E+08	2.38	*Negligible*	--
Pb-210	9.6E+10	1.77	4.5E+08	1.86
Bi-207	3.8E+05	2.27	1.8E+07	2.19
Bi-210m	6.7E+06	1.96	2.1E+08	2.23
Ra-226	1.0E+11	1.98	9.4E+08	2.25

Table 8. FY 2013 Estimate of the Area 3 RWMS Inventory Disposed after September 26, 1988 (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2025) (continued)

Nuclide	U-3ah/at		U-3bh	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Ra-228	1.3E+10	1.69	1.9E+11	2.70
Ac-227	2.5E+09	1.85	1.4E+06	2.15
Th-228	7.2E+10	1.91	1.8E+11	2.70
Th-229	4.0E+07	1.95	4.8E+07	2.53
Th-230	4.7E+10	2.00	7.1E+10	2.72
Th-232	1.4E+10	1.71	2.0E+11	2.70
Pa-231	3.8E+08	1.79	5.0E+06	2.16
U-232	5.3E+10	2.20	*Negligible*	--
U-233	1.6E+10	1.93	2.2E+10	2.52
U-234	7.4E+12	1.98	1.3E+11	2.08
U-235	3.4E+11	1.83	1.1E+10	2.18
U-236	3.6E+11	2.34	9.6E+07	2.71
U-238	1.3E+13	1.74	5.8E+11	2.32
Np-237	2.4E+11	2.08	1.5E+08	1.91
Pu-238	5.6E+11	1.97	1.8E+11	2.07
Pu-239	2.7E+12	1.68	5.1E+11	1.85
Pu-240	5.4E+11	1.70	8.6E+10	2.07
Pu-241	1.5E+12	1.75	1.6E+11	2.00
Pu-242	1.1E+08	1.61	4.0E+07	2.32
Am-241	5.3E+11	1.56	8.8E+10	1.84
Am-242m	2.3E+08	2.18	3.3E+06	2.84
Am-243	5.9E+08	1.80	4.3E+07	2.63
Cm-243	3.1E+06	1.74	9.9E+05	2.61
Cm-244	8.2E+09	1.60	1.1E+08	2.09
Cm-245	5.4E+08	1.90	8.2E+06	2.64
Cm-246	8.8E+07	1.86	*Negligible*	--
Cm-247	7.0E+05	2.72	*Negligible*	--
Cf-249	3.4E+03	2.21	*Negligible*	--
Cf-250	1.3E+03	2.81	*Negligible*	--
Cf-251	2.2E+08	2.29	*Negligible*	--
Total	**8.0E+15**		**4.5E+15**	

Negligible – Inventory less than 37 Bq

The volume of waste disposed at the Area 3 RWMS is divided approximately equally between the pre- and post-1988 period (Figure 1). Uncertainty is not estimated for the Area 3 RWMS volume, because the volume records are believed to be complete and no future volume is assumed.

The total activity was disposed predominantly in the post-1988 period since FY 2000 (Figure 2). Activity uncertainty includes characterization uncertainty and uncertainty in the composition of radionuclide mixtures (e.g., mixed fission products, depleted uranium).

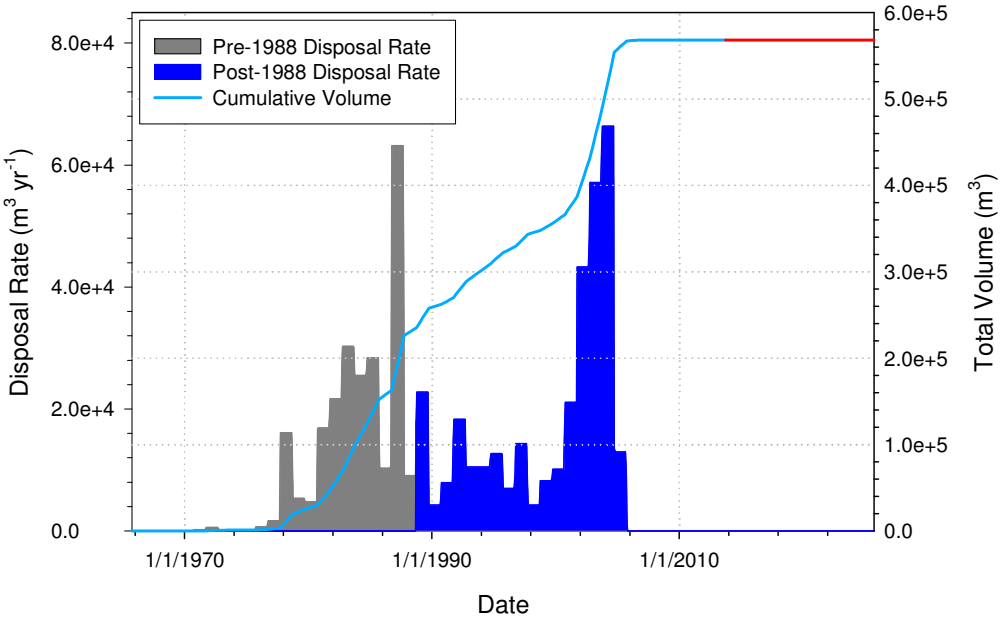

Figure 1. Annual Volume Disposal Rate and Total Volume for the Area 3 RWMS. Future Volume Shown in Red.

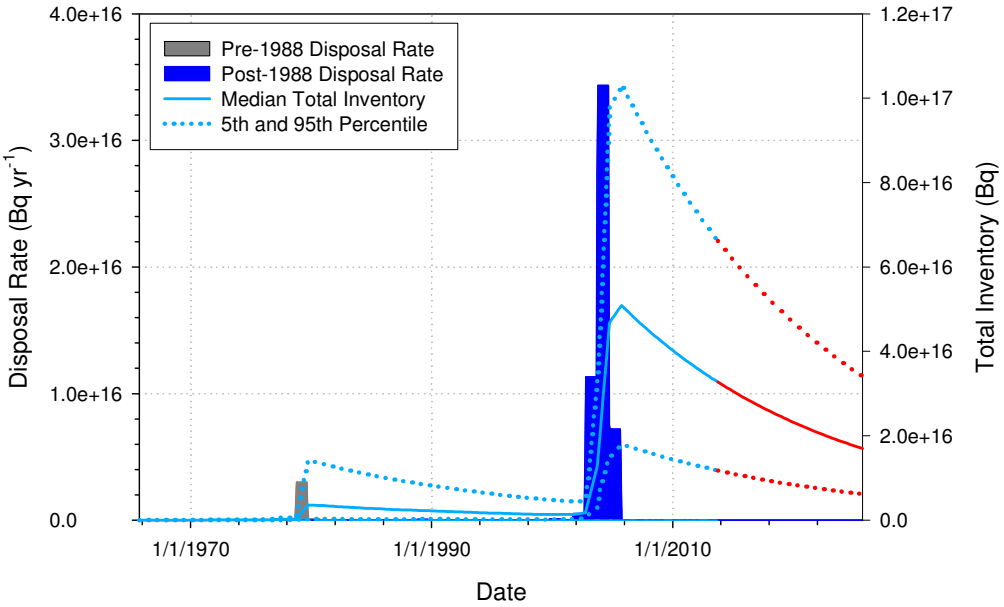

Figure 2. Activity Annual Disposal Rate and Total Inventory for the Area 3 RWMS. Future Inventory Shown in Red.

2.1.2.3 FY 2013 Closure Inventory Estimate for the Area 5 RWMS

The Area 5 RWMS PA GoldSim model divides the site inventory into three virtual disposal units based on the depth of burial. Most wastes are disposed in shallow land burial (SLB) disposal units. Wastes capable of producing significant radon-222 (^{222}Rn) flux densities are disposed below thicker covers in two radium disposal units (RaDUs), the lower cell of Pit 6 and the northern section of Pit 13. Prior to 1992, high specific activity and TRU wastes were disposed in GCD boreholes. The inventory of the three virtual disposal units is further divided into pre-1988, post-1988 disposed, and future portions.

The FY 2013 estimate of the Area 5 RWMS closure inventory was prepared using the GoldSim Area 5 Inventory v2.111 model. No significant changes were made to the Area 5 inventory model. Two minor or routine changes were made. The model was updated with FY 2013 disposal data. An input to the inventory model, the ^{234}U UGTA inventories, was corrected based on an errata sheet published for Bowen et al. (2001). The UGTA inventories are used to estimate the radionuclide composition of NNSS mixed fission products disposed before 1991. The correction does not cause a significant change in the inventory.

The model sums past disposals, revisions, and future inventory estimates probabilistically. Probability distributions representing uncertainty in annual activity disposed are assigned for each radionuclide and each FY. These distributions are sampled for each model realization to obtain a stochastic disposal time history for each radionuclide. Radioactive decay and ingrowth during the operational period are explicitly included in the model. The model's closure inventory estimates are well fit by a lognormal distribution. The geometric mean and standard deviation of the distribution are estimated by the sample moments (Table 9). The estimated inventories are decayed until the assumed date of closure on October 1, 2028. The CEUSP Waste is not included in the future waste estimate.

Table 9. FY 2013 Estimate of the Area 5 RWMS SLB Inventory (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028)

Nuclide	Pre-1988 SLB		Post-1988 SLB		Future SLB	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
H-3	3.3E+16	1.89	3.4E+16	1.53	5.7E+16	2.85
C-14	2.8E+11	1.98	2.1E+13	2.40	1.6E+12	5.52
Al-26	8.8E+06	2.13	1.2E+06	1.85	7.0E+04	25.0
Cl-36	4.8E+10	2.07	5.0E+08	2.04	2.9E+07	9.25
Ar-39	2.2E+11	2.05	8.1E+08	2.69	*Negligible*	--
Ar-42	*Negligible*	--	6.0E+08	2.30	2.0E+07	44.9
K-40	1.3E+10	2.01	3.3E+10	1.55	9.4E+09	2.33
Ca-41	3.5E+11	2.05	1.3E+09	2.66	2.4E+05	845
Ti-44	*Negligible*	--	1.9E+10	2.46	5.6E+08	54.2
Co-60	2.0E+12	3.02	3.4E+14	1.80	3.3E+14	3.71
Ni-59	9.1E+09	2.05	2.7E+12	1.69	4.2E+11	4.68

Table 9. FY 2013 Estimate of the Area 5 RWMS SLB Inventory (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028) (continued)

Nuclide	Pre-1988 SLB		Post-1988 SLB		Future SLB	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Ni-63	6.9E+11	2.05	2.7E+14	1.81	4.9E+13	3.52
Se-79	*Negligible*	--	3.5E+12	2.13	1.5E+11	49.4
Kr-85	3.8E+11	2.64	1.4E+10	1.69	5.0E+09	3.44
Sr-90	1.6E+15	3.94	2.5E+16	1.74	5.5E+15	4.66
Zr-93	1.2E+09	2.02	1.1E+08	1.97	1.0E+07	15.6
Nb-91	*Negligible*	--	1.4E+07	2.76	7.6E+03	465
Nb-93m	1.2E+11	2.05	1.3E+09	2.13	5.2E+07	7.24
Nb-94	2.9E+11	2.09	1.7E+11	2.52	7.0E+09	18.8
Mo-93	*Negligible*	--	1.5E+10	2.38	1.2E+07	3865
Tc-99	1.2E+13	2.74	5.8E+14	1.64	1.3E+14	2.74
Pd-107	5.3E+07	2.03	8.6E+05	1.94	4.1E+04	13.5
Ag-108m	*Negligible*	--	1.2E+12	2.16	8.5E+09	316
Cd-113m	9.5E+10	2.07	3.4E+10	2.22	9.8E+08	97.8
Sn-121m	2.6E+12	2.05	1.2E+10	2.81	2.6E+04	78.5
Sn-126	5.2E+08	2.02	3.6E+10	2.06	1.2E+09	75.5
I-129	3.9E+07	2.02	1.7E+10	2.03	2.8E+09	4.44
Cs-135	9.3E+08	2.02	3.2E+07	2.05	6.9E+05	69.0
Cs-137	3.0E+15	3.73	1.4E+15	1.77	3.7E+14	3.26
Ba-133	1.5E+08	3.20	3.0E+10	1.69	1.4E+10	3.32
Pm-145	*Negligible*	--	3.1E+07	2.13	1.8E+06	56.6
Pm-146	*Negligible*	--	2.3E+06	2.41	5.2E+05	22.7
Sm-147	*Negligible*	--	3.4E+04	2.67	2.1E+02	135
Sm-151	1.1E+12	2.01	2.4E+12	2.71	9.0E+10	41.9
Eu-150	3.8E+11	2.12	2.6E+09	2.63	3.2E+04	8962
Eu-152	2.4E+12	2.51	4.5E+13	2.21	6.3E+12	14.2
Eu-154	2.7E+11	2.30	6.4E+13	1.86	1.7E+13	16.1
Gd-148	*Negligible*	--	2.2E+07	2.04	8.3E+05	41.1
Tb-157	*Negligible*	--	2.6E+07	2.05	3.1E+05	280
Ho-166m	1.1E+10	2.08	2.9E+08	2.02	2.7E+05	1425
Pt-193	*Negligible*	--	1.6E+12	1.94	5.9E+10	348
Hg-194	*Negligible*	--	1.5E+07	2.66	3.1E+05	410
Pb-210	1.1E+12	3.00	8.8E+11	1.54	2.0E+11	2.60
Bi-207	4.7E+05	3.57	1.5E+07	1.87	1.4E+08	91.3
Bi-210m	*Negligible*	--	5.2E+07	2.72	1.2E+04	791
Ra-226	1.4E+12	3.01	1.2E+12	1.69	3.0E+11	2.82
Ra-228	4.6E+10	2.18	7.2E+11	1.49	3.1E+11	2.60

Table 9. FY 2013 Estimate of the Area 5 RWMS SLB Inventory (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028) (continued)

Nuclide	Pre-1988 SLB		Post-1988 SLB		Future SLB	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Ac-227	1.2E+10	2.09	8.9E+10	2.35	1.2E+10	6.59
Th-228	6.4E+10	1.93	2.8E+12	1.64	7.2E+11	2.36
Th-229	1.5E+08	2.23	6.2E+11	1.87	5.5E+10	4.52
Th-230	4.2E+10	1.85	3.1E+11	1.50	1.9E+11	3.29
Th-232	4.7E+10	2.19	7.6E+11	1.49	4.3E+11	2.68
Pa-231	7.8E+09	2.00	1.2E+10	1.44	2.6E+09	2.21
U-232	1.2E+10	2.05	1.9E+12	1.89	3.2E+11	3.54
U-233	3.2E+10	2.30	1.3E+14	2.25	1.0E+13	7.70
U-234	8.0E+13	2.02	1.6E+14	1.37	5.1E+13	1.80
U-235	3.3E+12	2.04	7.2E+12	1.38	2.8E+12	1.66
U-236	9.7E+11	2.86	7.3E+12	1.54	1.5E+12	2.30
U-238	9.0E+13	2.18	4.0E+14	1.47	1.4E+14	1.78
Np-237	2.3E+11	2.01	2.0E+11	1.58	4.0E+10	2.59
Pu-236	6.3E+03	3.43	1.1E+06	1.97	2.1E+06	24.1
Pu-238	6.8E+12	1.83	7.0E+12	1.53	3.2E+12	2.13
Pu-239	1.5E+13	1.98	1.8E+13	1.49	5.7E+12	1.95
Pu-240	2.5E+12	2.05	6.4E+12	1.70	1.7E+12	2.52
Pu-241	3.0E+12	2.03	3.9E+13	1.87	1.7E+13	2.90
Pu-242	7.0E+08	1.86	4.0E+11	2.50	4.6E+10	14.8
Pu-244	4.4E+09	3.81	2.4E+06	1.90	2.4E+05	9.38
Am-241	3.7E+12	1.87	1.0E+13	1.57	2.4E+12	2.35
Am-242m	*Negligible*	--	1.6E+09	1.83	3.4E+08	4.47
Am-243	4.4E+08	2.69	4.9E+10	1.85	9.7E+09	3.73
Cm-242	*Negligible*	--	1.3E+09	1.83	2.8E+08	4.41
Cm-243	5.0E+09	2.82	1.9E+10	1.95	3.8E+09	5.17
Cm-244	7.5E+10	2.75	3.0E+12	1.82	8.2E+11	3.31
Cm-245	1.2E+05	3.67	5.4E+11	2.08	4.8E+10	11.3
Cm-246	6.8E+04	3.02	9.4E+10	1.86	1.4E+10	4.89
Cm-247	*Negligible*	--	1.2E+08	1.92	8.5E+06	18.6
Cm-248	6.1E+04	3.56	9.4E+07	1.78	4.4E+09	5.29
Cf-249	*Negligible*	--	1.6E+09	1.67	3.1E+08	3.05
Cf-250	2.4E+05	2.86	1.0E+09	2.52	5.9E+06	143
Cf-251	*Negligible*	--	1.9E+08	2.00	1.8E+07	13.4
Cf-252	3.1E+02	2.21	2.8E+07	1.79	8.8E+07	2.98
Total	**3.8E+16**		**6.2E+16**		**6.4E+16**	

Negligible – Inventory less than 37 Bq

The total Area 5 RWMS inventory estimate in FY 2013 increases approximately 4% from the FY 2012 estimate. Increases are noted for three PA sensitive radionuclides, ^{3}H, strontium-90 (^{90}Sr), and technetium-99 (^{99}Tc). Two radionuclides not previously reported, niobium-91 and mercury-194, were disposed in FY 2013. Comparison of the disposed inventory to the PA screening limits does not identify any new radionuclides for inclusion in the PA/CA model.

The median SLB volume estimate increased 5% from 9.1×10^5 m^3 (3.2×10^7 ft^3) in FY 2012 to 9.6×10^5 m^3 (3.4×10^7 ft^3) in FY 2013 (Figure 3). The median post-1988 SLB volume has increased 7% from 7.3×10^5 m^3 (2.6×10^7 ft^3) in FY 2012 to 7.8×10^5 m^3 (2.8×10^7 ft^3) in FY 2013. The increases are due to increases in disposed volume and in the future volume forecast. Area 5 RWMS waste volume uncertainty is contributed by incomplete waste database records and uncertainty in future waste forecasts.

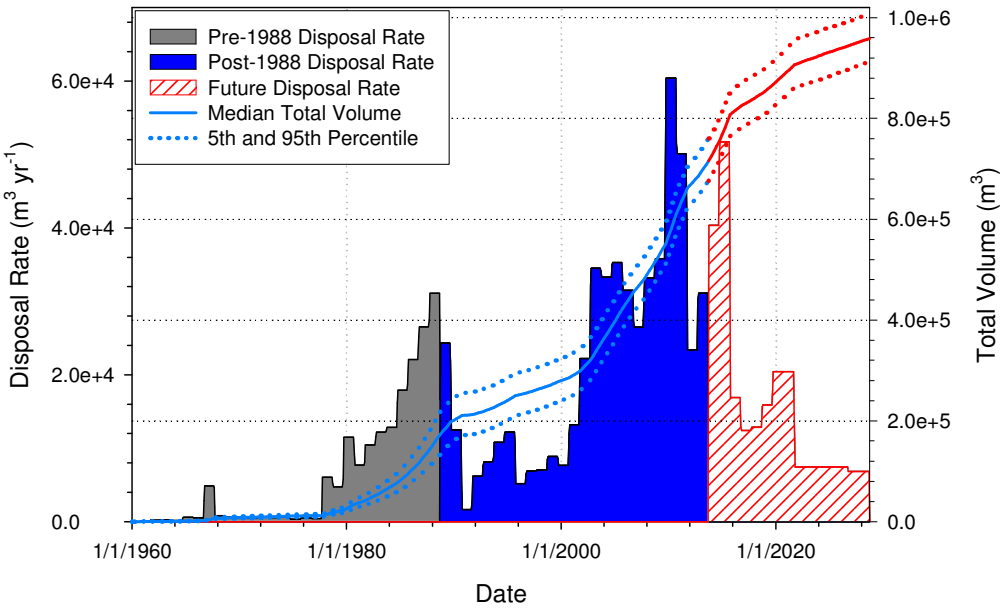

Figure 3. Annual Volume Disposal Rate and Total Volume for the Area 5 RWMS SLB Disposal Units. Future Volume Shown in Red.

The median closure inventory estimate increased 8% from 1.9×10^5 TBq (5.1×10^6 Ci) in FY 2012 to 2.0×10^5 TBq (5.5×10^6 Ci) in FY 2013 (Figure 4). The median post-1988 closure inventory estimate increased 6% from 1.2×10^5 TBq (3.2×10^6 Ci) in FY 2012 to 1.3×10^5 TBq (3.4×10^6 Ci) in FY 2013. The median activity forecast continues to project gradually declining total activity until closure due to the radioactive decay of the disposed inventory. The Area 5 RWMS inventory uncertainty includes characterization uncertainty, uncertainty in the composition of radionuclide mixtures (e.g., mixed fission products, depleted uranium), uncertainty in the activity not recorded in waste management databases, and uncertainty in the inventory of future waste.

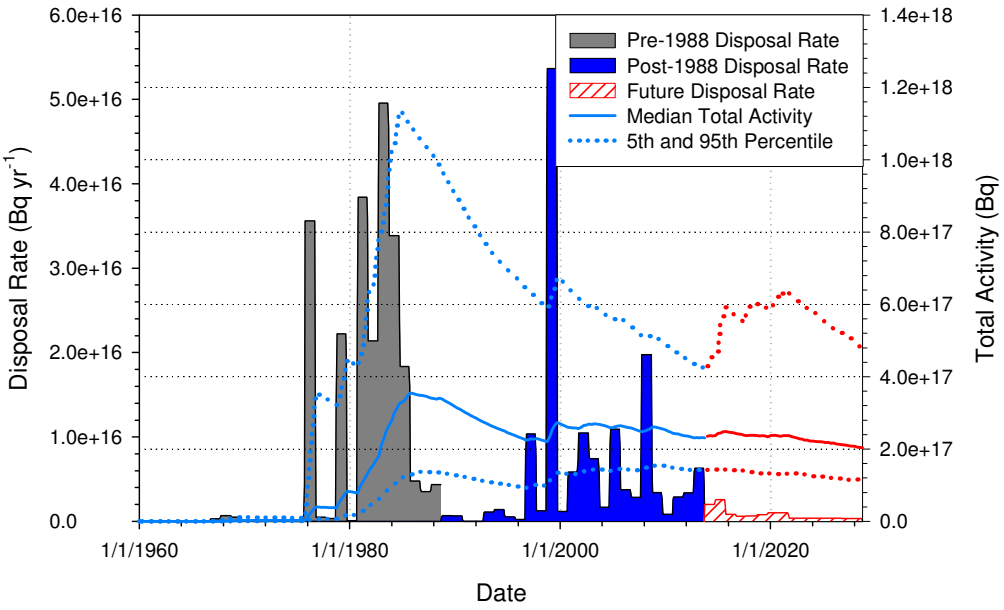

Figure 4. Annual Activity Disposal Rate and Total Inventory for the Area 5 RWMS SLB Disposal Units

RaDU Inventory

The lower cell of Pit 6 and Pit 13 were excavated to greater depth to dispose thorium wastes that have the potential to generate ^{222}Rn in the future, as radium-226 (^{226}Ra) is produced by the decay of ^{230}Th. The inventory of both disposal units is predominantly ^{232}Th. The lower cell of Pit 6 was operated from FY 1992 to FY 2002. The Pit 6 lower cell inventory remains unchanged from previous years (Table 10). The upper cell of Pit 6 was filled and closed in FY 2011.

Pit 13 began operations in FY 2004 with disposal of the Defense National Stockpile Center thorium nitrate waste stream. The entire thorium nitrate waste stream was disposed in FY 2004 and 2005 in a single layer, with the top of the waste 6.4 meters (m) (21 feet [ft]) below grade. In FY 2008 for PA modeling purposes, Pit 13 was divided into a northern RaDU portion containing the thorium nitrate waste below a thicker cover and a southern SLB portion with LLW below a thinner cover. The Pit 13 RaDU inventory is summarized in Table 10. The Pit 13 SLB inventory is included in the post-1988 SLB inventory.

Table 10. FY 2013 Estimate of the Area 5 RWMS RaDU Inventory Disposed (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028)

Nuclide	Pit 6 (Upper Cell)		Pit 6 (Lower Cell)		Pit 13 RaDu	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
H-3	2.9E+12	1.87	*Negligible*	--	1.3E+09	2.48
C-14	1.2E+09	2.53	*Negligible*	--	*Negligible*	--
Al-26	1.2E+03	2.59	*Negligible*	--	*Negligible*	--
Ar-42	1.0E+07	2.63	*Negligible*	--	*Negligible*	--
K-40	3.4E+08	2.56	*Negligible*	--	4.0E+03	2.51
Ti-44	3.2E+08	2.66	*Negligible*	--	*Negligible*	--
Co-60	2.0E+10	2.12	*Negligible*	--	5.4E+06	2.46
Ni-63	5.0E+10	2.27	*Negligible*	--	4.2E+07	2.62
Kr-85	2.2E+07	2.07	*Negligible*	--	*Negligible*	--
Sr-90	4.9E+10	1.97	1.9E+07	2.71	5.7E+09	2.52
Nb-94	7.8E+03	2.55	*Negligible*	--	*Negligible*	--
Tc-99	4.7E+12	2.22	9.8E+08	2.76	1.1E+11	1.82
Sn-126	*Negligible*	--	*Negligible*	--	1.4E+07	2.65
I-129	*Negligible*	--	*Negligible*	--	1.1E+07	2.69
Cs-137	5.2E+10	1.90	*Negligible*	--	7.1E+09	2.60
Ba-133	5.3E+04	2.24	*Negligible*	--	*Negligible*	--
Sm-151	2.0E+06	2.50	*Negligible*	--	*Negligible*	--
Eu-152	2.2E+06	1.78	*Negligible*	--	9.2E+06	2.66
Eu-154	3.1E+07	2.08	*Negligible*	--	1.4E+07	2.64
Pb-210	1.1E+09	1.98	6.9E+09	1.73	6.7E+10	1.65
Ra-226	7.8E+08	2.15	2.0E+10	1.74	1.4E+11	1.65
Ra-228	4.5E+09	2.16	6.2E+12	1.62	5.5E+12	1.06
Ac-227	5.3E+07	2.21	2.2E+06	1.89	8.7E+05	1.83
Th-228	4.3E+09	2.14	6.1E+12	1.61	5.3E+12	1.06
Th-229	2.3E+06	2.06	4.5E+09	2.16	2.1E+02	2.21
Th-230	2.6E+09	1.71	1.5E+12	1.76	1.9E+12	2.49
Th-232	4.9E+09	2.18	6.3E+12	1.62	5.9E+12	1.06
Pa-231	1.5E+08	2.08	5.9E+06	1.89	3.3E+06	1.84
U-232	3.0E+07	2.36	*Negligible*	--	1.8E+08	2.62
U-233	2.6E+08	2.07	1.7E+12	2.15	1.9E+05	2.17
U-234	3.5E+12	2.17	1.7E+11	1.90	1.1E+11	2.00
U-235	9.1E+10	2.02	8.7E+09	1.90	7.8E+09	1.86
U-236	2.6E+11	2.18	1.8E+08	2.24	1.2E+10	1.98
U-238	1.5E+13	2.43	2.2E+11	1.90	4.9E+11	2.00
Np-237	2.3E+09	2.03	7.8E+05	2.55	2.0E+09	2.14

Table 10. FY 2013 Estimate of the Area 5 RWMS RaDU Inventory Disposed (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028) (continued)

Nuclide	Pit 6 (Upper Cell)		Pit 6 (Lower Cell)		Pit 13 RaDu	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Pu-238	1.3E+10	2.20	1.3E+10	1.99	3.7E+08	2.51
Pu-239	1.4E+11	1.79	3.4E+06	2.15	8.8E+09	2.06
Pu-240	2.5E+10	1.68	*Negligible*	--	4.1E+07	2.41
Pu-241	7.9E+10	1.70	1.2E+10	2.22	5.6E+09	2.46
Pu-242	6.0E+06	1.81	*Negligible*	--	2.5E+03	2.71
Pu-244	4.1E+01	2.08	*Negligible*	--	*Negligible*	--
Am-241	2.7E+10	1.62	1.1E+09	2.23	1.3E+09	2.02
Am-242m	2.4E+05	2.32	*Negligible*	--	*Negligible*	--
Am-243	4.7E+07	2.12	*Negligible*	--	*Negligible*	--
Cm-242	2.0E+05	2.32	*Negligible*	--	*Negligible*	--
Cm-243	7.4E+07	2.56	*Negligible*	--	*Negligible*	--
Cm-244	2.9E+08	2.22	*Negligible*	--	*Negligible*	--
Cm-245	6.6E+05	2.37	*Negligible*	--	*Negligible*	--
Cm-247	9.2E+05	2.61	*Negligible*	--	*Negligible*	--
Cm-248	6.9E+05	2.50	*Negligible*	--	*Negligible*	--
Cf-249	5.2E+04	2.21	*Negligible*	--	*Negligible*	--
Total	**2.7E+13**		**2.2E+13**		**2.0E+13**	

Negligible – Inventory less than 37 Bq

GCD Inventories

The GCD boreholes have received high specific activity waste, including TRU waste regulated under 40 CFR 191. The GCD boreholes were active from FY 1984 through FY 1990. The PA divides the GCD inventory into pre- and post-1988 portions. The majority of the waste on an activity and volume basis was disposed in the pre-1988 period. The current GCD inventory estimates are summarized in Table 11. The GCD inventories are not significantly different from previous estimates.

Table 11. FY 2013 Estimate of the Area 5 RWMS GCD Borehole Inventory (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028)

Nuclide	Pre-1988 GCD		Post-1988 GCD	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
H-3	2.1E+16	2.35	1.7E+14	2.59
C-14	6.5E+04	3.06	*Negligible*	--
Cl-36	1.4E+04	3.04	*Negligible*	--
Ar-39	6.4E+04	3.08	*Negligible*	--
K-40	3.8E+03	2.86	*Negligible*	--
Ca-41	1.0E+05	3.09	*Negligible*	--
Co-60	9.4E+11	2.67	*Negligible*	--
Ni-59	2.6E+03	3.00	*Negligible*	--
Ni-63	2.2E+05	3.04	*Negligible*	--
Kr-85	5.9E+04	2.88	*Negligible*	--
Sr-90	6.3E+15	3.72	9.9E+07	4.83
Zr-93	3.6E+02	2.86	*Negligible*	--
Nb-93m	6.1E+04	3.01	*Negligible*	--
Nb-94	8.5E+04	3.08	*Negligible*	--
Tc-99	6.9E+09	3.71	5.7E+09	5.06
Cd-113m	5.6E+04	2.98	*Negligible*	--
Sn-121m	9.1E+05	2.89	*Negligible*	--
Sn-126	1.5E+02	2.85	*Negligible*	--
Cs-137	2.7E+14	3.71	*Negligible*	--
Sm-151	3.6E+05	2.87	*Negligible*	--
Eu-150	1.4E+05	3.25	*Negligible*	--
Eu-152	4.2E+05	2.97	*Negligible*	--
Eu-154	8.7E+04	2.94	*Negligible*	--
Ho-166m	3.3E+03	3.04	*Negligible*	--
Pb-210	2.8E+12	3.98	3.9E+04	2.66
Ra-226	3.6E+12	3.98	1.2E+05	2.66
Ra-228	8.0E+08	3.94	*Negligible*	--
Ac-227	6.8E+10	3.95	5.4E+05	2.77
Th-228	8.0E+08	3.94	*Negligible*	--
Th-229	7.8E+01	2.01	4.7E+01	2.60
Th-230	5.7E+07	3.24	1.5E+07	2.66
Th-232	8.0E+08	3.94	*Negligible*	--
Pa-231	4.8E+06	3.24	1.3E+06	2.77
U-232	4.0E+03	2.99	*Negligible*	--
U-233	3.7E+04	2.02	2.5E+04	2.60
U-234	1.4E+11	3.22	4.0E+10	2.66

Table 11. FY 2013 Estimate of the Area 5 RWMS GCD Borehole Inventory (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028) (continued)

Nuclide	Pre-1988 GCD		Post-1988 GCD	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
U-235	5.2E+09	3.22	1.5E+09	2.77
U-236	3.6E+08	4.07	*Negligible*	--
U-238	3.3E+10	2.74	7.4E+10	2.60
Np-237	2.0E+08	2.08	1.5E+08	2.60
Pu-238	4.1E+11	3.18	3.6E+06	5.07
Pu-239	2.8E+13	2.57	1.6E+08	4.98
Pu-240	1.0E+12	3.25	8.6E+06	5.21
Pu-241	1.2E+12	3.22	1.3E+07	5.03
Pu-242	1.6E+08	3.22	*Negligible*	--
Am-241	3.2E+12	2.47	8.4E+06	5.15
Cm-244	7.3E+03	2.88	*Negligible*	--
Total	**2.7E+16**		**1.7E+14**	

Negligible – Inventory less than 37 Bq

2.1.3 Waste Acceptance Criteria

WAC for the Area 3 and Area 5 RWMSs are described in *Nevada National Security Site Waste Acceptance Criteria* (NNSA/NFO 2013a). Revision 10 of the NNSS WAC was released in FY 2013. The only substantive change was an increase in the Documented Safety Analysis-derived package activity limits. The package activity limits are derived to limit the material-at-risk under accident scenarios considered in the Documented Safety Analysis.

WAC action levels are PA-derived waste concentrations used to screen waste streams for their potential to impact PA results. WAC action levels are unchanged and continue to be based on PA results.

Compliance with the NNSS WAC is ensured by the RWAP, an NNSA/NFO program, which reviews and approves all new or revised waste streams and generator waste certification programs (NNSA/NSO 2006). No significant changes occurred to the RWAP in FY 2013.

2.2 FACILITY DESIGN

Key facility design features are specifications impacting PA conceptual models, assumptions, or input parameters. Key design features for the Area 3 and Area 5 RWMSs include the following:

- Disposal unit volume, area, thickness, and depth below grade
- Disposal unit engineered barrier design and condition
- Controls that impact and compensate for subsidence

2.2.1 Disposal Unit Design

The Area 3 RWMS uses nuclear subsidence craters as waste disposal units. The Area 3 RWMS was placed in inactive status in July 2006, with the last waste disposed in April 2006. The two post-1988 disposal units, U-3ah/at and U-3bh, are operationally closed. No wastes were disposed at the Area 3 RWMS, and no new disposal units were opened in FY 2013. Area 3 RWMS disposal unit design continues to be consistent with the PA model.

Radioactive waste is disposed at the Area 5 RWMS in shallow unlined pits and trenches. Mixed waste is disposed in a RCRA-compliant double lined cell with a leachate collection system. In the past, ^{222}Rn-generating waste was disposed in deeper disposal units with thicker covers known as RaDUs, and high specific activity waste was disposed in intermediate depth GCD boreholes.

A new pit in the Area 5 RWMS northern expansion area, Pit 21, began operations in FY 2013. The depth, volume, and cover thickness of Pit 21 are consistent with other SLB disposal units. No other disposal units were added in FY 2013. Area 5 RWMS disposal unit design continues to be consistent with the PA model.

2.2.2 Engineered Barriers

Engineered barriers at the Area 3 and Area 5 RWMSs include flood protection systems, the closure covers, and the liner and leachate collection system for the Pit 18 mixed waste disposal unit at the Area 5 RWMS. The Area 3 and Area 5 RWMS flood protection systems and closure covers are described in the PAs and closure plans. The Area 3 and Area 5 RWMS flood protection systems and closure cover designs were unchanged in FY 2013. The Area 5 RWMS Pit 18 liner and leachate collection system was described in the FY 2010 Annual Summary Report (NSTec 2011). The Pit 18 liner and leachate collection system design is unchanged.

2.2.3 Environmental Monitoring

Monitoring activities at the Area 3 and 5 RWMSs and at the NNSS provide the data necessary to support PA and CA maintenance. The *Nevada Test Site Routine Radiological Environmental Monitoring Plan* (BN 2003) is the basis for all NNSS-wide environmental surveillance, site-specific effluent monitoring, and operational monitoring conducted by various missions, programs, and projects. The monitoring plan is in final form. Closure plans for the Area 3 RWMS and Area 5 RWMS (NSTec 2007b, 2008a) describe the specific monitoring programs for the waste disposal facilities. No significant changes occurred in the environmental monitoring plan in FY 2013.

Current monitoring activities at the Area 3 and Area 5 RWMS are summarized in Table 12. Two minor operational changes occurred in FY 2013. The Area 5 RWMS Sugar Bunker air monitoring station was moved approximately 1 km northeast to the closed sewage lagoons. Automated vadose zone water content monitoring of Area 5 RWMS operational covers and pit floors was temporarily suspended during final closure cover construction at the 92-ac Low-Level Waste Management Unit (LLWMU) in calendar year (CY) 2011. In December of 2011, vadose zone monitoring at the 92-ac LLWMU was resumed and continued throughout FY 2013.

Table 12. Summary of Area 3 and Area 5 RWMS Monitoring Programs

Monitoring Element	Area 3 RWMS	Area 5 RWMS
Vadose Zone Monitoring	• Measurements of soil water content in waste disposal unit cover • Eight drainage lysimeters for water balance since 2001	• Measurements of soil water content and water potential in waste disposal unit covers • Measurements of soil water content in waste disposal unit floor • Two weighing lysimeters (vegetated and bare) for water balance in operation since 1994
Groundwater Monitoring	• None	• RCRA detection monitoring at three wells
Radon Monitoring	• Radon flux measurements from waste covers (various locations)	• Radon flux measurements from waste covers (various locations)
Meteorology Monitoring	• Air temperature at 3 and 10 m (10 and 33 ft) • Relative humidity at two heights • Wind speed at two heights • Wind direction at two heights • Barometric pressure • Solar radiation • Precipitation	• Air temperature at 3 and 10 m (10 and 33 ft) • Relative humidity at two heights • Wind speed at two heights • Wind direction at two heights • Barometric pressure • Solar radiation • Precipitation
Direct Radiation Monitoring	• Nine thermoluminescent dosimeters (TLDs)	• Ten TLDs
Biota Monitoring	• Sampling vegetation, small mammals, and animal burrow spoils for tritium, gamma-emitting radionuclides, ^{90}Sr, americium-241 (^{241}Am), and plutonium	• Sampling vegetation, small mammals, and animal burrow spoils for tritium, gamma-emitting radionuclides, ^{90}Sr, ^{241}Am, and plutonium
Subsidence Monitoring	• Routine inspection of operational covers • U-3ax/bl closure cover surveyed annually	• Routine inspection of operational covers • 92-ac LLWMU closure cover surveyed annually

Table 12. Summary of Area 3 and Area 5 RWMS Monitoring Programs (continued)

Monitoring Element	Area 3 RWMS	Area 5 RWMS
Air Monitoring	• Atmospheric moisture sampling for tritium and air particulates sampled at three locations	• Air particulates sampled at two locations; atmospheric moisture sampling for tritium at two locations
Soil Temperature Monitoring around Radioisotope Thermoelectric Generators (RTGs)	• None	• Vertical and horizontal sensor arrays around four RTGs in Pit 5
Lined Mixed Waste Disposal Unit Leachate Monitoring	• None	• Pit 18 leachate monitored for toxicity characteristic contaminants, polychlorinated biphenyls, specific conductance, and pH

Environmental monitoring data are reported on a CY basis. The following four reports, published annually, contain details regarding the monitoring program and results for CY 2012:

- *Nevada National Security Site Environmental Report* (NSTec 2013b)
- *National Emission Standards for Hazardous Air Pollutants Report* (NSTec 2013c)
- *Waste Management Monitoring Report* (NSTec 2013d)
- *Area 5 Groundwater Monitoring Report* (NSTec 2014)

Results of the environmental monitoring programs were consistent with PA input parameters and model results (NSTec 2013d). CY 2012 monitoring results are consistent with trends observed in previous years.

The Area 5 RWMS Pit 18 is a RCRA-compliant double lined mixed waste disposal unit with a leachate collection system that began operations in 2011. Leachate is generated as a small fraction of precipitation and water used for dust control infiltrates into the open pit floor and sidewalls and flows over the liner to the collection sump. Annual reporting of leachate monitoring results in the Area 5 RWMS groundwater monitoring report began in FY 2013 (NSTec 2014). Pit 18 leachate is monitored for the parameters in Table 12. Leachate production is expected to cease after final installation of the ET closure cover.

2.2.4 Stability Control

Subsidence is minimized and controlled by WAC and site operations. The NNSS WAC requires that waste packages be loaded to ensure that the interior space is loaded as compactly and as efficiently as practicable. Site operations minimize subsidence by carefully planning waste placement and by monitoring and repairing subsidence detected on closed disposal units. Cover elevation is surveyed annually on units that have undergone final closure. No changes to these procedures occurred in FY 2013.

2.3 CLOSURE DESIGN

2.3.1 Closure Plan

The approved Area 3 RWMS PA/CA assumes that the site will be closed with a vegetated monolithic evapotranspirative (ET) cover of native alluvium. The cover is assumed to be 3 m (10 ft) thick after subsidence. The *Closure Plan for the Area 3 Radioactive Waste Management Site at the Nevada Test Site* is in final form (NSTec 2007b). The cover design is for a 3 m (10 ft) monolithic ET cover (NSTec 2007b), consistent with the Area 3 RWMS PA/CA. The Area 3 RWMS PA and CA assumptions continue to be consistent with completed closures and closure plans.

Closure plans for the Area 5 RWMS have evolved over time based on the documented results of PA modeling. The most recently approved PA version, the 2006 Area 5 RWMS PA update (BN 2006), assumes a 4 m (13 ft) thick closure cover. In FY 2009, an optimization of closure cover thickness was performed for the 92-ac LLWMU, the northern expansion area, and the entire Area 5 RWMS (Shott and Yucel 2009). The optimization used cost-benefit analysis to select the optimum cover thickness, ranging from 2.5 to 4.5 m (8.2 to 15 ft). Each cover option was constrained to meet all performance objectives and CA requirements in DOE M 435.1-1 (DOE 1999b). The cost of collective dose averted was found to be small relative to cover construction costs. The optimum cover that meets all PA and CA requirements was found to be the 2.5 m (8.2 ft) cover. The current Area 5 RWMS v4.115 GoldSim model assumes a 2.5 m (8.2 ft) cover.

The *Closure Plan for the Area 5 Radioactive Waste Management Site at the Nevada Test Site* is in final form (NSTec 2008a). Closure of the Area 5 RWMS is planned in two phases. The first phase is closure of the 92-ac LLWMU under the FFACO closure process. A Corrective Action Decision Document/Corrective Action Plan (CADD/CAP) for the 92-ac LLWMU (Corrective Action Unit [CAU] 111) was approved by the Nevada Division of Environmental Protection (NDEP) in FY 2009 (NNSA/NSO 2009). The preferred Corrective Action Alternative, a 2.5 m (8.2 ft) thick engineered monolithic ET cover, was constructed in FY 2011. The Closure Report for the 92-ac LLWMU was issued in FY 2012 (NNSA/NSO 2012a). Re-vegetation of the closure cover was initiated in FY 2012 and is ongoing.

The second phase, closure of the northern expansion area, is scheduled for FY 2028. The current Area 5 RWMS closure plan is to close the northern expansion area with a monolithic ET cover. The final cover thickness will be determined by future PA modeling when the final closure inventory is known. Area 5 RWMS closure plans continue to be consistent with PA modeling results.

2.3.2 Institutional Control Policy

The NNSA/NFO institutional control policy states that institutional controls will be implemented to maintain and enforce restricted access to, and use of, the NNSS and ensure the continuity of appropriate institutional controls in the future (NNSA/NSO 2008). Based on the institutional control policy, PA/CA analyses assume implementation of land-use restrictions consistent with the UGTA FFACO closure strategies for the NNSS (NNSA/NSO 2007). The planned land-use

restrictions will prohibit public access to groundwater for 1,000 years within the UGTA use restriction boundaries negotiated with the State of Nevada.

Although the final regulatory boundaries have not been negotiated, the Area 3 RWMS and Area 5 RWMS are expected to be within the boundaries of CAU 97 (Yucca Flat) and the CAU 98 (Frenchman Flat), respectively. The NNSA/NFO Assistant Manager of Environmental Management has administratively agreed to include the Area 5 RWMS within the CAU 98 use restriction boundaries (NNSA/NSO 2008). The Area 5 RWMS is currently within the initial Frenchman Flat CAU 98 use restriction boundaries (NNSA/NSO 2011b).

The institutional control policy has changed PA analyses in the following areas:

1) Long-term (i.e., chronic) exposure of intruders is assumed to be impossible based on NNSS land-use restrictions and planned UGTA groundwater-use restrictions.
2) Short-term or acute intruder exposure may occur.
3) Exposure of a member of the public and short-term exposure of intruders is assumed possible after institutional controls end. The period of institutional control will be randomly sampled from a probability density function derived from expert elicitation. The member of the public will be located at the use restriction boundary.
4) The institutional control policy and the probabilistic period of institutional controls are not applied to the 40 CFR 191.13 containment requirements, which do not allow PAs to assume institutional control is effective beyond 100 years.

These changes are implemented in the current Area 3 RWMS PA and Area 5 RWMS PA GoldSim models except for changing the point of compliance to the use restriction boundaries.

2.4 RESEARCH AND DEVELOPMENT

The PA/CA Maintenance Plan calls for annual reviews of R&D activities relevant to the PA. Onsite and offsite R&D activities (e.g., those performed at other DOE sites, the national laboratories, the Desert Research Institute, and academic institutions) provide the data used to evaluate uncertainty in conceptual models, mathematical models, and model parameters and to ensure continuing adequacy of the PA.

The DASs require NNSA/NFO to address all secondary issues (e.g., consistency of models and parameters between the Area 3 and Area 5 RWMSs) noted during the PA/CA reviews as part of the maintenance program. R&D is the mechanism for NNSA/NFO to address these issues and manage uncertainty.

No confirmatory testing is conducted under the R&D program. The environmental monitoring program includes measurement and monitoring of multiple parameters (e.g., vadose zone moisture contents, radionuclide concentrations in air and groundwater) that confirm the performance of the RWMSs and continuing adequacy of the PA.

2.4.1 FY 2013 R&D Activities

The major R&D effort undertaken in FY 2013 was the further development of the GoldSim models supporting the Area 3 RWMS and Area 5 RWMS PAs and CAs. Model development activities are performed to maintain consistency with known site conditions (e.g., site inventory, monitoring results), improve consistency between the Area 3 and Area 5 RWMS PA/CA models, and reduce model uncertainty.

Area 5 RWMS PA GoldSim Model Development

A new FY 2013 baseline version of the Area 5 RWMS model, 4.115, has been accepted for all model applications, including waste stream evaluations and compliance determinations (NNSA/NFO 2014). The FY 2013 PA update was performed with the Area 5 RWMS v4.115 PA model. Major developments since version 4.114 of the model include the following:

- All inventories and disposal unit dimensions are updated to FY 2013 estimates.
- Ingestion, inhalation, and air immersion dose conversion factors are updated with adult factors from the *Derived Concentration Technical Standard*, DOE-STD-1196-2011 (DOE 2011).
- The probability of drilling and construction intrusion at the SLB disposal units is updated using the FY 2013 disposal unit areas.

The changes have no significant effects on model results. The updated dose conversion factors have no effect on model results. The updated probabilities of intrusion slightly increase the results for chronic intrusion at SLB disposal units.

Area 3 RWMS GoldSim Model Development

The current baseline version of the Area 3 RWMS model, 2.102, was accepted for all model applications in FY 2011 (NNSA/NSO 2011a). A special analysis using the Area 3 RWMS v2.102 model was prepared in FY 2012 (NSTec 2012).

Although no new baseline versions were released in FY 2013, model maintenance and development continues. To maintain model consistency, Area 5 RWMS PA model improvements and parameter updates that are applicable to Area 3 are also applied to the Area 3 RWMS PA model.

Area 5 RWMS Inventory GoldSim Model Development

The Area 5 RWMS FY 2013 inventory estimate was prepared with the Area 5 Inventory v2.111 model. The only major change from the previous version is the addition of FY 2013 disposal data. The ^{234}U composition of the UGTA inventories was revised based on errata published for Bowen et al. (2001). The correction affects the ^{234}U inventory estimate for NNSS mixed fission product waste disposed before 1991. The correction does not have a significant impact on the inventory estimate.

Area 3 RWMS Inventory GoldSim Model Development

The Area 3 RWMS FY 2013 inventory estimate was prepared with the Area 3 Inventory v2.016 model. No changes were made to the Area 3 Inventory v2.016 in FY 2013.

2.4.2 Future R&D Activities

The long-term goal of the maintenance program is to reduce uncertainty in exposure scenarios (member of the public and inadvertent human intrusion), conceptual models, mathematical models, and model parameters. Reduction of uncertainty and associated improvement of the PA model will be accomplished through special studies. In addition, future R&D activities include the development of new waste concentration limits, evaluation of waste forms and containers (both engineering and geochemical properties) for disposal, the refinement of closure cover designs, and evaluation of institutional control and land-use options for optimizing disposal operations.

During FY 2013, the EPA American Meteorological Society/EPA Regulatory Model (AERMOD) (EPA 2005) was investigated for updating the atmospheric dispersion modeling in the Area 3 RWMS and Area 5 RWMS PA/CA models. AERMOD is the EPA preferred model for air permit modeling under the Clean Air Act. It has the advantages of improved accuracy relative to earlier models, the ability to simulate multiple area sources, and the capacity to account for terrain effects. AERMOD evaluations are continuing.

2.5 SUMMARY OF CHANGES

Waste operations, facility design, monitoring results, and R&D results for the Area 3 and Area 5 RWMSs were reviewed to identify changes potentially impacting the PAs and the DASs. Discovered and proposed changes are summarized below.

2.5.1 Discovered Changes

An errata sheet was issued for a data source, Bowen et al. 2001, used to estimate the inventory of NNSS derived mixed fission products (MFPs) disposed at the Area 3 RWMS and Area 5 RWMS. The inventory models were updated with the new data. The site inventories were not significantly changed by the revision. No other changes were discovered in FY 2013.

2.5.2 Proposed Changes

2.5.2.1 Area 3 RWMS

The Area 3 RWMS was inactive in FY 2013. No significant changes related to operations, facility design, or inventory occurred. The results of special analysis conducted with the most recent baseline model version are summarized in Section 2.5.3.1. Review of the maintenance plan, closure plan, and monitoring plan indicate that no changes or revisions are necessary.

2.5.2.2 Area 5 RWMS

Facility changes occurred at the Area 5 RWMS in FY 2013. A new SLB disposal unit began disposal operations. Additional inventory was disposed, including inventory from two new or

revised waste streams that required a special analysis for acceptance. Minor operational changes occurred to the Area 5 RWMS monitoring program. A new baseline PA/CA model was released with updated inventories, dose conversion factors, and probabilities of intrusion. Review of the maintenance plan, closure plan, and monitoring plan indicate that no changes or revisions are necessary.

2.5.3 R&D Changes

2.5.3.1 Area 3 RWMS

In FY 2012, a special analysis was prepared for the Area 3 RWMS using a new baseline PA/CA model, version 2.102 (NSTec 2012). Prior annual summary reports have documented multiple changes occurring since preparation of the PA and CA. Potentially important changes include the following:

- Development of a new and improved baseline PA and CA model implemented in the probabilistic GoldSim simulation platform
- A significant increase in the waste inventory disposed at the site
- Revision and updating of model parameters based on additional years of site monitoring data and new research and development results

Although changes have occurred, many important PA/CA issues remain unchanged, including the site conceptual model; important features, events, and processes (FEPs); and the points of compliance. The special analysis was performed to document the current status of the PA/CA model and to quantitatively assess the impact of cumulative changes on the PA and CA results. The results of the special analysis are used to assess the validity of the approved PA/CA and make a determination if revision of the PA or CA is necessary.

The Area 3 RWMS special analysis used the Area 3 RWMS v2.102 GoldSim model to assess the continuing validity of PA conclusions. The geometric mean inventory and standard deviation data listed in Tables 7 and 8 were entered into the inventory elements for U-3ax/bl, U-3ah/at, and U-3bh. The disposal unit area, disposal unit volume, and waste volumes were updated with current data. All disposal units were assumed to be closed with a 3 m (9.8 ft) thick cover. The model was run assuming a median period of active institutional control of 245 years, a 100-year period of passive institutional control, and a 1,000-year compliance period. The model was run in GoldSim version 10.5.2 with 5,000 LHS realizations.

Comparison of the maximum special analysis results with the PA performance objectives indicates that there continues to be a reasonable expectation of compliance with the performance objectives. The resident exposure scenario was evaluated for compliance with the air pathway performance objective (Table 13). The maximum mean air pathway annual total effective dose (TED) for a resident, 7E-6 millisievert (mSv) at 1,000 years, has decreased relative to the approved PA and is a small fraction of the 0.1 mSv limit. The mean and 95th percentile air pathway annual TED results are less than the performance objective for all scenarios. The air pathway annual TED is due predominantly to inhalation of lead-210 (^{210}Pb) for all scenarios at 1,000 years. At closure, ^{3}H is the predominant source of air pathway TED.

Table 13. Area 3 RWMS v2.102 GoldSim Model Member of Public Total Annual TED through the Air Pathway

Scenario	Mean Annual TED (mSv)	95th Percentile (mSv)	Time of Maximum
Resident	6.5E-6	1.7E-5	1,000 years
Resident with Agriculture	7.3E-6	1.9E-5	1,000 years
Transient Occupant	2.6E-6	7.3E-6	1,000 years

The maximum mean resident all-pathways annual TED, 7E-5 mSv at 1,000 years, has increased relative to the approved PA but remains a small fraction of the 0.25 mSv limit (Table 14). The mean and 95th percentile all-pathways annual TED results are a small fraction of the performance objective for all scenarios. The resident all-pathways annual TED is due predominantly to ^{210}Pb+P, where "+P" denotes that the dose from short-lived progeny in secular equilibrium is included. The resident with agriculture all-pathways TED is due predominantly to ^{210}Pb+P and ^{99}Tc. The transient occupant all-pathways TED is due predominantly to external exposure from ^{222}Rn progeny in cover soil.

Table 14. Area 3 RWMS v2.102 GoldSim Model Member of Public Total Annual TED through All-Pathways

Scenario	Mean Annual TED (mSv)	95th Percentile (mSv)	Time of Maximum
Resident	7.1E-5	2.0E-4	1,000 years
Resident with Agriculture	1.2E-3	3.6E-3	1,000 years
Transient Occupant	1.3E-3	3.4E-3	1,000 years

The maximum mean ^{222}Rn flux density, 0.03 becquerels per square meter per second (Bq m^{-2} s^{-1}), has increased relative to the PA results but is significantly less than the 0.74 Bq m^{-2} s^{-1} limit. The mean and 95th percentile ^{222}Rn flux densities are less than the performance objective throughout the 1000-year compliance period (Table 15).

Table 15. Area 3 RWMS v2.102 GoldSim Model ^{222}Rn Flux Density

Disposal Unit	Mean ^{222}Rn Flux Density (Bq m^{-2} s^{-1})	95th Percentile (Bq m^{-2} s^{-1})	Time of Maximum
U-3ah/at and U-3bh	0.029	0.070	1,000 years

The special analysis estimates intruder doses for acute intruder scenarios only. The Area 3 RWMS is expected to be located within the CAU 97 use restriction boundaries. Based on NNSA/NFO institutional control policies, chronic intrusion is assumed to be unlikely for 1,000 years. The mean and 95th percentile acute drilling intruder TEDs are a small fraction of the 5 mSv performance objective for both post-1988 disposal units (Table 16). Acute intruder doses were not estimated in the approved PA. The acute drilling TED is due predominantly to ^{222}Rn+P, ^{238}U+P, and plutonium-239 (^{239}Pu) at U-ah/at and ^{239}Pu, ^{222}Rn+P, and ^{228}Ra+P at U-3bh.

Table 16. Area 3 RWMS v2.102 GoldSim Model Acute Drilling Intruder TED

Scenario/Disposal Unit	Mean TED (mSv)	95th Percentile (mSv)	Time of Maximum
Drilling/U-3ah/at	2.3E-4	4.5E-4†	1,000 years
Drilling/U-3bh	4.2E-4	1.2E-3	1,000 years

† - Maximum 95th percentile value occurs at 140 years

The acute construction intruder TED is greater than the drilling intruder results. The mean and 95th percentile acute construction intruder TEDs are a small fraction of the 5 mSv performance objective for both post-1988 disposal units (Table 17). The acute construction TED is due predominantly to ^{239}Pu, ^{222}Rn+P, and ^{238}U+P at U-ah/at and ^{222}Rn+P, ^{228}Th+P, ^{239}Pu, and ^{228}Ra+P at U-3bh.

Table 17. Area 3 RWMS v2.102 GoldSim Model Acute Construction Intruder TED

Scenario/Disposal Unit	Mean TED (mSv)	95th Percentile (mSv)	Time of Maximum
Construction/U-3ah/at	0.014	0.036	1,000 years
Construction/U-3bh	0.016	0.037	1,000 years

The special analysis results indicate that changes to the Area 3 RWMS PA model do not significantly alter the PA results or conclusions. Although increases occur for the all-pathways annual TED and the ^{222}Rn flux density, all PA results are a small fraction of the performance objectives. The same conclusion was reached for the approved PA. The special analysis results continue to support a conclusion that there is a reasonable expectation of meeting all performance objectives. There is no need to revise the DAS at this time. The special analysis results support a conclusion that the Area 3 RWMS PAs remain valid, and revision is not necessary at this time.

2.5.3.2 Area 5 RWMS

A new baseline version of the Area 5 RWMS PA model, version 4.115, was released in FY 2013. The performance of the Area 5 RWMS was analyzed using the Area 5 RWMS v4.115 GoldSim model to assess the continuing validity of PA conclusions. The geometric mean inventory and standard deviation data listed in Tables 9 through 11 were entered into the inventory elements for the SLB, Pit 6, Pit 13 disposal units, and GCD boreholes, respectively. The disposal unit area, disposal unit volume, and waste volumes were updated with FY 2013 data. All SLB disposal units were assumed to be closed with a 2.5 m (8.2 ft) thick cover. The model was run assuming a median period of active institutional control of 245 years, a 100-year period of passive institutional control, and a 1,000-year compliance period. The model was run in GoldSim version 10.5.3 with 5,000 LHS realizations.

The results for the Area 5 RWMS v4.115 model indicate that there is reasonable expectation of compliance with the member of public performance objectives. The atmospheric pathway mean and 95th percentile annual TED for all scenarios are less than the limit of 0.1 mSv (Table 18). The air pathways results did not significantly change in FY 2013. The maximum air pathway

annual TED is less than 1% of the performance objective. The peak annual TED occurs at 1,000 years for all scenarios, except the Open Rangeland scenario at Cane Spring where the maximum occurs at 100 years. The resident air pathway TED at 1,000 years is contributed predominantly by ^{229}Th+P (22 %), ^{238}U+P (21 %), ^{210}Pb+P (15 %), ^{239}Pu (13 %), ^{234}U (9 %), ^{233}U (9 %), and ^{240}Pu (5 %). Pb-210 present at 1,000 years is produced predominantly by radioactive decay of ^{234}U present at the time of disposal. At closure, ^{3}H is the predominant source of air pathway TED.

Table 18. Area 5 RWMS v4.115 GoldSim Model Member of Public Total Annual TED through the Air Pathway

Exposure Scenario	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
Transient Visitor	7.8E-5	2.8E-04	1,000 years
Resident	1.5E-4	5.2E-04	1,000 years
Resident Farmer	4.3E-4	1.5E-03	1,000 years
Open Rangeland (Cane Spring)	6.8E-9	NA	100 years
Open Rangeland (NNSS Boundary)	1.1E-7	3.0E-07	1,000 years

The mean and 95th percentile annual TEDs for the all-pathways scenarios are less than the 0.25 mSv performance objective (Table 19). The all-pathway TEDs are not significantly changed in FY 2013. The maximum all-pathways TED is approximately 8% of the performance objective. The resident all-pathways TED at 1,000 years was predominantly due to ^{210}Pb+P (32 %), ^{238}U+P (29 %), ^{229}Th+P (13 %), and ^{226}Ra+P (6 %).

Table 19. Area 5 RWMS v4.115 GoldSim Model Member of Public Annual TED through All Pathways

Exposure Scenario	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
Transient Visitor	6.4E-3	1.5E-02	1,000 years
Resident	8.1E-4	2.6E-03	1,000 years
Resident Farmer	2.2E-2	7.4E-02	1,000 years
Open Rangeland (Cane Spring)	3.1E-3	NA	100 years
Open Rangeland (NNSS Boundary)	3.4E-3	NA	100 years

NA – not available, insufficient realizations to calculate 95th percentile

The mean and 95th percentile ^{222}Rn flux densities are less than the 0.74 Bq m^{-2} s^{-1} performance objective averaged over the entire site (Table 20). The same is true for all virtual disposal units, except for the Pit 13 RaDU, where the 95th percentile ^{222}Rn flux density exceeds the performance objective. The flux density result for the Pit 13 RaDU is not considered significant, because the performance objective is compared with the flux averaged over the site, not the flux from a portion of an individual disposal unit. The ^{222}Rn flux density results are not significantly changed in FY 2013. The ^{222}Rn flux density averaged over all disposal units is 30% of the performance objective.

Table 20. Area 5 RWMS v4.115 GoldSim Model ^{222}Rn Flux Density Results

Disposal Unit	Mean (Bq m^{-2} s^{-1})	95th Percentile (Bq m^{-2} s^{-1})	Time of Maximum
All	0.22	0.49	1,000 years
SLB	0.22	0.57	Closure
Pit 6 RaDU	0.084	0.18	1,000 years
Pit 13 RaDU	0.64	2.0	1,000 years
GCD	1.2E-8	3.5E-08	1,000 years

Based on the institutional control policy adopted in FY 2008, chronic intrusion is assumed to be an unlikely event. Chronic intrusion results are replaced with drilling and construction acute intruder scenario results. The mean and 95th percentile acute intruder doses are less than the 5 mSv performance measure for both scenarios at all virtual disposal units (Tables 21 and 22). The acute drilling scenario TEDs are not significantly different in FY 2013. The acute drilling intrusion TEDs remain a small fraction of the dose limit.

Table 21. Area 5 RWMS v4.115 GoldSim Model Acute Drilling Intruder TED

Disposal Unit	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
SLB	1.6E-3	2.7E-3	1,000 years
Pit 6 RaDU	0.040	0.077	1,000 years
Pit 13 RaDU	0.026	0.035	1,000 years
GCD	0.018	0.053	1,000 years

The SLB disposal unit acute construction TEDs are not significantly changed in FY 2013. The means and 95th percentiles are less than the performance measure for all scenarios. The mean SLB acute construction scenario TED is 24% of the performance measure. The acute construction intruder TED for the SLB disposal units is due to ^{238}U+P (35 %), ^{229}Th+P (24 %), ^{239}Pu (9 %), ^{233}U (7 %), and ^{234}U (6 %).

Table 22. Area 5 RWMS v4.115 GoldSim Model Acute Construction Intruder TED

Disposal Unit	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
SLB	1.2	2.1	1,000 years
Pit 6 RaDU	0.85	2.3	1,000 years
Pit 13 RaDU	0.056	0.19	1,000 years
GCD	3.3E-6	NA	100 years

NA – not available, insufficient realizations to calculate 95th percentile

The updated FY 2013 PA results show little or no change from the FY 2012 results. All results indicate that there is still reasonable assurance of meeting all performance objectives. Therefore, the Area 5 RWMS PA results are still considered valid, and no need to revise the PA is identified.

Comparison of the FY 2013 results with the 2006 PA update indicates that significant changes have occurred in the maximum TEDs and their time of occurrence. The air pathway results have increased for all scenarios, except the open rangeland scenario. The time of the maximum TED has shifted from 63 to 1,000 years for the Open Rangeland scenario at the NNSS site boundary. Although changes have occurred, the maximum air pathway TED is less than 1% of the performance objective. The all-pathways results have increased for the transient visitor but have decreased for all other scenarios. The ^{222}Rn flux density has increased for all disposal units. The intruder scenarios analyzed have changed from chronic scenarios to acute scenarios. The changes occurring since the 2006 PA update reflect the cumulative effects of inventory changes, updated model parameters, a new passive institutional control period, a new institutional control policy, a thinner closure cover, and new dose conversion factors.

2.6 CONCLUSIONS

2.6.1 Area 3 RWMS

The most significant change at the Area 3 RWMS is additional inventory disposed since 1996 when the approve PA inventory was prepared and its placement in inactive status. The site's conceptual model, important FEPs, site characteristics, and compliance points remain unchanged. Environmental monitoring results continue to indicate that the only releases from the site are low levels of tritiated water vapor that remain consistent with PA model results. Monitoring and R&D results continue to confirm and support the hydrologic conceptual model.

The three key questions can be answered as follows:

1. Does the annual summary information indicate that changes to the PA are required? A special analysis of the Area 3 RWMS (NSTec 2012) demonstrates that PA conclusions are unchanged and that there continues to be a reasonable expectation of compliance with all performance objectives. A full PA revision is not necessary at this time.
2. Does the annual summary information indicate that the conclusions of the PA remain valid? The special analysis results confirm that important PA conclusions remain unchanged. No groundwater pathway is expected at the site. All PA results continue to be a small fraction of their performance objectives.
3. Does the annual summary information indicate that facility performance will remain within the DOE M 435.1-1 PA performance objectives and any conditions in the facility DAS? The FY 2012 special analysis results indicate that there is still a reasonable expectation of compliance with all performance objectives.

2.6.2 Area 5 RWMS

The most significant changes for the Area 5 RWMS since preparation of the 2006 PA update include increased inventory, updated parameters, revised periods of institutional control, and a thinner closure cover. The conceptual model, important FEPs, site characterization data, and compliance points remain unchanged. Revision to the Area 5 RWMS PA is not necessary.

The three key questions can be answered as follows:

1. Does the annual summary information indicate that changes to the PA or CA are required? No significant changes occurred in FY 2013 that would require revision of the Area 5 RWMS PA.
2. Does the annual summary information indicate that the conclusions of the PA and CA remain valid? Although a number of changes have occurred since preparation of the 2006 PA update, the PA's conclusions continue to remain valid.
3. Does the annual summary information indicate that facility performance will remain within the DOE M 435.1-1 PA performance objectives and any conditions in the facility DAS? Updated FY 2013 PA results indicate that there is still a reasonable expectation of compliance with all performance objectives.

3.0 COMPOSITE ANALYSIS REVIEW

The CA evaluates the combined impacts of radionuclide releases from LLW disposal facilities and all other interacting sources of radioactive materials. The PA review above summarizes changes relevant to waste disposed after September 26, 1988. The CA review emphasizes changes not addressed in the PA review. CA radionuclide sources not addressed in the PA review include the pre-1988 RWMS waste inventory and residual radioactive materials from Environmental Restoration (ER) sites that interact with the RWMSs. Radioactively contaminated ER sites are mostly surface soils and groundwater units contaminated by nuclear weapon testing. The pre-1988 disposal units at the Area 3 RWMS and Area 5 RWMS are the only operating facilities that interact with the Area 3 and Area 5 RWMSs. Discussion of facility changes in the CA review is limited to changes at the pre-1988 RWMS disposal units.

3.1 WASTE OPERATIONS AND ENVIRONMENTAL REMEDIATION

3.1.1 Radioactive Waste Management Sites

3.1.1.1 Waste Characteristics and Facility Design

There were no discovered or proposed changes in the operation, facility design, and waste characteristics of the pre-1988 disposal units at the Area 3 and Area 5 RWMS. All pre-1988 disposal units at the Area 3 RWMS and Area 5 RWMS are now closed, except for the U-3ah/at disposal unit at the Area 3 RWMS, which is operationally closed. No operational changes occurred at either site. The CA models remain consistent with the facility designs and waste characteristics.

No new or additional data were acquired about pre-1988 waste forms, containers, and operations at the Area 3 RWMS in FY 2013. No remediation of pre-1988 wastes or disposal units was performed. A special analysis for the Area 3 RWMS pre-1988 waste was released in FY 2012 (NSTec 2012). Revised Area 3 RWMS disposal unit volume estimates were prepared to support the special analysis. There were no significant changes to the pre-1988 waste inventories for the Area 3 RWMS. The current Area 3 RWMS CA inventory was estimated with the Area 3 Inventory v2.016 model.

Pre-1988 waste forms, containers, facility design, and operations at the Area 5 RWMS were unchanged in FY 2013. No remediation involving pre-1988 wastes or disposal units was performed. No special analyses relevant to the Area 5 RWMS pre-1988 wastes were performed. There were no significant changes to the pre-1988 waste inventories for the Area 5 RWMS. The current Area 5 RWMS CA inventory was estimated with the Area 5 Inventory v2.111 model.

3.1.1.2 Monitoring

Pre-1988 waste and disposal units are covered by the same the monitoring activities discussed in Section 2.2.3. The results of environmental monitoring across the NNSS are reported annually in the Annual Site Environmental Report and the National Emission Standards for Hazardous Air Pollutants report (NSTec 2013b, 2013c). CY 2012 monitoring results are consistent with previous results and the CA resuspension and atmospheric dispersion model results. No

significant subsidence events were observed at pre-1988 disposal units at the Area 3 and Area 5 RWMS in CY 2012.

3.1.1.3 Closure

The Area 3 RWMS PA/CA assumes that the site will be closed with a vegetated monolithic ET cover of native alluvium (Shott et al. 2001). The cover is assumed to be 3 m (10 ft) thick after subsidence. The U-3ax/bl disposal unit, which contains most of the pre-1988 waste at the Area 3 RWMS, was closed in FY 2001 with the installation of a monolithic alluvium cover. The existing U-3ax/bl 2.7 m (8.9 ft) operational cover was supplemented with an additional 0.3 m (1 ft) of soil and sloped to promote drainage off the cover. The U-3ax/bl closure cover is consistent with the CA assumption of a 3 m (10 ft) monolithic cover. Current plans are to close U-3ah/at and U-3bh with a 3 m (10 ft) monolithic ET cover (NSTec 2007b). The Area 3 RWMS covers and closure plan remain consistent with CA model assumptions.

The Area 5 RWMS CA cover assumptions are consistent with closure plans (BN 2001b; NSTec 2008a). The CA assumes that the cover is maintained for 100 years and public access is restricted for 250 years. The cover is assumed to be a monolithic ET cover, measuring 2 to 6 m (6 to 20 ft) thick. The current Area 5 RWMS CA model assumes the site is closed with a 2.5 m (8 ft) monolithic ET cover. In FY 2011, the 92-ac LLWMU at the Area 5 RWMS, which includes all pre-1988 disposal units except the GCD Test borehole, was closed with a 2.5 m (8 ft) monolithic ET cover. Closure of the GCD and GCD Test boreholes will occur at final site closure in 2028. Closure of the pre-1988 Area 5 RWMS disposal units and the closure plan are consistent with the CA assumptions (NSTec 2008a).

3.2 RESEARCH AND DEVELOPMENT

No R&D activities occurred in FY 2013 specific to pre-1988 waste or residual radioactive contamination. The model development R&D activities described in Section 2.4 are also relevant for the CAs.

3.3 INTERACTING SOURCE TERMS

3.3.1 Underground Test Areas

The goal of UGTA CAU closure under the FFACO process is to define 1,000-year groundwater boundaries that enclose groundwater potentially exceeding the maximum concentration limits of the Safe Drinking Water Act. The Corrective Action Strategy is to use characterization and modeling studies, monitoring, and institutional controls to manage potential risks from contaminated groundwater. The strategy is implemented through a four-stage approach that includes: (1) Corrective Action Investigation Plan (CAIP), (2) Corrective Action Investigation (CAI), (3) CADD/CAP, and (4) Closure Report (CR) stages. An initial use restriction (UR) boundary and regulatory boundary objectives are identified at the start of the CADD/CAP stage. The CR stage finalizes the UR boundary and establishes the regulatory boundary. The UR boundary is established through combined assessments of contaminant boundary forecasts, requirements for protection of worker health and safety, and administrative policies designed to restrict access to

contaminated groundwater. A regulatory boundary is chosen to provide protection for the public and the environment from the effects of migration of radioactive contaminants.

The Area 3 RWMS and Area 5 RWMS CAs assume that the disposal sites are within UGTA UR boundaries and that the URs can control exposure of the public to contaminated groundwater for 1,000 years. In FY 2008, NNSA/NFO implemented a formal policy to implement and maintain the UGTA URs (NNSA/NSO 2008).

CAU 97, the Yucca Flat UGTA, is in the CAI stage of the FFACO process. The CAU 97 groundwater flow and radionuclide transport document was finalized in FY 2013 and submitted to NDEP for review. A formal peer review is planned for FY 2014. The CADD/CAP is expected to be finalized in FY 2015. The Area 3 RMWS is expected to be within the initial CAU 97 UR boundary. The Area 3 RWMS CA assumptions are still consistent with current plans for CAU 97.

CAU 98, the Frenchman Flat UGTA, is in a more advanced stage of the FFACO process. The CAU 98 CADD/CAP, completed and accepted by NDEP in 2011, describes the initial UR boundaries and regulatory boundary objectives (NNSA/NSO 2011b). The initial UR boundaries enclose three areas in Frenchman Flat. Two of the areas, the North Testing Area and the Central Testing Area, are based on forecasts of UGTA contaminant boundaries. The third UR boundary, the Area 5 Area-Relinquishment boundary, encloses the Area 5 RWMS and corresponds with the Radioactive Waste Management Complex boundary. The Area 5 Area-Relinquishment boundary is separated by approximately 735 m (2,400 ft) from the North Testing Area UR boundary northeast of the RWMS. This approximates the closest projected approach of groundwater contaminant plumes to the Area 5 RWMS boundary within 1,000 years.

The CAU 98 regulatory boundary objective is to protect receptors downgradient of the Rock Valley fault system from groundwater contamination. The basis for the objective is that, although contaminants resulting from underground nuclear testing are not forecasted to migrate out of Frenchman Flat within the next 1,000 years, the Rock Valley fault system is the expected pathway of groundwater flow out of the basin. The Rock Valley fault system, which occurs on the eastern and southern margins of Frenchman Flat, is a potential pathway from the uppermost slow-flowing alluvial aquifer to the deeper and regionally extensive lower carbonate aquifer.

CAU 98 model evaluation studies identified in the CADD/CAP were initiated in FY 2012. Two characterization wells were installed downgradient of the PIN STRIPE and MILK SHAKE events at points within the 50-year contaminant boundary. If the evaluations and any model refinements are accepted by NDEP, the final CAU 98 UR boundaries will be negotiated at the start of the CR stage in FY 2015. Revision of the Area 5 RWMS CA will begin after release of the final CR in FY 2016.

3.3.2 Soil Sites

The CAs included multiple contaminated Soil Sites characterized by the Radionuclide Inventory and Distribution Program (RIDP) (McArthur 1991) as source terms for atmospheric resuspension and dispersion modeling. The CAs assume that the contaminated Soil Sites will be closed in

place and any corrective actions will have minimal impacts on resuspension and atmospheric dispersion of radionuclides from the Soil Sites to the RWMSs.

The Area 3 RWMS CA included 28 Soil Sites contaminated by aboveground and belowground nuclear testing. Several sites progressed in the FFACO process in FY 2013 (Table 23). Additional site characterization data and closure activities continue to be consistent with the Area 3 RWMS CA assumptions. Completed or planned closure actions have had no significant impact on radionuclide inventories or radionuclide resuspension rates. Completed and planned corrective actions are not expected to have any impact on the CA model assumptions.

Table 23. FY 2013 Developments for ER Soil Sites Considered in the Area 3 RWMS CA

CAU	Site	Radiological COPCs or COCs	FFACO Status	Corrective Action
104	Area 7 Atmospheric Test Sites	None	CADD/CAP Issued (NNSA/NSO 2012b)	Remove Hazardous PSM, No Further Action (Test Site B7-B Clean Closure)
105	Area 2 Atmospheric Test Sites	Mixed Fission Products (MFP), Actinides	CAIP Issued (NNSA/NSO 2012c)	To Be Determined
568	Area 3 Plutonium Dispersal Sites	MFP, Actinides	Data Quality Objectives Process Initiated	To Be Determined
569	Area 3 Yucca Flat Atmospheric Test Sites	MFP, Actinides	CADD/CR Issued (NNSA/NFO 2013b)	Remove Hazardous PSM, Closure in Place with FFACO URs
571	Area 9 Yucca Flat Plutonium Dispersal Sites	MFP, Actinides	CAIP Issued (NNSA/NFO 2013c)	To Be Determined

CADD – Corrective Action Decision Document
CAP – Corrective Action Plan
CAIP – Corrective Action Investigation Plan
COCs – contaminants of concern
COPCs – contaminants of potential concern
CR – Closure Report
PSM – potential source material

The Area 5 RWMS CA considered eight contaminated Soil Site CAUs as possible sources of residual contamination. Four of the Soil Sites, the 306 Ground Zero (GZ) Rad Contaminated Area (Corrective Action Site [CAS] 05-45-04), the 307 GZ Rad Contaminated Area (CAS 05-45-05), the Kay Blockhouse (CAS 05-33-01), and the Gravel Gertie (CAS 05-23-01) were excluded from the CA based on their small radionuclide inventories, limited area, and distance from the RWMS relative to other potential sources. The Pu Valley soil site (CAU 366) was excluded based on the assumption that the intervening mountain ranges blocked atmospheric dispersion. Only three sources, the Gadget, Mechanics, and Explosives (GMX) site (CAS 05-23-15), PINSTRIPE (CAS 11-23-05), and the Frenchman Flat Atmospheric Test Site (ABLE CAS

05-23-05, HAMILTON CAU 573, and SMALL BOY CAU 541), were explicitly included in CA modeling.

No changes are reported in FY 2013 for contaminated Soil Sites considered in the Area 5 RWMS CA. Although corrective action investigations have developed additional site characterization data, the RIDP characterization data are still the preferred source for contaminated Soil Site inventories (NSTec 2008b). Completed or planned closure actions have had no significant impact on radionuclide inventories or radionuclide resuspension rates. CA assumptions remain consistent with the status of the Soil Sites. Completed and planned corrective actions are not expected to have any impact on CA model assumptions.

3.3.3 Industrial Sites

The CAs assume that the impact of the Industrial Sites is insignificant compared with the Soil Sites. No Industrial Sites are included in the CAs.

No Industrial Sites interacting with the Area 3 RWMS and Area 5 RWMS were characterized or remediated in FY 2013. The Area 3 RWMS and Area 5 RWMS CA assumptions concerning Industrial Sites remain unchanged.

3.4 SUMMARY OF CHANGES

3.4.1 Discovered Changes

The ^{234}U UGTA inventories were corrected in FY 2013 based on an errata issued for Bowen et al. (2001). The ^{234}U UGTA inventories are used by the GoldSim inventory models to estimate the radionuclide composition of NNSS MFPs disposed before 1991. The corrections have no significant impact on the inventory estimates.

3.4.2 Proposed Changes

The Area 3 RWMS has been inactive since FY 2006. Therefore, no significant operational changes occurred for the Area 3 RWMS. Closure of ER sources included in the CA is progressing, but closure activities have had no impact on the CA model assumptions. An updated Area 3 RWMS CA model was used for a special analysis in FY 2012. CA model changes are described in the special analysis (NSTec 2012).

The Area 5 RWMS 92-ac LLWMU, which includes all pre-1988 waste disposal units except the GCD Test Borehole, was closed with a 2.5 m (8.2 ft) monolithic ET cover in FY 2011. Revegetation of the 92-ac LLWMU cover began in FY 2012. These changes are consistent with the CA model.

Closure of ER sources included in the CA is progressing, but closure activities have had no impact on CA assumptions or models. Corrective action investigations at several ER sources excluded from the CA confirm assumptions that the sources have minimal potential to interact with the Area 5 RWMS. An updated Area 5 RWMS CA baseline model was released in FY 2013. There were no significant changes to the CA model.

The maintenance plan, closure plan, monitoring plan, and R&D activities are unchanged from previous years. Results from monitoring and R&D activities are consistent with previous results and continue to support CA conceptual models. No revisions of the maintenance plan, closure plan, monitoring plan, or R&D activities are required.

3.4.3 R&D Changes

3.4.3.1 CA Results for the Area 3 RWMS

The Area 3 RWMS v2.102 GoldSim model was used to update the CA results in FY 2012 (NSTec 2012). The model was run as described for the PA, except that the model was placed in CA mode.

The CA annual TED continues to be predominantly from inhalation of ^{239}Pu resuspended from the HORNET GZ Soil Site, which surrounds the Area 3 RWMS. The time of the maximum dose shifts from 250 years in the approved CA to 1,000 years in the special analysis. The shift in the timing of the maximum dose is a result of the probabilistic period of institutional control used in the special analysis. The CA annual TED also increases from 0.01 mSv in the approved CA to 0.02 mSv in the special analysis (Table 24). The increase is caused by updated parameter values in the soil resuspension model. The mean and 95th percentile doses are significantly less than the 0.3 mSv annual dose constraint, and the importance of the contributing sources is unchanged. Therefore, the Area 3 RWMS CA results are still considered valid.

Table 24. Area 3 RWMS v2.102 GoldSim Model CA All-Pathways Annual TED for a Resident at the 100 m (330 ft) RWMS boundary

Disposal Unit	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
All	0.021	0.031	1,000 years

3.4.3.2 CA Results for the Area 5 RWMS

The Area 5 RWMS CA results were updated with the Area 5 RWMS v4.115 GoldSim model. The model was run as described for the PA, except that the model was placed in CA mode. The FY 2013 CA TED estimate is not significantly different from the FY 2012 result (Table 25). The mean and 95th percentile doses are significantly less than the 0.3 mSv annual dose constraint. Therefore, the Area 5 RWMS CA results are still considered valid.

Table 25. Area 5 RWMS v4.115 GoldSim Model CA All-Pathways Annual TED for a Resident at the 100 m (330 ft) RWMS boundary

Disposal Unit	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
All	9.8E-4	3.0E-3	1,000 years

3.5 CONCLUSIONS

3.5.1 Area 3 RWMS

There have been no changes in FY 2013 that affect the conclusions of the CA, as indicated by reviews of facility operations, the disposal unit closure inventories, inventories of the ER sources of residual radionuclides, the progress of the ER cleanup projects, land-use planning, closure planning, and the results of the monitoring and R&D activities. There is no new information that would reduce the uncertainty of the current sources. A special analysis of the Area 3 RWMS was issued in FY 2012, which includes updated CA doses.

The three key questions can be answered as follows:

1. Does the annual summary information indicate that changes to the PA or CA are required? A special analysis of the Area 3 RWMS CA was prepared to determine the impacts of changes occurring since preparation of the last CA. The special analysis concludes that a CA revision is not necessary at this time.
2. Does the annual summary information indicate that the conclusions of the PA and CA remain valid? The special analysis for the Area 3 RWMS CA indicates that the annual TED to a resident from all interacting sources is a small fraction of the 0.3 mSv dose constraint and that the HORNET GZ Soil Site is the predominant source. The Area 3 RWMS special analysis results are consistent with the CA results, supporting a conclusion that the CA continues to be valid.
3. Does the annual summary information indicate that facility performance will remain within the DOE M 435.1-1 PA performance objectives, CA performance goals, and any conditions in the facility DAS? The Area 3 RWMS v2.102 GoldSim model results indicate that there is still a high likelihood of meeting the 0.3 mSv dose constraint.

3.5.2 Area 5 RWMS

There have been no changes in FY 2013 that affect the conclusions of the CA, as indicated by reviews of facility operations, the disposal unit closure inventories, estimated inventories of the ER sources of residual radionuclides, the progress of the ER corrective actions, land-use planning, closure planning, and the results of the monitoring and R&D activities. No new sources of contamination have been identified. Corrective action investigations at contaminated soil sites has confirmed and supported CA assumptions.

The only changes affecting the CA are the updated RWMS inventory estimates. The consequences of the changes were evaluated with the Area 5 RWMS v4.115 GoldSim model and found not to affect the CA conclusions.

The three key questions can be answered as follows:

1. Does the annual summary information indicate that changes to the PA or CA are required? The annual review of the CA indicates that no significant changes have occurred. No CA changes are required.

2. Does the annual summary information indicate that the conclusions of the PA and CA remain valid? Review of the Area 5 RWMS CA indicates that the CA conclusions remain valid.
3. Does the annual summary information indicate that facility performance will remain within the DOE M 435.1-1 PA performance objectives, CA performance goals, and any conditions in the facility DAS? The Area 5 RWMS v4.115 GoldSim model results indicate that there is a high likelihood of meeting the 0.3 mSv dose constraint.

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APPENDIX A

Checklist for Review of Annual Summary

This appendix summarizes the results of a review conducted to confirm that the annual summary contains all the information as required by the Low-Level Waste Disposal Facility Federal Review Group (LFRG) Program Management Plan.

Table A.1. Checklist for Review of Annual Summary

Requirement	Result
1.0 Key Questions *The annual summary for each disposal facility must provide information sufficient to evaluate three key questions about the PA for the facility:* *a. Does the annual summary information indicate that changes to the PA are required?*	Section 2.6 concludes that the Area 3 RWMS PA and the Area 5 RWMS PA do not require revision.
b. Does the annual summary information indicate that the conclusions of the PA remain valid?	Section 2.6 concludes that the Area 3 and Area 5 RWMS PAs remain valid.
c. Does the annual summary information indicate that facility performance will remain within the PA limits imposed by the U.S. Department of Energy Manual DOE M 435.1-1 performance objectives and any conditions in the facility DAS?	Section 2.6 concludes that the Area 3 and Area 5 RWMSs continue to meet all performance objectives based on PA model results using PA models updated with FY 2013 data.
2.0 Necessary Information *The information provided in the annual summary for each low-level waste disposal facility should include the following:* *a. Description of any changes affecting the PA. Does the annual summary indicate whether any changes affecting the PA have occurred? If so, are their effects on the PA adequately described?*	Changes occurring are described in Sections 2.1 through 2.4 and summarized in Section 2.5. The effects of changes on PA results are described in Section 2.5.3.
b. Description of any PA ramifications of special analyses and reviews performed or proposed for the facility. Does the annual summary indicate whether any special analyses or reviews were performed? If so, are the ramifications for the PA adequately described?	Special analyses for new or revised waste streams are described in Section 2.1.2.
c. Description of any proposed changes in facility design or operations. Does the annual summary indicate whether any changes are proposed in facility design or operations? If so, are the effects of the proposed change on the PA adequately described?	Changes to facility designs and operations are discussed in Section 2.1 and 2.2.
d. Description of any corresponding changes required in the PA maintenance plan, the closure plan, and the monitoring plan. Does the annual summary indicate whether any corresponding changes are required in the plans? If so, are they adequately described?	Section 2.5.2 concludes that no changes are required for the maintenance plan, closure plan, or monitoring plan.

Requirement	Result
e. *Description of any proposed changes in the PA. Does the annual summary indicate whether any changes to the PA are required? If so, are they adequately described?*	Section 2.5.3 describes proposed changes to the PA model. Section 2.6 concludes that no changes to the PA are required.
2.1 Factors to be Addressed *The basic factors to be addressed in the annual summary and evaluated by the LFRG in reviewing the annual summary are operations, facility design, closure design, and research and development. More detailed descriptions of the information relevant to these basic factors are provided below. (For additional detail on the scope and level of detail expected for the topics, see Section 2.2 of the "Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses," November 10, 1999.)* *2.1.1 Operations Considerations* *Disposal unit consistency with the PA models (e.g., size and configuration of trenches, shafts, and pits; waste placement and configuration; thickness of operational backfill/cover). Does the annual summary adequately describe disposal unit consistency with the PA models?* a. *Waste receipts including description of form and packaging (especially special waste forms) and their consistency with PA analyses and projections. Does the annual summary adequately describe waste receipts and their consistency with PA analyses and projections?*	Disposal unit design is discussed in Section 2.2.1. Disposal unit designs continue to be consistent with PA models. Waste receipts are described in Section 2.1.2. The impacts of waste receipts on PA results are described in Section 2.5.2.
b. *Waste acceptance criteria including radionuclides significant to and evaluated in the PA, radionuclide concentration and quantity limits established, waste form and packaging requirements, and consistency with PA results. Does the annual summary adequately describe the WAC and their consistency with the PA results?*	Section 2.1.3 describes the WAC and confirms the consistency of the WAC with PA results.
c. *Procedures and systems (e.g., verification of waste characteristics, inventory limit controls, generator certification) intended to prevent disposal of inappropriate wastes. Does the annual summary adequately describe procedures and systems?*	The Radioactive Waste Acceptance Program is described in Section 2.1.3.
2.1.2 Facility Design Considerations a. *Disposal technology and facility configuration consistency with the PA analyses. Is the consistency adequately described?*	Consistency of facility configuration with PA analyses is described in Section 2.2.
b. *Engineered barrier consistency with the PA. Is the consistency adequately described?*	Consistency of engineered barriers with PA analyses is described in Section 2.2.2.
c. *Monitoring provisions appropriate for evaluation of facility performance. Are monitoring provisions adequately described?*	The Monitoring Program is described in Section 2.2.3.
d. *Operational controls to promote stability and to compensate for potential subsidence. Are operational controls adequately described?*	Subsidence controls and monitoring methods are described in Section 2.2.4.

Requirement	**Result**
2.1.3 Closure Design Considerations *a. Engineered barrier description including consistency of the closure cover design with PA analysis and threats to cover integrity and viability. Are engineered barriers adequately described?*	Closure cover design and consistency with PA analyses are described in Section 2.3.
b. Future land-use plan consistency with PA assumptions. Is consistency of the land-use plan with the PA assumptions adequately described?	Land-use plan consistency with PA assumptions is described in Section 2.3.2.
2.1.4 Research and Development Considerations *a. R&D efforts required by the facility disposal authorization statement. Are these efforts adequately described?*	R&D efforts required by the Area 3 RWMS and Area 5 RWMS DASs are summarized in Section 1.1, Tables 1 and 3, respectively. The tables' status column indicates that all conditions were closed in 2002.
b. R&D efforts pursued for improving and refining the performance assessment. Are these efforts adequately described?	R&D efforts required by PA/CA reviews and their resolution are summarized in Section 1.2, Table 5. Ongoing R&D efforts are described in Section 2.4.
c. Results of any confirmatory testing performed. Was any confirmatory testing performed? If so, are the results adequately described?	Confirmatory monitoring of site performance is described under monitoring in Section 2.2.3. Monitoring results are published elsewhere as cited in the text.

Requirement	Result
2.2 Changes *The changes that could cause divergence from the conditions used for the PA analysis should be categorized as discovered changes, proposed changes, or R&D changes and should be listed and described in the annual summary.* *[Note: This section of the review should focus on description of the changes (discovered, proposed, and R&D) and any effects of the changes not described in Section 2.2.]* *2.2.1 Discovered Changes* *The annual summary should report divergences from expected or planned conditions that have been discovered in facility operations, construction, site characteristics, and other conditions significant to facility performance. Specific information should address the baseline from which the divergence was identified, comparison of expected conditions to any available monitoring results, significance of the divergence as indicated by comparison to the four LFRG review thresholds (listed below), and incorporation of the changes in the performance assessment, if appropriate.* *The four LFRG review thresholds that trigger the review by the LFRG are* *a. an increase of 25 percent or more in the forecasted doses reported in the current, approved facility documentation or any violation of the performance objectives imposed by DOE M 435.1-1,*	A minor change in a parameter used to calculate the ^{234}U content of mixed fission products was discovered in FY 2013. The change has no effect on inventory estimates. Section 2.5.3 summarizes the most recent PA results for the Area 3 and Area 5 RWMSs. Changes are noted. All results continue to meet all performance objectives. The Area 3 RWMS all-pathways dose and ^{222}Rn flux density have increased relative to the PA but remain a small fraction of the performance objective. The Area 5 RWMS air pathway dose has increased relative to the 2006 PA update, but remains less than 1 % of the performance objective. The all-pathways dose has decreased for most scenarios. The ^{222}Rn flux density has increased significantly due to inventory increases. The 95th percentile flux is less than the performance objective.
b. any change in the point of compliance as reported in the current approved facility documentation,	Changes to PA models are described in Section 2.4. No change in the point of compliance occurred in FY 2013.
c. any fundamental change in the analysis methodology or model used for the facility documentation, and	Changes to PA models are described in Section 2.4.
d. any fundamental change in the hydrologic or geologic parameters used in the facility analysis methodology or model.	Changes to PA models are described in Section 2.4. There are no changes in hydrologic or geologic models.

Requirement	Result
2.2.2 Proposed Changes *a. The annual summary should identify divergences from expected or planned conditions that have been or will be voluntarily made by the facility operators to facility operations, facility construction, or other conditions significant to facility performance. Specific information should address the baseline from which the divergence is planned, comparison of current performance to performance expected after the change is made, significance of the divergence as indicated by comparison to the four LFRG review thresholds (listed in Section 2.4.1 above), and incorporation of the changes in the performance assessment, if appropriate. Does the annual summary report any proposed changes? If so, are they adequately described?*	Proposed changes are described in Section 2.5.2.
2.2.3 Research and Development Changes *a. The annual summary should include descriptions of research and development (both generic and site-specific) relevant to the PA analysis models and input data for them that are to be used to improve the conclusions of the PA. The annual summary should include a description of the significance of the improvements, when and how the anticipated improvements will be incorporated in PA modeling and analyses, and whether the improvements are expected to change the conclusions of the PA. Does the annual summary report any R&D changes? If so, are they adequately described?*	R&D changes are described in Section 2.4. The effects of changes to the PA models are described in Section 2.5.3.
3.0 Composite Analysis Summary *The annual summary for each disposal facility should provide the information required by the LFRG members and staff to evaluate whether the facility CA continues to satisfy the requirements of DOE M 435.1-1 and any additional conditions specified in the facility disposal authorization statement. The focus of the CA review will be on the interacting source terms relative to the performance goals established in DOE M 435.1-1 because the review of the facility PA is focused on the facility itself.* *a. Does the annual summary state that the conclusions of the CA remain valid? If so, does the annual summary state whether confidence in the conclusions has changed?*	Section 3.5 concludes that the Area 3 and Area 5 RWMS CAs remain valid and that there continues to be a high likelihood of compliance with the 0.3 mSv dose constraint.
3.1 Key Questions *The annual summary for each disposal facility must provide information sufficient to evaluate three key questions about the composite analysis for the facility:* *a. Does the annual summary information indicate that changes to the CA are required?*	Section 3.5 concludes that no changes or revisions to the CAs are required.
b. Does the annual summary information indicate that the conclusions of the CA remain valid?	Section 3.5 concludes that the conclusions of the CAs remain valid.
c. Does the annual summary information indicate that the facility performance will remain within the CA performance goals provided in the DOE M 435.1-1 performance goals and any conditions in the facility DAS?	Section 3.5 concludes that there is a reasonable expectation that the Area 3 and Area 5 RWMSs meet the 0.3 mSv dose constraint.

Requirement	Result
3.2 Necessary Information *[This section of the review should focus on the effects of the changes on the CA. Section 3.4 should focus on description of the changes and any effects not described in this section.]* *The information provided in the annual summary for each low-level waste disposal facility should include the following:* *a. Description of any changes affecting the CA including changes in the design or operations of facilities with releases potentially interacting with the disposal facility releases. Does the annual summary indicate whether any changes affecting the CA have occurred? If so, are their effects on the CA adequately described?*	The pre-1988 RWMS disposal units are the only facilities interacting with the RWMSs. RWMS design and operations changes affecting the CAs are described in Section 3.1. The effects of all changes on the CA results are described in Section 3.4.3.
b. Description of any CA ramifications of special analyses and reviews performed or proposed for the facility. Does the annual summary indicate whether any special analyses or reviews were performed? If so, are the ramifications for the CA adequately described?	No special analyses relevant to the CA were performed in FY 2013. The effects of changes on CA results are assessed using the current CA model. Current CA results are included in Section 3.4.3.
c. A description of any proposed changes in the low-level waste disposal facility design or operations. Does the annual summary indicate whether any changes are proposed in facility design or operations? If so, are the effects of the proposed changes on the CA adequately described?	Section 3.1 describes RWMS facility changes occurring in FY 2013. No significant changes to pre-1988 disposal units occurred at the Area 3 RWMS and Area 5 RWMS in FY 2013.
d. A description of proposed changes (including remediation activities) in design or operations of facilities with releases potentially interacting with the disposal facility releases. Does the annual summary indicate whether any changes are proposed in the design or operations of facilities with releases potentially interacting with the disposal facility? If so, are the effects of the proposed changes on the CA adequately described?	Changes in facilities (the RWMSs) are summarized in Section 3.1.1. Changes in interacting Environmental Restoration sites are summarized in Section 3.3. Changes in Environmental Restoration sites due to completed and planned corrective actions are not expected to affect CA results.
e. A description of any corresponding changes required in the CA maintenance plan, the closure plan, and the monitoring plan. Does the annual summary indicate whether any corresponding changes are required in the plans? If so, are they adequately described?	Section 3.4.2 states that there are no recommended changes to the maintenance plan, monitoring plan, and closure plan.
f. A description of any proposed changes in the CA. Does the annual summary indicate whether any changes to the CA are required? If so, are they adequately described?	Proposed changes are summarized in Section 3.4.2. Section 3.5 concludes that no changes to the CAs are required.

Requirement	Result
3.3 Factors to be Addressed *The basic factors to be addressed in the annual summary and evaluated by the LFRG in reviewing the annual summary are operations, facility design, closure design, research and development, and interacting source terms. (For additional detail on the scope and level of detail expected for the topics, see Section 2.2 of the "Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analyses," November 10, 1999.)*	
3.3.1 Operations Considerations *a. Significant changes in the operations (including remediation activities) and configurations of facilities with releases that could potentially interact with releases from the low-level waste disposal facility. Does the annual summary describe any significant changes in potentially interacting facilities?*	Section 3.1 describes changes to the RWMSs operations and configuration. Section 3.3 describes changes to interacting Environmental Restoration sources affecting the CAs.
b. Disposal unit consistency with the CA models (e.g., size and configuration of trenches, shafts, and pits; waste placement and configuration; thickness of operational backfill/cover). Does the annual summary adequately describe disposal unit consistency with the CA models?	Section 3.1.1 describes RWMSs disposal unit changes affecting the CAs.
c. Waste receipts including description of form and packaging (especially special waste forms) and their consistency with CA analyses and projections. Does the annual summary adequately describe waste receipts and their consistency with CA analyses and projections?	Section 3.1.1.1 describes changes to the pre-1988 waste inventories. Changes to post-1988 inventories are described in Section 2.1.2.
d. Waste acceptance criteria including radionuclides significant to and evaluated in the CA, radionuclide concentration and quantity limits (established in the PA), and waste form and packaging requirements. Does the annual summary adequately describe the WAC and their consistency with the CA results?	The WAC are described in Section 2.1.3.
e. Procedures and systems (e.g., verification of waste characteristics, inventory limit controls, generator certification) intended to prevent disposal of inappropriate wastes. Does the annual summary adequately describe procedures and systems?	The Radioactive Waste Acceptance Program is described in Section 2.1.3.
3.3.2 Facility Design Considerations *a. Consistency with the CA analyses of operations technology and configuration at facilities with releases potentially interacting with releases from the low-level waste disposal facility. Is the consistency adequately described?*	Consistency of facility design with CA analyses is described in Section 3.1.1.
b. Engineered barrier consistency with the CA. Is the consistency adequately described?	Consistency of facility design with CA analyses is described in Section 3.1.1.1. Consistency of cover design with CA analyses is described in Section 3.1.1.3.
c. Monitoring provisions appropriate for evaluation of facility performance and interacting source terms. Are monitoring provisions adequately described?	The CA monitoring program is described in Section 3.1.1.2.
d. Operational controls to promote stability and to compensate for potential subsidence. Are operational controls adequately	Controls and monitoring of subsidence are described in

Requirement	Result
described?	Section 2.2.4.
3.3.3 Closure Design Considerations *a. Engineered barrier description (including those for facilities with releases that interact with the low-level waste disposal facility) including consistency of the closure cover design with CA analysis and threats to cover integrity and viability. Are engineered barriers adequately described?*	Consistency of disposal unit cover design with CA analyses is described in Section 3.1.1.3. Consistency of Environmental Restoration closures with CA analyses is described in Section 3.3.
b. Future land-use plan consistency with CA assumptions. Is consistency of the land-use plan with the CA assumptions adequately described?	The consistency of land-use plans with CA assumptions is discussed in Section 3.3.
3.3.4 Research and Development Considerations *a. R&D efforts required by the DAS. Are these efforts adequately described?*	R&D efforts required by the Area 3 RWMS and Area 5 RWMS DASs are summarized in Section 1.1, Tables 1 and 3, respectively. The tables' status column indicates that all conditions were closed in 2002. R&D efforts relevant to the CAs are described in Section 3.2. DAS-required R&D efforts to characterize UGTA source terms are described in Section 3.3.1.
b. R&D efforts pursued for improving and refining the composite analysis. Are these efforts adequately described?	R&D efforts relevant to the CAs are described in Section 3.2.
c. Results of any confirmatory testing performed. Was any confirmatory testing performed? If so, are the results adequately described?	Confirmatory monitoring is described in Section 3.1.1.2.
3.3.5 Interacting Source Term Considerations *a. Evaluation of significant interacting source terms. Does the annual summary indicate that there is a need to re-evaluate significant interacting source terms? If so, are they adequately re-evaluated?*	Section 3.3 reviews the status of interacting source terms and concludes that no significant changes have occurred for the Area 3 RWMS and Area 5 RWMS.
b. Alteration of existing source terms. Does the annual summary report any changes in existing source terms including new source terms?	Section 3.3 reviews corrective action investigations and corrective actions affecting interacting source terms and concludes that no significant changes have occurred for the Area 3 RWMS and Area 5 RWMS.
c. Alteration of uncertainty in characteristics of existing sources. Does the annual summary report any changes in uncertainty in characteristics of existing source terms?	Section 3.3 reviews the status of interacting source terms and concludes that there is no significant change in existing source term uncertainty.

Requirement	Result
3.4 Changes *The changes that could cause divergence from the conditions used for the CA analysis should be categorized as discovered changes, proposed changes, or R&D changes and should be listed and described in the annual summary.* *[This section of the review should focus on description of the changes (discovered, proposed, and R&D) and any effects of the changes not described in Section 3.2.]* *3.4.1 Discovered Changes* *The annual summary should report divergences from expected or planned conditions that have been discovered in facility operations, construction, site characteristics, and other conditions significant to determination of cumulative doses from the disposal facility and potentially interacting source terms. Specific information should address the baseline from which the divergence was identified, comparison of expected conditions to any available monitoring results, significance of the divergence as indicated by comparison to the four LFRG review thresholds (listed in Section 2.4.1 above), and incorporation of the changes in the performance assessment, if appropriate.* *a. Does the annual summary report any discovered changes? If so, are they adequately described?*	Section 3.4.1 describes discovered changes affecting the CA. A minor change in a parameter used to calculate the ^{234}U content of mixed fission products was discovered in FY 2013. The change has no effect on inventory estimates.
3.4.2 Proposed Changes *a. The annual summary should identify divergences (for both the low-level waste disposal facility and for facilities with potentially interacting source terms) from expected or planned conditions that have been or will be voluntarily made by the facility operators to facility operations, facility construction, interacting source terms, or other conditions significant to combined facility and interacting source behavior. Specific information should address the baseline from which the divergence is planned, comparison of current performance to performance expected after the change is made, significance of the divergence as indicated by comparison to the four LFRG review thresholds (listed in Section 2.4.1 above), and incorporation of the changes in the performance assessment, if appropriate. Does the annual summary report any proposed changes? If so, are they adequately described?*	Proposed changes to the CAs are described in Section 3.4.2. The effects of changes on CA results are presented and discussed in Section 3.4.3.

Requirement	Result
3.4.3 Research and Development Changes *a. The annual summary should include descriptions of research and development (both generic and site-specific) relevant to the CA analysis models and input data for them that are to be used to improve the conclusions of the CA. The annual summary should include description of the significance of the improvements, when and how the anticipated improvements will be incorporated in CA modeling and analyses, and whether the improvements are expected to change the conclusions of the CA. Does the annual summary report any R&D changes? If so, are they adequately described?*	The CA R&D efforts are described in Section 3.2. The significance and effect of R&D changes on CA results are described in Section 3.4.3.
4.0 Disposal Authorization Statements *a. The facility annual summary should describe the conditions stated in the current DAS for the facility. For conditions that specify actions to be taken (such as resolution of data uncertainties), the annual summary should describe the required action, any deadlines specified in the DAS, and the current status of efforts to satisfy the requirement. For conditions that place limits on the operations of a facility (such as the maximum allowable inventory of a specified radionuclide), the annual summary should describe the limit, actions taken to ensure compliance with the limit, and either a statement of compliance with the limit or a description and explanation of any divergence. Does the annual summary state whether any DAS conditions are in effect? If so, are they adequately described including satisfaction of any continuing limitations and description of actions to resolve temporary conditions?*	The DAS and closure of all DAS conditions in 2002 are discussed in Section 1.1. Minor issues being addressed by the PA/CA maintenance process are described in Section 1.2.
5.0 Status of Other Required Documents *The annual summary should describe the status of the facility PA/CA maintenance plan, the monitoring plan, and the closure plan. The description should state whether the documents are currently in draft or final form and should describe any planned revisions. For documents that are in draft form, a description of the key milestones and schedule for completion should be provided. Complete citations should be provided for the current version (or draft) of each document. Is the status of the documents adequately described including milestones and schedules for completion of any that are in draft form, and are full citations provided for the required documents?*	The final Maintenance Plan, Closure Plans, and Monitoring Plans are identified in Sections 1.2, 2.3.1, and 2.2.3, respectively. Complete citations are found in Section 4.0.

CA	Composite Analysis
DAS	Disposal Authorization Statement
DOE	U.S. Department of Energy
FY	fiscal year
LFRG	Low-Level Waste Disposal Facility Federal Review Group
mSv	millisievert(s)
PA	Performance Assessment
R&D	Research and Development
RWMS	Radioactive Waste Management Site
UGTA	Underground Test Area
WAC	Waste Acceptance Criteria

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