

The Evolution of the Nevada National Security Site Waste Acceptance Criteria - 15312

J. Poling, P. Arnold, G. Geisinger, S. Gordon
National Security Technologies, LLC (NSTec)
P.O. Box 98521, Las Vegas, NV 89193-8521, U.S.A.

R. Boehlecke
U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office
P.O. Box 98518, Las Vegas, NV 89193-8518, U.S.A

INTRODUCTION AND SUMMARY

The *Nevada National Security Site Waste Acceptance Criteria* (DOE/NV--325) is an evolution of requirements spanning almost three decades of waste acceptance at the Nevada National Security Site (NNSS). The original waste acceptance criteria (WAC) document was written in 1978 (document NVO-185) and underwent multiple revisions as time passed and disposal experience was gained. This document came into being when the NNSS first started receiving significant quantities of low-level radioactive waste (LLW) from offsite U.S. Department of Energy (DOE) generators, such as the Mound and Rocky Flats Plants.

The original WAC was far less prescriptive and rigorous than the current criteria since many of the current DOE order directives, Federal/State laws, and regulations did not exist. The current WAC reflects the results of numerous revisions in order to address the nuances of the varied waste streams and package configurations accepted for disposal at the NNSS. This includes waste streams that exhibit challenges not previously faced or covered by the WAC and therefore, from time to time, require new information and or changes to be made to the WAC. These wastes now represent a growing percentage of the remaining waste at cleanup sites across the DOE Complex. These waste streams present challenges, such as the technical basis for ensuring safe transportation to and disposal at the NNSS. The current WAC (Rev. 10 dated June 2013), is available online at:

http://www.nv.energy.gov/library/publications/Environmental/DOENV_325.pdf.

Other challenges for the NNSS include incorporating new and emerging technologies and addressing stakeholder concerns. Addressing these challenges sometimes results in changes to the NNSS WAC. Drivers for revising the NNSS WAC over the years have included operating experience improvements, the need to specify waste origin/ownership, and identifying preferred transportation routing. This paper will discuss various aspects of the NNSS WAC, and how it has evolved based upon DOE orders and requirements, acceptance of offsite mixed wastes, acceptance of non-radioactive classified wastes, stakeholder concerns and agreements, and the changing face of the remaining legacy waste at DOE sites across the United States.

BACKGROUND AND HISTORY

The DOE National Nuclear Security Administration Nevada Field Office (NNSA/NFO) Environmental Management organization is charged with the responsibility to carry out the disposal of onsite and offsite defense-generated and research-related LLW at the NNSS. Core elements of this mission include ensuring that disposal takes place in a manner that is safe and cost-effective while protecting workers, the public, and the environment.

In 1953, disposal was first established in Area 5 for onsite LLW generated as a result of weapons testing activities. During the 1950s, waste management consisted mainly of fencing large areas containing above-ground contaminated debris. The first disposal cell, a trench identified as Sugar Bunker, was excavated into the Area 5 alluvium in January 1961. This bunker (shown in Figure 1) was located approximately one-half mile south of the present day Area 5 Radioactive Waste Management Site (RWMS).

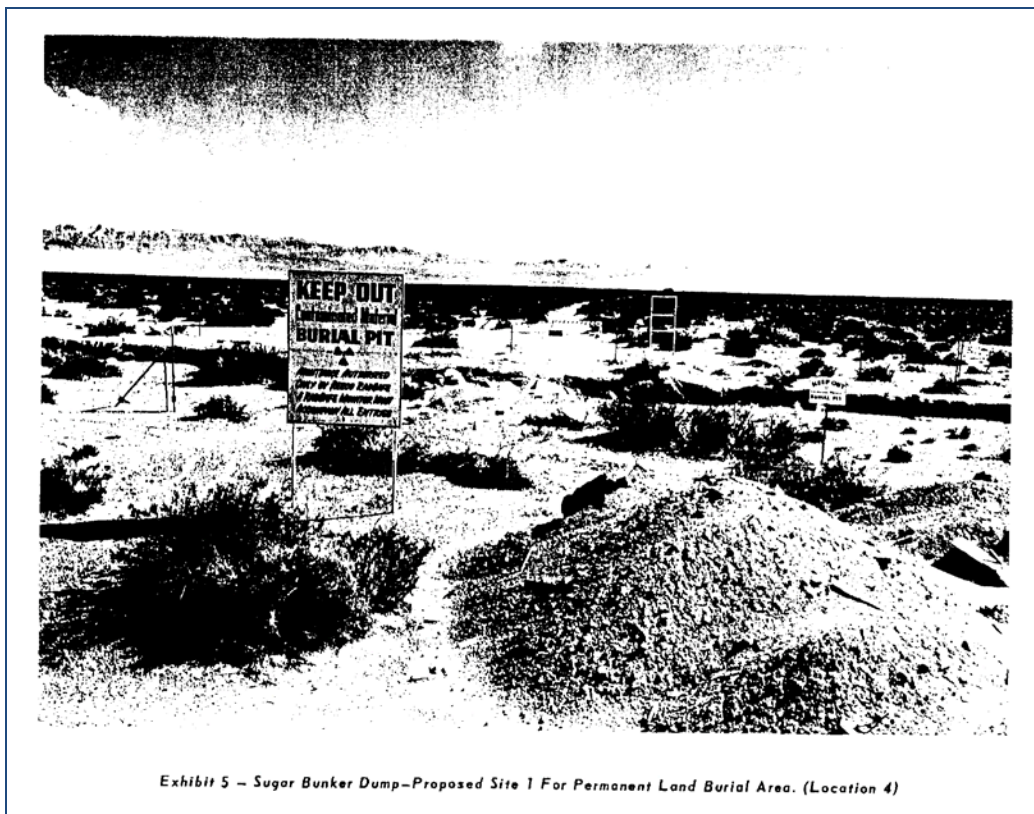


Figure 1. Historical Sugar Bunker Disposal Area

In July 1961, the Radiological Safety Division of Reynolds Electrical & Engineering Co., Inc. (a former Management & Operating Contractor) published a proposal which recommended the consolidation of accumulated waste on the NNSS into two locations, one of which is the present-day Area 5 RWMS and another in Area 3.

Beginning in 1963, individual waste shipment records were used to document key information - including the date received, origin of the waste, waste identification, type and number of each

container, approximate volume, estimated activity in curies, radiation levels at one foot, method of delivery, date of disposal, disposal location, and a section for remarks. This "Radioactive Waste Disposal Record" was in use from 1963 through 1978, when an electronic database replaced the paper records. See Figure 2 for a sample of the paper records.

RE-847 (54) 20

REYNOLDS ELECTRICAL & ENGINEERING CO., INC.
RADIOLOGICAL SCIENCES DEPARTMENT
AEC CONTRACT AT(29-2)-162

RADIOACTIVE WASTE DISPOSAL RECORD

DATE RECEIVED: 11/27/65 DATE OF DISPOSAL: 11/27/65

ORIGIN OF WASTE: Rad/ Safe Bldg #155

QUANTITY & TYPE OF CONTAINERS: 14 plastic bags

APPROX. TOTAL VOLUME (FT³): 44

mR/hr @ 1 FT. (EACH CONTAINER): .05

ESTIMATED RADIOACTIVITY (MILLI-CURIES):** 0.140 = 1.4 x 10⁻¹

METHOD OF DELIVERY TO DISPOSAL SITE: pick up truck

DISPOSAL LOCATION: UA-2, Sugar Bunker

DESCRIPTION: Contaminated waste in plastic bags

MONITOR: Billie L. McAllister

* ONE (1) PLASTIC BAG 36"X 54" FULL OF WASTE - APPROXIMATELY 4 CUBIC FEET.

** RULE OF THUMB FORMULA FOR DISPOSAL ESTIMATION OF RADIOACTIVITY FOR UNKNOWN ISOTOPES OR MIXED FISSION PRODUCTS:
 0.2(mR/hr @ 1 FT.) = MILLI-CURIES.

ALL ITEMS (PLASTIC BAGS, BOXES, CONTAINERS, ETC. OF CONTAMINATED WASTE) ARE TO BE MONITORED SEPARATELY.

REMARKS: _____

DISTRIBUTION:
 WHITE - RAMATROL
 PINK - AGENCY OR ACTIVITY
 YELLOW - AEC/NVCO

Figure 2. Sample of Paper Disposal Record

In 1978, an assessment was performed for use of the NNSS as a radioactive waste disposal location for offsite waste generators. The study indicated that the NNSS was a prime location for DOE to continue disposing radioactive waste due to the Government-owned buffer zones around

the NNSS, physiographic barriers, arid climate, optimal geologic and hydrologic conditions, and minimal natural phenomena disturbances. All these factors are characteristics of the area which contribute to safe and effective confinement of radionuclides associated with waste management activities.

In 1978, the DOE formally established a managed LLW disposal project at the NNSS. The two sites (Area 3 and Area 5) already accepting waste for disposal were selected to house the RWMSs. The sites, located about 13 miles (21 kilometers) apart, afforded DOE the opportunity to use at least two alternative technologies to effectively manage disposal costs: engineered shallow-land disposal cells in Area 5 and converted subsidence craters originally formed by historic underground nuclear weapons testing in Area 3. The engineered disposal cells (pits and trenches) are excavated and, consequently, more expensive to develop than the subsidence craters used at Area 3 (see example in Figure 3). Currently, the Area 5 RWMS is the base of operations for disposal, and the Area 3 craters have been placed into standby status for potential future use.



Figure 3. Example of Area 3 Disposal Crater

Subsequently, the NNSS was designated as the primary disposal location for DOE defense waste. The DOE Office of Defense Programs (DP) determined that all defense-generated waste that could not be disposed at the location on which it was generated must use the NNSS since there are no other external disposal options. This designation was continued until 1989, when numerous DP sites were placed into the DOE Environmental Management (EM) Program.

In 1987, the DOE was granted interim status under the Resource Conservation and Recovery Act to receive and dispose mixed low-level radioactive waste (MLLW) from the Rocky Flats Plant. This waste was disposed in Pit 3 at the Area 5 RWMS. Following promulgation of Environmental Protection Agency Land Disposal Restrictions, disposal of MLLW from the Rocky Flats Plant ceased in May 1990. In December 2005, the NNSS was authorized to resume disposal of offsite-generated MLLW in Pit 3 until November 30, 2010 – after which closure of Pit 3 occurred. A new RCRA Part B Permit was approved in 2011 and MLLW disposal now occurs in a new disposal unit, Cell 18 (see Figure 4).



Figure 4. Cell 18 at the NNSS

In February 2000, a Record of Decision (ROD) was issued for the Final Waste Management Programmatic Environmental Impact Statement (WM PEIS). Following issuance of the WM PEIS ROD, and the amended ROD for the NNSS Site-wide EIS, waste volumes increased

significantly in the period from FY 2001 through FY 2005, which were the peak timeframe of volume receipt from major site closures at Fernald and Rocky Flats.

Since FY 2005, annual disposal volumes at the NNSS have remained fairly consistent - with the exception of accelerated activity at EM Program sites (throughout the DOE Complex) in FY 2010 and FY 2011 funded by the American Recovery & Reinvestment Act. Current disposal activity is being influenced heavily by the closure and dismantling of former gaseous diffusion plant facilities in Piketon, Ohio, and Oak Ridge, Tennessee. The number and types of waste streams accepted for disposal at the NNSS has changed significantly in the past 10 years, and the Radioactive Waste Acceptance Program (RWAP) has evolved to accommodate these changes. A summary of waste volume totals received by fiscal year since 1980 is shown in Figure 5.

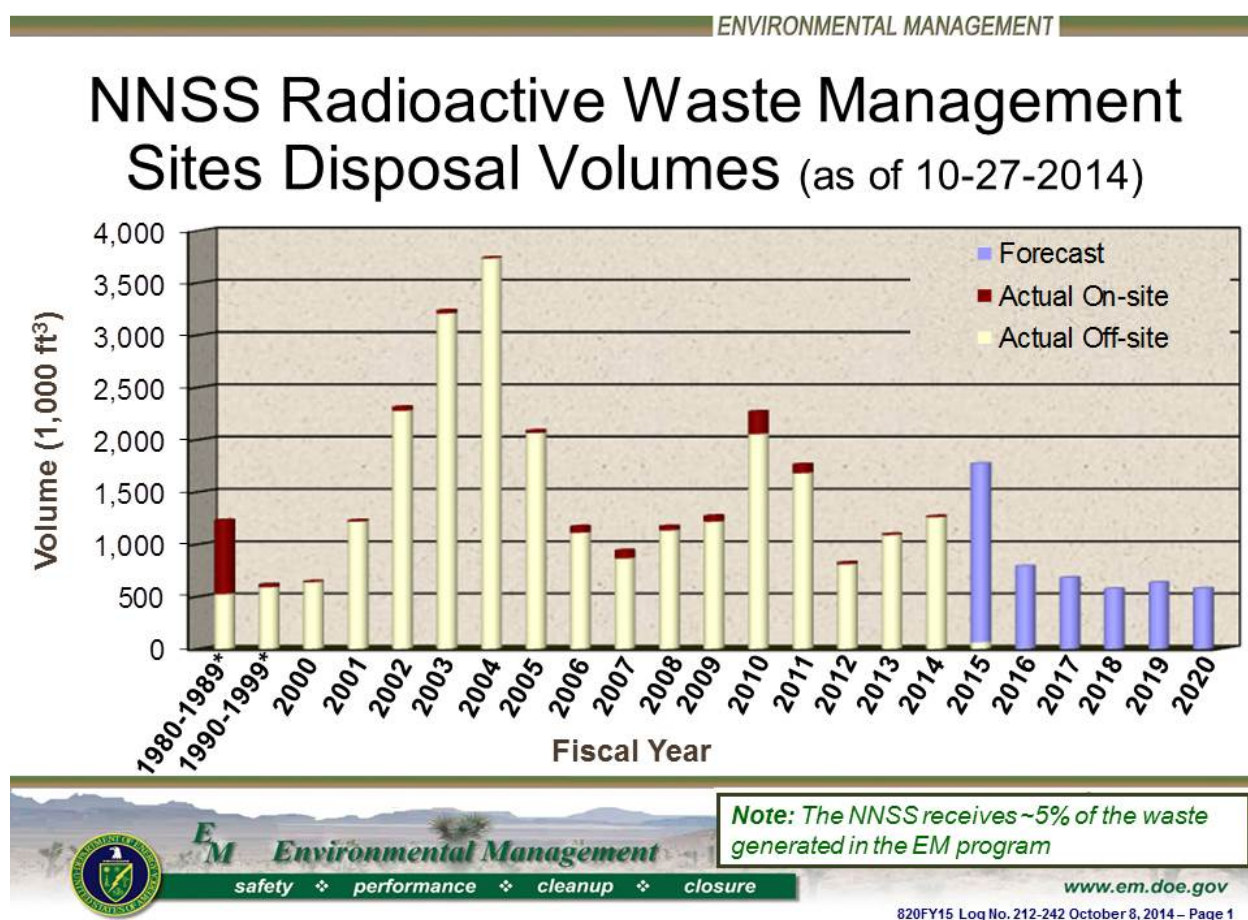


Figure 5. Summary of Total Annual Volumes Received at NNSS

Development of Waste Acceptance Criteria

The NNSS RWAP provides technical oversight and support to onsite and offsite waste generators through review of waste profiles, a coordinated audit and surveillance program that reviews generator compliance with NNSS WAC requirements, periodic complex-wide Generator Workshops, and monthly Waste Certification Official conference calls. Input on waste profile

reviews also includes evaluation of compliance with Performance Assessment requirements for the disposal facilities.

Waste generators obtain approval to ship to the NNSW by undergoing a rigorous process which certifies their compliance to the WAC. This process includes developing a site-specific NNSW WAC-compliant waste certification program and undergoing an on-site audit of the program by RWAP personnel. Once a generator is approved, each waste stream it intends to ship to the NNSW must be profiled and submitted for review by the RWAP Waste Acceptance Review Panel. This ensures that the specific waste stream meets the NNSW WAC before it is shipped.

The RWAP compliance process includes initial audits of the waste certification program, visual inspections of treatment and/or packaging, chemical screening, and the use of Real-Time Radiography (RTR). The process allows for use of varied combinations dependent upon the waste stream characteristics and treatment methodology. All chemical verification is conducted at the generator facility and performed by either RWAP personnel or by the generator with RWAP assistance. The same chemical verification methods used at Hanford are used by NNSW.

The original waste acceptance criteria issued in May 1978 (when the NNSW first started receiving significant quantities of offsite LLW) was far less prescriptive and rigorous than the current WAC document, since many of the current DOE order requirements, laws, and regulations did not exist in the 1980s. In 1988, the original waste acceptance criteria (which underwent four revisions) was replaced by what is now known as the NNSW WAC and contains an evolution of requirements (through 10 revisions) spanning almost three decades of waste acceptance at the NNSW.

When DOE Order 5820.2A, "Radioactive Waste Management" required disposal sites to have documented waste acceptance criteria, the NNSW criteria was again revised in 1996 to incorporate both the RWAP approval process and criteria changes. Performance Assessment requirements for radionuclide reporting were also added.

DOE implemented the evolving WAC through the RWAP. DOE and contractor personnel currently ensure that generator certification programs and waste streams comply with the NNSW WAC through facility evaluations and reviews of waste characterization data. The NNSW WAC has changed the focus of RWAP from auditing each generator's entire program annually to reviewing generator program and waste profile changes and conducting verification of final waste form compliance.

Waste Acceptance Criteria Changes

Over time, the WAC has been edited to include changing federal, state, operational, safety and DOE requirements. Requirements were researched for regulatory and operational necessity. Initial requirements were clarified and made consistent with DOE Order 5820.2A, which has since been replaced by DOE Order 435.1. Quality Assurance requirements changed from those in NQA-1, *Nuclear Quality Assurance -1* to DOE Order 414.1 *Quality Assurance* and Title 10 CFR 830.122, *Quality Assurance*. Each requirement in the NNSW WAC includes a reference to its regulatory driver (i.e., 49 CFR 173.45).

The transuranic radionuclide requirement was revised to add a list of isotopes for the generators to consider when validating the less than 100 nCi/g per disposal package limit. This list is intended to remind generators of other transuranic isotopes when calculating per package limits. The NNSS does not have the authorization to accept transuranic waste.

The requirement for hazardous wastes was revised to include a clarification of the State of Nevada regulations which stipulates that waste generated in another state, and considered hazardous in that state, will be considered hazardous in Nevada, even if Nevada statutes do not specifically designate the waste as hazardous (i.e., if California statutes consider a waste to be hazardous, even though Nevada statutes do not, any such waste sent to Nevada for disposal is considered hazardous waste). In addition, the *Free Liquid* requirement was changed to reflect the DOE Order 5820.2A requirement.

The *Gases* requirement was simplified to conform with DOE order language. Previous WACs added requirements for punctured aerosol cans to be recognizable by RTR and for expended gas cylinders to have the valve mechanisms removed. These requirements were changed to examples of how the *Gases* requirement may be met. The *Chelating Agent* requirement was changed to clarify that the agents of concern were unbound (free) agents. The *Explosive and Pyrophoric* requirements were split to mirror DOE Order 5820.2A.

Sealed sources present unique disposal requirements, and a Sealed Source Working Group was formed to develop appropriate waste acceptance criteria. The regulatory status of the radioactive component of the sources and shielding material was determined, and characterization and packaging requirements were developed and added to the WAC. These included having a separate waste stream for sources and detailed individual source characterization data.

The *LLW Containing Asbestos* requirements were revised to meet applicable Nevada asbestos statutes and included development of an NNSS Asbestos Operations & Maintenance Plan. These revisions included having a separate waste stream (for waste profiling) and specific package labeling. Asbestos waste was buried in a separate trench, and containers had to be segregated.

The *Strength* requirement (to enable stacking of disposal boxes changed from 4,000 lbs/ft² to 3,375 lbs/ft²). The NNSS WAC required physical testing or design engineering calculations to be used to prove compliance with this requirement. This requirement was lowered after a re-assessment of disposal site subsidence risks.

The *Handling* section was revised to specify removable skids as a preferred handling method for boxes. This removed void space between packages and reduced the risk of subsidence. It also allowed the disposal site to charge the generator for only the outer dimensions of the waste container. The *Size* requirement for boxes was removed. Although 4' x 4' x 7' standard boxes were considered the preferred size for disposal, innovative packages (i.e., Super Sacks) were permissible, and the disposal facility had to be consulted prior to approval to ensure compatibility with off-loading equipment.

The *Package Protection* requirements were simplified. The new requirements stated that the certified waste package must be secured using clips, bands, tamper-indicating-devices, or by welding.

Radionuclide reporting requirements were changed to satisfy the performance assessment for the Area 5 RWMS, which included Action Levels for 44 nuclides. To add a margin of conservatism, if the activity concentration in the final waste form exceeded one percent of the Action Level, it had to be quantified and reported to the disposal site. Additionally, if the activity concentration in the final waste form exceeded one percent of the total activity concentration, the radionuclide must be reported.

Revision 7 of the WAC was issued and became effective October 1, 2008. The bulk of the changes involved clarification of requirements with major changes involving document processing, Greater-Than-Class C waste, Polychlorinated Biphenyl (PCB) waste, and packaging. References to GTCC waste were subsequently removed from the WAC since the GTCC terminology does not apply to DOE waste classifications.

LLW containing PCBs requiring disposal in a permitted hazardous waste landfill were required to be segregated, packaged, and profiled separately from other waste streams. Since these wastes require disposal in the permitted mixed waste cell, the requirements for no free liquids, non-biodegradable sorbents, compatibility, and void space must also be met. Notification requirements of Title 40 Code of Federal Regulations (CFR) 761.61 for PCB remediation waste were also added to the WAC.

A new section regarding waste containers and shipping configurations was added. All packages must, at a minimum, meet Industrial Package One (IP-1) packaging requirements (49 CFR 173.410 and 173.411). All drums 55 gallons or less must be palletized, banded and shipped in a closed transport vehicle. Alternative shipping containers will be approved on a case-by-case basis with consent from NNSA/NFO Environmental Management Operations.

In addition to waste acceptance requirements, nuclear safety requirements are applicable under 10 CFR 830. The Area 5 RWMS is a nuclear facility and must maintain a Documented Safety Analysis (DSA). Occasional changes to the DSA drive changes to the NNSWAC. As such, the DSA increased the Plutonium 239 Equivalent-grams (PE-g) allowable for disposal based upon container strength. For waste packages that are Department of Transportation (DOT) specification 7A, Type A, or for which the generator can provide documentation of equivalence, the allowable PE-g limit per package was increased from 300 to 12,000. In addition, for waste shipments that contain only DOT specification 7A, Type A (or equivalent) package(s), the allowable PE-g limit per shipment was increased from 2,000 to 60,000. These revised PE-g requirements were incorporated in the NNSWAC, Rev. 10, in June 2013.

Performance Assessment

Implementing DOE Order 435.1 protects the public and the environment after a disposal facility closes. DOE Manual 435.1-1 sets dose limits (and other performance objectives) for releases of

radioactive material from disposal facilities. The performance assessment review incorporates a computer modeling exercise that identifies a facility design and waste inventory that will continue to meet the performance objectives under site-specific conditions for at least 1,000 years. An ongoing review of disposal facility performance assessment is required to ensure that DOE performance objectives are met for the NNSS RWMSs.

Facility construction, operation, and **waste inventory** are evaluated by the performance assessment to ensure that the site waste isolation and public health objectives are met. New or revised waste stream characteristics are compared with performance assessment waste characteristics. Wastes that are significantly different require special additional analysis, review, and approval before disposal is authorized. A process flow summary of the NNSS performance assessment review is shown in Figure 6.

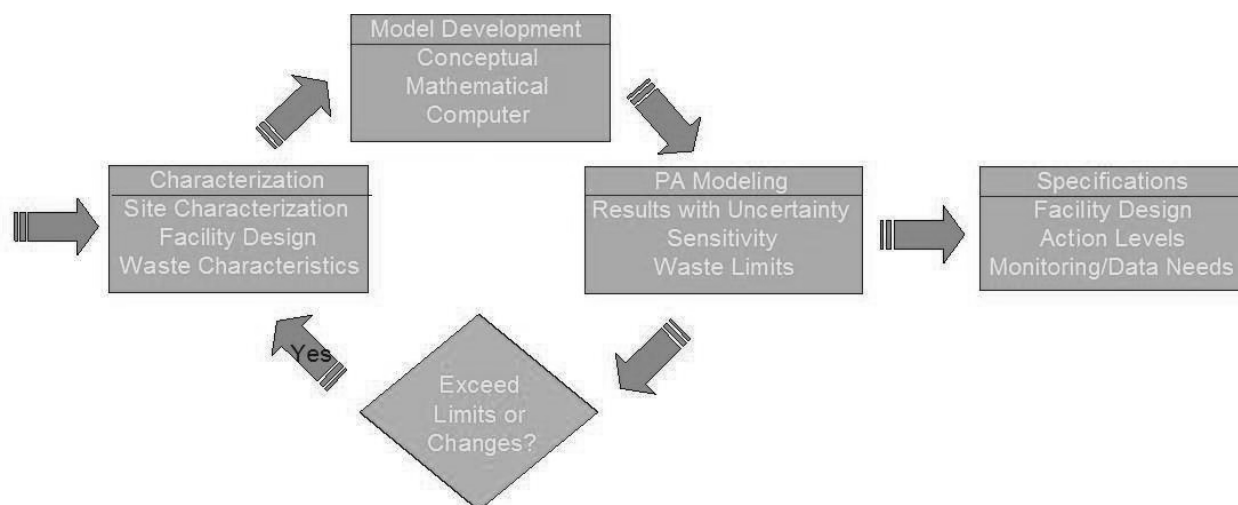


Figure 6. Summary of the NNSS Performance Assessment Review Process

Disposal of Classified Items

Prior to 2009, classified material from numerous DOE facilities was shipped to the Area 5 RWMS for long-term storage in a disposal-like configuration (burial). These storage areas were identical in design and construction to the waste burial cells and managed using the same operational procedures, but also include additional protection for classified matter. The storage was controlled by the WAC, which prevented the material from containing prohibited items or hazardous constituents that would disallow land disposal if the material had been declared “waste.”

To develop a coordinated corporate process to address classified material disposition at the NNSS, the Classified Material Disposition Task Group (CMDTG) was established by the DOE Deputy Assistant Secretary for Regulatory Compliance and the NNSA Office of Environmental Projects and Operations in June 2007. The CMDTG consisted of representatives from classification, safeguards and security, property, and waste management organizations within the DOE and the NNSA. The overall objective of the effort was to minimize the indefinite storage

of radioactive classified material that cannot be reused, declassified, or sanitized and to enable a new disposal capability at the NNSS for classified LLW/MLLW.

As a result of this group's efforts, the NNSS was designated as a classified waste/matter disposal site for non-radioactive materials (either without or with a hazardous constituent). To support this designation, two permit modifications were requested and approved:

- Existing NNSS solid waste permit for asbestiform and hydrocarbon-burdened waste was modified to allow disposal of non-hazardous and non-radioactive classified waste/matter.
- Existing NNSS RCRA permit for the mixed waste disposal unit (Cell 18) was modified to allow disposal of non-radioactive hazardous classified waste/matter.

To reflect these optimized classified matter/waste approaches, the WAC was revised to incorporate waste profiling, packaging, and transportation requirements of non-radioactive classified waste.

Stakeholder Concerns and Responses

Throughout the development of the WAC for disposal in Nevada, there has been a conscious effort to engage stakeholders at all levels and to promote identification of and open communication on issues and concerns relating to disposal of radioactive wastes.

In addition to assuring a sound technical basis, the NNSS WAC and the accompanying RWAP activities have been implemented in a manner to ensure transparency with DOE stakeholders. As part of the Agreement in Principle (AIP) with the State of Nevada, NDEP provides active participants who perform reviews of all waste profiles, assist DOE in the continuing evaluation of approved waste generator compliance, and serve as technical observers on field evaluations of generator waste certification programs. Citizen members of the Nevada Site-Specific Advisory Board (NSSAB) have also participated on RWAP evaluations of generator programs and facilities.

Stakeholder sensitivities and concerns with LLW/MLLW have included the following:

- Acceptance of unique, non-traditional, and higher-activity wastes by the NNSS
- Transportation routing of waste shipments from across the U.S. to the NNSS, with particular concern for and opposition to shipments going through the metropolitan Las Vegas Valley or across the O'Callaghan-Tillman Memorial Bridge (Hoover Dam By-Pass)
- Continued concern regarding off-loading from rail to truck inside Nevada of any NNSS-bound waste shipments
- Concerns regarding the physical transportation of sensitive or high-value wastes that might present additional security concerns

The NNSS WAC and RWAP functions contain a number of provisions that are designed to alleviate stakeholder concerns to include the following:

- Numerous WAC technical and procedural requirements established to ensure accurate characterization of wastes by generators while maintaining effective controls on regulatory compliance, nuclear safety, occupational safety, and protection of the public and the environment
- As stipulated in the Transportation Mitigation Action Plan included in the 1996 Final Waste Management Programmatic EIS, DOE has encouraged waste generators to review route selections carefully and to prohibit specific routes that involve transit through the metropolitan Las Vegas Valley or across the Hoover Dam By-pass Bridge (see Figure 7 for a sample of the route guidance that is currently provided)
- Waste generators shipping to the NNSWAC must utilize commercial carriers that have been evaluated and approved for inclusion by the DOE Motor Carrier Evaluation Program;
- Generator waste profile reviews and approvals now include initial analysis of any potential stakeholder sensitivities that may develop as a result of the nature or origin of the wastes, presence of or activity levels for specific radionuclides of concern to stakeholders, or concerns regarding the ability to meet WAC requirements
- Transparent communications between NNSA/NFO and NDEP in the spirit of the AIP
- Enhanced participation by representatives from the NDEP in the review of waste profiles, audits and surveillances performed at generator facilities, and evaluation of RWAP processes and procedures that are designed to ensure generator compliance with NNSWAC requirements
- Regular meetings with the NNSAB which are open to the public
- Grant distributed to Nevada counties to enhance emergency response capabilities that is funded by a disposal fee surcharge
- Notification of all facility evaluation results, reports, and corrective actions

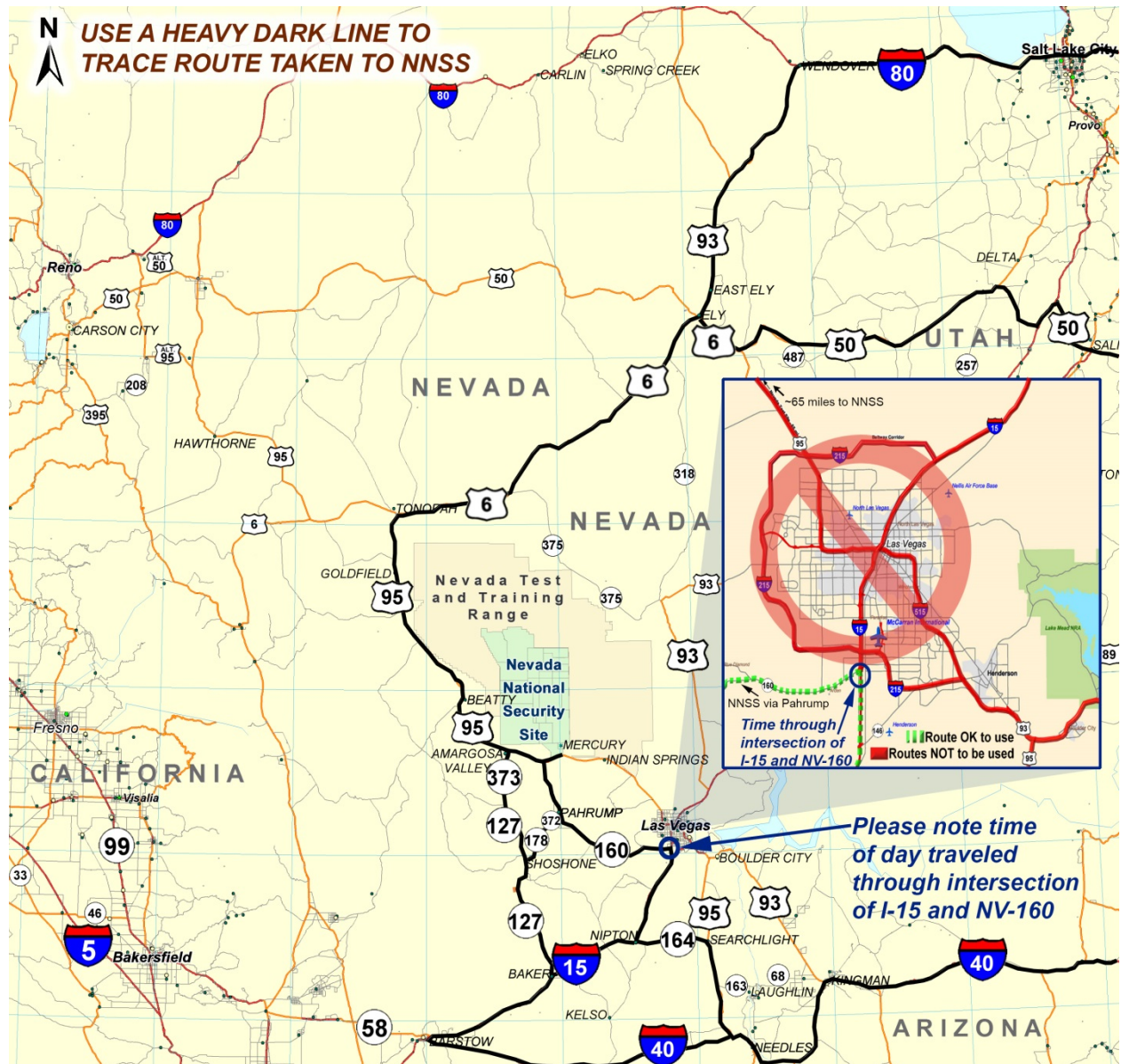


Figure 7. NNSS Shipment Routing Guidance

Current Status of Waste Acceptance at NNSS

The NNSS continues to serve as a disposal facility that supports the entire DOE Complex. During the last FY reporting period, the NNSS safely received and disposed 1.27 million cubic feet of waste in 1,405 shipments. In addition, the RWAP process reviewed 104 waste profiles and conducted 18 facility evaluations at generator locations. NDEP participated weekly on conference calls and sent representatives as observers on 11 generator site evaluations. Representatives from the NSSAB participated as observers on two generator site evaluations, attended two waste profile review meetings, and provided recommendations for RWAP process improvements.

REFERENCES

1. Krenzien, Susan K., Guertal, Rebecca M., Griffin, Wendy A., and Perkins, Brian K., “Nevada Test Site Waste Acceptance Criteria Changes.” Presented at the Waste Management 1997 Conference in Tucson, Arizona.
2. Becker, Bruce D., Di Sanza, E. Frank, Dolenc, Max R., Denton, Rose C., Hudson, Renee B., Carilli, Jhon T., and Merritt, Dona F., “A Historical Look at Nevada Test Site Low-Level Waste Disposal Operations.” Presented at the Waste Management 2005 Conference in Tucson, Arizona.
3. Pyles, Gary L., Carilli, Jhon T., Krenzien, Susan K., and Wrapp, John K., “The Changing Adventures of Mixed Low-Level waste Disposal at the Nevada Test Site.” Presented at the Waste Management 2007 Conference in Tucson, Arizona.
4. Carilli, Jhon T., Skougard, Michael G., Krenzien, Susan K., Wrapp, John K., Ramirez, Carlos V., Yucel, Vefa, Shott, Greg J., Gordon, Sydney J., Enockson, Katherine C., and Desotel, Lloyd T., “Low-Level Waste Overview of the Nevada Test Site Waste Disposal Operations.” Presented at the Waste Management 2008 Conference in Phoenix, Arizona.
5. U.S. Department of Energy, “Nevada National Security Site Waste Acceptance Criteria” DOE/NV—325-Rev.10 (June 2013)

ACKNOWLEDGEMENTS

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DOE/NV—1527