DOE/NV/25946--1158

2010 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

Prepared for

U.S. Department of Energy,
National Nuclear Security Administration
Nevada Site Office

Prepared by

National Security Technologies, LLC

Under Contract Number
DE-AC52-06NA25946

March 2011

DISCLAIMER

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof or its contractors or subcontractors.

Available for sale to the public, in paper, from:

U.S. Department of Commerce
National Technical Information Service
5301 Shawnee Road
Alexandria, VA 22312
Phone: (800) 553-6847
Fax: (703) 605-6900
E-mail: orders@ntis.gov
Online Ordering: http://www.ntis.gov/help/ordermethods.aspx

Available electronically at http://www.osti.gov/bridge

Available for a processing fee to the U.S. Department of Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
Phone: (865) 576-8401
Fax: (865) 576-5728
E-mail: reports@adonis.osti.gov

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 annually to U.S. Department of Energy (DOE) Headquarters. 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 Site Office performed an annual review of the Area 3 and Area 5 RWMS PAs and CAs in fiscal year (FY) 2010. This annual summary report presents data and conclusions from the FY 2010 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) (formerly the Nevada Test Site) 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.

Waste operations, R&D, and monitoring results for FY 2010 were reviewed and compared with the assumptions and conceptual models of the PAs and CAs of the Area 3 and Area 5 RWMSs. Important developments include the following:

- Construction of a new Resource Conservation and Recovery Act (RCRA)-compliant lined disposal unit at the Area 5 RWMS
- Development of new closure inventory estimates based on disposals through FY 2010
- Evaluation of new or revised waste streams by special analysis
- Development of version 4.110 of the Area 5 RWMS GoldSim PA model
- Nevada Department of Environmental Protection (NDEP) acceptance of the data and model of the Correction Action Decision Document/Corrective Action Plan (CADD/CAP) for the Frenchman Flat Underground Test Area (UGTA) corrective action unit (CAU) and establishment of initial contaminant boundaries.
- An industrial site, CAU 547, near the Area 3 RWMS was discovered to have a larger than expected Pu inventory.

Analysis of the latest available data using the Area 5 RWMS v4.110 GoldSim PA model indicates that all performance objectives can be met. The results and conclusions of the Area 5 RWMS PA are judged valid, and there is no need to the revise the PA.

The Area 3 RWMS has been in inactive status since July 1, 2006, with the last shipment received in April 2006. In FY 2010, there were no operational changes, monitoring results, or R&D

results for the Area 3 RWMS that would impact PA validity. Despite the increase in waste volume and inventory at the Area 3 RWMS since 1996 when the PA was approved, the facility performance evaluated with the Area 3 RWMS PA GoldSim model, version 2.0 (with the final closure inventory), remains well below the performance objectives set forth in U.S. Department of Energy Order DOE O 435.1, "Radioactive Waste Management" (DOE, 2001). The conclusions of the Area 3 RWMS PA remain valid. An update to the combined PA/CA document was in preparation in FY 2010.

The continuing adequacy of the CAs was evaluated with the new models, and no significant changes that would alter CA results or conclusions were found. Inclusion of the Frenchman Flat UGTA results in the Area 5 RWMS CA is scheduled for FY 2015, pending the completion of the closure report (CR) for the Frenchman Flat UGTA CAU in FY 2014. An industrial site, CAU 547, with corrective action sites (CASs) near the Area 3 RWMS was found to have a significant plutonium inventory in 2009. CAU 547 will be evaluated for inclusion of future revisions or updates of the Area 3 RWMS CA. The revision of the Area 3 RWMS CA, which will include the UGTA source terms, is expected in FY 2024, following the completion of the Yucca Flat CAU CADD, scheduled for FY 2023.

Near-term R&D efforts will focus on continuing development of the Area 3 and Area 5 RWMS GoldSim PA/CA and inventory models. The consequences of potential subsidence of the disposal units that may impact the Area 3 RWMS will be incorporated into the Area 3 RWMS GoldSim model in FY 2011.

TABLE OF CONTENTS

EXECUTIVE SUMMARY ... **i**
ACRONYMS AND ABBREVIATIONS ... **vii**
1.0 INTRODUCTION ... **1**
1.1 Status of Disposal Authorization Statement Conditions ... *2*
1.2 Tracking of Minor Issues ... *3*
2.0 PERFORMANCE ASSESSMENT ... **5**
2.1 Waste Disposal Operations ... *5*
2.1.1 Waste Form and Containers ... 5
2.1.2 Facility Design and Operations ... 5
2.1.2.1 New RCRA-Compliant Mixed Waste Disposal Cell ... 5
2.1.3 Waste Receipts ... 10
2.1.3.1 New or Revised Waste Streams ... 10
2.1.3.2 FY 2010 Closure Inventory Estimate for the Area 3 RWMS ... 11
2.1.3.3 FY 2010 Closure Inventory Estimate for the Area 5 RWMS ... 16
2.1.4 Institutional Control Policy ... 24
2.1.5 Waste Acceptance Criteria ... 25
2.1.6 Closure ... 25
2.1.7 Updated PA Results for FY 2010 ... 25
2.1.7.1 PA Results for the Area 3 RWMS ... 26
2.1.7.2 PA Results for the Area 5 RWMS ... 26
2.2 Monitoring and Research and Development Results ... *28*
2.2.1 Monitoring ... 28
2.2.1.1 Vadose Zone Monitoring ... 30
2.2.1.2 Groundwater Monitoring ... 33
2.2.1.3 Radon Monitoring ... 34
2.2.1.3 Meteorology Monitoring ... 34
2.2.1.4 Direct Radiation Monitoring ... 34
2.2.1.5 Biota Monitoring ... 34
2.2.1.6 Subsidence Monitoring ... 35
2.2.1.7 Air Monitoring ... 35
2.2.1.8 Soil Temperature Monitoring Around RTGs ... 35
2.2.2 Research and Development ... 36
2.2.2.1 Fiscal Year 2010 R&D Activities ... 36
2.2.2.2 Fiscal Year 2011 R&D Activities ... 37
2.2.2.3 Fiscal Year 2012 R&D Activities ... 37
2.2.2.4 R&D Activities Beyond Fiscal Year 2012 ... 37
2.3 Summary of Changes ... *38*
2.3.1 Proposed Changes ... 38
2.3.2 Discovered Changes ... 38

2.4 Recommended Changes 38
2.5 Conclusions 38
3.0 COMPOSITE ANALYSIS 41
3.1 Source Terms 41
3.1.1 Radioactive Waste Management Sites 41
3.1.1.1 Waste Characteristics and Facility Design 41
3.1.1.2 Closure 41
3.1.2 Underground Testing Areas 42
3.1.3 Soil Sites 42
3.1.4 Industrial Sites 43
3.2 Updated CA Results 43
3.3 Monitoring and R&D Results 43
3.3.1 Monitoring 43
3.3.2 Research and Development 44
3.4 Summary of Changes 44
3.4.1 Proposed Changes 44
3.4.2 Discovered Changes 44
3.5 Recommended Changes 44
3.6 Summary 44
4.0 REFERENCES 47
APPENDIX A 51
DISTRIBUTION 61

List of Figures

Figure 1. Location of Pit 18, the New Mixed Waste Disposal Cell.. 6
Figure 2. Schematic of the Pit 18 Liner System 7
Figure 3. Conceptual Model of Vadose Zone Flow and Transport 8
Figure 4. PA Conceptual Model of Transport Pathways 9
Figure 5. Volume Disposed per Year and the Arithmetic Mean of Cumulative Volume for the Area 3 RWMS.. 15
Figure 6. Activity Annual Disposal and Inventory for the Area 3 RWMS 16
Figure 7. Annual Volume Disposal Rate and Median Cumulative Volume for the Area 5 RWMS Shallow Land Burial Disposal Units.. 19
Figure 8. Activity Annual Disposal Rate and Median Inventory for the Area 5 RWMS Shallow Land Burial Disposal Units... 20
Figure 9. Monitoring Stations at the Area 3 RWMS 31
Figure 10. Location of the Area 5 RWMS Pilot Wells and Weighing Lysimeter Facility........... 32
Figure 11. Monitoring Stations at the Area 5 RWMS 33

List of Tables

Table 1. Status of the Area 3 RWMS DAS PA Conditions... 2
Table 2. Status of the Area 3 RWMS DAS CA Conditions 2
Table 3. Status of the Area 5 RWMS DAS PA Conditions... 3
Table 4. Status of the Area 5 RWMS DAS CA Conditions 3
Table 5. Minor Issues Identified in the LFRG Review Reports for the Area 3 and Area 5 RWMS PAs and CAs... 4
Table 6. Waste Streams Evaluated by Special Analysis in FY 2010.. 11
Table 7. FY 2010 Estimate of the Area 3 RWMS Inventory Disposed before September 26, 1988 11
Table 8. FY 2010 Estimate of the Area 3 RWMS Inventory Disposed after September 26, 1988 13
Table 9. FY 2010 Estimate of the Area 5 RWMS SLB Inventory 17
Table 10. FY 2010 Estimate of the Area 5 RWMS RaDU Inventory Disposed 21
Table 11. FY 2010 Estimate of the Area 5 RWMS GCD Borehole Inventory 22
Table 12. Area 5 RWMS v4.110 GoldSim Model Member of Public TED through the Air Pathway 26
Table 13. Area 5 RWMS v4.110 GoldSim Model Member of Public TED through All-Pathways 27
Table 14. Area 5 RWMS v4.110 GoldSim Model Rn-222 Flux Density Results....................... 27
Table 15. Area 5 RWMS v4.110 GoldSim Model Acute Drilling Intruder TED........................ 27
Table 16. Area 5 RWMS v4.110 GoldSim Model Acute Construction Intruder TED................ 28
Table 17. Summary of Area 3 and Area 5 RWMS Monitoring Programs 29
Table 18. Area 5 RWMS v4.110 GoldSim Model CA All Pathways Annual TED for a Resident at the Area 5 RWMS... 43
Table A.1. Checklist for Review of Annual Summary.. 51

This Page Intentionally Left Blank

ACRONYMS AND ABBREVIATIONS

ac	acre
BN	Bechtel Nevada
Bq	becquerel
Bq m^{-2} s^{-1}	becquerel per square meter per second
Bq m^{-3}	becquerel per cubic meter
°C	Degrees Celsius
CA	composite analysis
CADD	Corrective Action Decision Document
CAP	Corrective Action Plan
CAU	Corrective Action Unit
CFR	Code of Federal Regulations
Ci	curie
cm	centimeter
CR	closure report
CY	calendar year
DAS	Disposal Authorization Statement
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ET	evapotranspirative
°F	Degrees Fahrenheit
FFACO	*Federal Facility Agreement and Consent Order*
ft	foot
ft^3	cubic foot
FY	fiscal year
GCD	Greater Confinement Disposal
GCL	geosynthetic clay liner
ha	hectare
HDPE	high-density polyethylene
in.	inch
INL	Idaho National Laboratory
LCRS	leachate collection and removal system
LDS	leachate detection system
LFRG	Low-Level Waste Disposal Facility Federal Review Group

ACRONYMS AND ABBREVIATIONS (continued)

LHS	Latin hypercube sampling
LLW	low-level waste
LLWMU	Low-Level Waste Management Unit
m	meter
m^3	cubic meter
mSv	millisievert
NDEP	Nevada Division of Environmental Protection
NLFB	no liquid-flux boundary
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
NTS	Nevada Test Site
PA	performance assessment
R&D	research and development
RaDU	radium disposal unit
RCRA	Resource Conservation and Recovery Act
RTG	radioisotope thermoelectric generator
RWAP	Radioactive Waste Acceptance Program
RWMS	Radioactive Waste Management Site
SLB	shallow land burial
TBq	terabecquerel
TDR	time-domain reflectometer
TED	total effective dose
TLD	thermoluminescent dosimeter
TRU	transuranic
UGTA	Underground Test Area
WAC	waste acceptance criteria
yr	year

1.0 INTRODUCTION

This report summarizes the results of an annual review of conditions affecting the operation of the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs). The Area 3 and Area 5 RWMSs are operated in accordance with U.S. Department of Energy Order DOE O 435.1 “Radioactive Waste Management” (DOE, 2001). Based on the results of the review, a determination is made of the continuing adequacy of the performance assessments (PAs) and composite analyses (CAs).

The Area 5 RWMS PA documentation consists of the original DOE O 435.1 low-level waste (LLW) PA (Shott et al., 1998), referred to as the 1998 Area 5 RWMS PA, 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 (Cochran et al., 2001).
The Area 3 PA and CA were issued in a single document (Shott et al., 2001).

The Disposal Authorization Statements (DASs) for the Area 3 and 5 RWMSs (DOE, 1999a; 2000) require preparation of an annual summary report and a determination of the continuing adequacy of the PAs and CAs. The annual summary report is submitted to DOE Headquarters. Activities to maintain and review the PAs and CAs are conducted under the Maintenance Plan for the PAs and CAs (National Security Technologies, LLC [NSTec], 2007a).

Following the annual report format in the DOE PA/CA Maintenance Guide (DOE, 1999b), this report 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.
- Section 2.1.3 provides new estimates of the closure inventories derived from the actual disposals through fiscal year (FY) 2010 and reports updated PA results using data and models current through FY 2010.
- Section 2.2 summarizes the results of the monitoring conducted under the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Closure and Monitoring Plans for the Area 3 and Area 5 RWMSs (NSTec, 2007b; 2008) and the research and development (R&D) activities.
- Section 2.3 is a summary of changes in facility design, operation, or expected future conditions; monitoring and R&D activities; and the maintenance program.
- Section 2.4 discusses the recommended changes in disposal facility design and operations, monitoring and R&D activities, and the maintenance program.
- Section 2.5 addresses the key review questions addressing the continuing validity of the PA.

Similarly, the annual summary for the CAs (presented in Section 3.0) includes the following:

- Section 3.1 presents an assessment of the relevant site activities at the Nevada National Security Site (NNSS), formerly the Nevada Test Site (NTS), that would impact the sources of residual radioactive material considered in the CAs.
- Section 3.2 updates the CA results using the FY 2010 inventories and models.
- Section 3.3 summarizes the monitoring and R&D results that were reviewed in FY 2010.
- Section 3.4 presents a summary of changes in relevant site programs (including monitoring, R&D, and the maintenance program) that occurred since the CAs were prepared.
- Section 3.5 summarizes the recommended changes to these programs.
- Section 3.6 addresses the key review questions regarding the continuing validity of the PA.
- Appendix A is a self evaluation of the Low-Level Waste Disposal Facility Federal Review Group (LFRG) checklist for review of the annual summary.

1.1 STATUS OF DISPOSAL AUTHORIZATION STATEMENT CONDITIONS

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). The DAS conditions were resolved with the revision of the PA/CA document (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 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 of 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: 1) a 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	A revised Area 3 RWMS PA/CA was issued in December of 2001 (Shott et al., 2001). The DAS conditions were closed in 2002 (DOE, 2002a).

Condition	Status
dose from the underground testing residues and taken measures to mitigate the dose, as appropriate."	
"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 of 2001 (Shott et al., 2001). The DAS conditions were closed in 2002 (DOE, 2002a).

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). The 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).
"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 MINOR ISSUES

Tracking and resolution of all minor or secondary issues identified in the LFRG review reports for the Area 3 and Area 5 RWMS PAs and CAs continued in FY 2010. Table 5 lists the minor issues that are being tracked and resolved through the maintenance program. The resolution pathway for each issue is included in the third column of Table 5.

Table 5. Minor 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 Pathway
An engineered barrier will be added, and the assurance requirements of 40 CFR191 must be met for the GCD boreholes.	GCD PA	An engineered barrier will be added, and the assurance requirements will be met at the time of 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 probabilistic performance assessment models using the GoldSim software system is systematically eliminating 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 5 and Area 3 RWMSs are ongoing; data are being incorporated into the GoldSim models to increase confidence in the PA results.
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	Changes in potentially interacting sources will be evaluated through the maintenance program, and results will be presented in the annual summary reports.
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 will be reviewed through the maintenance program, and results will be 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; 2008); monitoring results will be evaluated and presented in the annual summary reports.

2.0 PERFORMANCE ASSESSMENT

2.1 WASTE DISPOSAL OPERATIONS

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. The assumptions and conceptual models of the PAs are compared with current operations to assess three key questions:

1. Are changes to the PAs required?
2. Are the conclusions of the PAs still valid?
3. Are the disposal facilities in compliance with all performance objectives and all DAS conditions?

Changes in waste inventory, facility design, WAC, institutional controls, and closure design occurring during FY 2010 are noted and described below. The impacts of these changes are assessed in Section 2.1.7.

2.1.1 Waste Form and Containers

The Area 3 and Area 5 RWMS PAs do not explicitly model the performance of waste forms and containers. Radionuclides are assumed to be fully available for release and transport at closure. These assumptions continue to apply for waste disposed through FY 2010.

2.1.2 Facility Design and Operations

The PAs use assumptions about disposal unit volume, area, and depth of burial that may affect performance. Historical information about these parameters for disposed waste remains unchanged.

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 currently operationally closed. No wastes were disposed at the Area 3 RWMS and no new disposal units were opened in FY 2010.

No new disposal units were operated at the Area 5 RWMS in FY 2010. Waste continues to be disposed in the same configuration as assumed in the PA for shallow land burial (SLB) disposal units.

2.1.2.1 New RCRA-Compliant Mixed Waste Disposal Cell

A double lined RCRA-compliant mixed waste disposal cell, Pit 18 (P18), was constructed in FY 2010 in the north-east corner of the Area 5 RWMS (Figure 1). The new mixed-waste disposal cell received no waste in FY 2010, but is expected to begin operations early in FY 2011.

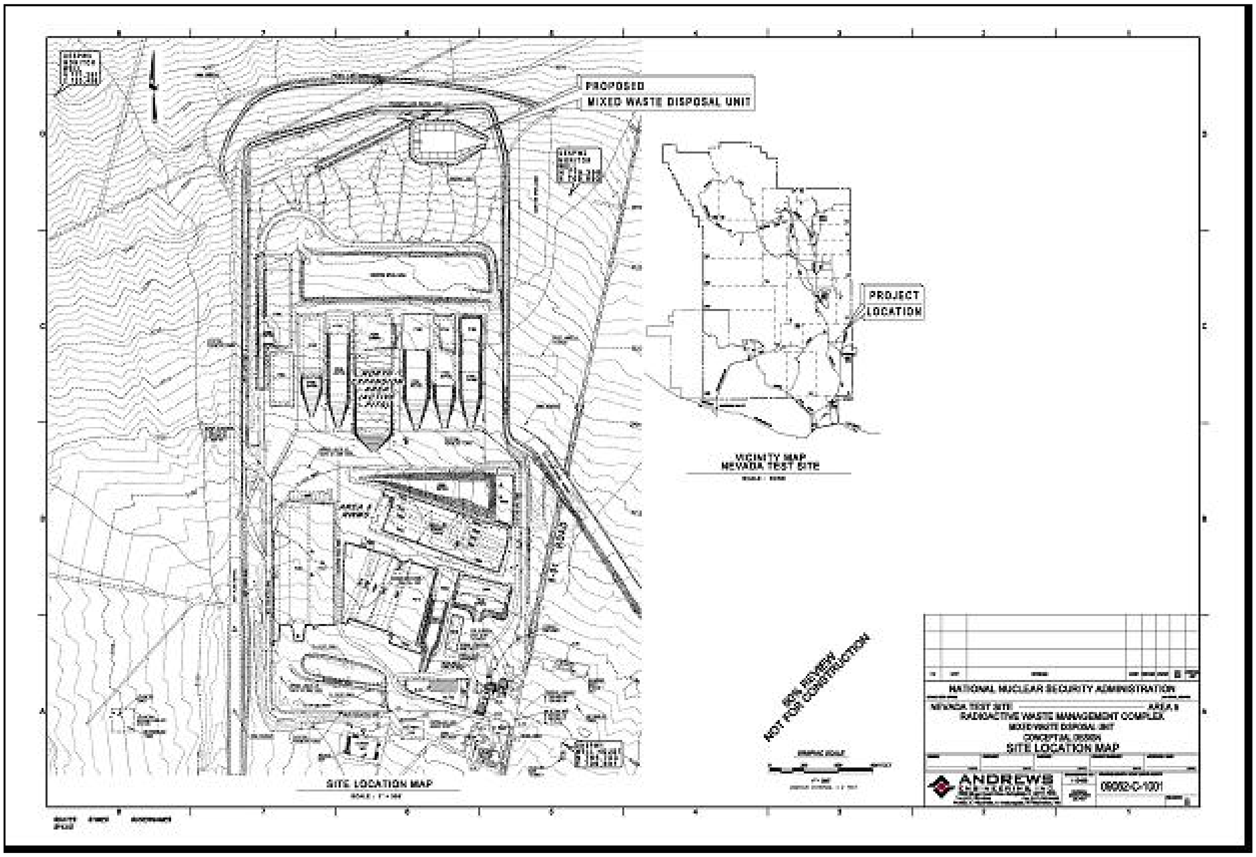


Figure 1. Location of Pit 18, the New Mixed Waste Disposal Cell

Pit 18 is 58 meters (m) wide by 95 m long by 6 m deep (190 feet [ft] wide by 310 ft long by 20 ft deep), with a disposal capacity of 33,360 cubic meters (m^3) (1.18E6 cubic feet [ft^3]). The cell foot-print will be 1.35 hectares (ha) (3.33 acres [ac]), which is about 4 percent of the area of the Area 5 RWMS disposal units.

Pit 18 has a double liner with primary and secondary leachate collection systems. Lining the floor and sideslopes of the cell will alter hydrologic performance at this location. Potential short-term and long-term impacts were evaluated in terms of the site’s hydrologic conceptual models of flow and transport that are implemented in the Area 5 RWMS PA model.

The liner above the cell bottom subgrade has the components shown in Figure 2. The liner is constructed on a subgrade of graded, compacted native alluvium. The first layer above the subgrade is a geosysthetic clay liner (GCL), with the secondary and primary liners and leachate collection systems located above that. The top layer, consisting of a surface layer of select native material and a type II backfill sub-layer, will be the working surface.

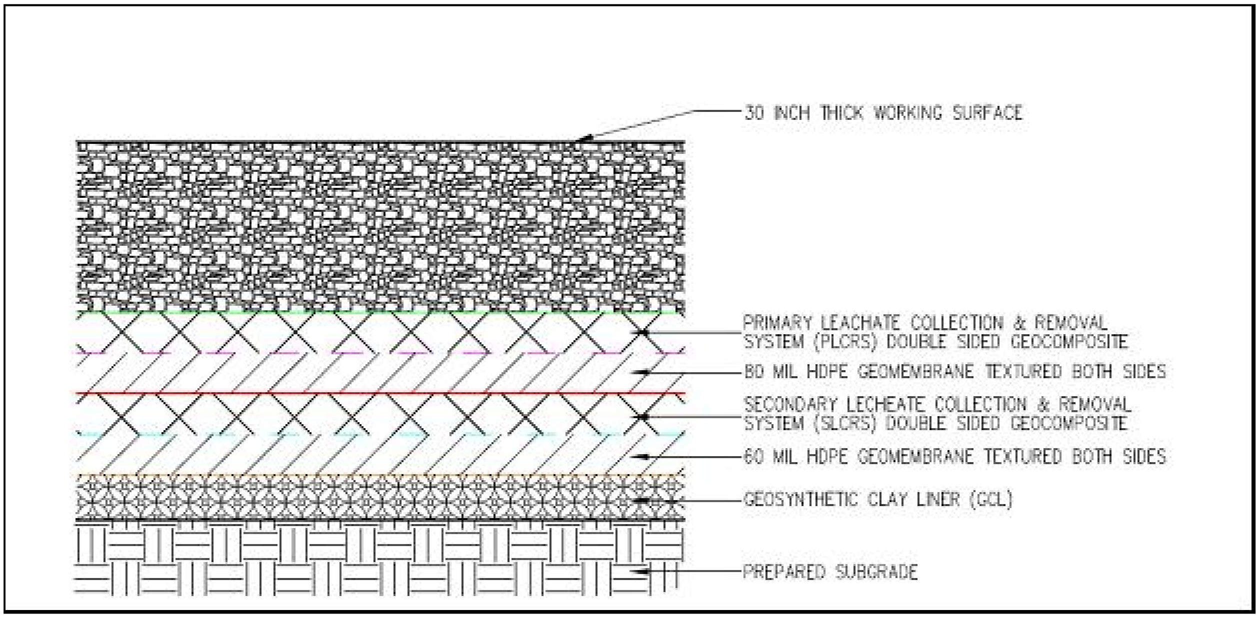


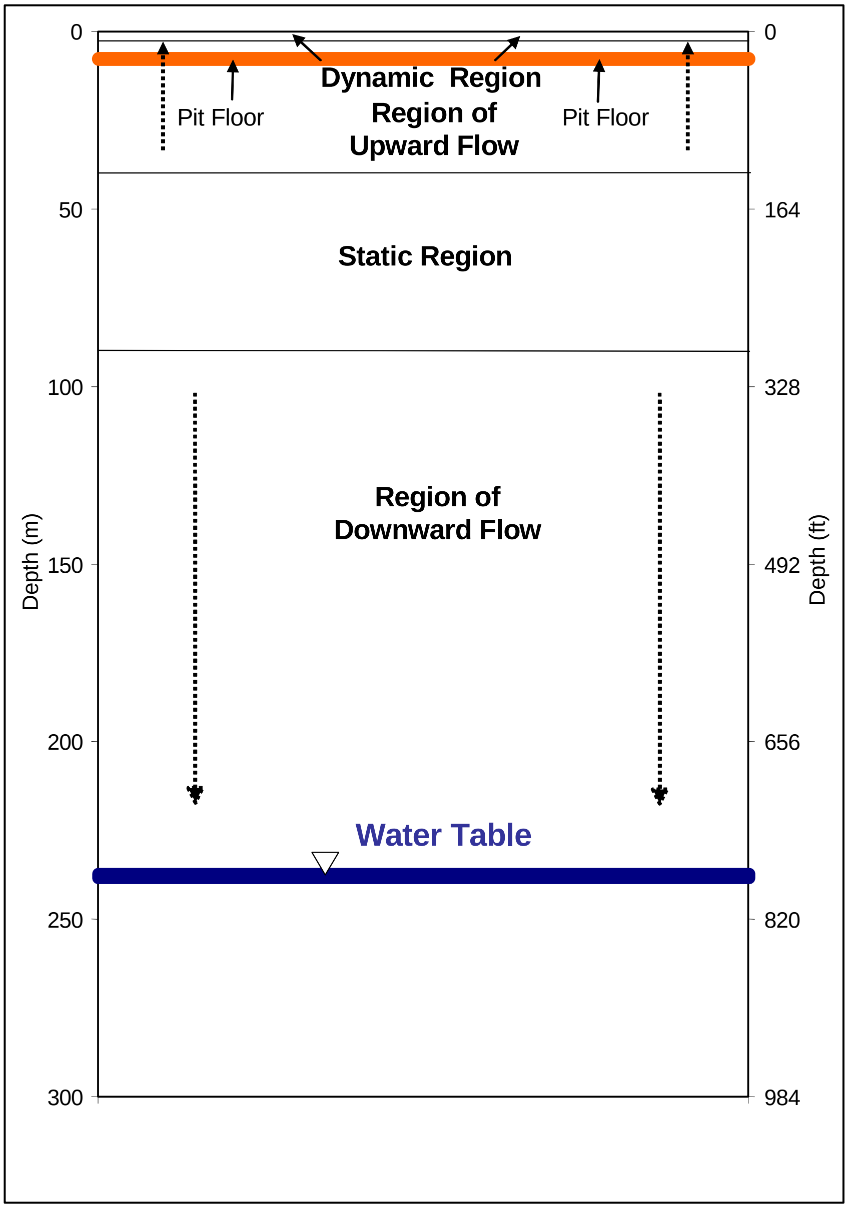
Figure 2. Schematic of the Pit 18 Liner System

A 60-mil high-density polyethylene (HDPE) geomembrane liner serves as the secondary liner. A leachate detection system (LDS) composed of double-sided geocomposite lies above the secondary liner. The primary 80-mil HDPE geomembrane liner is above the secondary liner. A double-sided geocomposite above the primary liner serves as the leachate collection and removal system (LCRS). This double-lined composite liner system extends across the base of the cell and up the perimeter sideslopes of the unit. The base portion of the liner will be constructed with cross slopes of 1.00 percent (minimum) and longitudinal slopes of 2.00 percent (minimum).

The leachate from the LCRS and LDS will be collected at respective sumps and pumped into a storage tank. The LCRS is designed to collect leachate from a 25-year 24-hour storm event assumed to occur when the cell is empty. Both systems will be maintained to be functional for the entire design period of 30 years or more. When the facility is full, it will be closed with a vegetated 2.5-m (8.2-ft) thick evapotranspirative (ET) cover. Following closure, no leachate is expected to reach the liner.

Impact on Area 5 RWMS Conceptual Models

The post-closure performance of the Area 5 RWMS (closed with vegetated ET covers) is evaluated in the GoldSim PA model, based on the flow and transport conceptual models summarized below. The conceptual model of unsaturated flow for the RWMS includes four regions of liquid flow in the vadose zone (Figure 3). Zone I, a near-surface zone approximately 35 m (115 ft) thick, is a zone of upward hydraulic gradients, resulting in upward liquid flux. Zone II, occurring from approximately 40 to 90 m (131 to 295 ft), is a static region with negligible liquid flux. Zone III, an intermediate region with downward liquid fluxes driven by gravity, occurs from approximately 90 m (295 ft) to within a few centimeters of the saturated zone. The final region, Zone IV, which is a thin capillary fringe, is a transitional zone between the vadose zone and the saturated zone (water table).



Dynamic Region: Magnitude and direction of liquid fluxes are variable and determined by episodic infiltration, evapotranspiration, and processes of biotic transport. No liquid-flux boundary is at mean depth of 2 m.

Zone I, Region of Slow Upward Flow: Region where the combination of low precipitation and high potential evapo-transpiration leads to a dry zone, inducing upward flow of pore water in the unsaturated zone from as deep as about 35 m. Mean and standard deviation of upward flux is 0.004 ± 0.003 millimeters per year.

Waste zone located in region of upward flux

Zone II-Static Region: Region of no vertical liquid (balance of matric suction and gravitational forces). The thickness and the depth below the surface of this region changes with the physical/textural properties of alluvium and *in situ* water content.

Zone III, Region of Slow Downward Flow: Region of steady downward flow (increased water contents allow downward drainage). Water in the vadose zone is currently recharging the water table most likely infiltrated during past pluvial climate cycles.

There is no aerially distributed recharge to the groundwater table under current conditions.

Figure 3. Conceptual Model of Vadose Zone Flow and Transport

Zone I includes a dynamic region in the upper few meters of the vadose zone where the water potential gradient periodically reverses as precipitation infiltrates and is returned to the atmosphere by evapotranspiration. A strong upward potential for flow is maintained in Zone I by the roots of xeric desert plants. Although there is a potential for upward flow in Zone I, the soil is normally so dry that liquid water advection is very slow.

The Area 5 RWMS PA model sets the limit of the dynamic zone 2 m (6.5 ft) below the top of the vegetated closure cover. This boundary where upward liquid advection rates approach zero is referred to as the no-liquid flux boundary (NLFB), shown in Figure 4. As shown in the figure, the transport pathways that move radionuclides from the waste zone into the upper cover soils and the atmosphere are liquid and vapor transport, plant uptake, and animal burrowing. The Area 5 RWMS PA model assumes all radionuclide inventory is released into the waste zone soils at closure, ignoring the presence of waste forms and containers that are barriers to release. By not taking credit for barriers, the current PA model avoids an additional source of model complexity and modeling uncertainty.

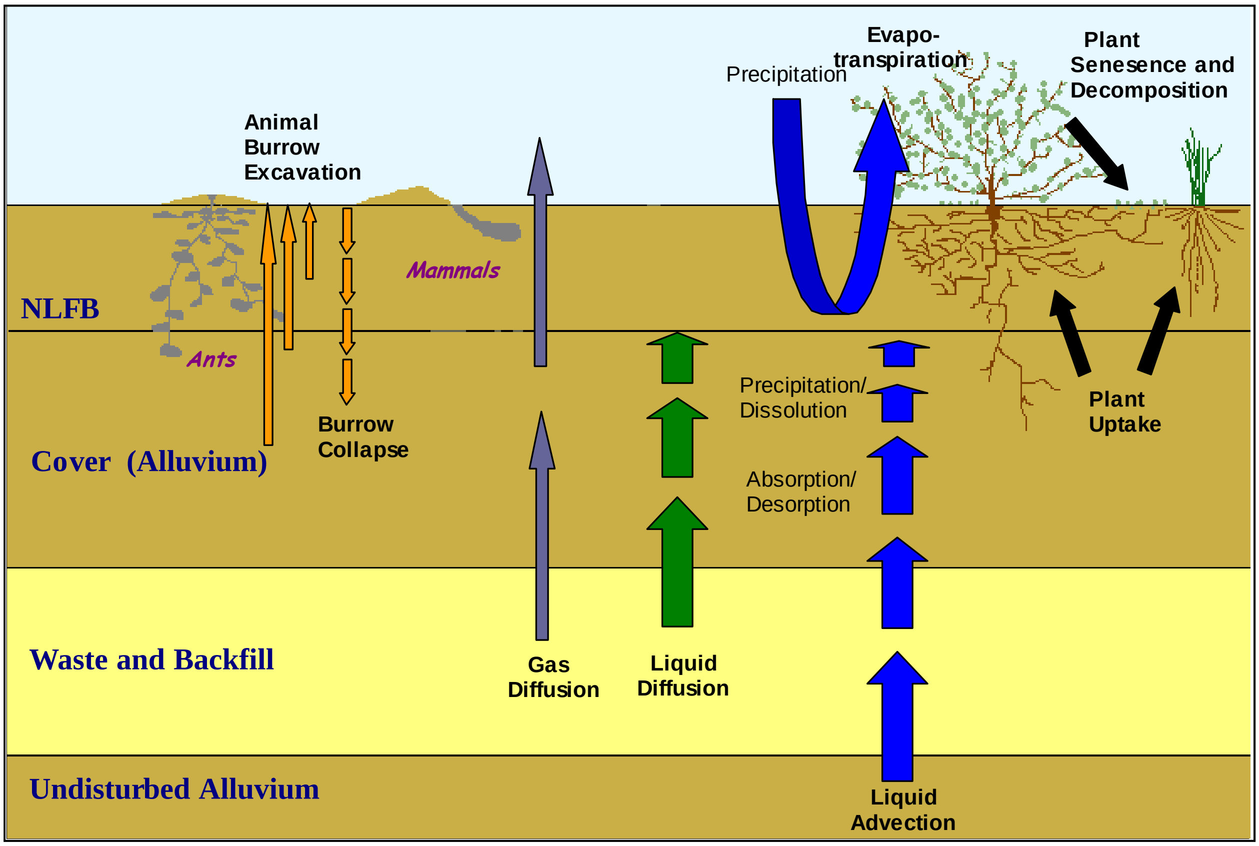


Figure 4. PA Conceptual Model of Transport Pathways

Pit 18 and its liner system is not expected to have any unique impacts during the operational phase. The liner system is virtually impermeable. Hence, no upward liquid flux will reach the waste from below. Further, any leachate generated within the waste will be removed by the LCRS system. Therefore, no drainage is expected below the GCL. Minimal releases of volatile radionuclides are observed from operational cells because containers are intact and biotic intrusion is minimal on operational covers. Upward releases during the operational period from Pit 18 should be no different than other disposal units at the Area 5 RWMS.

Following the cell closure with an ET cover, Pit 18 will be monitored for a maximum of 30 years. Leachate reaching the sumps through the drainage systems will diminish as moisture entering during operations drains and the ET cover minimizes infiltration. At the end of the monitoring period, sumps and risers for the sump pumps will be backfilled. The integrity of the liner systems are assumed to last a few hundred years past closure of the cell. During this period the liner system will cut off any upward liquid advection into the waste zone, thus reducing the amount of inventory transported to the surface layer of the closure cover. The presence of the liner system will have no other impact on the other transport pathways shown in Figure 4. After the liners degrade and lose their function as barriers to moisture movement, upward liquid advection into the waste zone will resume. Since the current Area 5 RWMS PA does not take any credit for waste forms and containers as barriers to radionuclide releases, it would be appropriate and conservative to ignore the presence of the liners within this cell as well. Therefore, it is concluded that the liners in the new mixed waste cell will have no significant impact on the current PA results, and no changes to the PA model are warranted when incorporating the additional inventory of this cell.

2.1.3 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 or when future waste forecasts change. Estimates of past disposals may change as disposal records are reviewed, database records are revised, and assumptions used to revise historical records change. Closure inventory uncertainty, however, is dominated by uncertainty in future disposals. Sources of uncertainty that are unique to future disposals include approval of new generators or new waste streams and wastes being sent to alternative disposal sites.

2.1.3.1 New or Revised Waste Streams

Each new or revised waste stream is evaluated by the Radioactive Waste Acceptance Program (RWAP) for its potential impacts on the PA and conformance with WAC. Part of this evaluation 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 alter PA assumptions or conceptual models require a special analysis for acceptance. Waste streams exceeding inventory screening criteria are evaluated by adding the 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.

In FY 2010, six special analyses were performed (Table 6). Three waste streams had mostly short-lived nuclides that exceed action levels. Two waste streams had significant concentrations of technetium-99 (^{99}Tc). The unirradiated light water breeder reactor fuel waste stream had a significant inventory of uranium-233 (^{233}U) fuel. The results of the special analyses indicated that all performance objectives could be met with addition of the waste streams to the site inventory. Therefore, all waste streams requiring special analysis in FY 2010 were accepted without conditions.

Table 6. Waste Streams Evaluated by Special Analysis in FY 2010

Waste Stream	Description	Issue	Result
NEID04TRA2328_0	Idaho National Laboratory (INL) Routinely Generated Contact Handled LLW at the Advance Test Reactor Complex	^{3}H, ^{60}Co, ^{90}Sr, and ^{137}Cs Inventory	Accepted
ORTN000000030_6	Oak Ridge K-25/K-27 Process Gas Piping and Miscellaneous Auxiliary Equipment	^{99}Tc Inventory	Accepted
INEL103597TR1_0	INL Unirradiated Light Water Breeder Reactor Rods and Pellets	^{233}U, ^{232}U, ^{234}U, and ^{229}Th Inventory	Accepted
ORTN000000025_7	Oak Ridge K-25/K-27 Classified Whole Converters	^{99}Tc Inventory	Accepted
PERMMACROCNT1_6	Permafix Macroencapsulated Debris	^{3}H Inventory	Accepted
NEID09INLCLLW_1	INL Routinely Generated Contact Handled Low-Level Waste	^{60}Co, ^{90}Sr, and ^{137}Cs Inventory	Accepted

2.1.3.2 FY 2010 Closure Inventory Estimate for the Area 3 RWMS

The Area 3 RWMS was placed in inactive status July 1, 2006. The site may be used in the future for 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 2010 inventory is unchanged from the previous year, as no disposals have occurred and the inventory model is unchanged.

The Area 3 RWMS inventory model estimates the inventory of wastes disposed before and after September 26, 1988. Pre-1988 waste was disposed in U-3ax/bl and U-3ah/at, with 80 percent of the volume and 99 percent of the activity disposed in U-3ax/bl (Table 7). The total pre-1988 inventory as of October 1, 2025, consists of approximately 151 terabecquerels (TBq) (4.1×10^3 curies [Ci]) in 2.3×10^5 m^3 (8.1×10^6 ft^3) of waste.

Table 7. FY 2010 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

Nuclide	U-3ax/bl		U-3ah/at	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
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
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

Nuclide	U-3ax/bl		U-3ah/at	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
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)

The post-1988 waste is disposed in U-3ah/at and U-3bh (Table 8). The post-1988 inventory is estimated to consist 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. FY 2010 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*	

Nuclide	U-3ah/at		U-3bh	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
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
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

Nuclide	U-3ah/at		U-3bh	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
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 5). The total activity has been disposed predominately in the post-1988 period since 2000 (Figure 6).

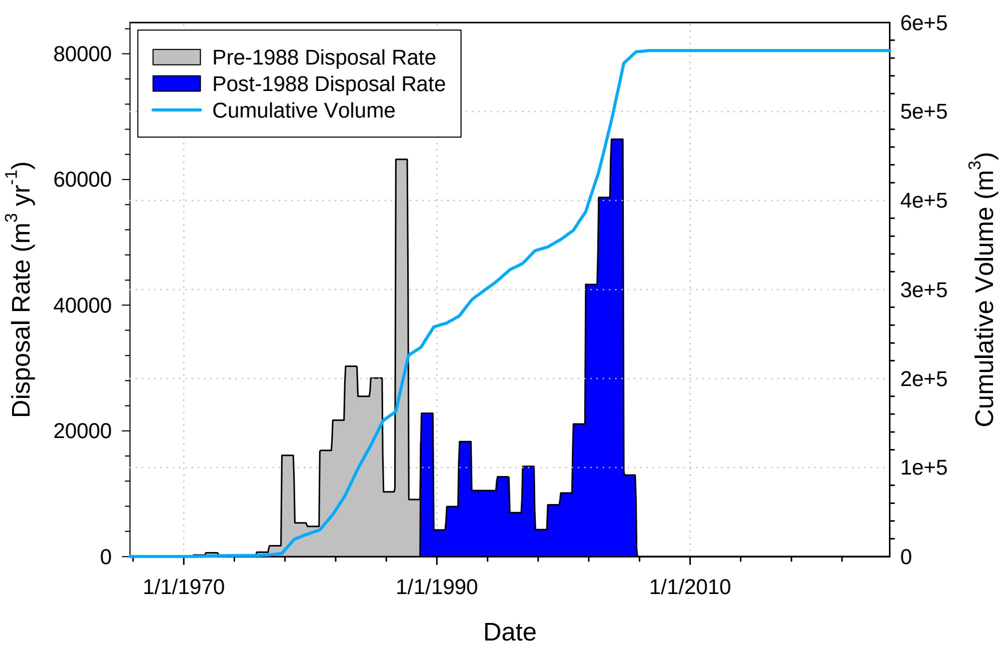


Figure 5. Volume Disposed per Year and the Arithmetic Mean of Cumulative Volume for the Area 3 RWMS

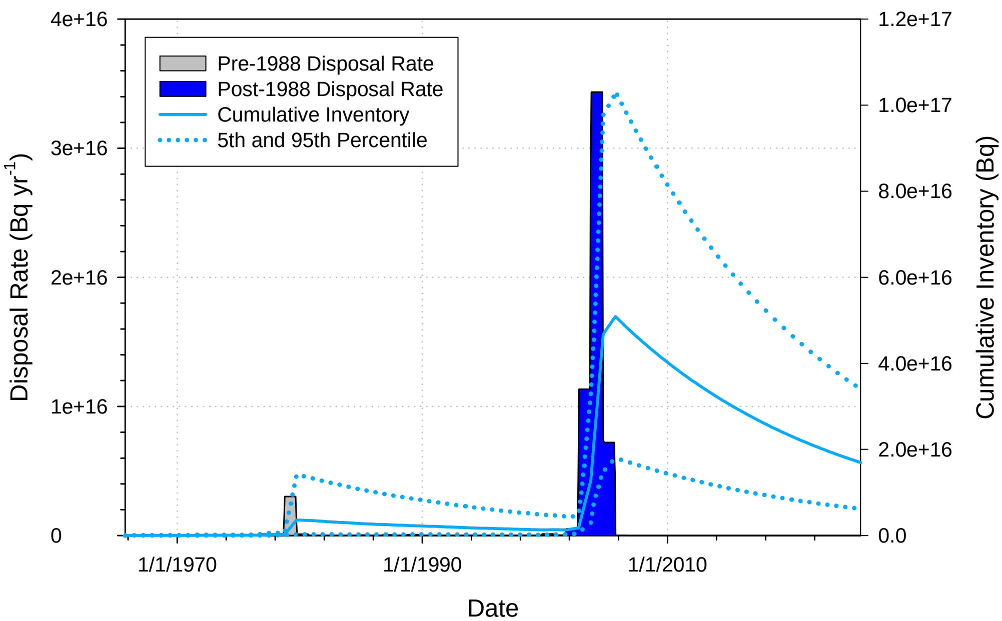


Figure 6. Activity Annual Disposal and Inventory for the Area 3 RWMS

2.1.3.3 FY 2010 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 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 (P06) and Pit 13 (P13). High specific activity wastes have been 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 2010 estimate of the Area 5 RWMS closure inventory was prepared using the GoldSim Area 5 Inventory v2.107 model. The model sums past disposals, revisions, and future inventory estimates 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 inventories are decayed until the assumed date of closure on September 30, 2028.

No significant changes were made to the A5 inventory model in FY 2010. Slight increases in the inventory are reported for FY 2010 (Table 9). No significant increases in disposed inventory of individual radionuclides are noted. Two new long-lived nuclides, argon-42 (^{42}Ar) and platinium-193 (^{193}Pt), were disposed in FY 2010. No new nuclides were added to the PA model.

Table 9. FY 2010 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	3.5E+16	1.81	3.3E+16	1.54	4.6E+16	2.69
C-14	2.9E+11	1.89	2.5E+13	2.09	1.6E+12	5.38
Al-26	9.3E+06	2.00	3.6E+04	2.50	*Negligible*	
Cl-36	5.2E+10	1.95	2.3E+08	2.22	1.9E+06	11.08
Ar-39	2.3E+11	1.93	1.0E+09	2.36	*Negligible*	
Ar-42	*Negligible*		6.2E+08	2.20	1.3E+05	1828.80
K-40	1.3E+10	1.88	2.1E+10	1.56	5.8E+09	2.97
Ca-41	3.7E+11	1.91	1.6E+09	2.35	4.3E+04	347.67
Ti-44	*Negligible*		1.9E+10	2.14	8.0E+07	523.11
Co-60	2.2E+12	2.41	2.5E+14	1.85	1.3E+14	4.78
Ni-59	9.7E+09	1.90	2.5E+12	1.62	3.7E+11	4.65
Ni-63	7.3E+11	1.92	2.5E+14	1.79	3.3E+13	4.90
Se-79	*Negligible*		3.6E+12	1.90	1.3E+11	117.98
Kr-85	4.3E+11	2.35	7.0E+09	1.69	1.6E+09	4.47
Sr-90	1.8E+15	3.82	1.8E+16	2.18	1.9E+15	8.52
Zr-93	1.2E+09	1.88	8.5E+07	1.95	4.5E+06	16.25
Nb-93m	1.2E+11	1.92	1.1E+09	2.25	7.8E+06	6.94
Nb-94	3.1E+11	1.90	2.1E+11	2.22	5.8E+09	27.81
Tc-99	1.3E+13	2.58	3.8E+14	1.70	6.8E+13	3.84
Pd-107	5.6E+07	1.88	8.5E+05	1.70	5.0E+04	8.25
Ag-108m	*Negligible*		2.6E+11	2.69	5.4E+08	356.23
Cd-113m	1.0E+11	1.89	3.5E+10	2.23	1.4E+09	53.00
Sn-121m	2.8E+12	1.92	1.4E+10	2.35	4.3E+04	38.77
Sn-126	5.4E+08	1.88	3.7E+10	1.97	2.4E+09	24.25
I-129	4.0E+07	1.84	1.8E+10	1.88	2.1E+09	4.50
Cs-135	9.8E+08	1.88	3.4E+07	1.84	1.0E+06	41.34
Cs-137	3.4E+15	3.20	8.3E+14	2.02	1.4E+14	4.97
Ba-133	1.9E+08	2.67	8.3E+09	1.85	3.8E+09	5.01
Pm-145	*Negligible*		8.6E+04	2.16	8.6E+03	38.78
Pm-146	*Negligible*		1.5E+05	1.85	7.2E+04	9.51
Sm-151	1.1E+12	1.89	2.0E+10	1.70	2.0E+09	6.89
Eu-150	4.1E+11	2.04	2.2E+09	2.73	1.8E+00	15.70
Eu-152	2.7E+12	2.23	4.8E+13	1.97	5.4E+12	13.64
Eu-154	3.3E+11	2.14	7.1E+13	1.77	1.8E+13	8.42
Gd-148	*Negligible*		1.5E+04	1.71	3.5E+03	6.78

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
Ho-166m	1.2E+10	1.93	2.8E+08	2.06	2.1E+04	2414.51
Pt-193	*Negligible*		2.8E+00	2.06	*Negligible*	
Pb-210	1.2E+12	2.63	2.4E+11	1.52	7.1E+10	2.33
Bi-207	5.5E+05	3.16	1.4E+07	1.76	1.8E+06	7.34
Bi-210m	*Negligible*		6.3E+07	2.21	4.6E+04	649.68
Ra-226	1.5E+12	2.64	3.7E+11	1.71	1.1E+11	2.67
Ra-228	4.7E+10	2.14	6.9E+11	1.42	3.7E+11	2.53
Ac-227	1.3E+10	1.91	9.6E+10	2.06	1.2E+10	5.50
Th-228	6.5E+10	1.87	2.6E+12	1.75	8.2E+11	2.60
Th-229	1.7E+08	2.03	5.9E+11	1.98	4.9E+10	5.69
Th-230	4.5E+10	1.81	2.8E+11	1.52	1.8E+11	3.47
Th-232	4.7E+10	2.14	7.2E+11	1.42	4.4E+11	2.61
Pa-231	7.9E+09	1.83	1.2E+10	1.39	2.9E+09	2.19
U-232	1.3E+10	1.94	1.7E+12	2.08	2.5E+11	5.00
U-233	3.7E+10	2.09	1.2E+14	2.34	8.1E+12	9.54
U-234	9.0E+13	1.99	1.3E+14	1.36	4.8E+13	2.01
U-235	3.7E+12	2.01	6.4E+12	1.37	2.7E+12	1.76
U-236	1.2E+12	2.64	5.3E+12	1.52	1.2E+12	2.40
U-238	1.0E+14	2.12	2.8E+14	1.46	1.2E+14	1.83
Np-237	2.5E+11	1.95	1.9E+11	1.48	3.8E+10	2.85
Pu-238	6.8E+12	1.93	6.4E+12	1.49	3.1E+12	2.24
Pu-239	1.4E+13	1.84	1.4E+13	1.52	4.5E+12	2.09
Pu-240	3.3E+12	1.75	6.2E+12	1.65	1.6E+12	2.75
Pu-241	3.9E+12	1.80	4.0E+13	1.83	1.3E+13	3.11
Pu-242	7.7E+08	1.77	5.2E+11	2.10	5.7E+10	13.10
Pu-244	5.0E+09	3.72	1.2E+06	2.12	3.5E+04	12.91
Am-241	4.5E+12	1.68	9.3E+12	1.54	2.3E+12	2.44
Am-242m	*Negligible*		1.7E+09	1.77	3.3E+08	4.46
Am-243	4.8E+08	2.20	4.6E+10	1.84	6.2E+09	5.41
Cm-243	6.2E+09	2.52	5.6E+09	1.87	7.8E+08	5.02
Cm-244	8.2E+10	2.74	2.4E+12	1.84	4.9E+11	4.68
Cm-245	1.4E+05	3.14	5.6E+11	1.97	5.0E+10	11.60
Cm-246	8.6E+04	2.83	9.5E+10	1.79	9.9E+09	7.62
Cm-247	*Negligible*		2.0E+07	2.07	1.3E+05	106.20
Cm-248	7.4E+04	2.89	2.1E+07	1.96	1.1E+09	5.06
Cf-249	*Negligible*		5.2E+08	1.75	7.0E+07	4.06
Cf-250	2.5E+05	2.31	1.6E+05	1.91	9.6E+03	21.55

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
Cf-251	*Negligible*		9.2E+07	1.87	8.1E+06	13.00
Total	4.0E+16		5.3E+16		4.9E+16	

Negligible – Inventory less than 37 Bq

The arithmetic mean SLB volume estimate has increased approximately 15 percent from 7.3×10^5 to 8.4×10^5 m^3 (2.6×10^7 to 3.0×10^7 ft^3) between FY 2009 and FY 2010 (Figure 7). The arithmetic mean post-1988 SLB volume has increased from 5.6×10^5 to 6.6×10^5 m^3 (2.0×10^7 to 2.3×10^7 ft^3).

The FY 2010 geometric mean closure inventory estimate increased slightly from 1.4×10^5 to 1.7×10^5 TBq (3.6×10^6 to 4.7×10^6 Ci) (Figure 8). The geometric mean post-1988 closure inventory estimate increased from 9.6×10^4 to 1.0×10^5 TBq (2.6×10^6 to 2.8×10^6 Ci).

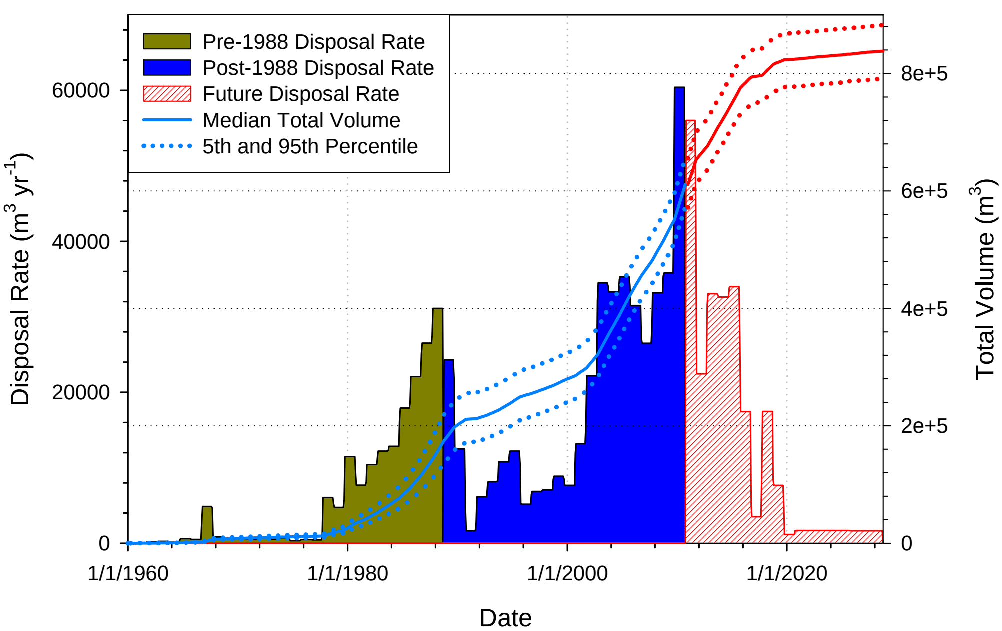


Figure 7. Annual Volume Disposal Rate and Median Cumulative Volume for the Area 5 RWMS Shallow Land Burial Disposal Units

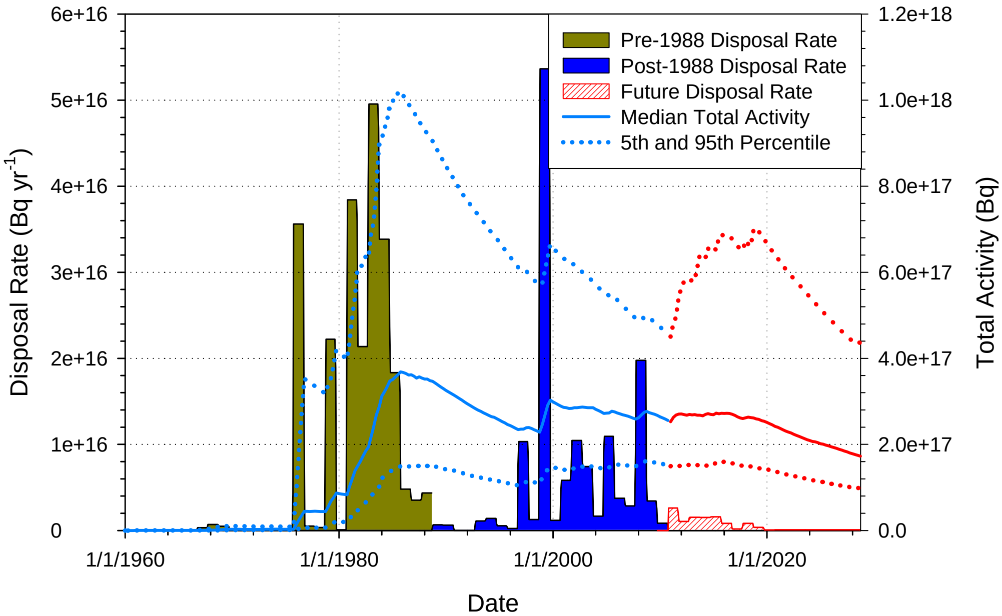


Figure 8. Annual Activity Disposal Rate and Median Inventory for the Area 5 RWMS Shallow Land Burial Disposal Units

RaDU Inventory

The lower cell of Pit 6 (P06) and Pit 13 (P13) were excavated to greater depth to contain thorium wastes that have the potential to generate ^{222}Rn in the future, as radium-226 (^{226}Ra) is produced by the decay of thorium-230 (^{230}Th). The inventory of both disposal units is predominately thorium-232 (^{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. The upper cell of Pit 6 (P06A) was near capacity in FY 2010, and an inventory for the upper cell is estimated (Table 10).

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, 6.4 m (21 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 low-level waste 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 2010 Estimate of the Area 5 RWMS RaDU Inventory Disposed (Estimates are calculated from 500 LHS realizations and decayed to October 1, 2028)

Nuclide	P06A (Upper Cell)		P06 (Lower Cell) RaDU		P13 RaDU	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
H-3	2.1E+12	1.81	*Negligible*		1.5E+09	2.16
C-14	1.3E+09	2.14	*Negligible*		*Negligible*	
Al-26	1.4E+03	2.26	*Negligible*		*Negligible*	
Ar-42	1.2E+07	2.14	*Negligible*		*Negligible*	
K-40	7.7E+05	2.21	*Negligible*		4.4E+03	2.21
Ti-44	3.9E+08	2.29	*Negligible*		*Negligible*	
Co-60	5.8E+09	2.17	*Negligible*		6.6E+06	2.27
Ni-63	1.0E+10	2.24	*Negligible*		4.9E+07	2.20
Kr-85	1.6E+07	2.23	*Negligible*		*Negligible*	
Sr-90	3.7E+10	1.90	1.9E+07	2.67	6.1E+09	2.17
Nb-94	9.2E+03	2.19	*Negligible*		*Negligible*	
Tc-99	8.4E+11	2.19	1.0E+09	2.72	7.0E+10	1.89
Sn-126	*Negligible*		*Negligible*		1.4E+07	2.16
Cs-137	3.9E+10	2.04	*Negligible*		8.2E+09	2.05
Ba-133	4.2E+04	2.59	*Negligible*		*Negligible*	
Eu-152	2.0E+06	1.73	*Negligible*		1.1E+07	2.13
Eu-154	1.2E+07	2.25	*Negligible*		1.6E+07	2.22
Pb-210	9.4E+08	2.03	6.9E+09	1.65	7.2E+10	1.51
Ra-226	1.5E+08	2.03	2.0E+10	1.66	1.5E+11	1.50
Ra-228	4.8E+09	1.96	5.8E+12	1.61	5.6E+12	1.05
Ac-227	5.2E+06	2.07	2.3E+06	1.91	5.9E+05	1.83
Th-228	4.6E+09	1.94	5.7E+12	1.61	5.4E+12	1.05
Th-229	1.4E+05	1.83	4.6E+09	2.18	2.4E+02	1.96
Th-230	1.8E+09	1.78	1.5E+12	1.68	2.1E+12	1.98
Th-232	5.3E+09	1.97	5.9E+12	1.62	5.9E+12	1.05
Pa-231	2.1E+07	2.09	6.2E+06	1.91	2.2E+06	1.85
U-232	3.4E+07	2.13	*Negligible*		1.9E+08	2.20
U-233	7.0E+07	1.91	1.7E+12	2.17	2.2E+05	1.94
U-234	1.2E+12	2.11	1.7E+11	1.89	8.6E+10	1.94
U-235	5.2E+10	2.10	9.1E+09	1.91	5.3E+09	1.87
U-236	7.0E+10	2.15	2.0E+08	2.10	9.7E+09	2.02
U-238	1.4E+12	2.03	2.2E+11	1.93	2.1E+11	1.82
Np-237	1.9E+09	2.07	7.5E+05	2.74	2.2E+09	1.91
Pu-238	1.8E+09	1.64	1.3E+10	1.98	3.9E+08	2.09

Nuclide	P06A (Upper Cell)		P06 (Lower Cell) RaDU		P13 RaDU	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Pu-239	7.0E+10	1.67	3.3E+06	1.97	9.1E+09	1.93
Pu-240	1.5E+10	1.68	*Negligible*		4.7E+07	2.02
Pu-241	3.7E+10	1.61	1.1E+10	2.18	6.4E+09	2.10
Pu-242	3.5E+06	1.82	*Negligible*		*Negligible*	
Am-241	1.5E+10	1.51	1.1E+09	2.19	1.5E+09	1.79
Am-242m	2.1E+05	2.24	*Negligible*		*Negligible*	
Am-243	2.0E+07	2.13	*Negligible*		*Negligible*	
Cm-243	8.5E+07	2.14	*Negligible*		*Negligible*	
Cm-244	8.3E+07	2.14	*Negligible*		*Negligible*	
Cm-245	7.0E+05	2.21	*Negligible*		*Negligible*	
Cm-247	1.0E+06	2.14	*Negligible*		*Negligible*	
Cm-248	7.2E+05	2.32	*Negligible*		*Negligible*	
Cf-249	8.0E+03	2.17	*Negligible*		*Negligible*	
Total	5.9E+12		2.1E+13		2.0E+13	

Negligible – Inventory less than 37 Bq

GCD Inventories

The GCD boreholes have received high specific activity wastes, 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 Table 11. The GCD inventories are not significantly different from previous estimates.

Table 11. FY 2010 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	2.2E+16	2.32	1.8E+14	2.19
C-14	7.1E+04	2.73	*Negligible*	
Cl-36	1.6E+04	2.68	*Negligible*	
Ar-39	7.4E+04	2.71	*Negligible*	
K-40	4.1E+03	2.59	*Negligible*	
Ca-41	1.2E+05	2.73	*Negligible*	
Co-60	9.9E+11	2.53	*Negligible*	
Ni-59	2.9E+03	2.69	*Negligible*	
Ni-63	2.5E+05	2.63	*Negligible*	

Nuclide	Pre-1988 GCD		Post-1988 GCD	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Kr-85	6.4E+04	2.61	*Negligible*	
Sr-90	5.4E+15	3.92	1.3E+08	3.87
Zr-93	3.9E+02	2.58	*Negligible*	
Nb-93m	6.8E+04	2.72	*Negligible*	
Nb-94	9.5E+04	2.75	*Negligible*	
Tc-99	7.0E+09	3.19	8.0E+09	3.78
Cd-113m	5.9E+04	2.75	*Negligible*	
Sn-121m	1.0E+06	2.71	*Negligible*	
Sn-126	1.7E+02	2.59	*Negligible*	
Cs-135	3.0E+02	2.60	*Negligible*	
Cs-137	2.7E+14	3.90	*Negligible*	
Sm-151	4.0E+05	2.60	*Negligible*	
Eu-150	1.5E+05	2.97	*Negligible*	
Eu-152	4.6E+05	2.80	*Negligible*	
Eu-154	9.8E+04	2.74	*Negligible*	
Ho-166m	3.6E+03	2.66	*Negligible*	
Pb-210	2.7E+12	4.13	4.5E+04	2.35
Ra-226	3.6E+12	4.13	1.5E+05	2.35
Ra-228	1.0E+09	2.96	*Negligible*	
Ac-227	7.0E+10	4.05	6.5E+05	2.44
Th-228	1.0E+09	2.96	*Negligible*	
Th-229	8.4E+01	1.88	5.5E+01	2.29
Th-230	5.3E+07	3.02	1.7E+07	2.35
Th-232	1.0E+09	2.96	*Negligible*	
Pa-231	4.5E+06	3.03	1.5E+06	2.44
U-232	4.4E+03	2.69	*Negligible*	
U-233	4.1E+04	1.91	2.9E+04	2.29
U-234	1.3E+11	3.00	4.7E+10	2.36
U-235	4.9E+09	3.01	1.8E+09	2.44
U-236	3.4E+08	3.79	5.3E+01	3.96
U-238	3.7E+10	2.52	8.5E+10	2.30
Np-237	2.5E+08	2.00	1.7E+08	2.30
Pu-238	2.9E+11	3.21	3.8E+06	3.92
Pu-239	1.7E+13	2.83	2.1E+08	3.93
Pu-240	3.6E+12	3.24	4.5E+07	3.97
Pu-241	4.1E+12	3.48	6.6E+07	4.09
Pu-242	3.5E+08	3.20	*Negligible*	
Am-241	5.7E+12	2.55	4.0E+07	3.94

Nuclide	Pre-1988 GCD		Post-1988 GCD	
	Geometric Mean (Bq)	Geometric Standard Deviation	Geometric Mean (Bq)	Geometric Standard Deviation
Cm-244	7.9E+03	2.61	*Negligible*	
Total	2.8E+16		1.8E+14	

Negligible – Inventory less than 37 Bq

2.1.4 Institutional Control Policy

In 2008, NNSA/NSO approved Policy NSO P 454.X, "Institutional Controls for the Nevada Test Site" (NNSA/NSO, 2008a). The policy states that NNSA/NSO will implement, maintain, and enforce institutional controls that restrict access to, and use of, the NNSS and ensure the continuity of appropriate institutional controls in the future.

Based on the institutional control policy, future PA/CA analyses will assume implementation of land-use restrictions consistent with the UGTA *Federal Facility Agreement and Consent Order* (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 compliance boundary negotiated with the State of Nevada. Although the final boundaries have not been negotiated, it is very likely that the Area 3 RWMS and Area 5 RWMS will be within the compliance boundaries of the Yucca Flat Corrective Action Unit (CAU) and the Frenchman Flat CAU, respectively. The NNSA/NSO Assistant Manager of Environmental Management has administratively agreed to include the Area 5 RWMS with the UGTA groundwater use restriction area (NNSA/NSO, 2008a). The Area 5 RWMS is currently within the initial Frenchman Flat UGTA CAU contaminant boundary. The institutional control policy has affected 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 the member of 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. The member of public will be located at the UGTA groundwater compliance boundary.
4) The institutional control policy and the probabilistic period of institutional controls is 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 5 RWMS PA GoldSim model except for changing the point of compliance to the UGTA groundwater compliance boundary. The changes above are recommended for the Area 3 RWMS PA GoldSim model, again excluding the change in the member of public point of compliance.

2.1.5 Waste Acceptance Criteria

Compliance with the NNSS WAC is ensured by the RWAP, an NNSA/NSO program (NNSA/NSO, 2006a). A minor revision of the NNSS WAC occurred in FY 2010 (NNSA/NSO, 2010). In addition to minor editorial changes, the revision was updated with new Documented Safety Analysis-derived plutonium equivalent gram conversion factors based on Federal Guidance Report 13 Supplemental CD dose conversion factors (U.S. Environmental Protection Agency [EPA], 1999).

2.1.6 Closure

The approved Area 3 RWMS PA/CA assumes that the disposal units will be closed with a vegetated monolithic ET cover of native alluvium. The cover is assumed to be 3 m (10 ft) thick after subsidence. This was a limiting assumption consistent with closure plans for U-3ax/bl. The current 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 the current 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 37-ha (92-ac) Low-Level Waste Management Unit (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 composite analysis requirements in U.S. Department of Energy Manual DOE M 435.1-1, “Radioactive Waste Management” (DOE, 1999c). 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 v4.110 GoldSim model assumes a 2.5 m (8.2 ft) cover.

Under the *Closure Plan for the Area 5 Radioactive Waste Management Site at the Nevada Test Site* (NSTec, 2008), closure is planned in two phases with the 92-ac LLWMU closing in FY 2011 and the northern expansion area closing in FY 2028. Closure of the 92-ac LLWMU is occurring under the FFACO closure process. A CADD/CAP for the 92-ac LLWMU was prepared and approved by the Nevada Department of Environmental Protection (NDEP) in FY 2009 (NNSA/NSO, 2009). The preferred Corrective Action Alternative was closure with a 2.5 m (8.2 ft) thick engineered monolithic ET cover. Construction of the final closure cover will begin in FY 2011. 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.

2.1.7 Updated PA Results for FY 2010

Revised PA inventories and models were issued for the Area 5 RWMS in FY 2010. The new inventories and models were used to update the Area 5 RWMS PA results. The Area 3 RWMS was in standby mode during FY 2010. Preparation of a PA/CA update for the Area 3 RWMS began in FY 2009 and is expected to be completed in FY 2011.

2.1.7.1 PA Results for the Area 3 RWMS

The Area 3 RWMS PA results will be updated in FY 2011. The FY 2006 Annual Summary Report results are still considered valid because no changes have occurred for the inventory and PA model (NSTec, 2007c). The FY 2006 results showed increases over the PA results and concluded that a PA update is needed.

2.1.7.2 PA Results for the Area 5 RWMS

The FY 2010 Area 5 RWMS inventory was analyzed using the Area 5 RWMS v4.110 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 units, Pit 6, Pit 13, and GCD, respectively. The disposal unit area, disposal unit volume, and waste volumes were updated with FY 2010 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 10.11(SP4) with 5,000 LHS realizations.

The results for the FY 2010 inventory indicate that there is reasonable expectation of compliance with the member of public performance objectives. The means and 95th percentiles for the atmospheric pathway for all scenarios are less than the 0.1 millisieverts per year (mSv yr^{-1}) limit (Table 12). The air pathways results show a moderate decrease for all scenarios. The peak total effective dose (TED) occurs at 1,000 years for all scenarios except the open rangeland scenarios. In FY 2010, an increasing inventory of ^{233}U caused the predominant source of dose to change from ^{238}U to ^{229}Th for all scenarios with peak TED at 1,000 years. Tritium is the primary source of dose for the open rangeland scenarios 100-year peak TED.

Table 12. Area 5 RWMS v4.110 GoldSim Model Member of Public Total TED through the Air Pathway

Exposure Scenario	Mean (mSv yr^{-1})	95th Percentile (mSv yr^{-1})	Time of Maximum
Transient Visitor	4.8E-5	1.9E-4	1,000 years
Resident	1.3E-4	5.3E-4	1,000 years
Resident Farmer	1.8E-4	6.9E-4	1,000 years
Open Rangeland (Cane Spring)	6.5E-9	NA	100 years
Open Rangeland (NNSS Boundary)	8.9E-8	NA	100 years

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

The means and 95th percentiles for the all-pathways scenarios are less than the 0.25 mSv yr^{-1} performance objective (Table 13). The all-pathway TEDs show increases or decreases depending on the scenario. The TED for the resident farmer and open rangeland scenarios increases. The open rangeland scenarios had the largest relative increase, approximately two times the FY 2009 TED. The increase reflects the increase in the ^{3}H inhalation and ingestion dose conversion factors in Federal Guidance Report 13. Even after the increase, the open rangeland all-pathway TED is only 1 percent of the performance objective.

Table 13. Area 5 RWMS v4.110 GoldSim Model Member of Public TED through All-Pathways

Exposure Scenario	Mean (mSv yr^{-1})	95^{th} Percentile (mSv yr^{-1})	Time of Maximum
Transient Visitor	3.8E-3	8.4E-3	1,000 years
Resident	6.6E-4	2.4E-3	1,000 years
Resident Farmer	1.7E-2	5.3E-2	1,000 years
Open Rangeland (Cane Spring)	2.8E-3	NA	100 years
Open Rangeland (NNSS Boundary)	3.0E-3	NA	100 years

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

The mean and 95^{th} percentile ^{222}Rn flux density is less than the 0.74 Becquerel per square meter per second (Bq m^{-2} s^{-1}) performance objective averaged over the entire site (Table 14). The same is true for all virtual disposal units, except for the Pit 13 RaDU, where the 95^{th} percentile ^{222}Rn flux density exceeds the performance objective. The flux density result for the Pit 13 RaDU is not considered significant, because the limit 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 increases for all disposal units, the SLB disposal units, and the Pit 6 RaDU. The increases are due to increases in inventory.

Table 14. Area 5 RWMS v4.110 GoldSim Model Rn-222 Flux Density Results

Disposal Unit	Mean (Bq m^{-2} s^{-1})	95^{th} Percentile (Bq m^{-2} s^{-1})	Time of Maximum
All	0.13	0.27	1,000 years
SLB	0.12	0.26	1,000 years
Pit 6 RaDU	0.055	0.10	1,000 years
Pit 13 RaDU	0.69	2.0	1,000 years
GCD	1.2E-8	3.4E-8	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 exposure scenario results. The mean and 95^{th} percentile acute intruder doses are less than the 5 mSv dose limit for both scenarios at all virtual disposal units (Tables 15 and 16). Acute drilling scenario TED increases or decreases depending on the scenario. The largest relative increase, 19 percent, occurs for GCD and is likely due to changes in the dose conversion factors.

Table 15. Area 5 RWMS v4.110 GoldSim Model Acute Drilling Intruder TED

Disposal Unit	Mean (mSv)	95^{th} Percentile (mSv)	Time of Maximum
SLB	2.1E-3	4.1E-3	1,000 years
Pit 6 RaDU	0.028	0.052	1,000 years
Pit 13 RaDU	0.026	0.034	1,000 years
GCD	0.016	0.041	1,000 years

The SLB disposal unit acute construction TED decreased significantly in FY 2010 due to the new dose conversion factors. The mean and 95^{th} percentile are now less than the performance objectives. The largest increase is observed for Pit 6.

Table 16. Area 5 RWMS v4.110 GoldSim Model Acute Construction Intruder TED

Disposal Unit	Mean (mSv)	95^{th} Percentile (mSv)	Time of Maximum
SLB	1.1	2.1	1,000 years
Pit 6 RaDU	0.15	0.28	1,000 years
Pit 13 RaDU	0.060	0.19	1,000 years
GCD	2.7E-6	NA	100 years

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

The FY 2010 PA results show increases and decreases relative to the FY 2009 results reflecting changes to the inventory estimates and dose conversion factors. The inventory changes in FY 2010 were relatively small. However, increases in the ^{233}U inventory have caused its progeny, ^{229}Th, to become a key radionuclide in many scenarios. Changes to dose conversion factors have significant impacts for individual radionuclides, but when combined across all radionuclides have relatively little effect. All results indicate that there is still a reasonable expectation 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 2010 results with the 2006 PA update indicates that significant changes have occurred in the maximum TEDs and their time of occurrence. The air pathway member of public results have increased for all scenarios, except the open rangeland scenario, and the time of the maximum TED shifted to 1,000 years. The all-pathways member of public results have increased for the transient visitor but decrease for the 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 biotic transport parameters, a new passive institutional control period, a new institutional control policy, a thinner closure cover, and new dose conversion factors.

2.2 MONITORING AND RESEARCH AND DEVELOPMENT RESULTS

2.2.1 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. Closure Plans for the Area 3 RWMS and Area 5 RWMS (NSTec, 2007b; 2008) describe the specific monitoring programs for the waste disposal facilities at the NNSS. The program for the RWMSs includes the following monitoring elements:

- Vadose Zone Monitoring
- Groundwater Detection Monitoring (Area 5 RWMS only)
- Radon Monitoring
- Meteorology Monitoring
- Direct Radiation Monitoring
- Biota Monitoring

- Subsidence Monitoring
- Air Monitoring
- Soil Temperature Monitoring around radioisotope thermoelectric generators (RTGs)

Environmental monitoring data are reported on a calendar year (CY) basis. The following four reports, published annually, contain details regarding the monitoring program and results for CY 2009:

- *Nevada Test Site Environmental Report* (NSTec, 2010a)
- *National Emission Standards for Hazardous Air Pollutants Report* (NSTec, 2010b)
- *Waste Management Monitoring Report* (NSTec, 2010c)
- *Area 5 Groundwater Monitoring Report* (NSTec, 2010d*)*

Monitoring activities are summarized in Table 17.

Table 17. 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 • 8 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 two heights • 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

Monitoring Element	Area 3 RWMS	Area 5 RWMS
Biota Monitoring	• Sampling vegetation, small mammals, and animal burrow spoils for tritium, gamma-emitting radionuclides, strontium-90 (^{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	• Routine inspection of operational covers
Air Monitoring	• Air particulates sampled at four locations; atmospheric moisture sampling for tritium at two locations	• Air particulates sampled at two locations; atmospheric moisture sampling for tritium at two locations
Soil Temperature Monitoring around RTGs	• None	• Vertical and horizontal sensor arrays around four RTGs in Pit 5 (P05)

2.2.1.1 Vadose Zone Monitoring

Vadose zone monitoring is conducted at the Area 3 and Area 5 RWMSs to confirm the key assumption of no percolation below the plant root zone, to detect changes in system conditions that may affect system performance, to assess and update parameters for the PA models, and to establish baseline data for long-term monitoring. Vadose zone monitoring data continue to confirm the conceptual models used in the Areas 3 and 5 RWMS PAs and CAs. CY 2009 was drier than average with annual precipitation totals for Areas 3 and 5 that were approximately 43 and 48 percent, respectively, of their long-term averages.

Two locations at the Area 3 RWMS are instrumented with vadose zone monitoring sensors: (1) the closure cover of U-3ax/bl and (2) a drainage lysimeter facility (Figure 9). U-3ax/bl is instrumented with time-domain reflectometers (TDRs) for volumetric water content measurements. Sensors are located approximately every 0.3 m (1 ft) to a depth of 2.44 m (8 ft) at four locations within the cover. Due to the drier than average conditions, the U-3ax/bl TDR data from CY 2009 indicate soil volumetric water contents were at baseline volumetric water content (~5 to 10 percent) for the majority of the year.

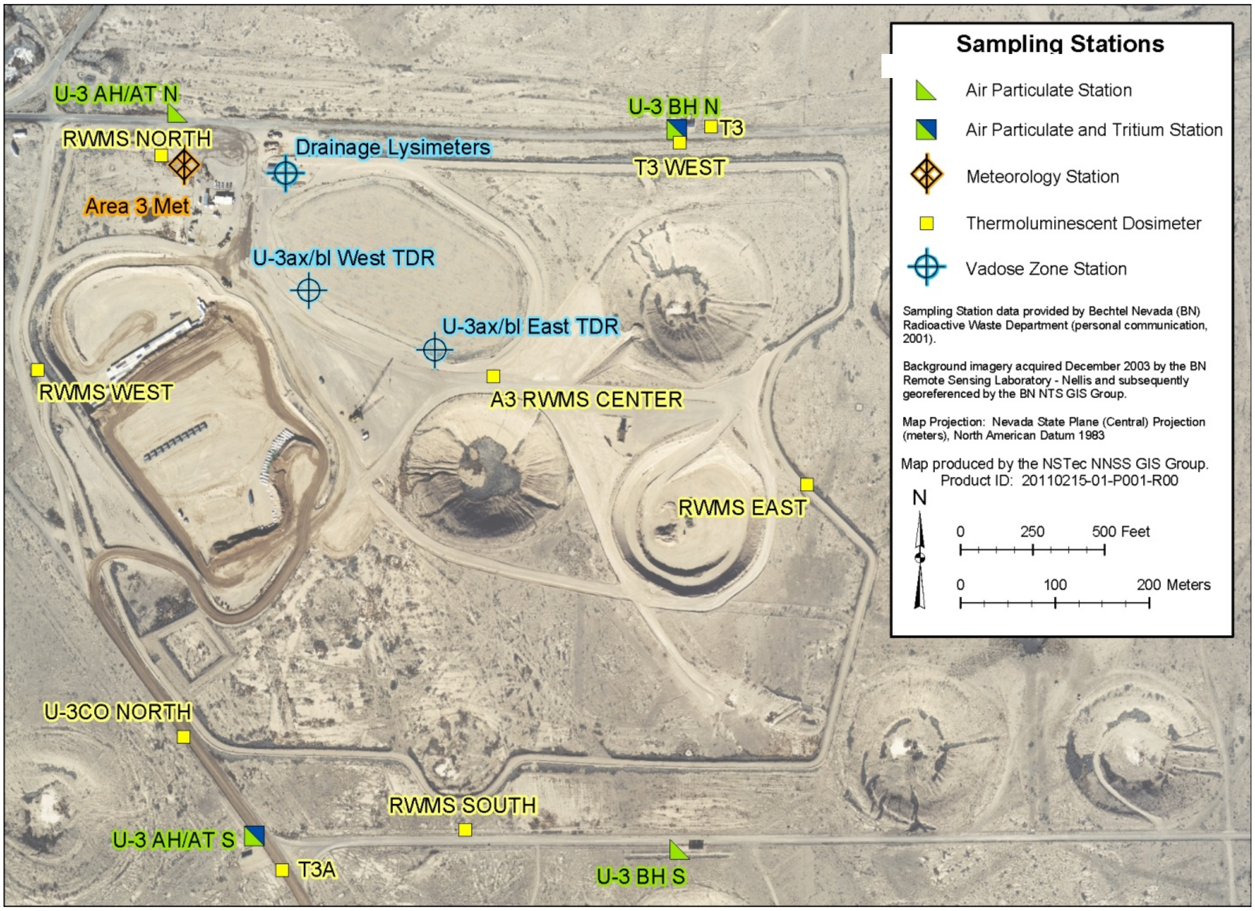


Figure 9. Monitoring Stations at the Area 3 RWMS

The Area 3 RWMS drainage lysimeters are instrumented with TDRs and heat dissipation sensors to measure matric potential. The Area 3 RWMS drainage lysimeter is used to conduct ET cover research. Currently, research is being conducted to assess the performance of ET covers under enhanced precipitation by applying irrigation to one-half of the paired lysimeters to achieve a three-times natural precipitation treatment.

Three operational covers, one pit floor, and two weighing lysimeters are instrumented at the Area 5 RWMS (Figures 10 and 11). The ten-year vegetated lysimeter data set was used to calibrate a vadose zone flow model. Model simulations are consistent with the conceptual model that there is no deep percolation under vegetated conditions (Desotell et al., 2006). Precipitation events in January and February increased the volumetric water contents of Area 5 RWMS pit covers. The covers dried throughout the rest of the year and had returned to background levels of approximately 12 percent moisture content by the end of CY 2009. The volumetric water content of the floor of Pit 5 was approximately 10 percent throughout the year with no indication of infiltration. The Area 5 RWMS weighing lysimeter data show a slight decrease in storage in both the vegetated and un-vegetated lysimeter in CY 2009.

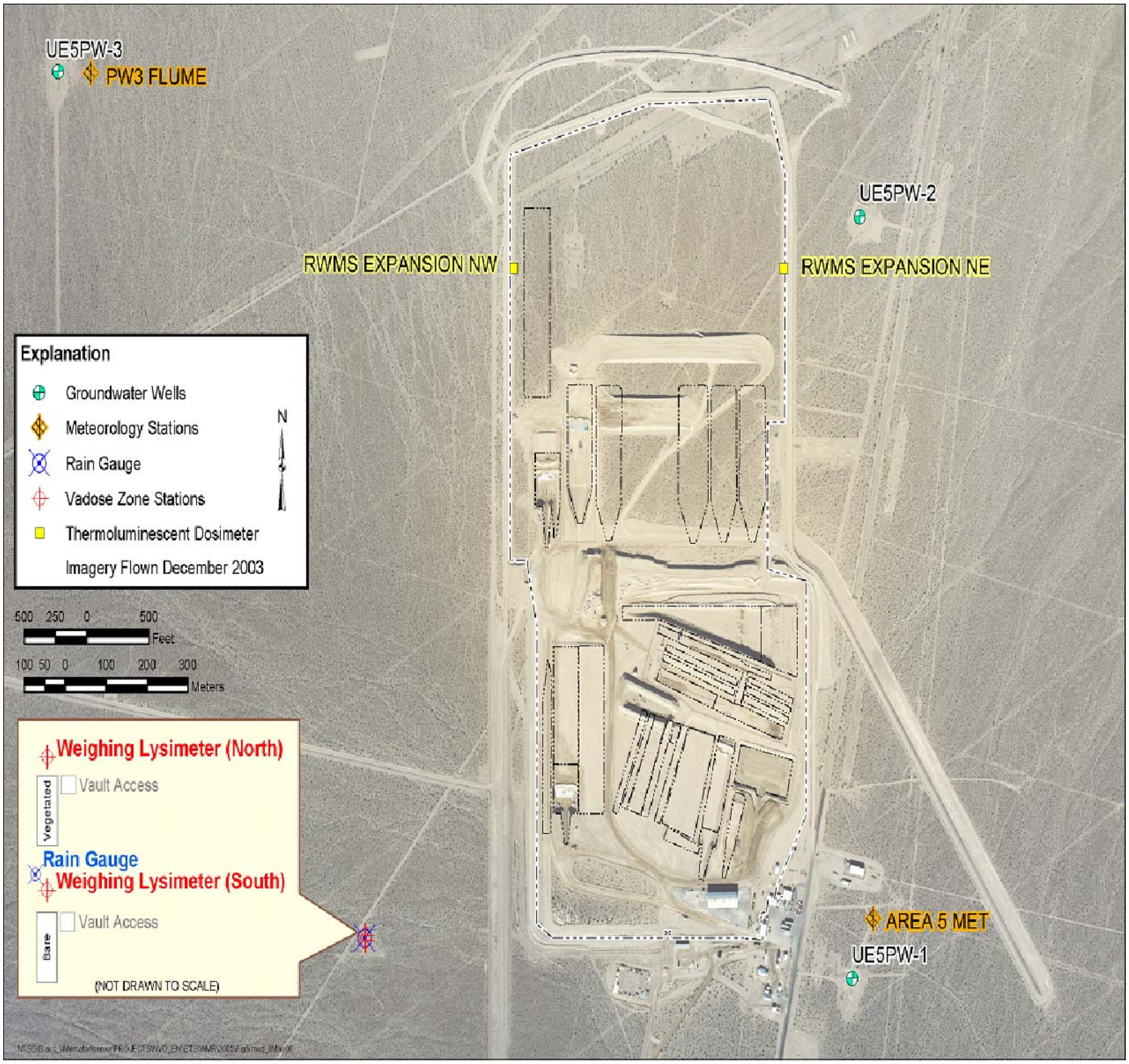


Figure 10. Location of the Area 5 RWMS Pilot Wells and Weighing Lysimeter Facility

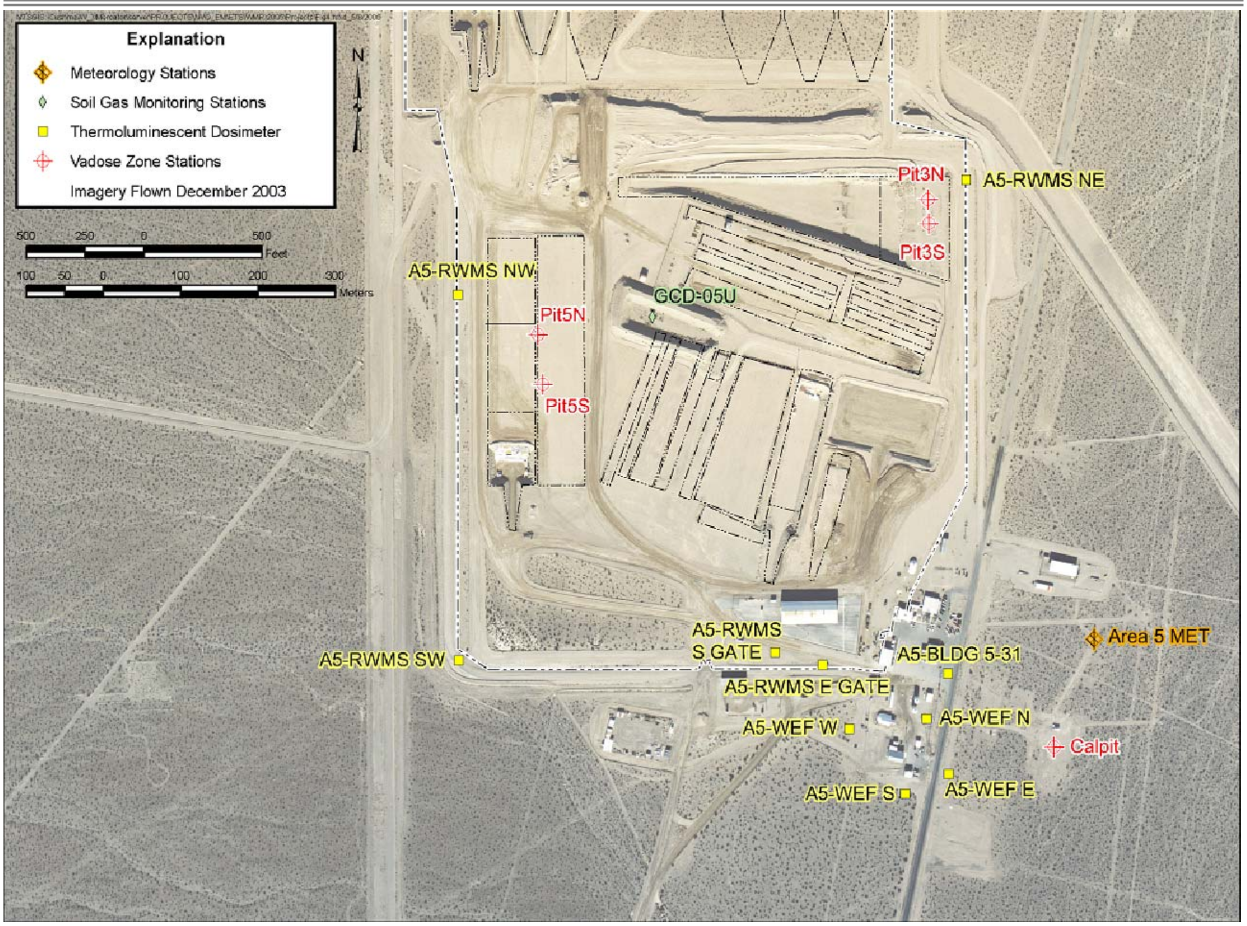


Figure 11. Monitoring Stations at the Area 5 RWMS

2.2.1.2 Groundwater Monitoring

Groundwater monitoring has been conducted for a suite of radiological and chemical constituents at the three wells surrounding the Area 5 RWMS since 1993 (Figure 10). In CY 2009 all wells were sampled two times for indicators of contamination (i.e., pH, specific conductance, total organic carbon, total organic halides, and tritium) and general water chemistry parameters. All analytical data continue to indicate that there is no measureable impact of Area 5 RWMS operations on the uppermost aquifer. Additionally, elevation measurements taken at the three wells surrounding the RWMS, as well as nearby locations, indicate the uppermost aquifer is approximately 235 m (771 ft) below ground surface and the water table is essentially flat, with very low groundwater velocities.

Groundwater is not monitored at the Area 3 RWMS. A groundwater monitoring waiver was granted by the State of Nevada for the mixed waste disposal unit U-3ax/bl, located within the Area 3 RWMS, because of the great depth to the water table (~490 m [1,607 ft] below ground surface), negligible chance of recharge, and likely presence of contamination from belowground nuclear weapon tests.

2.2.1.3 Radon Monitoring

Radon flux monitoring has been conducted at various locations within the Area 3 and Area 5 RWMSs since 2000. In CY 2009, ^{222}Rn flux density was monitored at the Area 3 RWMS U-3ax/bl cover, the Area 5 RWMS Pit 6 cover, and at background control sites. Pit 6 contains thorium waste expected to generate ^{222}Rn in the future as ^{226}Ra is produced by the decay of ^{230}Th. All results were a small fraction of the 0.74 Bq m^{-2} s^{-1} flux density limit and not greater than measured at the control sites. All results are generally consistent with PA results that project negligible ^{222}Rn flux at closure.

2.2.1.3 Meteorology Monitoring

Detailed meteorological data are collected at both the Area 3 and Area 5 RWMSs (Figures 9 and 11). Measurements include precipitation, air temperature, relative humidity, wind speed and direction, barometric pressure, and incident solar radiation. The meteorological parameters are used to quantify the exchange of water and heat between the soil and atmosphere. Meteorological measurements are taken to (1) confirm that the RWMSs are sited in arid environments, (2) be used as input in process level models, and (3) refine PA/CA parameter distributions. Onsite meteorological data were recently used in process level water balance modeling for the Area 5 RWMS (Desotell et al., 2006). Long-term data are being compiled to refine the wind speed distributions used in the PA/CA models. In CY 2009, precipitation totals were below average, totaling 8.76 centimeters (cm) (3.45 inches [in.]) and 6.27 cm (2.47 in.) at the Area 3 and Area 5 RWMSs, respectively. Reference evapotranspiration to precipitation ratios for CY 2009 are 17.4 and 24.6 for Area 3 and Area 5 RWMSs, respectively.

2.2.1.4 Direct Radiation Monitoring

Exposure rates measured by thermoluminescent dosimeters (TLDs) indicate that annual exposures at the Area 5 RWMS are within the range of exposures measured at NNSS background locations. The Area 3 RWMS is located within 400 m (1,300 ft) of 14 historic atmospheric nuclear weapons tests. These tests left radioactive surface soil contamination and therefore elevated radiation exposures across the area. During disposal operations, waste is covered with clean soil. The use of clean cover material has resulted in lowering TLD readings within the Area 3 RWMS to background levels.

2.2.1.5 Biota Monitoring

Three plants, eight small mammals, and three spoils samples from ant and mammal excavations were collected from the U-3ax/bl cover at the Area 3 RWMS in CY 2009 and analyzed for tritium, gamma-emitting radionuclides, ^{90}Sr, ^{241}Am, and plutonium. Tritium was detected at elevated levels in plants and animals. U-3ax/bl results for other radionuclides were similar to results from control areas. Soil samples were too dry to obtain water samples for tritium analysis.

Three plants, five small mammals, and three spoils samples from ant and mammal excavations were collected from the Area 5 RWMS in CY 2009. Tritium levels in plants and animals are higher at the Area 5 RWMS than the Area 3 RWMS. The levels of other radionuclides are similar to control areas.

Tritium vapor is known to be migrating through cover soils at the Area 3 and Area 5 RWMSs to the atmosphere. Emissions are a small fraction of regulatory limits (NSTec, 2010b). Plants and animals living on covers at the Area 3 and Area 5 RMWSs likely have elevated levels of ^{3}H due to exposure to contaminated cover soils. The levels detected pose negligible risk to the biota and humans (NSTec, 2010a).

2.2.1.6 Subsidence Monitoring

Subsidence has been formally monitored since 2000. Subsidence occurs most commonly in recently filled disposal units, especially along the edges where soil backfill may not be completely compacted. Subsided areas are repaired and documented. Prediction of the timing and magnitude of subsidence because of container collapse continues to be an area of high uncertainty where more research is needed. No large subsidence events occurred in CY 2009.

2.2.1.7 Air Monitoring

Air particulate samples are collected at the Area 3 and Area 5 RWMSs. Results for CY 2009 indicate that elevated levels of plutonium-239 plus plutonium-240 ($^{239+240}Pu$) and ^{241}Am are present at the Area 3 RWMS. The source of $^{239+240}Pu$ and ^{241}Am is likely the nearby soil contamination areas created by atmospheric nuclear weapons tests. Measured concentrations of airborne plutonium at the Area 3 RWMS are consistent with CA model calculations of resuspension from contaminated Soil Sites in Yucca Flat.

Air particulate data collected at the Area 5 RWMS are consistent with the screening analyses conducted for the Area 5 CA, which concluded that the contaminated Soil Sites in Frenchman Flat and the Area 5 RWMS are not interacting sources. Most measurements for airborne $^{239+240}Pu$ and ^{241}Am at the Area 5 RWMS are below the minimum detectable concentration.

Tritium in air data are collected at the Area 3 and Area 5 RWMSs. The maximum airborne ^{3}H activity concentration in CY 2009, 0.07 Bq m^{-3}, is a small fraction of the derived concentration guide. Tritium concentrations show less variability than in previous years. Concentrations exhibit a slight increase during the summer months when evapotranspiration is at its highest.

2.2.1.8 Soil Temperature Monitoring Around RTGs

All ^{90}Sr RTGs disposed in the Area 5 RWMS were disposed with conditions on the depth of burial, separation among RTGs, and separation from low-level waste. The conditions were imposed to (1) maintain maximum RTG surface temperature below 300 degrees Celsius (°C) (572 degrees Fahrenheit [°F]), (2) ensure that the 100°C (212°F) isotherm was deeper than 2 m (6.5 ft) below the ground surface, and (3) maintain temperature in adjacent low-level waste below 30°C (86°F). Four ^{90}Sr RTGs, disposed in Pit 5 on September 27, 2007, were instrumented with vertical and horizontal arrays of temperature sensors to confirm that RTG heat fields met the design criteria.

Data collected in FY 2010 indicate that temperatures continue to slowly increase with a maximum measured temperature in contact with the instrumented RTG of 107°C (225°F). Measurements continue to confirm that design criteria 2 and 3 above are being met. Although no temperature sensors were installed to measure the maximum RTG surface temperature, the model estimates the maximum temperature to be 139°C (282°F).

2.2.2 Research and Development

The PA/CA Maintenance Plan calls for annual reviews of R&D activities relevant to the PA. Results of both 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 necessary to manage uncertainty in conceptual models, mathematical models, model parameters, and evaluation scenarios of the PA and to ensure continuing adequacy of the PA.

The DASs require NNSA/NSO 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/NSO to address these issues and manage uncertainty.

2.2.2.1 Fiscal Year 2010 R&D Activities

The major R&D efforts undertaken in FY 2010 were the continuation of the development of the GoldSim models supporting the Area 3 RWMS and Area 5 RWMS PAs and CAs. These are summarized below.

Area 5 RWMS PA GoldSim Model Development

The FY 2010 PA update was performed with the Area 5 RWMS v4.110 PA model. Version 4.110 was approved by NNSA/NSO for all model applications, including waste stream evaluations and compliance determinations (NNSA/NSO, 2011). Major developments since version 4.105 of the model include the following:

- All inventories are updated to FY 2010 estimates.
- Internal and external radiological dose conversion factors were updated with adult dose conversion factors from the Federal Guidance Report 13 Supplemental CD (EPA, 1999).

Area 3 RWMS GoldSim Model Development

Version 2.0 is the current version of the model approved by NNSA/NSO for all model applications, including waste stream evaluations and compliance determinations, with the condition that the model should be run with subsidence for U-3ah/at disabled (NNSA/NSO, 2006b). No new versions of the Area 3 RWMS model were approved in FY 2010, but model revision in preparation for an Area 3 PA/CA update was initiated. Release of a final model was delayed to allow evaluation and possible incorporation of results from UGTA Yucca Flat crater infiltration modeling studies expected in FY 2011.

Area 5 RWMS Inventory GoldSim Model Development

The Area 5 RWMS FY 2010 inventory estimate was prepared with the Area 5 Inventory v2.107 model. The only major change from the previous version is the addition of disposal data updated through FY 2010.

2.2.2.2 Fiscal Year 2011 R&D Activities

The current R&D activity is development of the Area 3 RWMS GoldSim Model including:

- Further evaluation of subsidence; the consequences of subsidence will be incorporated into the model with the addition of new values for transport and media parameters under subsided conditions. Results of UGTA studies of crater infiltration in Yucca Flat, expected in FY 2011, will be evaluated.
- The member of public compliance scenario developed for the Area 5 RWMS model will replace the current scenarios implemented in version 2.0 of the model.
- Acute intruder scenarios will be added to the model to ensure consistency with the new institutional control policies (NNSA/NSO, 2007).
- Performing sensitivity analyses for the Area 3 RWMS GoldSim model.

2.2.2.3 Fiscal Year 2012 R&D Activities

Activities beyond FY 2011 will focus on the following:

- Updating the models as more data or information become available
- Using the model to support future disposal, closure, monitoring, and research decisions
- Using sensitivity analysis to simplify the Area 5 RWMS GoldSim model
- Evaluating new and revised waste streams as they are proposed

The GoldSim models will continue to be used to evaluate PA results using revised closure inventories that include current disposals. Based on the results of the sensitivity analyses undertaken in FY 2011, new studies may be undertaken in future years to reduce the uncertainty of sensitive model parameters, if it is feasible to do so.

2.2.2.4 R&D Activities Beyond Fiscal Year 2012

The long-term goal of the maintenance program is to reduce uncertainty in exposure scenarios (member of 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.

2.3 SUMMARY OF CHANGES

Waste operations, monitoring results, and R&D results for the Area 3 and Area 5 RWMSs have been reviewed to identify changes potentially impacting the PAs and the DASs. Waste operations changes required to ensure continuing compliance with the DASs have also been identified.

2.3.1 Proposed Changes

The Area 3 RWMS was inactive in FY 2010 and no significant changes affecting the PA were identified. An update to the Area 3 RWMS PA/CA was underway in FY 2010.

Multiple changes affecting the Area 5 RWMS PA occurred in FY 2010. The site inventory was updated to include disposals occurring in FY 2010 and new estimates of future inventory. Six new or revised waste streams required a special analysis. The Area 5 RWMS PA model was updated with Federal Guidance Report 13 Supplemental CD dose conversion factors. Final closure of the Area 5 RWMS 92-ac LLWMU with a 2.5 m (8.2 ft) cover is planned for FY 2011.

Pit 18, a double-lined RCRA-compliant mixed waste disposal cell, was constructed at the Area 5 RWMS in FY 2010. The cell will be closed with a monolithic ET cover. The Pit 18 ET cover is expected to perform as the SLB disposal unit cover. Percolation through waste to the depth of the liner is not expected. Therefore, the conceptual model for Pit 18 performance is unchanged from the SLB disposal unit model.

2.3.2 Discovered Changes

No PA changes were discovered in FY 2010.

2.4 RECOMMENDED CHANGES

Changes requested by waste operations or waste generators are tested with the PA models before they are implemented. If the changes are acceptable, inventory and PA models are revised to reflect the new conditions. Similarly, PA models are revised as new results from environmental monitoring or R&D programs are identified and confirmed. Occasionally, PA results may set conditions for waste operations or require changes to the monitoring plan.

None of the noted changes affect the PA maintenance plan, closure plans, monitoring plan or R&D plan. No changes are recommended for these planning documents.

There are no recommended changes to operations or monitoring based on PA results.

2.5 CONCLUSIONS

The most significant change at the Area 3 RWMS is the increased inventory since the approved PA in 1996 and its placement in inactive status. The site's conceptual model, important features, events, processes, and site characteristics remain unchanged. The FY 2006 A3 RWMS v2.0 GoldSim model results indicate that there is still reasonable expectation of compliance with the performance objectives. Overall, the Area 3 RWMS PA's conclusions regarding compliance and important parameters and processes remain valid. An update of the Area 3 RWMS PA is in preparation.

Analysis of the Area 5 RWMS proposed changes with the Area 5 RWMS v4.110 GoldSim model indicates that there is reasonable expectation of compliance with all performance objectives. Although a number of changes have occurred since preparation of the 2006 PA update, the PA's conclusions continue to remain valid. Therefore, no new revision to the Area 5 RWMS PA is necessary.

This Page Intentionally Left Blank

3.0 COMPOSITE ANALYSIS

3.1 SOURCE TERMS

The assumptions and conceptual models of the CAs are compared with current conditions to assess three key questions:

1. Are changes to the CAs required?
2. Are the conclusions of the CAs still valid?
3. Are the disposal facilities in compliance with the CA dose constraint and all DAS conditions?

The CA includes the waste source terms evaluated in the PAs for the Area 3 and Area 5 RWMSs. The results and conclusions of the PA review described above are applicable to the review of the CAs. The following sections emphasize changes and results relevant to issues unique to the CA. Issues unique to the CA mostly concern the pre-1988 inventory of the RWMSs and sources of residual radioactive materials from Environmental Restoration (ER) sites that interact with the RWMSs. Review results for the RWMSs and ER sources are summarized below.

3.1.1 Radioactive Waste Management Sites

3.1.1.1 Waste Characteristics and Facility Design

There were no proposed or discovered changes for pre-1988 waste forms and containers or for facility design and operations at the Area 3 and Area 5 RWMSs in FY 2010. No special analyses relevant to pre-1988 wastes were performed.

There were no significant changes to the pre-1988 waste inventories for the Area 3 RWMS. The Area 3 RWMS CA inventory was estimated with the A3 Inventory v2.012 model in FY 2009. The Area 5 RWMS CA inventory was estimated with the A5 Inventory v2.107 model (see Section 2.0). There were no significant changes to the Area 5 RWMS pre-1988 inventories.

3.1.1.2 Closure

The Area 3 RWMS PA/CA assumes that the site will be closed with a vegetated ET monolithic 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 was closed in FY 2001 with the installation of a monolithic alluvium cover. The existing 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 installed cover is generally consistent with the CA assumption of a 3 m (10 ft) monolithic cover.
The Area 5 RWMS CA makes similar but slightly less conservative assumptions (BN, 2001b). 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 Area 3 and Area 5 closure plans (NSTec, 2007b; 2008) remain consistent with the PA/CA assumptions. The current plans are to construct a 3 m (10 ft) monolithic ET cover at the Area 3 RWMS and a 2.5 m (8.2 ft) cover at the Area 5 RWMS. This remains consistent with existing CA assumptions.

3.1.2 Underground Testing Areas

The CAs for the Area 3 and Area 5 RWMSs assumed that land-use restrictions can control exposure of the public to groundwater contamination from UGTAs on the NNSS. In FY 2008, NNSA/NSO implemented a formal policy to implement and maintain the UGTA land-use restrictions.

Initial contaminant boundaries for the Yucca Flat CAU are tentatively scheduled for 2011 at the earliest. The Area 3 RMWS is expected to be within the initial CAU contaminant boundary. The results of the flow and transport model that will simulate alternative forecasts of the 1,000-year groundwater contaminant boundaries for Yucca Flat are not expected until FY 2023. The Area 3 RWMS CA assumptions are still consistent with current plans for the Yucca Flat CAU.

In 2010, the NDEP approved and accepted the Frenchman Flat UGTA CAU characterization data, groundwater flow model, and contaminant transport model for the CADD/CAP stage of the UGTA closure process. The initial contaminant boundaries for the Frenchman Flat CAU were also completed in 2010 (Navarro Nevada Environmental Service, LLC, 2010) and subjected to external peer review (Navarro-Intera, 2010). The initial contaminant boundaries include the Area 5 RWMS. Negotiation of compliance boundaries will follow a two-step process under the 2010 revision of the FFACO strategy. The initial compliance boundaries for the CADD/CAP stage will be negotiated with NDEP in 2011. The CADD/CAP stage will include evaluation and testing of the results of flow and transport models. If the evaluations and any model refinements are accepted by NDEP, the final compliance boundaries for Frenchman Flat will be negotiated at the start of the Closure Report (CR) stage in 2015.

The Area 5 RWMS CA is still consistent with the initial contaminant boundary for the Frenchman Flat UGTA. The Area 5 RWMS CA will require revision in FY 2015 with final closure of the Frenchman Flat UGTA.

3.1.3 Soil Sites

The CAs assume that the NNSS Soil Sites will not be remediated. No Soil Sites considered in the CAs have been characterized or remediated since completion of the CAs. The closure of Soil Sites is currently awaiting a regulatory determination of appropriate cleanup levels. Therefore, the results of the CAs remain valid and provide bounding estimates of site performance.

3.1.4 Industrial Sites

The CAs assume that the impact of the Industrial Sites is insignificant compared with the Soil Sites. No Industrial Sites have been characterized or remediated that impact interacting sources in Frenchman Flat since preparation of the CAs. The Area 5 RWMS CA assumptions remain unchanged.

In 2007, personnel from the Borehole Management Project, attempting to plug and close the U-9z borehole, encountered high levels of Pu contamination after opening a pipe connected to the well head. The site was within CAU 547, Miscellaneous Contaminated Waste Sites, a site thought to consist of gas sampling equipment. Subsequent investigation determined that the pipe was a vent pipe from the belowground PLAYER safety test. Safety tests are experiments to confirm that a nuclear detonation will not occur when a nuclear weapon is burned or its high explosives are accidentally detonated. Further investigations in 2009 identified two additional safety test sites, BERNANILLO in Area 3 and MULLET in Area 2, with similar levels of aboveground contamination. The BERNANILLO site is less than a kilometer north of the Area 3 RWMS and the MULLET site approximately 10 kilometers north. Preliminary inventory estimates are comparable with Pu inventories for the HORNET ground zero at the Area 3 RWMS. The CAU 547 corrective action sites are likely to be closed in place with a soil cover and land-use restrictions. CAU 547 is unlikely to be a significant source of airborne Pu because the contamination is contained in steel pipes and will have a soil cover installed. Nevertheless, CAU 547 should be described and evaluated in future Area 3 RWMS CA updates or revisions.

3.2 UPDATED CA RESULTS

The Area 5 RWMS CA results were updated with the A5 RWMS v4.110 GoldSim model. The model was run as described for the PA, except that the model was placed in CA mode. A slight decrease is observed for the dose at the Area 5 RWMS boundary (Table 18). 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 18. Area 5 RWMS v4.110 GoldSim Model CA All-Pathways Annual TED for a Resident at the Area 5 RWMS

Disposal Unit	Mean (mSv yr^{-1})	95th Percentile (mSv yr^{-1})	Time of Maximum
All	8.9E-4	3.0E-3	1,000 years

3.3 MONITORING AND R&D RESULTS

3.3.1 Monitoring

The monitoring activities discussed in Section 2.2.1 also pertain to the CAs. As discussed in Section 2.2.1, 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, 2010a; 2010b). Tritium, $^{239+240}$Pu, and ^{241}Am are the only man-made radionuclides routinely detected at the Area 3 RWMS at slightly elevated levels. The source of the $^{239+240}$Pu and ^{241}Am is believed to be the former atmospheric testing sites throughout Yucca Flat, including ground zeros in the immediate vicinity of the RWMS. FY 2010 monitoring results are consistent with previous results and the CA resuspension and atmospheric dispersion model results.

3.3.2 Research and Development

No R&D activities in FY 2010 had results that might impact the CA results and conclusions. The discussions of the R&D activities in Section 2.2.2 for PAs are also pertinent for CAs.

3.4 SUMMARY OF CHANGES

3.4.1 Proposed Changes

The Area 3 RWMS has been inactive since FY 2006. Therefore, no significant operational changes occurred for the Area 3 RWMS in FY 2010. Final closure of the Area 5 RWMS 92-LLWMU with a 2.5 m (8.2 ft) monolithic ET cover is planned for FY 2011.

The monitoring and R&D programs are largely unchanged from previous years. The Area 5 RWMS PA model was updated with Federal Guidance Report 13 Supplemental CD dose conversion factors in FY 2010. Results from monitoring and R&D are consistent with previous results and continue to support CA conceptual models.

3.4.2 Discovered Changes

An industrial site, CAU 547, with CASs located near the Area 3 RWMS was discovered to have a large Pu inventory. The source, which is contained in a steel pipe and will likely be closed with a soil cover, should be incorporated into the next Area 3 RWMS CA update or revision.

3.5 RECOMMENDED CHANGES

Changes requested by waste operations are tested with the CA models before they are implemented. If the changes are acceptable, inventory and CA models are revised to reflect the new conditions. Similarly, CA models are revised as new results from environmental monitoring or R&D programs are identified and confirmed. Progress in ER programs is reviewed for their impacts on CA assumptions and models. Occasionally, CA results may set conditions for waste operations or require changes to the monitoring plan.

The next CA revision should consider inclusion of CAU 547. There are no other recommended changes to the CA model in FY 2010.

None of the noted changes affect the CA maintenance plan, closure plans, or the monitoring plans. No changes are recommended for these planning documents.

There are no recommended changes to operations or monitoring based on CA results through FY 2010.

3.6 SUMMARY

The reviews of the Area 3 and Area 5 RWMS inventories, the results of the monitoring and R&D activities, and land-use planning show that the assumptions in the CAs have not changed. An ER source near the Area 3 RWMS, CAU 547, was found to have a greater inventory than previously thought. Although the source is not expected to have any impact on CA results, CAU 547 should be evaluated in the next Area 3 RWMS CA update or revision.

The Area 5 RWMS CA showed that there was negligible interaction between the contaminated Soil Sites in Frenchman Flat and the RWMS. Therefore, the Area 5 RWMS CA model calculates the dose for a future member of public 100 m (330 ft) from the RWMS boundary and does not explicitly include the minor air pathways doses from ER Soil Sites. No new sources of contamination have been identified, and there is no new information that would reduce the uncertainty of the current sources. The only changes affecting the CA are the use of new dose conversion factors and the reduction of the Area 5 RWMS closure cover thickness from 4 m (13 ft) to 2.5 m (8.2 ft). The consequences of the new dose conversion factors and the thinner cover were evaluated with the A5 RWMS v4.110 GoldSim model and found not to affect the CA conclusions.

There have been no changes in FY 2010 that affect the conclusions of the CAs, as indicated by reviews of the disposal unit closure inventories, estimated 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.

Current inventories have been analyzed with the new Area 5 RWMS CA model. The results indicate a high probability that the doses from all interacting sources are less than the 0.3 mSv annual dose constraint.

In conclusion, review of the Area 3 and Area 5 RWMS CAs indicates that the CA conclusions remain valid and that there is no need to revise the CAs at this time. Current CA models indicate there is a high likelihood that the Area 3 and Area 5 RWMSs continue to meet the 0.3 mSv annual dose constraint.

This Page Intentionally Left Blank

4.0 REFERENCES

Bechtel Nevada, 2001a. *Addendum 1, Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*. DOE/NV/11718--176-ADD1. Las Vegas, NV. November 2001.

Bechtel Nevada, 2001b. *Composite Analysis for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada.* DOE/NV--594. Las Vegas, NV. September 2001.

Bechtel Nevada, 2001c. *Addendum 1, Composite Analysis for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*. DOE/NV--594-ADD1. Las Vegas, NV. November 2001.

Bechtel Nevada, 2003. *Nevada Test Site Routine Radiological Environmental Monitoring Plan*. DOE/NV/11718--804. Las Vegas, NV. June 2003.

Bechtel Nevada, 2005. *Integrated Closure and Monitoring Plan for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site*. DOE/NV/11718--449. Las Vegas, NV. September 2005.

Bechtel Nevada, 2006. *Addendum 2 to the Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada*. DOE/NV/11718--176-ADD2. Las Vegas, NV. January 2006.

BN, see Bechtel Nevada.

CFR, see Code of Federal Regulations

Cochran, J.R, W.E. Beyeler, D.A. Brosseau, L.H. Bush, T.J. Brown, B.M. Crowe, S.H. Conrad, P.A. Davis, T. Ehrhorn, T. Feeney, B. Fogleman, D.P. Gallegos, R. Haaker, E. Kalinina, L.L. Price, D.P. Thomas, and S. Wirth, 2001. *Compliance Assessment Document for the Transuranic Wastes in the Greater Confinement Disposal Boreholes at the Nevada Test Site, Volume 2: Performance Assessment*. SAND2001-2977. Albequerque, NM. September, 2001.

Code of Federal Regulations, Title 40, Part 191, “Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Waste,” 1994.

Desotell, L. T., D. B. Hudson, V. Yucel, and J. T. Carilli, 2006. “Use of Long-Term Lysimeter Data in Support of Shallow Land Waste Disposal.” In: *Proceedings of the Waste Management ’06 Conference*. Tucson, AZ. February 26–March 2, 2006.

DOE, see U.S. Department of Energy.

EPA, see U.S. Environmental Protection Agency

Navarro-Intera, LLC, 2010. *External Peer Review Team Report Underground Testing Area Subproject for Frenchman Flat*. N-I/28091—021-CD. Las Vegas, NV. September 2010.

Navarro Nevada Environmental Services, LLC. 2010. *Phase II Transport Model of Corrective Action Unit 98: Frenchman Flat, Nevada Test Site, Nye County, Nevada*. N-I/28091--004, S-N/99205--122. Las Vegas, NV.

National Security Technologies, LLC, 2007a. *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*. DOE/NV/25946--091. Las Vegas, NV. January 2007.

National Security Technologies, LLC, 2007b. *Closure Plan for the Area 3 Radioactive Waste Management Site at the Nevada Test Site*. DOE/NV/25946--289. Las Vegas, NV. September 2007.

National Security Technologies, LLC, 2007c. *2006 Annual Summary Report for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada Test Site, Nye County, Nevada*. DOE/NV/25946--135. Las Vegas, NV. March 2007.

National Security Technologies, LLC, 2008. *Closure Plan for the Area 5 Radioactive Waste Management Site at the Nevada Test Site*. DOE/NV/25946--553. Las Vegas, NV. September 2008.

National Security Technologies, LLC, 2010a. *Nevada Test Site Environmental Report 2009*. DOE/NV25946--1067. Las Vegas, NV. September 2010.

National Security Technologies, LLC, 2010b. *National Emission Standards for Hazardous Air Pollutants – Radionuclide Emissions Calendar Year 2009*. DOE/NV/25946--1008. Las Vegas, NV. June 2010.

National Security Technologies, LLC, 2010c. *Nevada Test Site 2009 Waste Management Monitoring Report Area 3 and Area 5 Radioactive Waste Management Sites*. DOE/NV/25946--1009. Las Vegas, NV. June 2010.

National Security Technologies, LLC, 2010d. *Nevada Test Site 2010 Data Report: Groundwater Monitoring Program, Area 5 Radioactive Waste Management Site*. DOE/NV/25946--1133. Las Vegas, NV. January 2011.

NNSA/NSO, see U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office.

NSTec, see National Security Technologies, LLC.

Shott, G. J., L. E. Barker, S. E. Rawlinson, M. J. Sully, and B. A. Moore, 1998. *Performance Assessment for the Area 5 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada, Rev. 2.1.* DOE/NV/11718--176/UC-721. Bechtel Nevada, Las Vegas, NV. January 1998.

Shott, G. J., V. Yucel, M. J. Sully, L. E. Barker, S. E. Rawlinson, and B. A. Moore, 2001. *Performance Assessment/Composite Analysis for the Area 3 Radioactive Waste Management Site at the Nevada Test Site, Nye County, Nevada, Rev. 2.1.* DOE/NV--491-Rev 2.1. Bechtel Nevada, Las Vegas, NV. December 2001.

Shott, G.J., and V. Yucel, 2009. *Optimization of the Area 5 Radioactive Waste Management Site Closure Cover*. DOE/NV/25946--695. National Security Technologies, LLC, Las Vegas, NV. April 2009.

U.S. Department of Energy, 1999a. "Disposal Authorization Statement for the Department of Energy Nevada Operations Office Area 3 Radioactive Waste Management Site Low-Level Radioactive Waste Disposal Facility dated October 20, 1999." Memorandum from EM-35 to Kathleen Carlson, Manager, Nevada Operations Office. October 21, 1999.

U.S. Department of Energy, 1999b. DOE G 435.1-3, "Maintenance Guide for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments and Composite Analysis." Washington, D.C., November 1999.

U.S. Department of Energy, 1999c. DOE M 435.1-1, "Radioactive Waste Management," Washington, D.C., 1999.

U.S. Department of Energy, 2000. "Disposal Authorization for the Nevada Test Site Area 5 Low-Level Waste Disposal Facility." Memorandum from EM-35 to Kathleen Carlson, Manager, Nevada Operations Office. December 5, 2000.

U.S. Department of Energy, 2001. DOE O 435.1, "Radioactive Waste Management." U.S. Department of Energy, Washington, D.C., 2001.

U.S. Department of Energy, 2002a. "Disposal Authorization for the Nevada Test Site Area 3 Radioactive Waste Management Site Submittal of Revised Performance Assessment and Composite Analysis dated December 17, 2001." Memorandum from EM-43 to Kathleen Carlson, Manager, Nevada Operations Office. August 2, 2002.

U.S. Department of Energy, 2002b. "Disposal Authorization for the Nevada Test Site Area 5 Radioactive Waste Management Site Submittal of Revised Performance Assessment and Composite Analysis Addenda." Memorandum from EM-43 to Kathleen Carlson, Manager, Nevada Operations Office. May 23, 2002.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2006a. *Radioactive Waste Acceptance Program Implementation Plan*. RWAP-P1, Rev. 4. Las Vegas, NV. March 30, 2006.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2006b. "Low-Level Waste Acceptability Report for the Area 3 Radioactive Waste Management Site GoldSim Probabilistic Performance Assessment Model Version 2.0." Correspondence from Jhon Carilli, NNSA/NSO, to J. K. Wrapp, NSTec. November 22, 2006.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2007. *Institutional Control Policies and Implementation for the Area 5 and Area 3 Radioactive Waste Management Sites.* DOE/NV/25946—300. Las Vegas, NV. November 2007.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2008a. *Institutional Control of the Nevada Test Site.* NSO P 454.X. Las Vegas, NV. January 8, 2008.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2009. *Corrective Action Decision Document/Corrective Action Plan for the 92-Acre Area and the Corrective Action Unit 111: Area 5 WMD Retired Mixed Waste Pits, Nevada Test Site, Nevada*. DOE/NV--1326. Las Vegas, NV. July 2009.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2010. "*Nevada National Security Site Waste Acceptance Criteria*" DOE/NV—325-Rev.8. NNSA/NSO. September 2010.

U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2011. "Acceptance of the Area 5 Radioactive Waste Management Site Probabilistic Model, Version 4.110." Correspondence from E. F. DiSanza, NNSA/NSO, to J. K. Wrapp, NSTec. February 1, 2011.

U.S. Environmental Protection Agency, 1999. *Cancer Risk Coefficients for Environmental Exposure to Radionuclides*. EPA-402-R-99-001, Supplemental CD. Washington, DC.

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 2.5 concludes that the Area 3 RWMS PA needs to be updated and that the Area 5 RWMS PA does not require revision. Revision of the Area 3 RWMS PA was on going in FY 2010.
b. Does the annual summary information indicate that the conclusions of the PA remain valid?	Section 2.5 concludes that the conclusions of 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 DOE Manual 435.1-1 performance objectives and any conditions in the facility DAS?	Section 2.5 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 2010 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 Section 2.1 and summarized in Section 2.3. The effects of changes on PA results are described in Section 2.1.7.
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 and their impacts are described in Section 2.1.3.1.
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.
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 2.4 concludes that no changes are required for the maintenance plan, closure plan, or monitoring plan.
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 2.3.1 describes proposed changes to the PA model. Section 2.5 concludes that no changes to the PA are required.

Requirement	Result
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?*	Waste receipts are described in Section 2.1.3. The impacts of waste receipts on PA results are described in Section 2.1.7.
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 2.1.5 describes the WAC.
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 2.1.5.
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 2.1.2.
b. Engineered barrier consistency with the PA. Is the consistency adequately described?	Consistency of the closure cover with PA analyses is described in Section 2.1.6.
c. Monitoring provisions appropriate for evaluation of facility performance. Are monitoring provisions adequately described?	The Monitoring Program is described in Section 2.2.1.
d. Operational controls to promote stability and to compensate for potential subsidence. Are operational controls adequately described?	Controls and monitoring of subsidence is described in Section 2.2.1.6.

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?*	Consistency of the closure cover with PA analyses is described in Section 2.1.6.
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 2.1.4.
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 DAS are summarized in Section 1.1.
b. R&D efforts pursued for improving and refining the performance assessment. Are these efforts adequately described?	R&D efforts are described in Section 2.2.2.
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 2.2.1.
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 <u>discovered</u> 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 Manual 435.1-1,*	Section 2.1.7 summarizes the FY 2009 PA results for the Area 3 and Area 5 RWMSs. Current PA results for the Area 3 RWMS, which have not been revised since FY 2006, indicate that model and inventory changes have caused increases in projected results and that a PA update is needed. All results continue to meet all performance objectives. Comparison of the FY 2010 Area 5 RWMS PA results with the approved PAs indicates that all results continue to meet all performance objectives. Some results have increased relative to the 1996 PA update results. Results remain a small fraction of the performance objectives.
b. any change in the point of compliance as reported in the current approved facility documentation,	Changes to PA models are described in Section 2.2.2.1. No change in the point of compliance occurred in FY 2010.
c. any fundamental change in the analysis methodology or model used for the facility documentation, and	Changes to PA models are described in Section 2.2.2.1.
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 2.2.2.1. There are no major 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 2.3.1.
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?*	Proposed changes are described in Section 2.3.1. Changes to the PA models are described in Section 2.2.2.1.
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 3.6 concludes that the Area 3 and Area 5 RWMS CAs remain valid and that there is 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 3.6 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 3.6 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 DOE Manual 435.1-1 performance goals and any conditions in the facility DAS?	Section 3.6 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?*	Changes affecting the CAs are described in Section 3.2.
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?	Section 3.1 describes the review performed for the CA in FY 2010. Section 3.2 describes CA results using the results of the FY 2010 review.
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 changes occurring in FY 2010. Section 3.2 describes CA results using the results of the FY 2010 review. Section 3.4 summarizes changes.
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?	Proposed changes are summarized in Section 3.4.1.
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 3.5 summarizes recommended changes.
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 3.4.1. Section 3.6 concludes that no changes to the CAs are required.
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.)*	

Requirement		Result
3.3.1	*Operations Considerations*	Section 3.1 describes changes affecting the CAs.
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?*	
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 2.1.3.
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 2.1.5.
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 2.1.5.
3.3.2	*Facility Design Considerations*	Consistency of facility design with CA analyses is described in Section 3.1.
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?*	
b.	*Engineered barrier consistency the CA. Is the consistency adequately described?*	Consistency of cover design with CA analyses is described in Section 3.1.1.2.
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 3.3.1.
d.	*Operational controls to promote stability and to compensate for potential subsidence. Are operational controls adequately described?*	Controls and monitoring of subsidence are described in Section 2.2.1.6.
3.3.3	*Closure Design Considerations*	Consistency of cover design with CA analyses is described in Section 3.1.1.2.
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?*	
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 3.1.

Requirement	Result
3.3.4 Research and Development Considerations *a. R&D efforts required by the DAS. Are these efforts adequately described?*	R&D efforts relevant to the CAs are described in Section 3.3.2. DAS-required R&D efforts to characterize UGTA source terms are described in Section 3.1.2.
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 3.3.2.
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 3.3.1.
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 3.1 reviews the status of interacting source terms and concludes that no significant changes have occurred.
b. Alteration of existing source terms. Does the annual summary report any changes in existing source terms including new source terms?	Section 3.1 reviews the status of interacting source terms and concludes that no significant changes have occurred.
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 3.1 reviews the status of interacting source terms and concludes that no significant changes have occurred.
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 <u>discovered</u> 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 3.4.2 describes discovered changes.

Requirement	**Result**
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 CA are described in Section 3.4.1.
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 3.3.2. Proposed changes are summarized in Section 3.4.1.
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 DAS conditions are discussed in Section 1.1.

Requirement	Result
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 Maintenance Plan, Closure Plans, and Monitoring Plans are identified in Sections 1.0, 2.1.6, and 2.2.1, respectively. Complete citations are found in Section 4.0.

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

This Page Intentionally Left Blank

DISTRIBUTION

Jhon T. Carilli LLW Federal Sub-Project Director, Waste Management Project U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	4 copies
E. Frank DiSanza LLW Federal Project Director, Waste Management Project U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 copy
U.S. Department of Energy National Nuclear Security Administration Nevada Site Office Public Reading Facility P.O. Box 98521, M/S 400 Las Vegas, NV 89193-8521	2 CDs
U.S. Department of Energy National Nuclear Security Administration Nevada Site Office Technical Library P.O. Box 98518, M/S NSF 151 Las Vegas, NV 89193-8518	1 CD
U.S. Department of Energy Office of Scientific and Technical Information P.O. Box 62 Oak Ridge, TN 37831-0062	1 digital file
Environmental Management Library National Security Technologies, LLC P.O. Box 98521, M/S NLV094 Las Vegas, NV 89193-8521	1 digital file

Bruce M. Crowe — 1 copy
Navarro-Intera, LLC
P.O. Box 98592, M/S 505
Las Vegas, NV 89193-8518

David B. Hudson — 1 copy
National Security Technologies, LLC
P.O. Box 98521, M/S NLV083
Las Vegas, NV 89193-8521

Susan K. Krenzien — 1 copy
Navarro-Intera, LLC
P.O. Box 98592, M/S 505
Las Vegas, NV 89193-8518

Gregory J. Shott — 1 copy
National Security Technologies, LLC
P.O. Box 98521, M/S NLV083
Las Vegas, NV 89193-8521

Vefa Yucel — 1 copy
National Security Technologies, LLC
P.O. Box 98521, M/S NLV083
Las Vegas, NV 89193-8521