DOE/NV/03624--0388

Fiscal Year 2018 Annual Summary Report for the Area 3 and Area 5 Radioactive Waste Management Sites at the Nevada National Security Site, Nye County, Nevada

February 2019

Prepared by

Mission Support and Test Services, LLC

Prepared for

U.S. Department of Energy
National Nuclear Security Administration
Nevada Field Office
Under Contract DE-NA0003624

DISCLAIMER

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Executive Summary

The U.S. Department of Energy Standard *Disposal Authorization Statement and Tank Closure Documentation* (DOE-STD-5002-2017) requires preparation of an Annual Summary Report comparing low-level radioactive waste disposal facilities operations with the Disposal Authorization Statement (DAS) and its supporting technical documents including the performance assessment (PA) and the composite analysis (CA). The fiscal year (FY) 2018 Annual Summary Report for the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) was prepared by reviewing planned and discovered changes, waste receipts, monitoring results, research and development (R&D) results, and the status of DAS conditions and issues to assess the validity of the DASs, PAs, and CAs.

The Area 3 RWMS was placed in stand-by in 2006 and remained inactive in FY 2018. Resumption of waste disposal operations is planned for FY 2019. No proposed actions, new information, or discoveries affecting the Area 3 RWMS were identified in FY 2018. No significant changes have occurred since preparation of the most recent special analysis, which indicates a continuing reasonable expectation of meeting the PA performance objectives and measures, and the CA dose constraint in DOE O 435.1, "Radioactive Waste Management." No changes were made to documents supporting the Radioactive Waste Management Basis (RWMB) including the PA, CA, DAS, waste acceptance criteria (WAC), closure plan, monitoring plan, or maintenance plan. Monitoring results for the most recent year with available data, calendar year (CY) 2017, indicate no changes to long-term trends and no results inconsistent with expected performance. R&D results for the Area 3 RWMS Drainage Lysimeter Facility continue to be consistent with the conceptual site model (CSM). All Area 3 RWMS DAS conditions and secondary issues were closed in 2002.

The Area 5 RWMS continued disposal operations within the Northern Expansion Area in FY 2018. Eighty-six changes involving proposed actions, new information, or discoveries affecting the Area 5 RWMS PA and CA were screened during FY 2018 in the unreviewed disposal question (UDQ) process. Twenty-two changes required UDQ evaluations and two changes resulted in unreviewed composite analysis question evaluations. None of the proposed actions, new information, or discoveries had significant impacts on the PAs or CAs. All of the planned changes were implemented. No special analyses were performed, and no changes were made to documents supporting the RWMB including the PA, CA, DAS, WAC, closure plan, monitoring plan, or maintenance plan. Planning continued and construction commenced on development of the Western Expansion Area within the Radioactive Waste Management Complex. All Area 5 RWMS DAS conditions and secondary issues were closed in 2002.

The cumulative effects of changes occurring since preparation of the Area 5 RWMS PA and CA were assessed with the current baseline PA/CA model. Model results indicate that there is a reasonable expectation that the PA performance objectives and measures, and the CA dose constraint in DOE O 435.1, "Radioactive Waste Management," can be met. No PA or CA mean result exceeds 50% of its performance objective.

Monitoring results and R&D results continue to be consistent with the CSM. Monitoring results for CY 2017 indicate no changes to long-term trends and no results inconsistent with expected

performance. R&D results for the Area 5 RWMS Weighing Lysimeter Facility continue to be consistent with the CSM.

The FY 2018 review of Area 3 RWMS and Area 5 RWMS disposal operations supports the following conclusions:

- The Area 3 and Area 5 RWMS PA and associated CA assumptions and conclusions remain valid based on consideration of all changes identified or planned;
- The reasonable expectation that the Area 3 and Area 5 RWMSs will meet the performance objectives identified in DOE O 435.1, "Radioactive Waste Management", remains valid; and
- The DAS, based on interpretation of the data collected, monitoring results, and other information, continues to be adequate.

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Acronyms, Abbreviations, and Symbols

^{3}H	tritium
μg L^{-1}	microgram per liter
BN	Bechtel Nevada
Bq	becquerel(s)
Bq g^{-1}	becquerel(s) per gram
Bq L^{-1}	becquerel(s) per liter
Bq m^{-3}	becquerel(s) per cubic meter
Bq m^{-2} s^{-1}	becquerel(s) per square meter per second
C	carbon
CA	composite analysis
CAS	Corrective Action Site
CAU	Corrective Action Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Cf	californium
CFR	Code of Federal Regulations
cm	centimeter(s)
Cs	cesium
CSM	conceptual site model
CY	calendar year
DAS	Disposal Authorization Statement
DASWMM	Deputy Assistant Secretary for Waste and Material Management
DC	dose coefficient
DOE	U.S. Department of Energy
DOE M	U.S. Department of Energy Manual
DOE O	U.S. Department of Energy Order
DRISE	Director of Regulatory Intergovernmental and Stakeholder Engagement
EPA	U.S. Environmental Protection Agency
ET	evapotranspirative
Eu	europium
FFACO	*Federal Facility Agreement and Consent Order*
FY	fiscal year (Federal)
GCD	greater confinement disposal
Gd	gadolinium
INL	Idaho National Laboratory

km	kilometer(s)
km^2	square kilometer(s)
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level radioactive waste
LLWMU	Low-Level Waste Management Unit
LFRG	Low-Level Waste Disposal Facility Federal Review Group
m	meter(s)
m^3	cubic meter(s)
Mg	magnesium
mg L^{-1}	milligram(s) per liter
mm	millimeter(s)
mmhos cm^{-1}	millimho(s) per centimeter
mR yr^{-1}	milliroentgen per year
MSTS	Mission Support and Test Services, LLC
mSv	millisievert(s)
Nb	niobium
NFS	Nuclear Fuel Services
NNSA	U.S. Department of Energy, National Nuclear Security Administration
NNSA/NFO	U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
ORNL	Oak Ridge National Laboratory
PA	performance assessment
Pb	lead
PCBs	polychlorinated biphenyls
Ra	radium
R&D	research and development
RaDU	radium disposal unit
RCRA	*Resource Conservation and Recovery Act*
Rn	radon
RTG	radioisotope thermoelectric generator
RWMB	Radioactive Waste Management Basis
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site

SC	specific conductance
SLB	shallow land burial
SNL	Sandia National Laboratories
SOFs	sum of fractions
TBq	terabecquerel(s)
Tc	technetium
TED	total equivalent dose
Th	thorium
Ti	titanium
TOC	total organic carbon
TOX	total organic halides
TRU	transuranic
U	uranium
UCAQ	unreviewed composite analysis question
UCAQE	unreviewed composite analysis question evaluation
UDQ	unreviewed disposal question
UDQE	unreviewed disposal question evaluation
UGTA	underground test area
WAC	waste acceptance criteria
WVDP	West Valley Demonstration Project
yr	year(s)

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1.0 Introduction

This Annual Summary Report presents the results of the annual review of the Area 3 Radioactive Waste Management Site (RWMS) and Area 5 RWMS performance assessments (PAs), composite analyses (CAs), Disposal Authorization Statements (DASs), and Radioactive Waste Management Bases (RWMBs). The Area 3 and Area 5 RWMSs received DASs in 1999 and 2000, respectively, as required by U.S. Department of Energy Order (DOE O) 435.1 "Radioactive Waste Management" (U.S. Department of Energy [DOE] 2001). The Area 3 and Area 5 RWMS DASs (DOE 1999a, 2000) require preparation of an Annual Summary Report and a determination of the continuing adequacy of the PAs and CAs. The PA/CA Maintenance Plan (National Security Technologies, LLC [NSTec] 2007) implements the annual review and Annual Summary Report requirement.

The Annual Summary Report is submitted to the DOE, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) for review and approval. NNSA/NFO submits the Annual Summary Report to the Deputy Assistant Secretary for Waste and Material Management (DASWMM) and the Director of Regulatory Intergovernmental and Stakeholder Engagement (DRISE). The DASWMM and DRISE forward the Annual Summary Report to the Low-Level Waste Disposal Facility Federal Review Group (LFRG) for review and comment to ensure the site complies with DOE O 435.1 requirements. The LFRG provides the DASWMM and DRISE with their review comments for consideration.

The annual review evaluates new information, planned and discovered changes regarding facility operations, facility design, waste inventories, site monitoring, research and development (R&D) results, PA/CA models, and other documents supporting the RWMB including unreviewed disposal question evaluations (UDQEs), unreviewed composite analysis question evaluations (UCAQEs), special analyses, waste acceptance criteria (WAC), closure plans, monitoring plans, and the maintenance plan. The review is conducted to assess the validity of the following statements.

- The Low-Level Radioactive Waste (LLW) Disposal Facility PA and associated CA assumptions and conclusions remain valid based on consideration of all changes identified or planned;
- The reasonable expectation that the LLW Disposal Facility will meet the performance objectives identified in DOE O 435.1, "Radioactive Waste Management," remains valid; and
- The DAS, based on interpretation of the data collected, monitoring results, and other information, remains valid.

In addition, any changes to the RWMB due to revision of supporting documents (e.g., the Documented Safety Analysis, Waste Acceptance Criteria, Closure Plans, and Maintenance Plan) or preparation of special analyses are described. The Annual Summary Report follows the guidance in DOE Standard, *Disposal Authorization Statement and Tank Closure Documentation* (DOE-STD-5002-2017) (DOE 2017).

1.1 Disposal Facility Operations, History, and Future Plans

1.1.1 Area 3 RWMS

The Area 3 RWMS covers approximately 0.48 square kilometers (km^2) in central Yucca Flat on the Nevada National Security Site (NNSS). Fourteen aboveground nuclear tests were conducted within Area 3 from 1952 to 1958. Three ground zeros with contaminated surface soil occur within or directly adjacent to the Area 3 RWMS. Eight belowground nuclear tests conducted from 1961 to 1963 created seven subsidence craters within the Area 3 RWMS boundary.

Three Area 3 RWMS disposal cells have received disposed wastes. Two pairs of adjacent craters where excavated to create the U-3ax/bl and U-3ah/at disposal cells. The U-3bh crater was the third cell to receive waste. Two unused craters, U-3az and U-3bg, are available for future disposal. No plans currently exist to dispose of waste in the unused craters.

Waste disposal began at the Area 3 RWMS as early as 1966 with disposal of debris from NNSS nuclear testing operations in the U-3ax crater. In 1968, the Area 3 RWMS was formally designated as a radioactive waste disposal facility. The NNSS began accepting offsite waste in 1978. The U-3ax crater continued to receive NNSS testing debris until 1984 when it was combined with the U-3bl crater to create the U-3ax/bl disposal cell. The U-3ax/bl disposal cell continued to receive mostly uncontainerized bulk wastes from NNSS operations until late 1987 when it was operationally closed. A final 3-meter (m) vegetated monolithic evapotranspirative-(ET-) closure cover was installed in 2001.

Disposal of NNSS testing debris continued in the U-3at crater in early 1988. In 1989, clean-up of atmospheric testing debris slowed and the area between the U-3at and U-3ah craters was excavated to create the U-3ah/at disposal cell. After 1989, waste disposed at U-3ah/at was mostly containerized waste from offsite generators.

Disposal operations in U-3bh began in 1997 with disposal of uncontainerized Pu-contaminated soil from the CLEAN SLATE I safety test site. Since then, U-3bh has received containerized and bulk waste from on site and off site generators.

Most waste disposed in the U-3ah/at and U-3bh disposal units are offsite wastes regulated by DOE O 435.1. Historically, the Area 3 RWMS has been the preferred disposal site for bulk wastes. Each disposal unit has received bulk uncontainerized waste or soft-sided containers (e.g., supersacks, burrito wraps) at some time during its operation.

In July 2006, the Area 3 RWMS was placed in standby mode and all disposal operations ceased. The active disposal units, U-3ah/at and U-3bh, were covered with 1.2- to 2.4-m operational covers. Operational covers at U-3ah/at and U-3bh are currently below existing grade. U-3ax/bl, which corresponds with *Federal Facility Agreement and Consent* Order (FFACO) Corrective Action Unit (CAU) 110, was permanently closed in 2001 with an engineered monolithic ET cover. The Area 3 RWMS remained in standby for most of fiscal year (FY) 2018. Preparation of the Area 3 RWMS for resumption of waste disposal operations in FY 2019 began in the latter part of FY 2018. Disposal of bulk soils from Nevada environmental restoration projects is expected to resume in FY 2019.

1.1.2 Area 5 RWMS

The Area 5 Radioactive Waste Management Complex (RWMC) occupies approximately 3.0 km^2 of land set aside for radioactive waste disposal in northern Frenchman Flat on the NNSS. The Area 5 RWMS describes the operationally active area on the eastern portion of the RWMC. The Area 5 RWMS includes two waste disposal areas: the 92-acre Low-Level Waste Management Unit (LLWMU) and the Northern Expansion Area. The 92-acre LLWMU includes FFACO CAU 111.

Shallow land burial (SLB) of on-site-generated LLW in unlined pits and trenches began at the Area 5 RWMS in 1961. In 1978, disposal of waste from off-site generators began and continues to the present. LLWs are disposed in unlined SLB cells to within 1.2 m of grade and covered with 2.4-m thick alluvium operational covers. At final closure, SLB operational covers are shaped, graded, and revegetated to create a minimum 2.5-m thick monolithic ET final closure cover. Construction of a new SLB disposal cell, Cell 24, in the northern expansion area began in FY 2018.

Since 1987, mixed wastes have been disposed in three *Resource Conservation and Recovery Act* (RCRA) regulated disposal cells. Mixed wastes are currently disposed in two double-lined RCRA-compliant disposal cells, Cells 18 and 25. Cell 18 is near capacity and expected to close in FY 2019. Cell 25 was constructed and began accepting mixed waste in FY 2018.

From 1983 to 1991, transuranic (TRU) and high-specific activity wastes were disposed in 3-m-diameter, 36-m-deep greater confinement disposal (GCD) boreholes. The boreholes were filled with waste to approximately 21 m below grade and backfilled with alluvium. Approximately 21 m^3 of TRU waste were also inadvertently disposed in classified Trench 4 in 1986.

Disposal operations are expected to continue until site capacity is utilized. Development of infrastructure supporting the Western Expansion Area of the Area 5 RWMC began in FY 2018. Construction of a flood control berm and channel around the northern and western boundaries of the RWMC was initiated and a water main was rerouted around the disposal area.

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2.0 Changes Potentially Affecting the PA, CA, DAS, or RWMB

Changes potentially affecting the PA, CA, DAS, or RWMB are identified and evaluated through the Unreviewed Disposal Question (UDQ)/Unreviewed Composite Analysis Question (UCAQ) process. In addition to changes in the documents listed above, changes reviewed as potential UDQEs include changes to documents, plans, or procedures supporting the RWMB, changes to waste operations and the disposed waste inventory, WAC deviation requests, non-conformances, and corrective actions. Corrective actions completed under the Environmental Restoration FFACO are reviewed as potential UCAQEs.

Eighty-six changes involving proposed actions, new information, or discoveries were screened in FY 2018. All of the changes involved the Area 5 RWMS. Twenty-two changes required UDQEs, and two changes resulted in UCAQEs (Table 2.1). None of the changes required a special analysis. None of the UDQEs or UCAQEs required LFRG notification.

Most changes screened in FY 2018 involve disposal of new or revised waste streams. Fifteen of the 22 UDQEs address the acceptance of new or revised waste streams with waste activity concentrations exceeding WAC Action Levels or having long-lived radionuclides without WAC Action Levels.

Other routine or reoccurring UDQEs conducted in FY 2018 include:

- A UDQE addressing the migration of the PA/CA models from GoldSim version 11.1.6 to 12.0.
- UDQE addressing the FY 2018 Area 5 RWMS closure inventory estimate.
- A UDQE and a UCAQE addressing the cumulative effect of changes to the Area 5 RWMS PA/CA model.

One UDQE addresses the effects of delayed revegetation of the Area 5 RWMS closure covers. Disposal records indicate that Area 5 RWMS operational covers remain un-vegetated for an average of 30 years before final closure. The 92-ac LLWMU was closed in FY 2012 and initial attempts to revegetate the closure cover failed. Revegetation of covers after final closure may require an additional 10 years. During this period without native vegetation, precipitation may percolate into the waste and near-surface vadose zone. UDQE simulations indicate that water content increases are small, limited to the near-surface vadose zone, and that percolating water is very unlikely to recharge the uppermost aquifer within 1,000 years (Mission Support and Test Services [MSTS] 2018a).

Two UDQEs address the development and testing of the revision 2.0 PA inventory screening limits for the Area 5 RWMS. The screening limits are used to identify radionuclides that must be included in the PA model and to screen new waste profiles with long-lived radionuclides without WAC Action Levels. Screening limits are calculated for 116 radionuclides using updated data and methods (MSTS 2018b). The screening limit derivation was updated and revised to use reference person dose coefficients (DCs) and intake rates. During review of the screening limits,

a unit conversion error was discovered in the revision 1.0 screening limits. Some conservatism is removed in the derivation of the revision 2.0 screening limits to compensate for the unit conversion error. The revision 2.0 limits are equal to or greater than the revision 1 limits, except for a few uncommon gaseous radionuclides. The revision 2.0 screening limits were tested to confirm that they remain sufficiently protective for their intended purpose and found to be acceptable. Review of profiles accepted using the revision 1.0 screening limits confirms that they remain acceptable using the revision 2.0 limits.

One UCAQE addresses the impacts of FFACO corrective actions on the Area 5 RWMS CA and assesses the need to revise or update the CA. Since preparation of the Area 5 RWMS CA, final closure of all FFACO Corrective Action Sites (CASs) within 10 kilometers (km) of the disposal site, except one, has occurred. The UCAQE conducted screening assessments to determine if 90 Industrial, 19 Soils, and ten Underground Test Area (UGTA) CASs have any potential to interact with releases from the disposal facility (MSTS 2018c). None of the CASs was found to interact significantly with the Area 5 RWMS. The Area 5 RWMS CA reached the same conclusion about the interaction of the Area 5 RWMS with sources of residual contamination. No need to revise or update the Area 5 RWMS CA was identified.

Two changes evaluated through the UDQ/UCAQ process remained incomplete at the end of FY 2018. A UDQ screening initiated in FY 2017 remains unresolved pending selection of a final corrective action. Between 2009 and 2015, 48 Nuclear Fuel Services (NFS) Fuel Manufacturing Facility waste shipments contaminated with chromium were disposed at the Area 5 RWMS as LLW. Some of the mischaracterized waste was disposed in the 92-acre LLWMU, which has since undergone final closure. The non-conformance is expected to be closed through the FFACO process. A UDQE addressing disposal in the western expansion area of the Area 5 RWMC was in preparation at the end of FY 2018.

Table 2.1 Potential Changes Affecting the Area 5 RWMS PA, CA, DAS, or RWMB

UDQ/UCAQ Identification Number (Document Number)	Change, Discovery, Proposed Action, New Information Description	Evaluation Results	Special Analysis Number (If Applicable)	PA, CA, DAS, or RWMB Impacts
UDQ-2018-007 (DOE/NV/25946—3416 [MSTS 2017])	Acceptance of revised waste stream, Lawrence Livermore National Laboratory (LLNL) EnergyX Macroencapsulation Waste (BCLAMACRONCAP, Rev. 2), tritium (^{3}H) and radium-226 (^{226}Ra) exceed WAC Action Levels	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-009 (DOE/NV/03624—0003 [MSTS 2018d])	Acceptance of revised waste stream, Los Alamos National Laboratory (LANL) Regulated Asbestos Contaminated LLW (LANL000000029, Rev. 5), europium-154 (^{154}Eu), ^{226}Ra, and niobium-94 (^{94}Nb) exceed WAC Action Levels	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-020 (DOE/NV/03624--0014 [MSTS 2018e])	Acceptance of revised waste stream, Idaho National Laboratory (INL) Radioactive Waste Management Complex LLW (INEL11006367N, Rev. 4), waste stream sum of fractions exceeds 1.0	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-021 RWAP-2018-006_00	Acceptance of revised waste stream, LANL TA-53 Beamline LLW (LANL000000010, Rev. 5), long-lived nuclides without Action Levels, titanium-44 (^{44}Ti) and gadolinium-148 (^{148}Gd), exceed screening limits	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-018 (DOE/NV/03624--0055 [MSTS 2018f])	Acceptance of revised waste stream, INL Unirradiated Light Water Breeder Reactor Waste (INEL167203QR1, Rev. 1), thorium-229 (^{229}Th), ^{230}Th, ^{232}Th, uranium-232 (^{232}U), ^{233}U, and ^{234}U exceed WAC Action Levels	Waste stream accepted with condition limiting total activity of ^{233}U	NA	No significant impact

UDQ/UCAQ Identification Number (Document Number)	Change, Discovery, Proposed Action, New Information Description	Evaluation Results	Special Analysis Number (If Applicable)	PA, CA, DAS, or RWMB Impacts
UDQ-2018-013 (DOE/NV/03624--0054 [MSTS 2018g])	Acceptance of revised waste stream, West Valley Demonstration Project (WVDP) Contaminated Concrete and General Debris (WVDP000000013, Rev. 12), ^{226}Ra exceeds WAC Action Level	Waste stream accepted with condition limiting total activity of ^{226}Ra	NA	No significant impact
UDQ-2018-014 (DOE/NV/03624--0191 [MSTS 2018a])	Delayed revegetation of the Area 5 RWMS closure cover	No significant impact for 10-year delay of revegetation	NA	No significant impact
UDQ-2018-024 (DOE/NV/03624--0070 [MSTS 2018h])	Acceptance of revised waste stream, WVDP Drum Cell Cement Solidified Waste (WVDP000000018, Rev. 4), technetium-99 (^{99}Tc) exceeds WAC Action Level	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-028 (DOE/NV/03624--0090 [MSTS 2018i])	Acceptance of revised waste stream, WVDP Asbestos Contaminated LLW Debris (WVDP000000023, Rev. 3), ^{226}Ra exceeds WAC Action Level	Waste stream accepted with condition limiting total activity of ^{226}Ra	NA	No significant impact
UDQ-2018-026 (DOE/NV/03624--0083 [MSTS 2018j])	Acceptance of new waste stream, NNSS Uranium Powder (LRY5LLWFY1801, Rev. 0), ^{234}U exceeds WAC Action Level	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-032 UDQ-2018-061 (DOE/NV/03624--0212 [MSTS 2018b])	Development and testing of revision 2.0 PA screening limits	Updated PA screening limits are developed for long-lived nuclides	NA	No significant impact
UDQ-2018-033 (DOE/NV/03624--0087 [MSTS 2018k])	Acceptance of revised waste stream, Sandia National Laboratories (SNL) Sealed Sources (ASLA000000030, Rev. 1), ^{226}Ra exceeds WAC Action Level	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-040 (DOE/NV/03624--0097 [MSTS 2018m])	Acceptance of revised waste stream, Transuranic Waste Processing Center Mixed LLW (FWORCHMLLW103, Rev. 13), ^{99}Tc exceeds WAC Action Level; californium-249 (^{249}Cf) and ^{251}Cf exceed screening limits	Waste stream accepted without conditions	NA	No significant impact

UDQ/UCAQ Identification Number (Document Number)	Change, Discovery, Proposed Action, New Information Description	Evaluation Results	Special Analysis Number (If Applicable)	PA, CA, DAS, or RWMB Impacts
UDQ-2018-042 (DOE/NV/03624--0117 [MSTS 2018n])	Acceptance of revised waste stream, Oak Ridge National Laboratory (ORNL) Activated Metal (ORNLACTMETAL1, Rev. 6), 14 radionuclides exceed WAC Action Levels; ^{44}Ti and ^{148}Gd exceed screening limits	Waste stream accepted with conditions limiting total activity of cesium-137 (^{137}Cs), lead-210 (^{210}Pb), and ^{226}Ra	NA	No significant impact
UDQ-2018-046 (DOE/NV/03624--0118 [MSTS 2018o])	Acceptance of new waste stream, INL Uranium Metal and Oxide (INEL18008231Q, Rev. 0), ^{226}Ra exceeds WAC Action Level	Waste stream accepted without conditions	NA	No significant impact
UDQ-2018-058 (RWAP-2018-018_00)	Migration of the Area 5 RWMS v4.201 PA model to GoldSim 12.0	No change detected	NA	No significant impact
UDQ-2018-060	Development and initiation of waste disposal operations in the Area 5 RWMS Western Expansion Area	Evaluation is ongoing	NA	To be determined
UDQ-2018-071 (DOE/NV/03624--0188 [MSTS 2018p])	Acceptance of revised waste stream, Portsmouth Gaseous Diffusion Plant Spent Trap Media (PORTLPP000011, Rev. 8), ^{99}Tc exceeds WAC Action Level	Waste stream accepted with condition limiting total activity of ^{99}Tc	NA	No significant impact
UDQ-2018-084 (RWAP-2018-023_00)	Acceptance of revised waste stream, LANL TA-53 Beamline LLW (LANL000000010, Rev. 6), long-lived nuclide without Action Level, ^{44}Ti, exceeds screening limit	Waste stream accepted without conditions	NA	No significant impact
UDQ-2019-004 (RWAP-2019-002_00)	FY 2018 Area 5 RWMS Inventory Update	FY 2018 closure volume estimate is approximately two times PA update estimate.	NA	No significant impact
UDQ-2019-010 (RWAP-2019-003_00)	FY 2018 Area 5 RWMS PA Update	Area 5 RWMS continues to comply with all DOE Manual (DOE M) 435.1-1 performance objectives.	NA	No significant impact

UDQ/UCAQ Identification Number (Document Number)	Change, Discovery, Proposed Action, New Information Description	Evaluation Results	Special Analysis Number (If Applicable)	PA, CA, DAS, or RWMB Impacts
		No LFRG reporting criteria are exceeded.		
UCAQ-2019-001 (RWAP-2019-003_00)	FY 2018 Area 5 RWMS CA Update	Area 5 RWMS continues to meet the DOE M 435.1-1 CA dose constraint. No LFRG reporting criteria are exceeded.	NA	No significant impact
UCAQ-2018-002 (DOE/NV/03624--0125 [MSTS 2018c])	Update of Composite Analysis Sources Potentially Interacting with the Area 5 RWMS	Review of FFACO corrective actions affecting sources of residual radioactive contamination interacting with the Area 5 RWMS indicates that no significant changes have occurred.	NA	No need to revise the Area 5 RWMS CA identified

NA – not available, special analysis not necessary

2.1 Cumulative Effects of Changes

The Area 3 RWMS was placed in stand-by in 2006. In 2012, a special analysis (NSTec 2012) was prepared to evaluate the cumulative effect of changes occurring since preparation of the PA and CA (Shott et al. 2001). No significant changes have occurred that would affect the Area 3 RWMS PA, CA, DAS, or RWMB since preparation of the special analysis. The Area 3 RWMS PA, CA, DAS, and RWMB remain valid.

Multiple changes have occurred since preparation of the 2006 Area 5 RWMS PA update (Bechtel Nevada [BN] 2006). Changes impacting the PA and CA are implemented in the current baseline PA/CA model. The effect of cumulative changes was evaluated with the new FY 2018 baseline Area 5 RWMS PA/CA model, version 4.203b. The 2006 Area 5 RMWS PA update used model version 3.11 as documented in BN (2006). Important PA/CA model changes occurring since version 3.11 include:

- Disposed waste inventories and volumes are updated through the end of FY 2018.
- A period of passive institutional control is assumed to occur after the end of active institutional control. The duration of passive institutional control is stochastic and based on an elicitation of subject matter experts (Black et al. 2001).
- Closure cover thickness is reduced from 4 to 2.5 m based on a cover optimization study (Shott and Yucel 2009).
- Multiple radionuclides are added to the model, including a gaseous carbon-14 (^{14}C).
- The radon effective diffusion coefficient is based on laboratory measurements using site-specific cover materials.
- The dimensions and final inventories of the Pit 6 radium disposal unit (RaDU) and the Pit 13 RaDU are updated to reflect as-built conditions.
- Many biointrusion parameters are updated based on site-specific characterization data. Termite burrowing is removed from the model based on site-specific investigations (BN 2006).
- A residential exposure scenario without agriculture is added to the model based on the results of expert elicitation of subject matter experts (Black et al. 2001).
- Drilling and construction acute intrusion scenarios are included the model. Land use restrictions planned for the Area 5 RWMS combined with National Nuclear Security Administration land ownership and NNSS institutional control policies (NNSA/NFO 2015) are assumed to eliminate the possibility of chronic intrusion for 1,000 years after closure.
- The radiological assessment model is modified to calculate age- and gender-weighted total equivalent dose (TED). Ingestion and inhalation dose coefficients DCs are reference person DCs from DOE (2011). External irradiation DCs are from Federal Guidance Report 13 (EPA 1999). Member of public assessment parameters, including ingestion rates, inhalation rates, and time spent in various activities are revised to allow calculation of age- and gender-weighted intakes or exposure times.
- Parameters related to air pathway exposures are updated including soil mass loading, soil resuspension rates, and the particulate deposition velocity.

The Area 5 RWMS version 4.203b model results indicate that there is a reasonable expectation of compliance with all performance objectives and measures. All results remain less than 50% of their performance objective or measure.

Results obtained with the A5 RWMS, version 4.203b, PA model comply with the air pathway annual TED performance objective and are a small fraction of the 0.1 millisievert (mSv) limit (Table 2.2). The FY 2018 air pathway results have increased relative to the 2006 Area 5 RMWS PA update results (BN 2006) except for the open rangeland scenarios. The FY 2018 open rangeland scenario results have decreased relative to the 2006 Area 5 RMWS PA update. The time of the maximum result has shifted from 63 to 1,000 years for all scenarios due to the addition of a period of passive institutional control.

Table 2.2 Comparison of the 2006 Area 5 RWMS PA Update and FY 2018 Reference Person Annual TED through the Air Pathway

Exposure Scenario	2006 PA Update (BN 2006)			FY 2018		
	Mean (mSv)	95th Percentile (mSv)	Time of Maximum†	Mean (mSv)	95th Percentile (mSv)	Time of Maximum†
Transient Visitor	4.1E-5	3.7E-4	63 yr	7.6E-5	2.6E-4	1,000 yr
Resident	NA	NA	NA	1.9E-4	6.4E-4	1,000 yr
Resident with Agriculture	1.1E-5	9.9E-5	63 yr	4.1E-4	1.4E-3	1,000 yr
Open Rangeland (Cane Spring)	2.5E-8	2.2E-7	63 yr	8.0E-9	2.0E-8	1,000 yr
Open Rangeland (NNSS Boundary)	2.3E-7	2.0E-6	63 yr	1.4E-7	3.4E-7	1,000 yr

NA – not available, analysis not performed
† - years since closure

The Area 5 RWMS PA model, version 4.203b, mean and 95th percentile all-pathways annual TEDs are less than the 0.25 mSv performance objective for all scenarios (Table 2.3). The mean all-pathways results are 12% or less of the performance objective. The FY 2018 all-pathways results are less than the 2006 Area 5 RWMS PA update results for all scenarios except the transient visitor scenario. The transient visitor results are a small fraction of the performance objective.

Table 2.3 Comparison of the 2006 Area 5 RWMS PA Update and FY 2018 Reference Person Annual TED through All Pathways

Exposure Scenario	2006 PA Update (BN 2006)			FY 2018		
	Mean (mSv)	95th Percentile (mSv)	Time of Maximum	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
Transient Visitor	1.5E-3	3.4E-3	1,000 yr	6.6E-3	1.5E-2	1,000 yr
Resident	NA	NA	NA	1.1E-3	2.9E-3	1,000 yr
Resident with Agriculture	4.4E-2	3.9E-2	1,000 yr	3.1E-2	9.5E-2	1,000 yr
Open Rangeland (Cane Spring)	2.2E-2	1.8E-2	1,000 yr	6.7E-3	2.1E-2	1,000 yr
Open Rangeland (NNSS Boundary)	4.4E-2	3.3E-2	1,000 yr	7.0E-3	2.3E-2	1,000 yr

NA – not available, analysis not performed

The A5 RWMS PA model, version 4.203b, mean and 95th percentile radon-222 (^{222}Rn) flux density averaged over all disposal units complies with the performance objective (Table 2.4). The flux density averaged over all disposal units increased in FY 2018 to 31% of the 0.74 becquerel per square meter per second (Bq m^{-2} s^{-1}) performance objective. The mean flux remains less than the LFRG notification criterion of exceeding 50% of the performance objective. The FY 2018 ^{222}Rn flux densities have increased significantly relative to the 2006 Area 5 RWMS PA update results. The increase is due to increased SLB inventory and a decrease in cover thickness (Shott and Yucel 2009).

Table 2.4 Comparison of the 2006 Area 5 RWMS PA Update and FY 2018 ^{222}Rn Flux Density Results

Disposal Unit	2006 PA Update (BN 2006)			FY 2018		
	Mean (Bq m^{-2} s^{-1})	95th Percentile (Bq m^{-2} s^{-1})	Time of Maximum	Mean (Bq m^{-2} s^{-1})	95th Percentile (Bq m^{-2} s^{-1})	Time of Maximum
All	0.044	0.096	1,000 yr	0.23	0.49	1,000 yr

The Area 5 RWMS PA model, version 4.203b, acute drilling intruder scenario mean and 95th percentile results comply with the performance measure (Table 2.5). The mean results are a small fraction of the 5 mSv performance measure. Because the 2006 Area 5 RWMS PA update did not evaluate acute intrusion scenarios, comparison with updated PA results is not possible.

Table 2.5 FY 2018 Acute Intruder TED Results

Disposal Unit	FY 2018 Acute Drilling			FY 2018 Acute Construction		
	Mean (mSv)	95th Percentile (mSv)	Time of Maximum	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
SLB	1.5E-3	2.5E-3	1,000 yr	1.1	1.8	1,000 yr
Pit 6 RaDU	0.041	0.077	1,000 yr	0.82	2.1	1,000 yr
Pit 13 RaDU	0.026	0.034	1,000 yr	0.052	0.17	1,000 yr
GCD	0.016	0.044	1,000 yr	1.9E-6	NA	100 yr

The mean and 95th percentile acute construction scenario results are less than the performance measure. The acute construction result for the SLB disposal units is a significant fraction of the 5 mSv performance measure (22%), but less than the 50% of the limit LFRG notification criterion.

Multiple changes have occurred since preparation of the Area 5 RWMS CA (BN 2001a). Important changes include corrective actions and final closure of all but one source of residual radioactive material within 10 km the Area 5 RWMS. A UCAQE prepared in FY 2018 concludes that these corrective actions have no effect on the CA results or conclusions.

The Area 5 RWMS PA/CA model, version 4.203b, was used to assess the cumulative changes to the CA model and waste inventory. The CA mean and 95th percentile results are less than the 0.3-mSv dose constraint (Table 2.6). The CA mean annual TED is a small fraction of the dose

constraint. The FY 2018 CA results are significantly less than the 2001 Area 5 RWMS CA results. The current Area 5 RWMS PA/CA release and transport model is much less conservative than the model used in the Area 5 RWMS CA. The conservatism was removed based on the results of site-specific investigations of biointrusion (BN 2006) and detailed process modeling of upward liquid advection (Wolfsberg and Stauffer 2003). The CA exposure scenario has also changed from a resident with agriculture to a resident without agriculture scenario based on elicitation of subject matter experts (Black et al. 2001).

Table 2.6 Comparison of the 2001 Area 5 RWMS CA and FY 2018 Annual TED Results

Disposal Unit	2001 CA (BN 2001a)			FY 2018		
	Mean (mSv)	95th Percentile (mSv)	Time of Maximum	Mean (mSv)	95th Percentile (mSv)	Time of Maximum
All	1	4	1,000 yr	1.4E-3	3.9E-3	1,000 yr

Analysis of the effects of cumulative changes potentially affecting the PA, CA, DAS, and RWMB indicates that there is a reasonable expectation that the Area 5 RWMS meets all PA performance objectives and the CA dose constraint in DOE O 435.1, "Radioactive Waste Management" and that the PA, CA, DAS, and RWMB remain valid.

2.2 Waste Receipts

The Area 3 RWMS has been in stand-by since 2006. Preparations to resume waste disposal operations began in FY 2018. The disposed waste volume, inventory, and waste forms are unchanged since the last special analysis (NSTec 2012) (Table 2.7). Waste volume and inventory are divided into post-1988 portions regulated under DOE O 435.1 and pre-1988 waste, subject to the CA requirements only. Waste disposal limits have not been derived for the Area 3 RWMS and a sum of fractions (SOFs) cannot be calculated. The most recent special analysis results are a small fraction of all performance objectives and measures (NSTec 2012). Disposed waste continues to be consistent with NNSS WAC requirements. No new or discovered information is available that would support revisions of past waste inventory data.

The Area 5 RWMS pre-1988 waste volume and activity was unchanged in FY 2018. The Area 5 RWMS post-1988 SLB disposed waste volume increased 0.5% in FY 2018 relative to the prior year (Table 2.8). The post-1988 SLB disposed waste volume is approximately 123% of the volume analyzed in the most recent Area 5 RWMS PA update (BN 2006). The projected closure activity, including future waste, is approximately double the activity analyzed in the Area 5 RWMS PA update. The PA and CA model results are not sensitive to waste volume and total activity, but scale linearly with waste activity concentration. Therefore, consistency with past PA/CA results is compared against waste activity concentration through a SOFs calculation. The disposed SLB waste SOFs remains less than 1.0, indicating that the disposed waste activity concentration is less than the limits determined in the most recent PA update. The probabilistic median SOFs is significantly greater than the deterministic value due to very conservative assumptions about the uncertainty in disposed activity. The SOFs results indicate a high likelihood that disposed waste concentration is less than the limits established in the Area 5 RWMS PA update. Revision of the PA is not considered necessary because the waste

concentration continues to comply with the PA limits. The updated PA/CA results in Section 2.1 confirm this conclusion.

The NNSS WAC Action Levels continue to be based on the most recent Area 5 RWMS PA update (BN 2006). Disposed waste continues to be consistent with NNSS WAC requirements.

Table 2.7 Waste Receipts at the Area 3 RWMS

Period	Disposal Unit	Disposed Volume to Date (m^3)	PA/CA Estimated Disposal Capacity† (m^3)	Percent Filled Volume (%)	Sum of Fractions (Total Activity‡)	PA/CA Impacts
Pre-1988	U-3ax/bl	2.3E5	2.3E5	100	NA (1.5E2 TBq)	No significant changes (see NSTec 2012)
	U-3ah/at	7.7E3	3.1E5	2	NA (1.1 TBq)	No significant changes (see NSTec 2012)
Post-1988	U-3ah/at	2.9E5	3.1E5	94	NA (8.0E3 TBq)	No significant changes (see NSTec 2012)
	U-3bh	4.4E4	7.5E4	57	NA (4.5E3 TBq)	No significant changes (see NSTec 2012)

† - NSTec 2012
‡ - NSTec 2012, geometric mean activity disposed to date decayed to closure on 10/1/2025
NA – SOFs not available, waste concentration limits not determined for disposal cell

Table 2.8 Waste Receipts at the Area 5 RWMS

Period	Disposal Unit	Disposed Volume to Date (m^3)	PA/CA Estimated Disposal Capacity (m^3)	Percent Filled Volume (%)	Sum of Fractions (Total Activity[§])	PA/CA Impacts
Pre-1988	SLB	1.7E5	1.7E5[†]	100	NA (4.5E4 TBq)	See Section 2.1
	GCD	2.7E2	2.9E2[†]	93	NA (3.2E4 TBq)	See Section 2.1
Post-1988	SLB	7.0E5	5.7E5[‡]	123	deterministic: 0.57 median: 0.88 (9.4E4 TBq)	See Section 2.1
	Pit 6	5.0E3	5.0E3[‡]	100	NA (23 TBq)	See Section 2.1
	Pit 13	1.1E4	1.1E4[‡]	100	NA (20 TBq)	See Section 2.1
	GCD	14	1.1E2[‡]	13	NA (1.7E2 TBq)	See Section 2.1

[†] - BN 2001a
[‡] - BN 2006
[§] **-** geometric mean activity disposed to date, activity decayed to closure on 10/1/2028
NA – SOFs not available, waste concentration limits not determined for disposal cell

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3.0 Monitoring

The Area 3 and Area 5 RWMS monitoring results are reported on a calendar year (CY) basis in three annual reports: the *Groundwater Monitoring Data Report* (MSTS 2018q), the *NNSS Waste Management Monitoring Report* (MSTS 2018r), and the *NNSS Environmental Report* (MSTS 2018s). The Area 3 and Area 5 RWMSs compliance monitoring results did not exceed any action level (Tables 3.1 and 3.2). Performance monitoring results for CY 2017 continue to be consistent with long-term trends and the conceptual site model (CSM) (Tables 3.3 and 3.4).

Air monitoring results from the Area 3 and Area 5 RWMSs indicate that the doses from airborne emissions are less than the 0.1 mSv annual limit described in DOE M 435.1-1 (DOE 1999b) and Title 40 Code of Federal Regulations (CFR) 61, "National Emission Standard for Hazardous Air Pollutants*"* (CFR 1989). A slight increase in ^{3}H in air was observed at the Area 3 RWMS and to a lesser degree at the Area 5 RWMS in August of 2017. The increase corresponds in time with a known ^{3}H release from the Dense Plasma Focus Facility. Groundwater monitoring at the Area 5 RWMS indicates that the uppermost aquifer is not impacted by releases from the site.

Although monitoring results do not indicate that major changes to the monitoring program are needed, minor changes were made. Three additional cover moisture content monitoring stations were installed in operational covers on Cells 13, 17, and 20 in the Area 5 RWMS Northern Expansion Area. Soil water content monitoring on the 92-acre LLWMU closure cover indicates that water occasionally percolates to the deepest sensors at 1.8 m. This suggests that very small fluxes of water may reach the depth of buried waste ($\geq$ 2.5 m) on poorly vegetated covers. These small fluxes are extremely unlikely to reach the uppermost aquifer, which is more than 235 m below the surface. The absence of significant amounts of native xerophytic vegetation on the 92-acre LLWMU closure cover is a deviation from PA and CA assumptions and was evaluated by a UDQE (MSTS 2018a).

Efforts to revegetate the closure cover for the 92-acre LLWMU (including FFACO CAU 111) at the Area 5 RWMS with native desert vegetation continue. A study of multiple revegetation approaches is underway.

Table 3.1 Area 3 RWMS Compliance Monitoring

Monitoring Type	Monitoring Results and Trends		Performance Objective/Measure or Regulatory Limit	Action Level	Action Taken	PA/CA Impacts
^{3}H in Air (Annual Mean[1])	BILBY Crater	1.7E-2 Bq m^{-3}	0.1 mSv in a year	7.8E2 Bq m^{-3}†	None	None
	KESTRAL Crater North	1.7E-2 Bq m^{-3}				
	U-3ax/bl South	2.6E-2 Bq m^{-3}				
Gross Alpha in Air (Annual Mean[1])	BILBY Crater	1.3E-4 Bq m^{-3}	None	None	None	None
	KESTRAL Crater North	1.3E-4 Bq m^{-3}				
	U-3ax/bl South	1.3E-4 Bq m^{-3}				
Gross Beta in Air (Annual Mean[1])	BILBY Crater	8.4E-4 Bq m^{-3}	None	None	None	None
	KESTRAL Crater North	8.6E-4 Bq m^{-3}				
	U-3ax/bl South	8.6E-4 Bq m^{-3}				
Gamma Emitters in Air (Annual Mean[1])	BILBY Crater	No man-made nuclides detected	0.1 mSv in a year	^{137}Cs: 3.6E-1 Bq m^{-3}†	None	None
	KESTRAL Crater North					
	U-3ax/bl South					
^{241}Am in Air (Annual Mean[1])	BILBY Crater	3.3E-7 Bq m^{-3}	0.1 mSv in a year	1.5E-4 Bq m^{-3}†	None	None
	KESTRAL Crater North	5.0E-7 Bq m^{-3}				
	U-3ax/bl South	4.4E-7 Bq m^{-3}				
^{238}Pu in Air (Annual Mean[1])	BILBY Crater	6.9E-8 Bq m^{-3}	0.1 mSv in a year	1.4E-4 Bq m^{-3}†	None	None
	KESTRAL Crater North	8.6E-8 Bq m^{-3}				
	U-3ax/bl South	1.1E-7 Bq m^{-3}				
$^{239,240}Pu$ in Air (Annual Mean[1])	BILBY Crater	2.7E-6 Bq m^{-3}	0.1 mSv in a year	1.2E-4 Bq m^{-3}†	None	None
	KESTRAL Crater North	3.0E-6 Bq m^{-3}				
	U-3ax/bl South	2.8E-6 Bq m^{-3}				
^{222}Rn Flux[2]	No measurements in CY 2017 Last measurement in CY 2014		0.74 Bq m^{-2} s^{-1}	None	None	None

† - 1/10th of DOE-STD-1196-2011, Table 5 Derived Concentration Standard for Air
[1] – MSTS (2018s)
[2] – MSTS (2018r)

Table 3.2 Area 5 RWMS Compliance Monitoring

Monitoring Type	Monitoring Results and Trends		Performance Objective/Measure or Regulatory Limit	Action Level	Action Taken	PA/CA Impacts
^{3}H in Air (Annual Mean[1])	DoD Compound	2.1E-2 Bq m^{-3}	0.1 mSv in a year	7.8E2 Bq m^{-3}†	None	None
	Area 5 Sewage Lagoon	1.7E-2 Bq m^{-3}				
Gross Alpha in Air (Annual Mean[1])	DoD Compound	1.2E-4 Bq m^{-3}	None	None	None	None
	Area 5 Sewage Lagoon	1.2E-4 Bq m^{-3}				
Gross Beta in Air (Annual Mean[1])	DoD Compound	8.9E-4 Bq m^{-3}	None	None	None	None
	Area 5 Sewage Lagoon	9.1E-4 Bq m^{-3}				
Gamma Emitters in Air (Annual Mean[1])	DoD Compound	No man-made nuclides detected	0.1 mSv in a year	^{137}Cs: 3.6E-01 Bq m^{-3}†	None	None
	Area 5 Sewage Lagoon					
^{241}Am in Air (Annual Mean[1])	DoD Compound	1.2E-7 Bq m^{-3}	0.1 mSv in a year	1.5E-4 Bq m^{-3}†	None	None
	Area 5 Sewage Lagoon	2.3E-7 Bq m^{-3}				
^{238}Pu in Air (Annual Mean[1])	DoD Compound	5.0E-8 Bq m^{-3}	0.1 mSv in a year	1.4E-4 Bq m^{-3}†	None	None
	Area 5 Sewage Lagoon	6.7E-8 Bq m^{-3}				
^{239,240}Pu in Air (Annual Mean[1])	DoD Compound	1.9E-7 Bq m^{-3}	0.1 mSv in a year	1.2E-4 Bq m^{-3}†	None	None
	Area 5 Sewage Lagoon	1.5E-6 Bq m^{-3}				
^{222}Rn Flux[2] (Short-Term Sample)	< 0.04 Bq m^{-2} s^{-1} See MSTS (2018r) for details.		0.74 Bq m^{-2} s^{-1}	None	None	None
Groundwater Level (Elevation Above Mean Sea Level[2])	UE5PW-1	733.42 m	None	None	None	None
	UE5PW-2	733.55 m				
	UE5PW-3	733.65 m				
Groundwater Indicators of Contamination (Annual Range*[3])	pH: 8.28 – 8.48 SC: 0.357 – 0.378 mmhos cm^{-1} TOC: <1.0 mg L^{-1} TOX: <0.01 µg L^{-1} ^{3}H: <11 Bq L^{-1}		^{3}H: 0 .04 mSv in a year	pH: < 7.6 or > 9.2 SC: 0.44 mmhos cm^{-1} TOC: 1 mg L^{-1} TOX: 50 µg L^{-1} ^{3}H: 74 Bq L^{-1}	None	None
Groundwater Chemistry‡[3]	All three wells similar. No trend or change observed. See MSTS (2018q) for details.		None	None	None	None
Groundwater Alkalinity[3]	No trend or change observed. See MSTS (2018q) for details.		None	None	None	None
Cell 18 Mixed Waste Cell Leachate§[3]	^{3}H: 9.40E+2 – 2.70E+3 Bq L^{-1} No other indication of contamination		None	40 CFR 261.24 Regulatory Levels ^{3}H: 1.48E4 Bq L^{-1}	None	None

***** - pH, Specific Conductance (SC), Total Organic Carbon (TOC), Total Organic Halides (TOX), ^{3}H
† - 1/10th of DOE-STD-1196-2011, Table 5 Derived Concentration Standard for Air
‡ - calcium, magnesium, potassium, sodium, iron, manganese, sulfate, chloride, fluoride, and silicate
§ - toxicity characteristic contaminants (40 CFR 261.24), polychlorinated biphenyls (PCBs), pH, SC, ^{3}H

[1] – MSTS (2018s)
[2] – MSTS (2018r)
[3] – MSTS (2018q)

Table 3.3 Area 3 RWMS Performance Monitoring

Monitoring Type	Monitoring Results and Trends		Performance Objective/Measure or Regulatory Limit	Action Level	Action Taken	PA/CA Impacts
Radiation Exposure (Range[1])	119 – 299 milliRoentgen per year (mR yr^{-1}), Long-term trends unchanged		None	None	None	None
Meteorology†[1]	Conditions in CY 2017 consistent with long-term averages. See MSTS (2018r) for details.		None	None	None	None
Drainage Lysimeter Facility‡[1]	No drainage from vegetated lysimeters with natural precipitation. Results continue to support CSM. See MSTS (2018r) for details.		None	None	None	None
CAU 110 Closure Cover Water Content[1]	No percolation observed below 150 cm. Results continue to support CSM. See MSTS (2018r) for details.		None	None	None	None
CAU 110 Cover Subsidence (Cumulative Mean[1])	Mean cumulative subsidence since 2000: 1.9 cm		None	None	None	None
Radionuclides in Animal Burrow Spoils§[2]	All less than control sample		None	None	None	None
Radionuclides in Biota[2]	Plant Composite	^{3}H: 5.7E5 Bq m^{-3} of water	None	None	None	None
	Kangaroo Rat	^{3}H: 1.9E5 Bq m^{-3} of water	None	None	None	None

† - temperature, relative humidity, barometric pressure, wind speed and direction, precipitation, reference evapotranspiration
‡ - temperature, water content, and water potential in 8 lysimeters with three vegetation treatments and two climate treatments
§ - ^{152}Eu, ^{238}Pu, $^{239,240}Pu$, ^{241}Am in soil collected from animal burrow spoils
[1] - MSTS (2018r)
[2] - MSTS (2018s)

Table 3.4 Area 5 RWMS Performance Monitoring

Monitoring Type	Monitoring Results and Trends		Performance Objective/Measure or Regulatory Limit	Action Level	Action Taken	PA/CA Impacts
Radiation Exposure (Range[1])	< 182 mR yr^{-1}, Long-term trends unchanged		None	None	None	None
Meteorology†[1]	Conditions in CY 2017 consistent with long-term averages. See MSTS (2018r) for details.		None	None	None	None
Weighing Lysimeters‡[1]	No drainage from vegetated lysimeter since monitoring began in 1995. Results continue to support CSM. See MSTS (2018r) for details.		None	None	None	None
Water Content Monitoring§[1]	Pit 5 floor water content constant since 1999. Results continue to support CSM. See MSTS (2018r) for details.		None	None	None	None
Pit 5 RTG Temperatures[1]	Temperatures continue to be consistent with special analysis. See MSTS (2018r) for details.		None	None	None	None
Radionuclides in Animal Burrow Spoils*[2]	All less than Minimum Detectable Concentration		None	None	None	None
Radionuclides in Biota[2] (Mean)	Plant Composite	^{3}H: 4.7E8 Bq m^{-3} of water	None	None	None	None
	Kangaroo Rats	^{3}H: 1.3E6 Bq m^{-3} of water $^{239,240}Pu$: 1.1E-2 Bq g^{-1} (wet)	None	None	None	None
CAU 111 Cover Subsidence (Cumulative Mean[1])	Mean cumulative subsidence since 2012: 1.2 cm		None	None	None	None

RTG – radioisotope thermoelectric generator
† - temperature, relative humidity, barometric pressure, wind speed and direction, precipitation, reference evapotranspiration
‡ - temperature, water storage, and water content in a bare and a vegetated lysimeter
§ - Four CAU 111 closure cover monitoring stations, one station in the floor of Pit 5 in CAU 111
* - ^{152}Eu, ^{238}Pu, $^{239,240}Pu$, ^{241}Am in soil collected from animal burrow spoils
[1] - MSTS (2018r)
[2] - MSTS (2018s)

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4.0 Research and Development

Monitoring of the Drainage Lysimeter Facility is the only R&D activity at the Area 3 RWMS (Table 4.1). The facility consists of eight 2.4-m deep drainage lysimeters. The lysimeters are subject to six treatments created by combining three vegetation treatments (bare, invader plants, and native plants) and two precipitation treatments (natural precipitation, three times natural precipitation). Drainage has never been observed from lysimeters receiving natural precipitation. Differing amounts of drainage are observed among the irrigated lysimeters. Drainage from the bare irrigated lysimeter is the greatest and occurs regularly. Lesser amounts of drainage occur infrequently at the irrigated lysimeter with invader plants. Drainage from the irrigated lysimeters with native plants is less frequent. Area 3 lysimeter monitoring continues to support the CSM that negligible percolation occurs below the plant root zone in areas vegetated with native plants under current climatic conditions.

Table 4.1 Research and Development Activities

Document Number	Results	PA/CA Impacts
DOE/NV/03624—0240 MSTS (2018r)	Area 3 Drainage Lysimeters: No drainage observed for bare and vegetated lysimeters receiving natural precipitation. Drainage observed for irrigated lysimeters receiving three times natural precipitation.	Lysimeter results continue to support CSM.
DOE/NV/03624—0240 MSTS (2018r)	Area 5 RWMS Weighing Lysimeters: The vegetated lysimeter continues to be significantly drier than the bare lysimeter. Average CY 2017 water storage: Vegetated lysimeter 119 mm, Bare lysimeter 212 mm. No water drainage below 2 m observed.	Lysimeter results continue to support CSM.
RWAP-2019-003_01	Describes results of FY 2018 Area 5 RWMS baseline PA/CA model (A5 RWMS v4.203b).	See Section 2.1 for discussion of current baseline PA/CA model results.

R&D activities at the Area 5 RWMS include monitoring of the Area 5 Weighing Lysimeter Facility, the initiation of cover revegetation studies, and continued development of the Area 5 RWMS PA/CA model. The Area 5 Weighing Lysimeter Facility consists of two 2-m deep precision weighting lysimeters. One lysimeter is vegetated with native plants, while the other is maintained in a bare, unvegetated state. After more than 20 years of observation, no drainage has been observed in either lysimeter. The bare lysimeter is significantly wetter than the vegetated lysimeter with a long-term mean volumetric water content of 10.6% versus 5.9%. Area 5 lysimeter monitoring continues to support the CSM that negligible percolation occurs below the plant root zone in areas vegetated with native plants.

The Tribal Revegetation Project, a collaborative effort among NNSA/NFO, tribal representatives, and several universities, was initiated in FY 2017 (Spoon and Barcalow 2017). The project is testing multiple revegetation strategies on the 92-acre LLWMU closure covers at the Area 5 RWMS. No results were reported in FY 2018.

The Area 3 and Area 5 RWMS PA/CA models are updated annually to reflect current conditions. In FY 2018, the Area 5 RWMS model was updated to include waste disposed during the year. Section 2.1 summarizes the current baseline model, version 4.203b, and its results. No changes were made to the Area 3 RWMS PA/CA model.

5.0 Planned or Contemplated Changes

The Area 3 RWMS will resume active waste disposal operations in FY 2019. The U-3ah/at disposal cell will dispose plutonium-contaminated soils from the CLEAN SLATE II and III safety experiment sites on the Tonopah Test Range. Disposal is expected to continue as long as environmental restoration soil wastes are available for disposal. The most recent special analysis (NSTec 2012) assumes final closure in FY 2025.

Planned or contemplated changes for the Area 5 RWMS involve construction of new disposal cells within the Northern Expansion Area and continued development of the Western Expansion Area within the RWMC (Table 5.1). No additional disposal cells are expected for the Northern Expansion Area after Cell 24 is completed. Disposal operations are expected to move to the Western Expansion Area as the Northern Expansion Area reaches its capacity.

Table 5.1 Planned or Contemplated Changes

Planned or Contemplated Change	Change Basis	PA/CA Impact	Schedule
Resumption of Disposal in U-3ah/at at the Area 3 RWMS	Additional capacity is required for bulk environmental restoration soil waste.	No impact	Ongoing until capacity reached or all waste disposed
Construction of SLB Cell 24 at the Area 5 RWMS	Additional LLW capacity is required.	No Impact	Complete FY 2019
Closure of RCRA Cell 18 at the Area 5 RWMS	Cell 18 is approaching its capacity.	No Impact	Complete FY 2019
Development of the Area 5 RWMS Western Expansion Area	The current operational area, the Northern Expansion Area, is approaching its capacity. The western portion of the RWMC is being developed for future operations.	No Impact	Continue planning and development of flood control berm and channel. Operations begin: FY 2020 – 2021

Development of the Area 5 RWMS Western Expansion Area is the subject of an ongoing UDQE. The Area 5 RWMS site characterization data, CSM, and PA/CA model and its assumptions are applicable to the entire RWMC. However, a 100-year flood hazard zone exists on the southern portion of the Western Expansion Area. Erosion and flooding scenarios analyzed in the PA may not be appropriate for the flood hazard zone. Disposal in the flood hazard zone may require analysis of additional flooding and erosion scenarios. Development of new disposal cells in the Western Expansion Area is within the scope of the 2006 Area 5 RWMS PA update (BN 2006), conditional on no disposal cells in the 100-year flood hazard zone. The design of the planned disposal cells are consistent with existing cells, the CSM, and the PA/CA model assumptions. The planned or contemplated changes do not require updating or revision of the PA or CA provided development is prohibited within the flood hazard zone.

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6.0 Status of DAS Conditions, and Key and Secondary Issues

The Area 3 RWMS PA and CA were issued in a single document (Shott et al. 2001). The Area 3 RWMS DAS was issued on October 20, 1999 (DOE 1999a). The Area 3 RWMS DAS contained one PA condition and two CA conditions (Table 6.1). In addition, three CA secondary issues were identified in the PA/CA review report. All DAS conditions and secondary issues were resolved when the final PA/CA document (Shott et al. 2001) was issued (DOE 2002a).

The Area 5 RWMS PA documentation consists of the original LLW PA (Shott et al. 1998) and supporting addenda (BN 2001b, 2006). An Area 5 RWMS PA update was issued in 2006 (BN 2006). The Area 5 RWMS CA was issued as a single document (BN 2001a) and has a single addendum (BN 2001c).

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

The Area 5 RWMS DAS was issued on December 5, 2000 (DOE 2000). The PA and CA each had two conditions and two secondary issues (Table 6.2). All Area 5 RWMS PA and CA DAS conditions and secondary issues were closed on May 23, 2002 (DOE 2002b). The GCD PA has one remaining unresolved secondary issue.

Table 6.1 Status of the Area 3 DAS PA/CA Conditions, Key and Secondary Issues

Key/Secondary Issue or DAS Condition Number	Issue Description	Initial Resolution Scheduled Date	Projected Resolution Scheduled Date	Disposition Documentation & Date Completed	PA,CA, DAS Impact
DAS Condition PA-1.1	*Lack of justification for excluding particular exposure scenarios based on exhumed waste*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved
DAS Condition PA-1.2	*Inadequate justification for omission of surface water*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved
DAS Condition PA-1.3	*Lack of sensitivity analysis regarding the assumed 250 years of institutional control*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved
DAS Condition PA-1.4	*Need for clarification of the RCRA/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulatory involvement, if any, in low-level waste disposal at Area 3*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved
DAS Condition PA-1.5	*Need for clarification of the location of the point of maximum exposure*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved
DAS Condition PA-1.6	*Need for better explanation of the borehole and field data within the framework of the no-recharge conceptual model*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved

Key/Secondary Issue or DAS Condition Number	Issue Description	Initial Resolution Scheduled Date	Projected Resolution Scheduled Date	Disposition Documentation & Date Completed	PA,CA, DAS Impact
DAS Condition CA-1	*Provide to LFRG, within eight months of the date of issuance of this disposal authorization statement, a revision to the composite analysis that includes qualitative assessment including an options analysis of the effect of groundwater contamination resulting from underground nuclear testing. Before any portion of the Nevada Test Site is considered for a reduction in institutional control, Nevada Operations Office will have quantified the potential dose from the underground testing residues and taken measures to mitigate the dose, as appropriate.*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved
DAS Condition CA-2	*Need for a better explanation of the borehole and field data within the framework of the no-recharge conceptual model.*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). DAS conditions closed in 2002 (DOE 2002a).	No impact, issue resolved

Key/Secondary Issue or DAS Condition Number	Issue Description	Initial Resolution Scheduled Date	Projected Resolution Scheduled Date	Disposition Documentation & Date Completed	PA,CA, DAS Impact
Secondary Issue CA-1	*No discussion of the data quality objective process.*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). Secondary issue closed in 2002 (DOE 2002a).	No impact, issue resolved
Secondary Issue CA-2	*Limited discussion of land use planning*	June 2000	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). Secondary issue closed in 2002 (DOE 2002a).	No impact, issue resolved
Secondary Issue CA-3	*Lack of comparison of modeling results with site monitoring results*	June 200	Complete December 2001	Revised Area 3 RWMS PA/CA issued December 2001 (Shott et al. 2001). Secondary issue closed in 2002 (DOE 2002a).	No impact, issue resolved

Table 6.2 Status of the Area 5 DAS PA/CA Conditions, Key and Secondary Issues

Key/Secondary Issue or DAS Condition Number	Issue Description	Initial Resolution Scheduled Date	Projected Resolution Scheduled Date	Disposition Documentation & Date Completed	PA,CA, DAS Impact
DAS Condition PA-1	*"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."*	NA	2002	An addendum to the Area 5 RWMS PA was issued in November 2001 (BN 2001b). The DAS conditions were closed in 2002 (DOE 2002b). Pit 6 was closed in FY 2012.	No impact, issue resolved
DAS Condition PA-2	*"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."*	NA	2002	An addendum to the Area 5 RWMS PA was issued in November 2001 (BN 2001b). The DAS conditions were closed in 2002 (DOE 2002b).	No impact, issue resolved
Secondary Issue PA-1	Inconsistencies exist between conceptual models for the Area 5 RWMS PA and CA, the Area 3 RWMS PA and CA, and the GCD PA.	NA	2005	Inconsistencies resolved with development of GoldSim PA/CA model	No impact, issue resolved
Secondary Issue GCD PA-1	An engineered barrier will be added, and the assurance requirements of 40 CFR 191 must be met for the GCD boreholes.	NA	2028	The 40 CFR 191.14 Assurance Requirements will be met at the time of final closure of the RWMC.	No impact

Key/Secondary Issue or DAS Condition Number	Issue Description	Initial Resolution Scheduled Date	Projected Resolution Scheduled Date	Disposition Documentation & Date Completed	PA,CA, DAS Impact
DAS Condition CA-1	*"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."*	December 2001	November 2001	An addendum to the Area 5 RWMS CA was issued in November 2001 (BN 2001c). The DAS conditions were closed in 2002 (DOE 2002b).	No impact, issue resolved
DAS Condition CA-2	*"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."*	NA	November 2001	An addendum to the Area 5 RWMS CA was issued in November 2001 (BN 2001c). The DAS conditions were closed in 2002 (DOE 2002b).	No impact, issue resolved
Secondary Issue CA-1	*The maintenance program must include periodic assessment of changes in potentially interacting sources (Underground Test Areas [UGTAs], industrial sites) and impacts on the CAs.*	NA	Completed	Requirement is implemented in maintenance plan (NSTec 2007). The DAS conditions were closed in 2002 (DOE 2002b). UCAQ Evaluation indicates that FFACO corrective actions have no impact on CA conclusions (MSTS 2018c).	No impact, issue resolved

Key/Secondary Issue or DAS Condition Number	Issue Description	Initial Resolution Scheduled Date	Projected Resolution Scheduled Date	Disposition Documentation & Date Completed	PA,CA, DAS Impact
Secondary Issue CA-2	*The maintenance program must include periodic assessment of changes in land-use restrictions and impacts on the CAs.*	NA	Completed	Requirement is implemented in maintenance plan (NSTec 2007). The DAS conditions were closed in 2002 (DOE 2002b). UCAQ Evaluation indicates that FFACO corrective actions have no impact on CA conclusions (MSTS 2018c).	No impact, issue resolved

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7.0 Certification of the Continuing Adequacy of the PA, CA, DASs, and RWMB

The FY 2018 annual review indicates that all Area 3 and Area 5 RWMS PA and CA assumptions and conclusions remain valid. The most recent UDQEs, UCAQEs, and special analyses indicate that there continues to be a reasonable expectation that the Area 3 and Area 5 RWMSs will meet the performance objectives identified in DOE O 435.1, "Radioactive Waste Management." The DASs, based on interpretation of the data collected, monitoring results, and other information, remain valid. No documents supporting the RWMBs were revised and the RWMBs remain valid.

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Appendix A: Annual Summary Report Review Criteria

Table A1 Self-Assessment of Annual Summary Report Review Criteria

Review Criteria	Criteria Description	Discussion
ASR-1	Provide an overview of the documents and data used to make the certification of the continued adequacy of the PA, CA, DAS, other DAS technical basis documents, and the radioactive waste management basis (RWMB) to meet the DOE O 435.1 performance objectives/measures. If these documents need revision, a corrective action plan should be developed and implemented.	An overview of the documents reviewed is summarized in Section 1.0. Details of documents reviewed are described in Section 2.0.
ASR-2	All Change Control Process evaluations (called UDQE/UCAQE in Chapter 8) or other change control processes (e.g., non-conformances, corrective action) used to evaluate proposed actions, changes, and new information to determine if these activities are within the boundaries analyzed in the approved PA and CA. Their potential effect on the continued adequacy of the DAS, PA, CA, and RWMB should be provided. Specific information for each identified change should be described. Specific information for each identified change should be described in Table 9-1 below.	The UDQEs, UCAQEs, and potential effects on the DAS, PA, CA, and RWMB are summarized in Section 2.0. Specific information for each identified change is listed in Table 2.1.
ASR-3	An evaluation and discussion of the cumulative effects of all the changes that have been identified in “Changes Potentially Affecting the PA, CA, DAS, or RWMB” during the year.	The effects of cumulative changes are described in Section 2.1.
ASR-4	The information regarding waste receipts should be provided and discussed. In addition, a discussion regarding waste receipts should be included (Table 9.3).	The waste receipts are summarized in Section 2.2. The waste receipts are listed in Table 2.2.
ASR-5	This section should include monitoring results using the following table format. In addition, a discussion regarding monitoring results should be included. For compliance monitoring (Table 9-5), action levels that are exceeded should be documented along with any	Monitoring results are summarized in Section 3.0. Results are listed in Tables 3.1 through Table 3.4. No action levels are exceeded. All monitoring results are consistent with expected behavior.

Review Criteria	Criteria Description	Discussion
	corrective actions in the ASR. For performance monitoring, results differing from expected behavior should be documented and discussed with any corrective actions.	
ASR-6	R&D, field studies, etc. results should be provided and discussed. See Table 9-8 for information.	Research and development activities are described in Section 4.0. Research and development activities are summarized in Table 4.1.
ASR-7	Planned or contemplated changes (including completion schedules) in disposal facility design, construction, operations, closure, R&D, land use or in technical basis documents (MP, CP, WAC, MonP, Change Control Process) should be presented in a table following the format in Table 9-11.	Planned or contemplated changes are summarized in Section 5.0. Changes are listed in Table 5.1.
ASR-8	Provide a status update on any DAS conditions and key or secondary issues resulting from an LFRG review of the facility's PA and CA and other technical basis documents (e.g., MonP, CP, etc.). See Table 9-13 for information.	The statuses of DAS conditions, key issues, and secondary issues are summarized in Section 6.0. The conditions and issues are listed in Tables 6.1 and 6.2.
ASR-9	The following statement signed by the FEM or designee should be included in the ASR. *I certify to the best of my knowledge that information in this ASR is true, accurate and complete and that any proposed or implemented changes associated with the PA or other technical basis documents provide a reasonable expectation that the performance objectives/measures identified in DOE O 435.1 will be met.*	Review of changes potentially affecting the PAs, CAs, DASs, RWMBs, and the results of the UDQEs, UCAQE, and special analyses indicate that there is a reasonable expectation that the performance objectives/measures identified in DOE O 435.1 will be met. The required signed statement is provided in the annual summary report cover letter.

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