Office of Enterprise Assessments
Assessment of Nevada National Security Site Radioactive Waste Disposal Facilities

January 2017

Office of Nuclear Safety and Environmental Assessments
Office of Environment, Safety and Health Assessments
Office of Enterprise Assessments
U.S. Department of Energy

Table of Contents

Acronyms

ALARA	As Low As Reasonably Achievable
ALWD	Activity-Level Work Documents
CA	Composite Analysis
CFR	Code of Federal Regulations
CRAD	Criteria and Review Approach Document
DAS	Disposal Authorization Statement
DOE	U.S. Department of Energy
EA	Office of Enterprise Assessments
EM	DOE Office of Environmental Management
EPA	Environmental Protection Agency
FFACO	Federal Facilities Agreement and Consent Order
FR	Facility Representative
LFRG	Low-Level Waste Disposal Facility Federal Review Group
LLW	Low-Level Waste
LWIS	Low-Level Waste Information System
MAR	Material At Risk
MOP	Member of the Public
NDA	Non-Destructive Analysis
NDEP	Nevada Department of Environmental Protection
NFO	Nevada Field Office
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NSTec	National Security Technologies, LLC
OFI	Opportunity for Improvement
PA	Performance Assessment
PCM	Personnel Contamination Monitor
PSDR	Package Shipment Disposal Request
RCRA	Resource Conservation and Recovery Act
RTR	Radiographic Transmission Review
RWAP	Radioactive Waste Acceptance Program
RWMB	Radioactive Waste Management Basis
RWMS	Radioactive Waste Management Site
RWP	Radiological Work Permit
SME	Subject Matter Expert
SMP	Safety Management Program
UDQ	Un-reviewed Disposal Question
UGTA	Underground Test Area
WAC	Waste Acceptance Criteria
WARP	Waste Acceptance Review Panel
WMIS	Waste Management Infobank System

Office of Enterprise Assessments
Assessment of Nevada National Security Site
Radioactive Waste Disposal Facilities

EXECUTIVE SUMMARY

The Office of Nuclear Safety and Environmental Assessments, within the U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA), assessed radioactive waste management and disposal facilities operations at the Nevada National Security Site (NNSS). EA conducted initial onsite scoping and observations from August 8 through August 11, 2016, and follow-up onsite observations and data collections from August 29 through September 1, 2016. EA also observed an NNSS audit of waste generator waste acceptance criteria (WAC) certification processes at the Idaho National Laboratory from September 13 through September 15, 2016. This assessment is part of a DOE complex wide evaluation of radioactive waste management practices. DOE Order 435.1, *Radioactive Waste Management*, and DOE Manual 435.1-1, *Radioactive Waste Management Manual*, establish requirements for waste disposal practices intended to ensure the protection of the environment and the safety and health of workers and the public during the current operations and throughout the future performance periods. This assessment focused on the NNSS Area 3 and Area 5 Radioactive Waste Management Facilities (RWMF). The assessment included implementation of waste characterization processes, determination and conformance to waste acceptance criteria and inventory limits, waste disposal work planning and control for current worker protection, performance assessments, composite analysis, environmental monitoring verifying facility performance and model assumptions, and closure plans intended to ensure long-term performance of the disposal cells.

EA concluded that there is reasonable assurance that radiation doses from facility operations to the workers, current and future members of the public, and the environment are maintained within appropriate limits and that the performance objectives in DOE Order 435.1 and its manual will continue to be satisfied. The dry environment, stable soil, and hydrogeologic properties of the locations for these facilities make them highly favorable for the long-term isolation of the disposed waste assuring natural protection for potential future receptors.

This report identified several weaknesses, including: 1) the need to assure specific waste shipment hazards analysis is performed in advance, so that controls are tailored for the specific waste package source terms and consider both normal and potential off-normal conditions; and, 2) the need to assure sufficient monitoring and measurements are performed to validate the assumptions and conditions supporting the Waste Acceptance Criteria and Performance Assessments.

Office of Enterprise Assessments
Assessment of Nevada National Security Site
Radioactive Waste Disposal Facilities

1.0 PURPOSE

The Office of Nuclear Safety and Environmental Assessments, within the U.S. Department of Energy (DOE) Office of Enterprise Assessments (EA), conducted an independent assessment of radioactive waste management and disposal facilities operations at the Nevada National Security Site (NNSS) as part of a DOE-wide set of targeted assessments of radioactive waste management practices, including disposal operations and waste generator and processor operations. These targeted assessments are intended to evaluate performance at individual facilities. In addition, the series of assessments is intended to evaluate the practical implementation of the current DOE Order 435.1, *Radioactive Waste Management*, and DOE Manual 435.1-1, *Radioactive Waste Management Manual*, for consideration during planned updates.

2.0 SCOPE

As specified in the *Plan for the Office of Enterprise Assessments Targeted Review of Radioactive Wastes Disposal Practices at the Nevada National Security Site,* July 2016, this assessment primarily evaluated the disposal operations at the Area 3 and Area 5 Radioactive Waste Management Facilities (RWMF). EA focused on the implementation of (and conformance to) the inventory limits and waste acceptance criteria (WAC), monitoring to verify conformance to the limits, and environmental testing, monitoring, and modeling that supports the performance assessment (PA); and the composite analysis (CA) to ensure that dose performance objectives identified in Manual 435.1-1 are satisfied.

3.0 BACKGROUND

DOE Order 435.1-1 provides the high-level regulatory requirements and responsibilities for radioactive waste management throughout DOE. Manual 435.1-1 provides specific requirements intended to protect against exposures to radioactive and hazardous wastes, including the short-term hazards for current workers, members of the public, and the environment, and long-term hazards to future potential receptors. The Office of Environmental Management (EM) is evaluating the current order and manual, which were issued in 1999, with minor changes since that time. Revisions to the order and supporting technical standard are planned for 2017. Notable events (such as those at the Waste Isolation Pilot Plant) have indicated the need to evaluate the implementation of WAC requirements and impacts on short- and long-term performance of waste disposal facilities across DOE.

The Nevada National Security Site (NNSS), located northwest of Las Vegas, Nevada, is operated by NSTec through a contract managed by the Nevada Field Office (NFO). While primarily a National Nuclear Security Agency (NNSA) site, NFO also includes a contingent of technical staff to manage the DOE Office of Environmental Management (EM) activities at NNSS. Those EM staff provide Contracting Officer Representatives, management, and oversight of the EM related work scope for the NNSS contract. This scope of work includes management of the Area 3 and Area 5 waste disposal activities as well as monitoring and control of the legacy weapons testing areas. In addition to the NSTec contract for site operations, NFO also maintains a support contract with Navarro to assure independent evaluations and recommendations regarding acceptance of generator waste profiles and generator Waste Acceptance Criteria certifications programs.

4.0 METHODOLOGY

The DOE independent oversight program is described in and governed by DOE Order 227.1A, *Independent Oversight Program*. EA implements the independent oversight program through a comprehensive set of internal protocols, operating practices, assessment guides, and process guides. Organizations and programs within DOE use varying terms to document specific assessment results. In this report, EA uses the terms "deficiencies, findings, and opportunities for improvement (OFIs)" as defined in DOE Order 227.1A. In accordance with DOE Order 227.1A, DOE line management and/or contractor organizations must develop and implement corrective action plans for the deficiencies identified as findings. Other important deficiencies not meeting the criteria for a finding are also highlighted in the report and summarized in Appendix C. These deficiencies should be addressed consistent with site-specific issues management procedures.

The evaluation criteria for this targeted assessment were based on selected and applicable sections of Manual 435.1-1. The objectives, criteria, and lines of inquiry for this assessment were drawn from the following sections of EA CRAD 31-11, *Low-Level Radioactive Waste Management*:

- 4.1 Radioactive Waste Management Planning and Generic Safety Requirements
- 4.2 Radioactive Waste Identification, Characterization, and Monitoring
- 4.7 Waste Disposal
    - 4.7.1 Disposal Facility Siting and Approval
    - 4.7.2 Disposal Facility Design and Operations
    - 4.7.3 Facility Closure and Post-Closure Surveillance and Maintenance
- 4.8 DOE Oversight.

The *Plan for the Office of Enterprise Assessments Targeted Review of Radioactive Wastes Disposal Practices at the Nevada National Security Site,* July 2016, outlines the activities performed for this assessment, including document reviews; onsite observations of operations, maintenance, and monitoring activities; demonstrations of sampling and analysis processes; and personnel interviews. EA conducted initial onsite scoping and observations from August 8 through August 11, 2016, and follow-up onsite observations and data collection from August 29 through September 1, 2016. EA also observed an NNSS audit of waste generator waste acceptance criteria (WAC) certification processes at the Idaho National Laboratory (INL) from September 13 through September 15, 2016. EA reviewed foundational documents, including the radioactive waste management basis (RWMB) documents; WAC, PA, CA, PA maintenance plans; closure plans; monitoring plans; and special analysis addendums to the PA. Additional documents included implementing procedures, monitoring and sample analysis results, waste package characterizations documents, work planning and control documentation, inventory programs, self-assessment reports, and annual updates. EA observed plan-of-the-day and pre-job brief meetings; waste package receipt and placement; environmental monitoring locations; and lysimeter test beds. EA also interviewed waste certification process auditors, inventory data system managers, waste disposition and placement staff, environmental monitoring subject matter experts (SMEs), environmental modeling personnel, and facility managers. The members of the EA assessment team, the Quality Review Board, and EA management responsible for this assessment are listed in Appendix A. A detailed list of the documents reviewed, personnel interviewed, and observations made during this assessment, relevant to the findings and conclusions of this report, is provided in Appendix B.

5.0 RESULTS

5.1 Radioactive Waste Management Planning

Criteria:

Radioactive Waste Management Basis: Facilities, operations, and activities that generate, handle, process, store, package, transport or dispose of low-level waste (LLW) shall have an RWMB consisting of physical and administrative controls to ensure the protection of workers, the public, and the environment. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV) CRAD 31-11, Section 4.1, Criteria 1

Training and Qualification of Personnel: Training is provided to all personnel associated with the management of radioactive wastes, including planning, identification, characterization, monitoring, generation, storage, staging, processing, treating, packaging, transportation, and disposal, to ensure they are competent commensurate with their responsibilities for compliance with the requirements of applicable regulations and DOE programs. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV) CRAD 31-11, Section 4.1, Criteria 5

Quality Assurance Program: All radioactive waste facilities, operations, and activities have a quality assurance program in accordance with applicable regulations and DOE programs. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV) CRAD 31-11, Section 4.1, Criteria 6

Integrated Safety Management: Appropriate safety management programs and practices, including Radiation Control, Industrial Hygiene, Fire Protection and Emergency Management, Criticality Safety (as applicable), Maintenance, Industrial Safety, Training, and Qualifications, are established and implemented in effective procedures for the assessed radioactive waste management facilities. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV) CRAD 31-11, Section 4.1, Criteria 8

Records Management: A program is in place to ensure that appropriate records are maintained to demonstrate that radioactive wastes are managed in an environmentally sound manner, and that recordkeeping-related activities are performed in accordance with all applicable DOE, Federal, state, and local requirements. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV) CRAD 31-11, Section 4.1, Criteria 11

NNSS has an established and approved RWMB. In accordance with Manual 435.1-1, Area 3 and Area 5 have disposal authorization statements (DASs) that were approved by the Deputy Assistant Secretary for Waste Management. The Area 3 DAS was issued in October 1999, and the Area 5 DAS was issued in December 2000. The RWMB documents appropriately provided reference to and invoked the plans, procedures, and requirements under which the LLW facilities must operate. In the case of nuclear facilities with authorization basis/safety basis documentation, controls required for a RWMB are also implemented by the applicable authorization basis/safety basis documentation.

National Security Technologies, LLC (NSTec) has established and implemented programs for training and qualification of personnel, quality assurance, integrated safety management, and records management for the assessed waste management activities through site wide institutional programs governing these areas. NSTec implements the programs using high-level program documents including: CCD-QA02.001, *Training Program Manual*; PD-0001.002, *Quality Assurance Program;* CCD-QA05.001, *NSTec Integrated Work Control Process*; CCD-QA04.003, *Records Management*; and CD-2120.019, *Emergency Preparedness and Response*. EA confirmed that each of these programs are in place and supported with an appropriate document hierarchy sufficient to meet Manual 435.1-1 requirements. However, the scope of this assessment did not include a comprehensive programmatic review of the site

wide adequacy these broad programs. EA's observations related to the implementation of these programs at the radioactive waste management facilities are presented in the remaining sections of this report.

Within the scope of this assessment, the fundamental programmatic and procedural structures for radioactive waste management and planning are in place and properly implemented at NNSS.

5.2 Radioactive Waste Identification, Characterization, and Monitoring

Criteria:

Waste Stream Identification and Characterization: The facility has established processes that ensure hazardous and radioactive waste streams are properly identified and characterized. Waste stream characterization and analysis processes and capabilities are designed and implemented to verify conformance with the WAC. Processes incorporate appropriate levels of documentation and clearly defined data quality objectives and limiting conditions. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV) CRAD 31-11, Section 4.2, Criteria 1

Waste Acceptance Criteria: Each facility receiving waste for accumulation, storage, or staging; processing, treatment, or repackaging; shipping; or final disposal shall have a defined WAC. (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV and CRAD 31-11, Section 4.2, Criteria 2)

Monitoring to Certify Waste Acceptance Criteria Conformance: Each facility that receives and handles LLW shall have effective analysis, monitoring, and/or inventory records processes to certify that the wastes conform to the WAC, the facility safety basis, and the inventory limits. Measurement, analysis, and process records techniques shall be sufficient to verify all aspects of WAC compliance (radiological, chemical, and physical attributes). (DOE Order 435.1; DOE Manual 435.1-1, Chapters I and IV, and CRAD 31-11, Section 4.2, Criteria 3)

DOE/NV-325, *Nevada National Security Site Waste Acceptance Criteria*, (i.e., NNSS WAC) appropriately defines the requirements, terms, and conditions under which NNSS will accept (1) DOE hazardous and non-hazardous, non-radioactive classified waste; (2) DOE LLW; (3) DOE mixed LLW; and (4) Department of Defense classified waste. The WAC defines what constitutes acceptable waste and includes specific parameters and limitations associated with proper waste form, waste packaging, mixed waste, and the process for deviations to any requirements, which are to be evaluated on a case-by-case basis.

Most of the NNSS-disposed waste is generated at other DOE sites and shipped to NNSS for disposal. While NNSS relies on NSTec as the primary operating contractor for the radioactive waste management sites, NFO also contracts to Navarro for primary management of the Radioactive Waste Acceptance Program (RWAP) including audits of the generator's WAC certification programs. In accordance with the NNSS WAC, the generator is responsible for identifying and characterizing waste streams to ensure compliance with the WAC. NNSS requires the generators to follow the RWAP requirements, delineated in the WAC. The Waste Acceptance Review Panel (WARP) is a technical resource established to provide recommendations to the Nevada Field Office (NFO) regarding approval decisions for all generator WAC certification programs and waste streams with profiles. The WARP includes broad representation, including membership with representatives from NFO, Nevada Department of Environmental Protection (NDEP), Navarro, and NSTec. Generators must have their WAC certification programs reviewed by the WARP and approved by NFO before application to dispose of specific waste streams at NNSS. Generators are required to prepare waste profile forms for each of their waste streams, and then submit the forms to the WARP for review. Once a generator waste profile is accepted, an RWAP assessment team conducts periodic assessments at the generator facilities to verify WAC compliance. WARP waste

profile reviews and RWAP assessments are performed using a formally defined systematic approach that considers the applicable elements of the WAC, including chemical and radiological characterization, land disposal restrictions, PA compliance, and verification methods for criticality safety, and mixed waste. EA reviewed WARP waste profile review documentation for several waste streams disposed during this 2016 assessment and found that the WARP had conducted exhaustive reviews, with comments from various SMEs that required resolution by the generators before the waste profiles were accepted for disposal. EA also attended a WARP weekly conference call meeting in which approval recommendations for several waste profiles were issued. This process is implemented in a deliberate, formal manner.

The RWAP program conducts annual WAC assessments at the generator facilities to verify compliance. EA observed the RWAP assessment process at INL, one of the generator sites. The process was thorough and based on appropriate predetermined lines of inquiry and checklists. The RWAP assessment included observation of generator waste packing operations, waste stream radiographic transmission review (RTR) and non-destructive analysis (NDA) operations, and waste shipment preparations. Although the assessment process was thorough, EA and the RWAP assessors noted that not all aspects of the WAC could be verified by direct measurements or visual observations. For example, specific isotopes, such as Ni 63, Tc-99, and I-129, listed in the WAC are not easily detectable using the NDA systems deployed at the generator's site. Similarly, the generator does not directly measure or sample for most chemical constituents listed in the WAC during re-packaging operations. Instead, determinations of "Acceptable Knowledge" based on previous transportation, inventory, and process records, and scaling factors relative to measurable signals are used. Because much of the re-packaged waste was received by the generator site from other DOE facilities, in some cases decades ago, the process relies heavily on the determinations of Acceptable Knowledge based on retained records of the original transfers or records of the original waste stream characterizations. EA observed and the RWAP review team acknowledged that this dependence on legacy records which were generated before the current WAC limitations and not always validated by up-to-date sampling or assays, represents a challenge in the characterization and certification processes. As such, the RWAP assessors took advantage of all available resources to verify the traceability and accuracy of the legacy records. The assessors also took appropriate efforts to verify the training and capabilities of the generator staff to identify anomalies in the wastes during re-packaging and certification for transfer to the appropriate disposal facilities.

NNSS effectively uses two web-based applications (i.e., the waste management Infobank system [WMIS] and the low-level waste information system [LWIS]) to facilitate data management in support of its waste management activities. WMIS is a comprehensive application containing a number of modules that facilitate performance of waste management responsibilities in various areas, including disposal operations, environmental monitoring, mixed LLW, the PA, RWAP, project management, waste generator services, site closure, and program administration. The LWIS system is a separate application accessible from WMIS that handles the management of all generator waste profile information that has been approved by the DOE NFO based on WARP review and recommendations, including performance of automated WAC limit checks for individual waste containers and shipments prior to disposal at NNSS. EA compared the use and data outputs from these systems to documentation for several shipments of waste received during the review, including the waste profile information and package shipment disposal requests (PSDRs) containing package-specific details for each shipment. Collectively, the WMIS and LWIS provided for effective management of generator waste profile information and waste shipment records for the shipments that EA observed being received and disposed at NNSS.

5.3 Waste Disposal Operations

5.3.1 Disposal Authorization Statement

Criterion:

Disposal Authorization Statement: A DAS shall be obtained prior to construction of a new LLW disposal facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.1, Criteria 4

The Deputy Assistant Secretary for Waste Management issued DASs for the Area 3 and Area 5 radioactive waste management sites (RWMSs) in accordance with requirements and processes in DOE Order 435.1 *Radioactive Waste Management*. The DAS for the Area 3 RWMS was issued in October 1999. The Low-level Waste Disposal Facility Federal Review Group (LFRG) reviewed the PA for the Area 5 RWMS and recommended conditional acceptance to the Deputy Assistant Secretary in August 1996. NNSS contractors revised the PA in January 1998 to address the conditions. Based on the LFRG assessment of the revisions, the Deputy Assistant Secretary issued the current DAS for the Area 5 RWMS in December 2000.

5.3.2 Performance Assessment

Criteria:

Performance Assessment: A site-specific radiological PA and CA shall be prepared and maintained. The performance assessment shall include calculations for a 1,000-year period after closure of potential doses to representative future members of the public and potential releases from the facility to provide a reasonable expectation that the performance objectives identified in Manual 435.1-1 IV P (1) are not exceeded as a result of operation and closure of the facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.1, Criteria 2

Performance Assessment: The PA shall be maintained to evaluate changes that could affect the performance, design, and operating bases for the facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.2, Criteria 2

The Area 3 RWMS and Area 5 RWMS DASs require preparation of an annual summary report and a determination of the continuing adequacy for the PAs and CAs of both Areas in accordance with Manual 435.1-1. The annual summary evaluations of the adequacy of the PA are prepared, with particular attention to monitoring for potential subsidence within the RWMS.

In the 1990s, the US Department of Energy Nevada Operations Office Waste Mangemnet Division identified concerns about the potential amount and effects of subsidence in the Area 3 and 5 RWMSs on potential radiological releases. In 1998, a working group evaluated these concerns under contract DE-AC08-96NV11248 and reported the results in *Consequences of Subsidence for the Area 3 and Area 5 Radioactive Waste Management Sites, Nevada Test Site*. This report indicated that the waste already placed in the RWMSs contained a significant amount of void space resulting from incomplete filling of waste containers, limited internal compaction of contents, and void between containers. These voids are expected to produce significant subsidence as the waste containers deteriorate and collapse over time. The review evaluated the effectiveness of various approaches to mitigate the impact of subsidence, including extended active maintenance periods, the use of dynamic compaction, and a variety of layered or hardened cap designs. The working group concluded that the most practical option was to develop an alternative cover design based on a single, thick layer of alluvium obtained from the local area to accommodate subsidence with limited fracturing and without discontinuous layering that could result in

easier access to or exposure of the waste. The site followed the recommendations of the working group in the 92 acres that are already capped, and the PAs have been updated to incorporate this closure approach in the modeling for the areas that remain operational.

The summary evaluations of the PAs are submitted annually, incorporating additions to the inventory and monitoring results evaluating subsidence, meteorological data, lysimeter soil moisture evaporation test bed results, cap plant covering tests, and deep well sampling results. Based on the PAs for the Area 3 and 5 RWMSs, there is reasonable assurance that the performance objectives will be satisfied.

Area 3

Area 3 and Area 5 PAs considered the acute drilling and construction scenario and residential exposure scenario as the base case for compliance evaluation. However, for Area 3, the dynamic probabilistic subsidence model predicts that the cover will subside below the existing grade within 1,000 years for most model runs, while in Area 5 the disposal unit cover remains above grade. This PA modeling difference was necessary because the greater thickness of waste for area 3 compared to area 5 and to simulate the potential for test crater chimney collapse. Regardless, the models predict that the waste in Area 3 will remain sufficiently covered and that natural erosion processes will eventually fill the localized depressions.

Extensive EA observations within Area 3 and crater/chimney characterization reports support the assumptions of the PA. Reviewed monitoring results support the conclusions in the annual updates that doses are, and will remain, within the performance objectives. The PA criteria for Area 3 are satisfied.

Area 5

According to the Area 5 closure plan, when the units reach capacity a monolithic cap, made of the same alluvial material as the local soil, will be installed above grade, with sufficient depth to ensure that the wastes remain covered, even if the containers degrade and slump. While most Area 5 trenches are unlined, a unique cell, Pit 18 (used for Resource Conservation and Recovery Act [RCRA] wastes), is lined, but will have the same unlined monolithic cap design. Leachate sample testing from the lined Pit 18, as well as other lysimeter test bed and deep well samples, supports the assumptions and conclusions of the PA for Area 5 with respect to waste stability, moisture evaporation rates, and leach rates of nuclides. Additional biotic (animal) sampling, radon flux density monitoring, and area airborne monitoring for tritium (hydrogen-3) and other nuclides support the basic assumptions in the PA models. Based on the results for Area 5 PA 2015 annual summary, there is reasonable assurance that all performance objectives will continue to be met.

The basic modeling assumptions and data are reasonable and supported. Annual summaries include appropriate documentation of increases in the total disposed inventory and environmental monitoring results that indicate the performance of the facility. The PA criteria for both Area 3 and Area 5 are satisfied.

5.3.3 Composite Analysis

Performance Assessment: A site-specific radiological PA and CA shall be prepared and maintained. The performance assessment shall include calculations for a 1,000-year period after closure of potential doses to representative future members of the public and potential releases from the facility to provide a reasonable expectation that the performance objectives identified in Manual 435.1-1 IV P (1) are not exceeded as a result of operation and closure of the facility. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.1, Criteria 2

The criteria for evaluation of the CA are similar to those for the PA except the CA is intended to consider the interaction of all other source terms that will be residual on the site with the source term resulting from the disposal facility. The CA is a planning tool used to ensure that doses to a future member of the public (MOP) resulting from exposure to all residual sources remaining on the site do not exceed specified performance objectives. Specifically, doses must not exceed 100 mrem in a year. DOE implements a further administrative control limit of 30 mrem in a year to account for uncertainties in the modeling. The point of compliance for the CA evaluation may be at the boundary of the land use restrictions, which may or may not correspond to the point of compliance for the PA at 100 meters from the disposal cell boundary.

The NNSS site was previously used for above ground and below ground nuclear weapons testing and the residual source terms from that testing remain on site. The current national security missions of the NNSS are to perform subcritical and other security related materials and physics experiments, and systems testing for other defense applications. Public access to the NNSS is currently restricted and is expected to remain restricted as long as the NNSS has an active national security mission. If the NNSS national security mission ends, the release of the NNSS land for public access is expected to be constrained based on historical contamination from atmospheric nuclear testing, underground nuclear testing, nuclear rocket testing, and radioactive waste disposal. As a planning tool, the CA evaluates the impact of the waste disposal activities on land use restrictions and considers the superposition of exposures to other residual source terms remaining on the site.

Yucca Flat has been the site of 84 atmospheric and 662 underground nuclear tests. Past nuclear testing left contaminated facilities, equipment, and soils throughout Yucca Flat. The impact of surface contamination from the atmospheric testing is well characterized and established. The impact of the underground testing had previously been less well characterized, but is now being evaluated as part of the Underground Test Area (UGTA) program. Remediation of the UGTA is unlikely to be cost effective because of the volume of contaminated soil and the great depth of contamination. The UGTA program is evaluating the impact of underground testing on groundwater. The objective of the UGTA program is to develop deep groundwater models that assist in establishing a future land-use boundary in which access to groundwater use and subsurface intrusion will continue to be restricted. The UGTA studies and modeling will be used to set land use restriction boundaries where the annual median dose from ground water ingestion swill be less than 4 mrem per year over a 1,000-year period. While much of this analysis is completed, NFO has not yet issued the final reports for NSTec to integrated the results into the CAs.

A panel of independent SMEs has evaluated the effectiveness and probable duration of long-term institutional controls in Frenchman Flat and Yucca Flat through formal elicitation (Black et al., 1998). Based on the elicitation, the CA assumes that active institutional controls will remain in place and effective for a median period of 250 years after closure.

Area 3

The Area 3 RWMS is located in Yucca Flat, a closed basin on the eastern edge of the NNSS. The environment in Yucca Flat is well suited for the isolation and disposal of radioactive waste. The nearest current permanent residents are 57 kilometers (35 miles) to the southwest at Amargosa Valley, a small rural community near the NNSS boundary.

Although the UGTA program has not yet established the final institutional control boundary, the CA assumes that the Area 3 RWMS lies entirely within this containment area. The CA estimates the dose from all interacting sources for a member of the public (MOP) living near the Area 3 RWMS. A MOP near the Area 3 RWMS may be exposed to residual surface contamination at the Soil Sites in Yucca Flat and Plutonium Valley from the atmospheric testing and contamination in groundwater from underground

nuclear testing. Remediation of contamination from underground nuclear testing is not economically feasible. The current plan for managing the UGTAs is for DOE or successor governmental entities to establish and maintain a restricted area that controls access to groundwater near the Area 3 RWMS.

The CA model conservatively assumes the point of compliance is located 100m (330 feet) from the Area 3 RWMS, which is the same location as the PA point of compliance. This location is also within the HORNET ground zero Soil Site created by atmospheric weapons tests. The CA assumes that the MOP is exposed to residual radioactivity in soil contamination areas in Yucca Flat and Plutonium Valley, as well as wastes disposed in the U-3ax/bl, U-3ah/at, and U-3bh disposal units at the Area 3 RWMS. The CA assumes that contamination is primarily transported to the MOP residence by resuspension and atmospheric dispersion. The CA also assumes that the MOP will also be exposed to volatile and nonvolatile radionuclides released from the Area 3 RWMS by the same processes as assumed in the PA, i.e., plant uptake, animal intrusion, gaseous diffusion, and upward liquid advection. However, the CA assumes UTGA based land disturbance and drilling controls to eliminate the potential for exposure to contaminated groundwater for at least 250 years. CA modeling determined that the administrative performance objective of limiting dose to an MOP near Area 3 RWMS to less than 30 millirem in a year would be satisfied.

Area 5

The CA assumes that waste disposal operations at the Area 5 RWMS will cease in 2028 and final closure will be performed promptly. In accordance with the closure plan, the cells are expected to be covered with a 2 to 6 meter thick monolayer alluvium cap. The CA assumes closure is followed by a 250-year period of active institutional control. The CA assumes that the closure cap will be actively maintained for the first 100 years after closure, during which the maintenance effectively repairs subsidence and removes invasive deep root vegetation from the cap. The CA further assumes corrosion and collapse of steel containers will continue beyond the 100-year maintenance period, resulting in further subsidence and the formation of depressions and cracks in the cap. Despite this additional subsidence, the CA modeling expects the cap will remain above grade and continue to cover the waste when subsidence is complete. Based on the geometry and the composition of the closure cap, EA found this evaluation to be reasonable and well supported.

The Area 5 RWMS PA conceptual model of radionuclide release assumes that contaminants are released from waste to the overlying soil cover by gaseous diffusion, upward liquid advection, plant uptake, and animal burrowing. The PA model, supported by lysimeter test bed measurements and other soil moisture measurements, evaporation rates concludes that water-driven downward migration of wastes will not be sufficient to reach the water table. Notwithstanding some limitations and opportunities for improvement in the environmental monitoring noted in section 5.3.7 of this report, EA reviewed the available near surface data and found it reasonably supports these conclusions for near surface migration.

The CA model calculated the total effective dose equivalent to a future member of a small rural community resident in Frenchman Flat. The calculations presume residents work at an offsite location, but are exposed while at home. The CA model assumes all agriculture is noncommercial and limited by the infertile soil and arid conditions at the site. The CA model assumes residents are exposed to external irradiation from nonvolatile radionuclides in the soil; immersion in gaseous radionuclides in the air; inhalation of soil particles in the air; inadvertent ingestion of soil; and ingestion of vegetables, beef, poultry, milk, and eggs.

The primary source of uncertainty in the CA result is the dose contribution from the Frenchman Flat UGTA. The closure plan, DOE/NV-1538-Rev. 1, *Underground Test Area Closure Report for Corrective Action Unit 98: Frenchman Flat Nevada National Security Site, Nevada*, is currently in review. Once

completed, the DOE UGTA program study results will assist to selection of management options and administrative control boundaries for the Frenchman Flat working through the Federal Facilities Agreement and Consent Order (FFACO) process. NSTec plans to revise and update the CA once final reports are accepted and issued.

Within the limitations of the yet to be finalized UGTA study results, EA found the CA analysis and assumptions to be reasonable and well supported. The CA criteria for both Area 3 and Area 5 are satisfied.

5.3.4 Hazards Analysis and Control

Criterion:

Hazards Analysis and Control: Hazards associated with the handling, sample, or assay analysis and disposal of waste have been identified, analyzed, and documented. An appropriate set of controls have been identified in the facility safety basis and implementing procedures. Hazard analysis and controls consider normal operations and potential off-normal conditions, such as a container breach, facility fire, or natural phenomenon events. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV)

EA observed ongoing waste disposal operations at the Area 5 RWMS, which is currently active and contains approximately 200 acres of land developed for LLW and mixed LLW waste storage and disposal. EA did not observe operations at the Area 3 RWMS, which is available for waste disposal operations, but has been inactive for a number of years. EA observed waste disposal operations governed by technical procedures, including SOP-2151-234, *Radioactive Waste Operations Craft Activities*, SOP-2151.203, *Low-Level Waste Handling and Storage Program*, SOP-2151.238, *Off-Loading 10-160B Cask*, and OP-2151.233, *Low-Level Waste Shipment Administrative Procedure*. These operations procedures adequately conveyed the scope of work and steps performed. Pre-job briefings were effective in conveying the specific work scopes, associated hazards, and controls. The pre-job briefing for receipt and disposal operations included a thorough discussion of waste placement requirements contained in the operations procedure. Work group supervisors also verbally confirmed workers' responsibilities and specific assignments for scheduled placement activities.

Hazards associated with LLW operations include both non-radiological and radiological hazards. The most prevalent hazards associated with waste disposal activities are non-radiological hazards related to industrial safety, including use of heavy equipment, forklifts, cranes and hoists, and rugged terrain. Many of the controls for these hazards are contained in NSTec procedures (e.g., CD-P280.001, *General Safety Rules*, CD-G022.004, *Mobile Crane Operations and Construction/Demolition Rigging*, and CD-P450.011, *Heat and Cold Stress*). The work planning and control processes implemented at the RWMS were consistent with CCD-QA05.001, *NSTec Integrated Work Control Process*, and the industrial safety hazards that EA observed were appropriately controlled during operations consistent with the institutional procedures. For example, all workers had appropriate personal protective equipment, such as hardhats, safety shoes, and reflective vests, and spotters assisted movement of equipment. Hoisting and rigging operators demonstrated good practices, including verification of equipment status, (heavy equipment, as well as below the hook slings and braided chokers), establishment of boundaries to protect against counterweight impact, use of tag lines, and use of reach tooling and load avoidance (prohibition working under suspended loads). Conduct of operations and communication was effective. Waste disposal personnel performed extensive hoisting and rigging and powered industrial truck operations effectively within controls, and included excellent support labor to guide operations. Monitoring of industrial safety and industrial hygiene hazards are included in pre-task hazard checklists. Application of controls included heat stress announcements and establishment of work rest regimes. Additionally, operational procedures are embedded with warnings related to hazards identified in the hazard screening. Area 5

Operations and Nuclear Facilities management were actively engaged and present for higher hazards waste placement operations. Based on these observations and review of work control processes, EA determined that NSTec adequately analyzes and controls typical industrial hazards encountered during normal LLW operations.

The most prevalent radiological hazard associated with NNSS waste disposal operations is the need to unload containers exhibiting high radiation fields, with most applied controls designed to measure and address external dose rate hazards. EA observed two such operations during the assessment. As discussed later in this section, a less common radiological hazard is the potential for a leak or breach of containers during transportation and/or handling that could result in the spread of radiological contamination and/or the presence of airborne radioactivity that could result in internal dose. Radiological controls for normal operations focused on the external radiation dose hazards, including confirmatory surveys of incoming shipments consisting of direct radiation measurements, but also included field counting of large area wipes, and removable contamination smears (alpha and beta-gamma analysis) for a 10% sample of waste containers. EA observed good application of As Low As Reasonably Achievable practices, including use of containers for shielding, backfilling of higher activity waste packages and use of shepherd hooks and mirrors to retrieve lifting devices from cask liners, and good interaction with Radiation Control Technicians (RCT) coverage during waste placement activities.

The radiological hazards for LLW operations are controlled through use of radiological work permits (RWPs), which are intended to provide information on expected radiological conditions for specific work and to specify requisite radiological controls. NSTec assigned governing RWPs to all work observed by EA at Area 5. However, the scope and span of control of some of these RWPs was too broad to meet institutional procedures that require RWPs to convey specific information and requirements for discrete job evolutions/tasks and to ensure that controls are tailored to the work being performed. Most work observed by EA was controlled by a single RWP (RWP 16-0005-01), which was broadly written to allow entry into different types of radiological areas (Radiation Areas, High Radiation Areas, Contamination Areas, High Contamination Areas, and Airborne Radiation Areas), each having a distinct sets of controls, and to govern the performance of a wide variety of operations under these conditions over long periods of time. This practice is not consistent with the intent and specific requirements of OP-0441.306 and CD-0441.005, *Radiological Work Permit Process* (**Deficiency**). Some specific examples include:

- The RWP development did not consider and include a listing of all activity-level work documents (ALWD) associated with the RWP, as required by OP-0441.306. In addition to two specific ALWDs, the RWP incorrectly lists "Various" in the ALWD section, and the work description allowed much more work than would be covered by the two listed ALWDs. This is important since an adequate RWP cannot be prepared without knowledge of the specific work scope and work flow contained in the governing ALWD.

- The RWP was incorrectly developed and designated as a "standing RWP" rather than a "job-specific" RWP. OP-0441.306 does not allow use of standing RWPs for the types of high-risk changing radiological conditions authorized by RWP 16-0005-01 (i.e., CA, HCA, ARA work).

- The RWP does not include delineation of any tasks and subtasks as called for in OP-0441.306, resulting in the personal protective equipment and radiological conditions sections that are not appropriate for some of the allowed radiological conditions and may be confusing to workers during implementation.

- The RWP contains multiple and potentially confusing RWP suspension limits due to the multiple conditions allowed by the RWP. Typically, reaching a "suspension limit" is used to void the continued use of the RWP, but in this case, it is used to change to a different set of controls.

- The RWP inappropriately uses hold points to convey response to exceeding suspension limits. As indicated in the NNSS Site Radiological Control Manual, hold points are cautionary steps in a technical work document (e.g., a procedure or RWP) requiring the Radiological Control Organization to perform some action or verification, and should be satisfactorily completed before the work is continued. Hold points are typically intentional temporary pauses in the work while awaiting the results of discrete radiological actions, such as a radiological measurement, sample collection, or inspection to verify continued safe conditions or allow documentation of operational status.

EA discussed these observations with NSTec radiation protection management, who agreed these indicated weaknesses in the RWP development and implementation, and recognized the need to enter these observations and procedural discrepancies into the site-level issues tracking process.

NSTec analysis supporting the safety basis appropriately addressees potential exposures for members of the public and on site collocated workers. Emergency response procedures are available to address apparent off-normal events, such as fire, spills, releases, and natural phenomenon events. These invoke the appropriate general response actions to ensure facility personnel safety. Typical initial response is for the personnel to leave the immediate work area, assess conditions, and evaluate measurement, control, and recovery actions. However, due to elevated external radiation backgrounds, NSTec does not routinely deploy active work area air monitoring during waste handling operations, and real-time monitoring is usually limited to RCT direct radiation surveys focused on external exposures. Waste processing personnel do not anticipate the presence of airborne radioactivity during routine LLW operations, but there is always the potential for a breach of waste containers during handling that could result in the spread of radiological contamination and/or the presence of airborne radioactivity that could result in internal dose. In some package-specific cases, radiological impact of a breach could be significantly higher than the established monitoring and RWP controls, (which primarily address external dose hazards), are able to quickly detect, recognize as an off-normal condition, and address. Because emergency response procedures and the broadly written RWPs do not include package- or shipment-specific source term hazard analysis that considers the potential or impact of an airborne or aerosol release, detection or recognition of an off-normal condition may be delayed and the response may not be timely and tailored to the specific hazards. For these cases, the current typical level of pre-job hazard analysis and off-normal condition monitoring, prevention, and response preparation may not be sufficient to protect the in trench facility workers for off-normal conditions. The established Emergency Planning Hazards Assessment addresses incidents that rise to the level of an alert or site area emergency to protect co-located workers, emergency responders, and members of the public, but may not provide sufficient protection for the in-trench facility worker for a lower level off-normal release event. (**OFI-NSTec-1**)

Overall, other than the observed deficiency with RWP development and the possible need for additional analysis of airborne release potential for some specific waste types, radiological hazards associated with the normal or routine handling and disposal of radioactive waste at NNSS Area 5 have been properly identified, analyzed, documented and controlled through the use of site-level work planning and control processes.

5.3.5 Waste Acceptance Criteria, Inventory Control, and Receipt Acceptance

Criteria:

Waste Acceptance Criteria and Inventory Control: WAC for receipt of material to the facility are established based on the facility capabilities in conformance to the facility safety basis, hazards analysis, and limitations in the DAS. Processes are established and implemented to ensure inventory controls, WAC conformance, and documentation of wastes container constituents. Facility inventory records are maintained to accurately reflect receipt, disposal, effluent (leachate or off-gassing) release, and decay transformation of wastes and hazardous materials. Audit and inventory reconciliation processes are implemented. Records archive processes are established to ensure retrievability and traceability to specific waste generators, shipments, and packages. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV)

Receipt Acceptance: A process is established to verify conformance to the WAC. The process may include a review of certification documentation, shipping manifests, periodic sampling, and/or monitoring of received packages or shipments. Transfer for receipt shall not be authorized unless the supplying facility can certify conformance to the WAC. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV)

The NNSS WAC defines the acceptable waste parameters for disposal at NNSS (see Section 5.2). WAC considerations include transportation and handling requirements, container packaging requirements, safety basis considerations for the material at risk (MAR) and facility worker safety, and long-term waste stability and long-lived isotopic concentrations that impact future receptor doses as analyzed in the PA. The WAC defines prohibitions for reactive, energetic, or pyrophoric materials and compressed gases, as well as limitations on void space and free liquids. Per Section 6.3 of the NNSS WAC, the applicable DOE, Department of Transportation, and Environmental Protection Agency (EPA) required documentation, as well as the NNSS-required Package Shipment Disposal Request (PSDR) must accompany all shipments. The PSDR is designed to document all waste container constituents in each shipment to demonstrate WAC compliance, and is transferred in both hardcopy and electronic formats. Before arriving at NNSS, electronic PSDR information must be transmitted to the disposal operations group for upload into LWIS, which compares the PSDR shipment information with the applicable waste profile acceptable parameters and limitations and WAC requirements. The LWIS system automatically flags any deviations for review and resolution by the Waste Operations Specialist and generator. The PSDR upload process greatly simplifies compliance checking of individual shipments against accepted waste profile parameters to ensure WAC compliance and suitability for shipment and disposal. EA found that the established PSDR processes combined with the automated LWIS flags of deviations provides an appropriate mechanism to satisfy the WAC and inventory criteria.

However, one of the waste shipments that EA observed was not formally accepted for disposal by NNSS (via PDSR upload and LWIS checks) before being released from the generator site for transport. NNSS confirmed that PSDR uploads are not always completed prior to shipments leaving the generator site and that these shipments are at risk for being returned at the generator's expense if deviations are found and cannot be resolved. In these cases, the profiles had previously been approved by DOE NFO through the RWAP process in part addressing Manual 435.1-1 IV K. 1: Authorization *"Low-level waste shall not be transferred to a storage, treatment, or disposal facility until personnel responsible for the facility receiving the waste authorize the transfer."* However, the specific shipments details have not been approved via the LWIS screening process prior to transfer assuring operational coordination and acceptance. This may not fully meet the intent of specific sections of the manual (e.g., Manual 435.1-1 G. 2: *Evaluation and Acceptance. "The receiving facility shall evaluate waste for acceptance, including confirmation that the technical and administrative requirements have been met;"* and Manual 435.1-1 IV

K. 2: Data. *"Waste characterization data, container information, and generation, storage, treatment, and transportation information for low-level waste shall be transferred with or be traceable to the waste."* The NNSS WAC does not specifically require the PSDR upload before a shipment is released for transport to NNSS. Shipments transferred before verifying that the uploads are completed, reviewed, and accepted by the receiving facility do not assure NNSS is fully aware of the conditions of the specific shipment, and prepared to conduct the receipt and waste placement using appropriate shipment-specific hazard analysis, controls, RWPs, and staffing and resources. Further, shipments with discrepancies that cannot be resolved, and must be returned, result in greater risk during transportation. (**OFI-NSTec-2**)

EA observed receipt, acceptance, and disposal of seven truck waste shipments from several generators. Waste operations personnel used the LWIS system effectively for shipment processing, which provided an appropriate means for inventory tracking and controls, documentation of waste container constituents, physical location tracking, and records retrieval, consistent with DOE Manual 435.1-1 requirements. The LWIS system also generated real-time MAR reports showing Area 5 inventory (above ground) changes with each shipment, and waste operations personnel appropriately compared these reports with MAR limits to ensure that documented safety analysis limits were not exceeded.

Shipment processing and receipt acceptance followed the requirements of two NNSS operations procedures, including SOP-2151.203, *Low-Level Waste Handling and Storage Program*, and OP-2151.233, *Low-Level Waste Shipment Administrative Procedure*. These procedures govern overall waste handling and disposal and required administrative activities, such as PSDR upload, processing LLW shipment paperwork, receipt inspection, and recording of burial information.

For each observed shipment, radiological confirmatory surveys of incoming shipments included direct radiation measurements, a large area wipe, and a 10% sample of waste containers for removable contamination (alpha and beta-gamma analysis). Concurrent with radiological surveys, waste specialists reviewed each shipment folder and prepared waste package checklists for each shipment, which were later used when offloading containers to validate that actual waste container numbers matched the PSDR information, package integrity was intact, and waste package marking and labeling were consistent with the shipment paperwork. Each disposal cell is equipped with a three-dimensional grid system to identify the location of individual waste containers for later retrieval if necessary. After placement of individual waste containers into the disposal cell, EA observed waste specialists properly uploading the grid locations to LWIS using handheld scanners. EA found no deviations from NNSS procedural requirements during observation of this work.

EA noted a concern with WAC compliance for non-mixed LLW. While the Area 5 RCRA permit requires mixed waste verification protocols, NNSS does not currently perform confirmatory monitoring of incoming non-RCRA LLW waste for verification of the generator's WAC certification for LLRW. Instead, NNSS relies primarily on the adequacy of the generator waste certification processes, the RWAP assessments of the generator's certification processes as noted above, and the documentation associated with the shipments and transfers.

While routine RWAP generator audits and surveillances are being performed to assess generator WAC certification processes, several factors indicate these alone are not sufficient to ensure WAC compliance in certain areas, such as void space minimization and prohibition on free liquids. As examples:

- EA's recent waste management assessment at one generator site and disposal site identified several important flaws with waste characterization for materials destined to the local onsite disposal that could lead to WAC non-conformances. Additionally, the onsite audit process of WAC certification practices lacked evidence of performance-based assessments and failed to identify the characterization flaws. That generator's WAC certification and verification audit

processes for onsite disposal were analogous to the processes used for offsite disposal at the NNSS. However, the recent RWAP review of that generator site's wastes certification practices for waste destined for NNSS did not identify any concerns about the scope of their reviews.

- At another site recently evaluated by EA, void space minimization was not effectively implemented for wastes shipped to NNSS, despite a WAC requirement to minimize void space to the extent practical. When questioned, the generator site personnel stated there was no fiscal incentive to rigorously pursue void space minimization because waste disposal at NNSS was a pass-through cost (i.e., there is no volume surcharge for waste disposal at NNSS). Considering the additional costs, need for specialized facilities and equipment, and potential hazards for onsite processing, the generator indicated that additional efforts to minimize void space or improve waste stability were impractical.

- Lastly, an NNSS generator recently self-reported that it had incorrectly shipped nonconforming wastes containing free liquids, and this waste had been disposed of at NNSS in 2015. Following this generator's self-reporting, the specific waste package was located, retrieved from the disposal cell, and returned to the generator. The circumstances surrounding the generator's self-reporting were fortunate but happened only by chance, when a supervisor at the generator's facility discovered the potential for free liquids in a new shipment being prepared for NNSS and was told that the packaging was the same as the previous shipment.

DOE Guide 435.1-1, *Implementation Guide for Use with DOE Manual 435.1-1*, recommends that one or more of the following should be performed to demonstrate that the waste presented meets the waste acceptance requirements:

- Testing, sampling, and analysis of the contents of a representative sample of waste packages as they are received at the facility.

- Testing and analysis of a number of samples taken by the generator facility.

- Detailed review of sampling and analysis data generated by the sending facility or an independent laboratory employed by the generating facility.

- Audit, surveillance, or observation of the sender's waste characterization activities and processes and waste certification programs.

DOE Guide 435.1-1 further states that facilities receiving LLW from many generators or offsite generators or high-activity LLW (such as NNSS) may need to implement more detailed waste evaluation and acceptance processes than a facility receiving waste from a small number of onsite generators. Waste evaluation and testing methods often include random sampling, waste package assays, spectrographic monitoring (NDA), radiographs (RTR), or intrusive waste package inspections, none of which is currently performed at NNSS for incoming wastes. NNSS Area 5 formerly performed RTR inspections for some package types, but the equipment is in need of upgrades and refurbishment. RWMS is considering redevelopment of these inspection capabilities. Considering the identified challenges to WAC conformance identified above, the current practice of reliance on the RWAP audits without the addition of verification techniques such as enhanced receipt inspections, RTR, or NDA that are recommended by the guide may not be sufficient to assure conformance with the WAC. (**OFI-NSTec-3**)

With regard to waste records management, operational waste management records are maintained and available for later retrieval. NSTec has implemented a policy consistent with the National Archive &

Records Administration (NARA) approved DOE Records Schedule Guidelines for records retention which calls for destruction of many operational records after 75 years. However the active monitoring, and maintenance period is expected to last 100 years. It is NFO policy to maintain and enforce institutional controls and land use restrictions as long as necessary to ensure performance assessment and composite analysis dose objectives can be satisfied. The SME elicitation estimates the median effective period for institutional controls to be 250 years. Lack of retained inventory and waste placement records during the latter part of the active monitoring and maintenance period would adversely affect maintenance decisions and activities. Records destruction at 75 years, which is consistent with the NARA and DOE records schedule, is not consistent with recommendations in DOE Guide 435.1-1 *Implementation Guide for use with DOE M435.1-1 Chapter IV Low-level Waste Requirements*. Page IV 91 of the guide states, "*DOE low-level waste disposal facilities should plan on maintaining pertinent records at least through the operations, closure, and post-closure monitoring periods, and consider making them part of any local land use records. The pertinent records would be those that identify physical, chemical, and radiological characteristics of the waste and the certification of that information*." Further records destruction before the end of the active monitoring and maintenance period would adversely affect maintenance or remediation decisions in the later portion of that period. (**OFI-NSTec-4**) Further assessment of the policies and clarification of guidance on records retention as they relate to long-term maintenance and control of legacy waste disposal facilities and contaminated sites may be necessary.

5.3.6 Support Facility and Disposal Cell Operations

Criteria:

Support Facility and Disposal Cell Design and Operations: The following facility requirements and general design criteria, at a minimum, apply:

- *LLW systems and components shall be designed to maintain waste confinement.*

- *Ventilation: Staging, assay, and disposal facilities are designed and maintained with appropriate ventilation controls that consider normal conditions, such as off-gassing, and potentially off-normal situations, such as an energetic event or area fire. Ventilation controls shall prevent deflagration or detonation; protect health and safety of facility workers from acute and chronic exposures; and ensure that airborne effluents are maintained within applicable requirements and guidelines.*

- *Disposal facilities are designed and maintained with appropriate monitoring and controls for personnel exposures to direct radiation, contamination, chemical, and physical hazards, considering both normal and potential off-normal situations.*

- *Disposal facilities are designed and maintained to control contamination or prevent or minimize release of the material during normal operations and during off-normal conditions or emergency events.*

- *Facilities shall include sufficient capacity for controlling site runoff and dewatering of disposal cell operations (i.e., removal, containment, monitoring, and if necessary treatment, and/or effluent release of leachate and contact water).*

- *Disposal facilities and systems are designed, maintained, and managed to conform to applicable National Fire Protection Association code requirements.*

(DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.2, Criteria 4

NNSS Area 5 active disposal units are designed and built as open and generally uninhabited areas designed to accept waste for permanent disposal. There are no installed active SSCs such as fire suppression systems, ventilation systems or installed real-time radiological monitoring systems in the trenches. With the exception of the mixed waste RCRA trench which is lined and has an active water management sump and hold up tank, most trenches are designed and built using the local natural alluvial soils for rain water management berms. As discussed in Section 5.3.2 of this report, NSTec personnel conduct routine environmental monitoring and sampling to detect any potential migration of contamination from the disposal units, including direct radiation exposure, airborne radioactivity, biota, subsidence, groundwater, meteorology, and the vadose (unsaturated soil) zone. Lysimeter test beds are used to evaluate water infiltration and evaporation rates near the disposal cells. NSTec personnel also collect and analyze the water from the RCRA trench for contaminants prior to release.

NSTec typically posts disposal areas as Controlled Areas and Radioactive Material Areas. Depending on the waste handling operations, these may be up-posted to Radiation Areas or High Radiation Areas. NSTec does not generally expect these areas to become radiologically contaminated. RCTs conduct monthly area radiological and contamination surveys in accordance with the Area 5 survey plan to verify and document the conditions in the cells. Results of these surveys confirm the appropriate postings.

During waste placement activities, radiological control technicians provide active job coverage to manage exposures. Contamination surveys during observed disposal operations included shipment receipt surveys, checking of worker's hands throughout placement operations, and surveys of packages, truck beds, and forklifts after completion of waste placement. However, because the disposal cell areas are normally considered to be clean areas and are therefore not required to be posted and controlled as contamination areas, personnel are not required to use personnel contamination monitors or to be frisked following entry into the disposal cells and equipment is not required to be surveyed before leaving the cells or the site. EA noted that some waste containers that are covered with fill and no longer available for visual inspection could breach or degrade and release contaminants into the soil or into adjacent active areas of open disposal units. As was noted previously in section 5.3.4 of this report, the radiological monitoring processes established in the RWPs primarily focus on external dose hazards. While active radiological control is exercised during operations, a container breach or leak during handling operations could go undetected, resulting in personnel or equipment contamination. Because final release contamination checks, frisks, or personnel contamination monitor checks are not required, there is potential for the contamination to go undetected when personnel and equipment leave the area or the site. (**OFI-NSTec-5**)

5.3.7 Environmental Monitoring

Criteria:

Monitoring Plan: A preliminary monitoring plan for an LLW disposal facility shall be prepared and submitted to Headquarters for review with the PA and CA. Plans shall be implemented to ensure sufficient monitoring of groundwater, surface water, gaseous or particulate effluent releases, and ambient radiation conditions to evaluate conformance to the PA and CA objectives. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.1, Criteria 3

Monitoring: Capabilities and procedures shall be implemented to ensure sufficient monitoring of ground, surface, leachate, or contact water; gaseous or particulate effluent releases; and ambient radiation conditions to evaluate conformance to the PA. The monitoring plan shall be updated within one year following issuance of the DAS to incorporate and implement conditions specified in the DAS and address changes identified during operations. Plans will be reviewed and updated whenever changes in

conditions or operations are identified. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.2, Criteria 7

DOE Manual 435.1-1 IV requires the following attributes for the monitoring plan:

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

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

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

The environmental monitoring program is intended to inform and validate the assumptions and modeling that form the basis for the PA.

The monitoring at the Area 5 RWMS is required under a variety of regulatory drivers, including Federal regulations and DOE orders. The Area 5 RWMS is primarily a LLW disposal site that includes LLW and LLMW, small amounts of TRU waste, mixed TRU waste, and asbestiform waste. Low-level and TRU/mixed TRU classified materials are also stored at the Area 5 RWMS. Waste with only a radioactive component is self-regulated by the DOE. In accordance with DOE Manual 435.1-1 IV B. (1), the radioactive component of mixed waste is self-regulated by the DOE, whereas the hazardous component of mixed waste is regulated by RCRA under the authority of the EPA. The NDEP has been granted the authority by the EPA to administer the RCRA in Nevada. Monitoring data, collected via sensors and analysis of samples, are required to evaluate radiation doses to the general public; to confirm, validate, and maintain the PA; to demonstrate regulatory compliance; and to evaluate the actual performance of the RWMSs.

At Area 3 and Area 5, environmental monitoring data includes direct radiation exposure measurements; radioactive sample analysis from the air, groundwater, soil, and biota (plants and animals); radon flux density; meteorology; subsidence; and the vadose (unsaturated soil) zone moisture content. In Area 3, direct radiation monitoring data indicates exposure levels at the RWMSs are within the range of background levels measured at the NNSS. Measurements in the immediate vicinity of the disposal cells for Area 3 are often lower than the surrounding areas due to the use of clean fill for the covers. Elevated exposure levels outside of Area 3 are attributed to nearby historical aboveground nuclear weapons tests. Air monitoring data shows that tritium concentrations in vapor and americium and plutonium concentrations in particulates are below Derived Concentration Standards for these radionuclides. Radon flux measurements in Area 3 are not different from background levels and are below regulatory limits. The vadose zone extends approximately 800 feet below land surface in area 5, and 1600 feet below the surface in area 3. Evapotranspiration from the vadose zone is attributed for negating the groundwater pathway at the site. Because this evapotranspiration pathway is an essential aspect of the PA mode, vadose zone water balance, as measured by near surface lysimeter testing, has received particular attention in comparison to other sites where the water table is closer to land surface. The lysimeter data covers the near surface moisture measurement down to approximately 8 meters in depth with most surface water percolation limited to 60 centimeters or less in a vegetated final cover. Stable isotope data from the deep ground water aquifer indicates groundwater age is approximately 10,000 years and that recharge occurred during a much wetter period. Current monitoring data does not extend significantly below the waste emplacement levels. Between 1993 and 1998 neutron moisture content measurements

were taken periodically to a depth of a few hundred feet at bore holes at area 3 and area 5. Since then, the movement of moisture in the deep vadose zone between these two levels has been evaluated primarily using theory and mathematical calculations, not direct measurement. Periodic measurements of deep vadose zone moisture using neutron probe logging or similar techniques may provide additional site-specific data to assist continuing validation of the model assumption of persistent unsaturated flow conditions at depth and assure potential future environmental changes are evaluated. (**OFI-NSTec-6**)

The most recent analyzed and published lysimeter test bed monitoring data is from 2014. These water balance measurements indicate that evapotranspiration from the vegetated surfaces dries the soil and prevents downward percolation of precipitation more effectively than evaporation as measured from the bare soil. Vadose zone monitoring of Area 5 and Area 3 RWMS cell covers shows no evidence of precipitation percolating through the covers to the waste. Moisture from precipitation did not percolate below 60 centimeters (2 feet) in the vegetated final cover on the U-3ax/bl disposal unit at the Area 3 RWMS, and moisture from precipitation and irrigation did not percolate below 45 centimeters (1.5 feet) on the 92-acre area final cover. During 2014, measurements from the Area 3 drainage lysimeters that receive only natural precipitation showed there was no drainage through 2.4 meters (8 feet) of soil. During 2014, precipitation at the Area 3 RWMS was 2.6% above average, and precipitation at the Area 5 RWMS was 24% below average. Water content measurements from below the waste and approximately 8 m below the cover surface at the 92-Acre Area have not measured any changes since the sensors were installed and covered in 1999.

In Area 5, the RCRA groundwater monitoring wells are completed in the uppermost aquifer at approximately 740 feet below land surface. Contamination has not been detected in the RCRA wells and is not expected since the water balance analysis indicates surface water evaporates without penetrating to groundwater depths. The current monitoring plan requires groundwater monitoring of tritium from the wells, as well as the standard RCRA analytes. The rationale is that tritium is the most mobile nuclide and would therefore be an indicator parameter for future potential radionuclide contamination. However, many waste packages in the Area 5 RWMS contain other radionuclides with longer half-lives and higher radiotoxicity without the presence of tritium. Further, based on the modeling, the migration of tritium would be limited by the evapotranspiration processes while the other nuclides would remain in the soil and migrate in wetting fronts with each precipitation event. Since the current monitoring using liquid scintillation counter analysis is currently limited to tritium, the process is not capable of detecting and evaluating migration of these other radionuclides in the soil surrounding the disposal cells or detecting the nuclides. Current monitoring does not use techniques such as alpha and beta screening, or include the higher energy channel LSC results for the existing sampling. In accordance with DOE Manual 435.1-1 I-V R (2.) and (3.), the monitoring program shall be capable of measuring and evaluating releases and migration of radionuclides and detecting changing trends in performance to allow application of any necessary corrective action prior to exceeding the performance objectives. Although the modeling predicts that significant migration is not likely, by limiting monitoring analytes to tritium, the monitoring program is not able to satisfy these requirements to detect migration of the other constituents of the waste. (**OFI-NSTec-7**)

Current modeling in the PAs indicate that the performance objectives will be satisfied. The current monitoring data indicates that the Area 3 and the Area 5 RWMSs are performing within expectations of the model and parameter assumptions for the facilities' PAs. However, certain parameters and assumptions in the model have not yet been validated by direct measurements. The current monitoring program does not address all of the significant nuclide contributors to the source term considered in the PAs. While the conclusions of the PA models are reasonable, in some specific areas, documented testing or measurements are not sufficient to verify or validate the model assumptions and ensure that the conclusions of the PA are fully supported.

5.3.8 Closure Plan Development and Maintenance

Criteria:

Closure Plan: The disposal facility design and operation must be consistent with the disposal facility closure plan and lead to disposal facility closure that provides a reasonable expectation that performance objectives will be met. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.2, Criteria 6

Closure Plan Development and Maintenance: A preliminary closure plan shall be developed and submitted to Headquarters for review with the PA and CA. The closure plan shall be updated following issuance of the DAS to incorporate conditions specified in the DAS. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.3, Criteria 1

Prompt Closure Processes: Closure of a disposal facility shall occur within a five-year period after it is filled to capacity, or after the facility is otherwise determined to be no longer needed. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.3, Criteria 2

Institutional Controls and Monitoring: Monitoring plans shall be implemented to support verification of performance objectives during a period of post-closure administrative control. (DOE Order 435.1; DOE Manual 435.1-1, Chapter IV) CRAD 31-11, Section 4.7.3, Criteria 4

An essential aspect of operating a disposal facility is to ensure that, after the waste is in place, it will not require additional treatment, relocation, or significant long-term maintenance to satisfy the performance objectives for safety of the public and environment. Multiple sections of DOE Manual 435.1-1 reiterate the need for disposal facility siting, design, operations, and waste forms to achieve long-term stability, minimize slumping, and minimize the need for long-term maintenance.

Area 3

Manual 435.1-1 IV Q. (2) states, "*Closure of a disposal facility shall occur within a five-year period after it is filled to capacity, or after the facility is otherwise determined to be no longer needed*." Waste placement operations at the Area 3 RWMS have not been conducted since the end of June 2006, although disposal capacity is available for future disposals at two existing units, U-3ah/at and U-3bh. EA inquired whether the prompt closure requirements in Manual 435.1-1 were applicable and should be invoked. However, according to the NFO, the Area 3 RWMS could begin accepting a new waste stream as early as 2017. In the interim, NSTec plans to continue routine inspection and monitoring. NSTec expects to start closure activities at the Area 3 RWMS in fiscal year 2025. Closure activities are expected to include the development of final PA and CA documents, a final closure plan, closure cover design, cover construction, and initiation of the post-closure maintenance and monitoring activities.

The current closure plan for the active or future cells at Area 3 RWMS was approved in 2007 and follows DOE Order 435.1 and DOE Manual 435.1. According to the current closure plan, the RWMS closure will be conducted in the two phases: operational closure and final closure. Operational closure will be conducted during the operational period as disposal units are filled. Operational covers of native alluvial soil have been placed on the filled units and over emplaced waste in the partially filled units to minimize infiltration, facilitate operations, promote worker safety, and prepare the facility for final closure. As the need arises, future disposal units will be developed to utilize the available disposal areas with the Area 3 RWMS. Final closure cap installation for the other existing units and future potential units is tentatively scheduled to take place during 2025-2030. Plans for the final closure cap designs include optimization of cover thickness through formal cost-benefit analysis. Final closure is primary intended to minimize

infiltration, attenuate radon flux, and minimize release of radionuclides by plant and burrowing animal activities during the post-closure compliance period.

A final closure cover is already in place on unit U-3ax/bl (Corrective Action Unit 110) at the Area 3 RWMS. This cell was previously closed as a FFACO site and contains hazardous constituents and pre-1988 LLW. NSTec plans to continue to conduct post-closure care and monitoring for the U-3ax/bl unit in accordance with Title 40 CFR 264, Standards *for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities* and conditions set by NDEP. Active cover maintenance, and monitoring, will continue for 100 years after the facility closure in 2028. Additional institutional controls and land use restrictions for drilling or subsurface disturbance inside the UGTA determined boundaries are expected to be implemented and maintained indefinitely during closure of the Yucca Flat disposal area under the FFACO process. Institutional controls include government ownership, regulations regarding land and resource use, restrictions for drilling or subsurface disturbance, and maintenance of archival records. Based on the SME elicitation, these are estimated to be effective for a median period of 250 years. Passive controls, such as permanent markers, are expected to continue to function thereafter.

Area 5

The current closure plan for the Area 5 RWMS was prepared in 2008. The RWMS is being closed in 2 phases: closure of the 92-acre area completed in 2012 and closure of the northern expansion area anticipated in 2028.

Closure of the Area 5 RWMS disposal cells is taking place in accordance with the requirements under which each cell is regulated. As indicated in the preceding section on monitoring, some of these RCRA-related activities are regulated under the authority of the NDEP as granted by the EPA, while the radiological components are under DOE self-regulation following DOE M435.1-1. Six groups of closure units have been defined by waste type, location, and similarity in regulatory requirements: (1) Corrective Action Unit 111, (2) Asbestiform LLW Unit, (3) Pit P03U Mixed Waste Disposal Unit, (4) LLW Unit, (5) TRU GCD Borehole Unit, and (6) Expansion Area LLW Unit. The first five, which are located in the 92-acre area, were closed in 2012. The closure of the expansion area cells are scheduled to occur in 2028 when the Area 5 RWMS closes. Since NDEP approved the closure of the Corrective Action Unit 111, Asbestiform LLW Unit, and Pit 3 MWDU, the closure followed applicable state regulations.

According to the preliminary closure plan, as with Area 3, the Area 5 cells, including the RCRA cells, are planned to be closed with a monolithic cap cover of the same natural alluvium material excavated to form the cells. The thickness for the area 5 cover is anticipated to ensure that even with non-contiguous localized subsidence the cap will remain above the existing grade and continually cover the waste. The thickness is planned to be optimally designed to minimize infiltration, attenuate radon flux, and minimize release of radionuclides by plant and burrowing animal activities during the post-closure compliance period.

Following closure, active institutional controls, such as control of access, active cover maintenance and monitoring, are expected to continue for 100 years after the facility closure, currently planned for 2028. Institutional controls and monitoring for hazardous RCRA constituents are required to be conducted for 30 years following closure of the mixed waste cells according to the RCRA permit conditions negotiated with NDEP. In accordance with M.435.1-1, the closure plan, and the post closure-monitoring plan, passive institutional controls, such as markers, records, or archives, and government ownership regulations regarding land and resource use, are expected to continue after the active maintenance and monitoring period.

5.4 DOE Oversight

Criteria:

Site Office Oversight Program: Oversight processes are tailored according to the effectiveness of contractor assurance systems, the hazards at the site activity, and the degree of risk, giving additional emphasis to potentially high consequence activities. (DOE Order 226.1b section 4.b (5))

Facility Representatives: Facility Representatives (FR) provide effective routine operational awareness to determine that the contractor is operating DOE facilities in a safe manner. (DOE Order 226.1b and DOE STD-1063-2006)

Safety System and Safety Management Program Oversight: The DOE field element has established and implemented effective processes using Safety System Oversight and Subject Matter Experts in formal assessments and routine operational awareness activities to apply engineering and/or discipline specific expertise in its oversight of the assigned safety systems, to monitor performance of the contractor's cognizant system engineer programs, and to provide assessment and oversight of the safety basis, and associated safety management programs. (DOE Order 226.1b and DOE Order 426.1 appendix D)

Reports, Notifications, and Approvals: DOE Field Offices submit reports to and request approvals from the Office of Environmental Management or other line management in coordination with the Low-Level Waste Disposal Facility Federal Review Group as required. This may include RWMB documents, initial and revised Disposal Authorization Statements, annual Performance Assessment and Composite Analysis reports, and annual activity reports. (DOE Manual 435.1-1 Chapter 1 and Chapter 4)

NFO uses an internal process directive, NFO Order 226X, Rev2, *Federal Oversight Program*, outlining roles, responsibilities, authorities, and accountabilities for oversight of the facilities at the NNSS. The directive appendices provide appropriate direction for expectations and implementation of the contractor assurance system governance and oversight conducted by NFO contract management personnel, operational awareness activities conducted by FRs and NFO SMEs, and formal planned assessments conducted either as self-assessments by the contractors and corporate entities, external audit teams, or NFO SMEs. NFO last updated this internal directive in February 2016. The NFO internal process directives apply to both the NNSA and EM line organizations at NNSS, which operate well together under the umbrella of the NFO, sharing resources and SMEs where practical.

EA interviewed NFO contract management and performance assurance personnel regarding the performance metrics and issues management processes used for assessing the performance at the RWMSs. NFO uses an electronic dashboard system to track contractor performance, including environmental and safety issues. The system tracks metrics specific for each facility at NNSS, including the environmental management processes and results for the Area 3 and Area 5 RWMSs, as well as the overall assessment of NSTec and the other contractor organizations. The dashboard input is continually updated and NFO management reviews the metrics on a monthly basis. NFO contract management conducts biweekly meetings with NSTec management to ensure progress and address issues. EA reviewed some output reports related to the NSTec RWMS and found the metrics are appropriate and the processes are effective for contract management.

In addition to the CORS for the NSTec Area 3 and Area 5 operations and Navarro scope of work, the EM organization within NFO has two radioactive waste SMEs specifically assigned to support waste management operations at the RWMSs. The senior SME also serves as the NFO representative to the LFRG and actively participates in LFRG reviews, assessments, meetings, and policy discussions throughout the DOE complex. The senior SME also actively participates in oversight of the RWAP

processes and activities supporting WAC reviews and generator assessments. The other SME provides appropriate backup for the senior SME and was the lead assessor for a December 2015 NFO formal assessment of the radioactive waste management practices at NNSS, "*Oversight Assessment Report for NSTec Area 5 Radioactive Waste Management Complex Low-Level Waste (LLW) Program – DOE Order 435.1*." The 2015 NFO assessment used selected objectives, criteria, and lines of inquiry from EA CRAD-31-11, *Low-Level Radioactive Waste Management Criteria Review and Approach Document*. The 2015 NFO assessment noted one finding that not all aspects of the RWMB had been reviewed and approved by NFO following a 2012 modification to the area 5 RWMB addressing disposal of non-radiological, non-hazardous classified wastes. The 2015 NFO assessment provided documentary evidence of effective site-office oversight. NFO also provided significant evidence that NFO SMEs and FRs are performing appropriate operational awareness and formal assessments, spending a significant portion of their time with direct field oversight activities. The safety basis for the RWMSs does not require safety significant structures, systems, and components (SSCs) but does operate under the controls and limitations of safety management programs (SMPs). EA interviews of SMEs and document reviews verified that NFO SMEs for the radiological control, industrial safety, and waste management SMPs are actively engaged with safety basis reviews, Un-reviewed Disposal Question (UDQ) processes, and other issues review and resolution processes related to the RWMSs. EA also reviewed a sampling of documentation of the NFO staff Technical Qualification Program. Based on this sampling EA concluded that NFO effectively tracks and manages qualifications, and the NFO staff are appropriately qualified for their assigned responsibilities.

EA reviewed the documentation of the annual PA, CA, and annual report submissions to the LFRG. In recent years, there has been some delay with respect to LFRG review and response to the annual updates submittals from the sites, and some modifications to the submissions due dates because of LFRG reorganizations and personnel changes, but NFO submissions are timely and up to date.

Within the scope of this review, EA determined that NFO has established and implemented effective oversight processes that evaluate the adequacy and effectiveness of the contractor's radioactive waste management program.

6.0 FINDINGS

EA identified no findings during this assessment. Deficiencies that did not meet the criteria for a finding are listed in Appendix C of this report, with the expectation from DOE Order 227.1A for site managers to apply their local issues management processes for resolution.

7.0 OPPORTUNITIES FOR IMPROVEMENT

EA identified some OFIs to assist cognizant managers in improving programs and operations. While OFIs may identify potential solutions to findings and deficiencies identified in appraisal reports, they may also address other conditions observed during the appraisal process. EA offers these OFIs only as recommendations for line management consideration; they do not require formal resolution by management through a corrective action process and are not intended to be prescriptive or mandatory. Rather, they are suggestions that may assist site management in implementing best practices or provide potential solutions to issues identified during the assessment.

OFI-NSTec-1: Consider incorporating shipment- or package-specific source term emergency hazard evaluations into the work planning and control processes to ensure adequate means of detecting and responding to an off-normal condition. In particular, evaluate waste containers that, if breached, have

potential for release of dispersible powders, aerosols, or other contaminants that could result in worker uptake doses that are significantly higher than the external dose hazards represented by the contained source.

OFI-NSTec-2: Consider modifying the NNSS WAC to include a requirement that waste shipments not be released from the generator site for transport until the PSDR upload is complete and compliance checks have been accomplished to ensure that NNSS is aware of the shipment-specific source conditions and prepared for receipt.

OFI-NSTec-3: Consider instituting procedural requirements for use of additional periodic measurement and surveillance methods, such as assays, radiographs (RTR), spectrographic measurements (NDA), and intrusive physical inspections, as recommended by DOE Guide 435.1-1 to verify the generator's certification and to supplement current manifest document reviews and RWAP WAC certification program assessments.

OFI-NSTec-4: Consider establishing specific records retention periods longer than 75 years consistent with recommendations in DOE Guide 435.1-1 *Implementation Guide for use with DOE M435.1-1 Chapter IV* for applicable waste management and disposal records. Include any records that identify physical, chemical, and radiological characteristics of the waste and the certification of that information that may be needed to assist activities throughout the post closure maintenance, monitoring, and institutional control periods.

OFI-NSTec-5: Consider instituting a policy, practice, and procedure implementing personnel and equipment clearance checks following disposal cell operations as a precaution to minimize potential for offsite migration or uptakes of undetected contamination from a breached or leaking waste container.

OFI-NSTec-6: Consider using periodic deep vadose zone moisture content measurements at the Area 5 RWMS to increase confidence and continued validation in modeling assumptions of moisture migration at depth and assure site specific evaluation for potential future environmental changes. Measurements utilizing neutron probes or similar bore hole logging technology may provide additional data at depths and locations not covered by the current monitoring systems.

OFI-NSTec-7: Consider enhancing the existing groundwater sampling and analysis processes by using alpha and beta screening techniques, similar analysis such as the higher energy channel LSC data, and/or other spectroscopy measurements to detect other radionuclide constituents of the waste in addition to tritium.

Appendix A
Supplemental Information

Onsite Dates of Assessment:

Scoping: August 8-11, 2016
Data collection: August 29 – September 1, 2016
Data collection WAC Audit Observations: September 13-15, 2016

Office of Enterprise Assessments (EA) Management

Glenn S. Podonsky, Director, Office of Enterprise Assessments
William A. Eckroade, Deputy Director, Office of Enterprise Assessments
Thomas R. Staker, Director, Office of Environment, Safety and Health Assessments
William E. Miller, Deputy Director, Office of Environment, Safety and Health Assessments
C.E. (Gene) Carpenter, Director, Office of Nuclear Safety and Environmental Assessments
Patricia Williams, Director, Office of Worker Safety and Health Assessments
Gerald M. McAteer, Director, Office of Emergency Management Assessments

Quality Review Board

William A. Eckroade
John S. Boulden III
Thomas R. Staker
William E. Miller
C.G. (Gene) Carpenter
Michael A. Kilpatrick

EA Site Lead for the Nevada National Security Site

Timothy Mengers

EA Reviewers

Timothy Mengers – Lead
Joseph Lischinsky
Mario Vigliani
Thomas Naymik

Appendix B
Key Documents Reviewed, Interviews, and Observations

Documents Reviewed

- DOE/NV—1538-Rev. 1, *Underground Test Area (UGTA) Closure Report for Corrective Action Unit 98: Frenchman Flat Nevada National Security Site, Nevada*, June 2016.
- DOE/NV/11718—003-REV.1, *Site Characterization Data from the U3ax/bl Exploratory Boreholes at the Nevada Test Site*, August 2005.
- DOE/NV/11718-198, UC-721, *Hydrogeologic Characterization of U-3bh Collapse Zone: Data Report*, February 1998.
- DOE/NV/11718—199-REV.1, *Hydrogeologic Characterization of the U-3at Collapse Zone*, August 2005.
- DOE/NV/11718—1271, DOE/NV/25946—042, *Hydrogeologic Characterization of the U-3bl Collapse Zone*, September 2006.
- *DOE/NV, Consequences of Subsidence for the Area 3 and Area 5 Radioactive Waste Management Sites, Nevada Test Site (Working Group Report)*, March 1998.
- ITLV/13052-121-Rev. 0, *Lessons Learned from the Frenchman Flat Corrective Action Unit Groundwater Flow and Radionuclide Transport Model*, September 2000.
- N-I/28091-004, S-N/99205-122-Rev. 1, *Phase II Transport Model of Corrective Action Unit 98: Frenchman Flat, Nevada Test Site, Nye County, Nevada, January 2010*.
- *NS Technologies, LLC, Parameters for the Area 5 GoldSim Model*, (under contract number DE-AC52-06NA25946) October 2015.
- DOE/NV-325- Rev. 10a February 2015, *Nevada National Security Site Waste Acceptance Criteria*
- SOP-2151.238, *Off-Loading 10-160B Cask* (SBI)
- SOP-2151.235, *Vertical Off-Load and Re-Assembly of the TN RAM Cask*
- SOP-2151.207, *Radioactive Waste Management Site (RWMS) Inspections* (SBI)
- SOP-2151.203, *Low-Level Waste Handling and Storage Program* (SBI)
- SOP-2151-234 *Radioactive Waste Operations Craft Activities* (SBI)
- SOP-2151.203 *Job Hazard Analysis*
- SOP-2151.453, *Area 5 Radioactive Waste Facilities Decontamination Procedure* (SBI)
- SOP-2151.237, *Off-Loading Greater Control Low-Level waste Using NAC-LWT Cask* (SBI)
- OP-2151.205, *Entry and Exit Control Program for the Area 3 & 5 Radioactive Waste Facilities* (SBI)
- OP-2151.522, *Radioactive Inventory Control Program* (SBI)
- OP-2151.233, *Low-Level Waste Shipment Administrative Procedure*
- Waste Shipment Folder contents for Shipment POL16255
- Waste Shipment Folder contents for Shipment INL16038
- Waste Shipment Folder contents for Shipment INL16036
- Waste Shipment Folder contents for Shipment BWL16041
- Waste Shipment Folder contents for Shipment ORL16232
- Waste Shipment Folder contents for Shipment ORL16238
- Waste Shipment Folder contents for Shipment ORL16239
- Waste Shipment Folder contents for Shipment PFL16110
- Waste Shipment Folder contents for Shipment DRL16187
- Waste Shipment Folder contents for Shipment INM16054
- LWIS print out of PSDR Shipment # DRL16187
- LWIS print out of PSDR Shipment # INL16048
- LWIS print out of PSDR Shipment # INM16054

- LWIS print out of PSDR Shipment # ORL16229
- LWIS print out of PSDR Shipment # ORL16232
- LWIS print out of PSDR Shipment # ORL16238
- LWIS print out of PSDR Shipment # PFL16110
- PRE-JOB BRIEFING & POST-JOB BRIEFING (Off-Loading 10-160B Cask (SBI) 8-11-16
- Dose Rate Information E-mail Shipments INL16048 INL16054 (002)
- ALARA Planning Spreadsheets Shipment INL16048 (002)
- ALARA Planning Spreadsheet DRL16187
- Radiological Survey Report 8/11/16 (DRL16187)
- DRL16187 Radiological Survey Report
- ALARA (FRM-1420) for 16-0005-01
- Waste Profile ORTN000000039, Rev. 11
- Waste Profile ORTN000000040,, Rev. 5
- Waste Profile INEL166322NR0, Rev. 1
- Waste Profile INEL16004854N, Rev. 6
- Waste Profile PERM000000033, Rev. 1
- Waste Profile ORTN000000030, Rev. 14
- BCLADOEOSRPSS, Rev. 2 waste profile documents
- LWIS Desktop Instructions
- Radiological Work Permits (RWP 16-0005 1-5)
- DOE/NV/25946--801 REVISION 2 NEVADA NATIONAL SECURITY SITE RADIOLOGICAL CONTROL MANUAL
- OP-0441.306, Radiological Work Permit (RWP) Process
- CD-0441.005, *Radiological Work Permit (RWP) Process*
- SOP-0441.211, *Direct and Indirect Surveys*
- SOP-0441.207 *Portable Radiation Monitoring Instrument Operability*
- SOP-0441.206 *Operation of the Tennelec Series 5 Low Background Counting System*
- WMIS User's Guide
- LWIS User's Guide
- Radiological Survey Report 8-9-16
- Radiological Operations Survey Plan Area 3 5 11-008 (002)
- Pre-Brief and Post-Debrief 8-9-16
- Plan of the Day 8-9-16
- PLN-1022, *Health and Safety Plan for the Area 3 and 5 Radioactive Waste Management Facilities*
- CCD-QA05.001-003, *Activity Level Hazard Analysis Process*
- CCD-QA05.001-006, *Technical Procedure Process and Use*
- CCD-QA05.001-007, *Plan of the Day/Plan of the Week*
- CCD-QA05.001-008, *Time Out/Stop Work*
- CCD-QA05.001-009, *Pre-Job Briefings and Post-Job Debriefings*
- CCD-QA05.001-010, *Activity Level Work Document Writing Requirements*
- CD-G022.003, *Mobile Crane Inspections*
- CD-G022.004, *Mobile Crane Operations and Construction/Demolition Rigging*
- CD-G022.005, *Rigging Inspections*
- CD-P280.001, *General Safety Rules*
- CD-P280.009, *Back Injury Prevention Program*
- CD-P280.024, *Inclement Weather Protection (Severe Weather*)
- CD-P280.031, *Barricades and Traffic Control*

- CD-P280.034, *Personal Protective Equipment*
- CD-P280.039, *Ladder Safety*
- CD-P280.042, *Powered Industrial Trucks*
- CD-P280.043, *Aerial Work Platforms/Lifts*
- CD-P450.003, *Hearing Conservation Program*
- CD-P450.011, *Heat and Cold Stress*
- CCD-QA05.001 *NSTec. Integrated Work Control Process*
- CCD-QA05.001-003 *Activity Level Hazard Analysis Process*
- CCD-QA02.001-*Training Program Manual*
- PD-0001.002-*Quality Assurance Program*
- CCD-QA04.003-*Records Management*
- CD-2120.019-*Emergency Preparedness and Response*
- OA-AMEM-15-035 - *December 2015 Oversight Assessment Report for NSTec Area 5 Radioactive Waste Management Complex (RWMC) Low-Level Waste (LLW) Program - DOE Order 435.*1
- DOE/NV/25946--2736 February 2016 *2015 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*
- CSR-1490.100 rev 0 August 2002 *Nuclear Criticality Review of Low Level Waste Disposal at the Nevada Test Site Radioactive Waste Management Sites.DOE/MMSA/NFO Technical Qualifications Program Performance Metrics,* August 31, 2016
- *Nevada Field Office Technical Qualifications Program Status* August 2016
- NFO Organization Chart July 2016
- NFO Order 226.X Rev 2, February 17, 2016 *Federal Oversight Program*
- *Disposal Authorization Statement for the Department of Energy Nevada Operations Office Area 3 Radioactive Waste Management Site low Level Radioactive Waste Disposal Facility*, Rev 0, October 20, 1999
- *Disposal Authorization Statement for the Department of Energy Nevada Operations Office Area 5 Radioactive Waste Management Site low Level Radioactive Waste Disposal Facility*, Rev 0, December 5, 2000
- DE-AC08-96NV11248 *Consequence of Subsidence for the Area 3 and Area 5 Radioactive Waste Management Sites Nevada Test Site (Working Group Report)* March 1998
- RWAP FY 2016 Summary of Facility Evaluations and Verifications
- RBMS: RWAP-1801 Rev 0. *Waste Generator Document Review and Acceptance*
- RBMS PA-1501 Rev 0, June 14, 2016 *Assessments Program*
- Navarro Waste Traceability Checklist
- Navarro Radiological Waste Characterizations Checklist
- Navarro Chemical Characterization Checklist
- Navarro Quality Assurance Checklist

Interviews

- Vadose Zone and Groundwater Sampling Technician
- UGTA Groundwater Modeling Manager
- PA and CA Modelers
- NSTec. Area 5 Operators
- NSTec. Area 5 Shift Manager
- NSTec. Area 5 Radiation Control Technician

- NSTec. Area 5 Radiation Control Supervisor
- NSTec. Waste Specialists
- NSTec. Waste Operations Managers and Supervisors
- NSTec. Area 5 NOD Facility Manager
- NSTec. Area 5 Operations Manager
- NSTec. Radiation Protection Operations Supervisor
- NSTec. Radiation Protection Program Manager
- NFO acting Chief of Staff and Performance Management SME
- FR for area 3 and 5 RWMAs
- NFO Criticality Safety SME
- NFO Radiation Safety SME
- NFO Training and Technical Qualifications Manager
- NFO Radioactive Waste SMEs
- Navarro RWAP Assessment Team lead
- Navarro RWAP Chemical Waste Characterization Auditor
- Navarro Waste Traceability Auditor
- Navarro Radiological Waste Characterization Auditor

Observations

- Area 3 and Area 5 Monitoring Stations
- Area 5 Waste Cells and Cover
- Area 3 Waste Cells, Completed Cover and Interim Cover
- Area 3 Crater Erosion and Vegetation
- LLW Shipment Receipt and Acceptance of Waste Shipments into Area 5
- Area 5 Disposal Cells Waste Placement Operations
- Area 5 PODs and Shift Turnover Meetings
- Area 5 Pre-job briefings for Waste Shipment Receipt and Placement including Casks, Drums, Super Sacks, Boxes and Palletized Waste Packages
- Idaho Waste Generator WAC Certification Program audit

Appendix C
Deficiencies

The deficiency that did not meet the criteria for a finding is listed below, with the expectation from U.S. Department of Energy Order 227.1A, *Independent Oversight Program*, for site managers to apply their local issues management processes for resolution.

- National Security Technologies, LLC has not followed all OP-0441.306 and CD-0441.005, *Radiological Work Permit Process*, requirements related to radiological work permit (RWP) development at Area 5, resulting in overly broad RWPs that are incorrectly classified as standing RWPs, a lack proper delineation of tasks and/or sub-tasks, and a lack formal linkage to all applicable technical work documents.