

**Multi-discipline Waste Acceptance Process at the Nevada National Security Site – 13573**

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**ABSTRACT**

The Nevada National Security Site low-level radioactive waste disposal facility acceptance process requires multiple disciplines to ensure the protection of workers, the public, and the environment. These disciplines, which include waste acceptance, nuclear criticality, safety, permitting, operations, and performance assessment, combine into the overall waste acceptance process to assess low-level radioactive waste streams for disposal at the Area 5 Radioactive Waste Management Site. Four waste streams recently highlighted the integration of these disciplines: the Oak Ridge Radioisotope Thermoelectric Generators and Consolidated Edison Uranium Solidification Project material, West Valley Melter, and classified waste.

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## **INTRODUCTION**

Generators wishing to dispose of low-level radioactive waste (LLRW) at the Nevada National Security Site's (NNSS) Area 5 Radioactive Waste Management Site (RWMS) must comply with the NNSS Waste Acceptance Criteria (WAC). A profile, documenting the waste stream's physical, chemical, and radiological characteristics is sent to the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) for disposal approval. The profile is reviewed by the Waste Acceptance Review Panel (WARP) which is made up of representatives from numerous disciplines including nuclear criticality, permitting, operations, safety, transportation, performance assessment, and waste acceptance. These disciplines ensure the waste can be safely managed at the NNSS.

The NNSA/NSO RWMS has accepted LLRW from the Department of Energy (DOE) and Department of Defense (DOD) community since 1976. Most waste streams were radioactively contaminated trash such as used personal protective equipment, paper, wood, and plastic. These low-activity waste streams had little effect on the disciplines listed above so approval did not require extensive research or analysis. However, as the DOE and NNSA community reduce their footprints and more buildings are marked for destruction, more complex and higher activity waste streams are being proposed for disposal at the RWMS. These require more coordination, scrutiny, research, and analyses to ensure the RWMS can safely accept and dispose of them.

## **DISCIPLINES AND AUTHORIZING DOCUMENTS**

The RWMS is operated under a Radioactive Waste Management Basis (RWMB) required by DOE Order 435.1, *Radioactive Waste Management*. The RWMB documents the permits, agreements, and procedures under which the management and operating (M&O) contractor operates the RWMS.

### **Documented Safety Analysis (DSA)**

The DSA describes the facility, activities, and operations; systematically identifies hazards; evaluates normal, abnormal, and accident conditions; and derives hazard controls to provide an adequate level of safety to the public, workers and the environment. The DSA also sets technical standards including limits on exposed containers within disposal units, safety buffer zones, and hazard controls. The nuclear safety and criticality representative may analyze a proposed waste stream against the DSA, technical standards, or require a criticality study to ensure safe operations.

### **Disposal Authorization Statement (DAS)**

The DAS acts as the DOE permit for operating the RWMS. A performance assessment (PA) is required to obtain a DAS. The PA documents how the disposal site meets the performance

objectives in DOE Order 435.1. The DAS also requires the disposal site to have waste acceptance criteria.

The Performance Assessment representative investigates the impact of the waste stream on the disposal site's performance assessment (PA). The PA is a rigorous process of mathematical modeling that simulates the conditions and variables of the waste and disposal site. Some waste streams only require a sum of fractions calculation to ensure compliance with the PA, others require a more detailed analysis called a special analysis. These analyses require the proposed waste stream characteristics be input into a RWMS model and a dose to man and the environment is generated. This is compared to the DOE Order 435.1, *Radioactive Waste Management* performance objectives of:

- 0.10 mSv/yr (10 mrem/yr) via the air pathway,
- 0.25 mSv/yr (25 mrem/yr) via all pathways,
- 0.74 Bq/m<sup>2</sup>-s<sup>2</sup> (20 pCi/m-s<sup>2</sup>) for radon,
- protect the inadvertent human intruder, and
- protect the groundwater

The Radioactive Waste Acceptance Program (RWAP) representatives facilitate the approval process for the NNSA/NSO and chair the WARP. The RWAP ensures compliance to NNS Waste Acceptance Criteria. The criteria consist of specific requirements for waste form, characterization, packaging, and transportation. Program personnel verify, through on-site audits, that the waste generator complies with radioactive waste management and transportation regulations.

### **Environmental Permits**

The RWMS operates under three State of Nevada issued permits: NEV HW0101, a Resource Conservation, and Recovery Act Part B permit for hazardous waste management and SW 532 and 523, solid waste permits regulating asbestos, non-radioactive classified, and hydrocarbon burdened wastes.

The Nevada Division of Environmental Protection (NDEP) has regulatory authority over these permitted facilities and has a representative on the WARP. Under the Agreement in Principle, NDEP also accompanies RWAP personnel on audits.

### **Operational Procedures**

The M&O contractor manages and maintains the Category-2 non-reactor, RWMS disposal facility, and is responsible for handling and disposing LLRW. The operations representatives ensure the waste can be safely off-loaded and disposed. A waste stream may require additional

logistics, planning, equipment, procedures, or personnel. New waste streams sometimes require new standard operation procedures (SOPs), As Low As Reasonably Achievable (ALARA) reviews, critical lift plans, set-backs for remote handling, equipment and the logistics and coordination of shipments.

### **RADIOISOTOPE THERMOELECTRIC GENERATORS (RTGs)**

RTGs are power sources fueled by radioisotope decay. They were built to be reliable power sources for harsh environmental conditions and were considered Type B containers. Oak Ridge proposed disposing of six RTGs, normally not a problem at the RWMS; however, these six introduced additional challenges.

The RTGs did not have certificates of compliance, the Department of Transportation documentation verifying the container meets Type B package specifications. The RTGs also contain large amounts of strontium, such that, since they are not in Type B packages, they exceeded the Plutonium Equivalent Gram (PE-g) DSA technical standard requirements. The Nuclear Safety Basis team reviewed the waste stream to determine if the strontium could be safely handled and disposed at the RWMS. Their analysis determined if DOT Type 7A packaging was used, the DSA limits could be raised from 300 to 12,000 PE-g and waste could still be managed and disposed safely. The RTGs meet this standard and the DSA and NNSSWAC were revised to include the new standard and requirements.

Two RTGs contained liquid mercury above the RCRA regulation limit, thus making them hazardous waste. The RCRA treatment method for mercury is amalgamation, which was not a viable option as the RTGs were self contained and breaching the outer shell would not only break the Type B package compliance but also raise dose to worker concerns. However, equivalent methods are allowed through the RCRA system. Therefore, EPA Region IV (for Tennessee) and Region IX (for Nevada) needed to agree that the RTG's robustness was equivalent to macroencapsulation, and provided an equally protective treatment method. Region IX published the required notice announcing its proposed decision for public comment. No public comments were received, so Region IX granted the equivalency and NDEP concurred, with the condition that the RTGs be disposed in the RWMS RCRA Permitted Mixed Waste Disposal Unit and all other NNSSWAC requirements were met.

The PA representative conducted a special analysis for each RTG to ensure compliance with the DAS and PA. A special analysis involves inputting the waste stream's radiological characteristics into a model of the RWMS to determine if, by disposing of the waste, the PA would be impacted. All but one RTG was in compliance with the DAS and PA. The one outlier contains nearly 22.2 Terabecquerel (600,000 curies) of strontium and the special analysis indicated problems with heat generation and the insulating properties of the RWMS soil. This

RTG was rejected and remains at the generator's site.

Due to the lack of certificates of compliance for the RTGs, they were shipped in Type B casks. Therefore, the M&O contractor needed to review the cask's Safety Analysis Reports for Packaging (SARPs) to prepare on-site procedures to open the cask, remove the RTGs, and close the cask. A shipping company representative was present for the first RTG received for disposal. The M&O contractor also developed a lift plan, requiring approval from the hoisting and rigging subject matter expert.

In all, this one waste stream of six items needed coordinated efforts from seven different disciplines and nine organizations or authorities.

### **CONSOLIDATED EDISON URANIUM SOLIDIFICATION PROJECT (CEUSP)**

The CEUSP waste stream originated from nuclear energy research on the thorium fuel cycle. The high uranium content material had gadolinium and cadmium oxide added prior to solidification for criticality safety and was subjected to high temperature denitrification. The CEUSP waste is bonded to the inside of containers and is a very stable radioactive, non-hazardous waste. The containers have an external dose of 3 Sv/hr (300 R/hr) on contact. The proposed waste stream needed RCRA, PA, Criticality, DSA, and operational determinations. Additionally, this waste stream generated public interest.

Cadmium and chromium are RCRA regulated metals. Therefore, a hazardous waste determination was conducted. The permitting team determined the cadmium was still being used for its intended purpose; that is, as a neutron poison for criticality concerns. The chromium was found to be trivalent chromium which is not a RCRA regulated metal and was therefore not an issue. NDEP agreed with the determination that the waste stream is non-hazardous under RCRA.

The PA team conducted a preliminary special analysis against the PA and determined it would not impact the RWMS compliance.

The Nuclear Safety Basis team included this material in its RTG analysis and concluded if the burial containers meet the Type 7A packaging requirements, there would be no nuclear safety concerns.

Although heavily poisoned, the CEUSP waste stream contains fissionable materials. The NNSSWAC requires a Nuclear Criticality Safety Evaluation (NCSE) for any fissionable material exceeding specific amounts. The NCSE determined that each CEUSP container must be isolated from other wastes. Therefore disposal will be in specifically prepared locations within a waste cell at the RWMS. This waste stream also requires remote handling due to the high radiation exposure, a lift plan, and worker protection requirements.

Once all the above determinations were made and approved, the WARP recommended NNSA/NSO approve the CEUSP waste stream for disposal.

## **CLASSIFIED WASTE**

### **Background**

Sanitization (the permanent elimination of classified information) requirements have historically proven challenging for large volumes of classified matter, referred to as classified waste in this paper, which cannot be readily destroyed or declassified for a variety of reasons. Until 2009 generators were allowed to ship classified waste to the RWMS to be buried for long-term storage in a disposal configuration. These burial repositories were identical in design and construction to the waste disposal cells and operated using the same procedures. With the closure of 92-acres of the RWMS proposed for 2010, the NNSA/NSO, DOE Deputy Assistant Secretary for Regulatory Compliance (EM-10) and the NNSA Office of Environmental Projects and Operations (NA-56) established a task group to coordinate a corporate process to address classified disposition at the NNSS. The task group consisted of subject matter experts from classification, safeguards and security, property, and waste management organizations within the DOE and the NNSA. They incorporated lessons learned from the classified transuranic shipments and Inspector General reports. Fortuitously, DOE Manual 470.4-4A, *Information Security* was being revised during this time frame and the task group was able to include classified matter permanent burial requirements within the Manual.

So, in 2009, NNSA/NSO, using the task group's cost/benefit analysis, security risk assessment, new institutional control policy, and generator data calls, was able to declare the legacy classified waste to be permanently buried under DOE M 470.4-4A and designate the RWMS as a Classified Waste Disposal Facility in accordance with DOE Guide 435.1, *Radioactive Waste Management*. The NNSA/NSO also discontinued classified waste storage at the RWMS.

Also, the PA was changed to incorporate the institutional control policy into the inadvertent human intrusion scenarios, which impacted the NNSSWAC radiological thresholds. The NNSSWAC was revised to reflect the new limits and include the generator requirements for permanent burial dispositions. Thus the 92-acres, which included radioactive classified and hazardous disposal units, were closed on-time in 2010.

### **Non-radioactive, Non-hazardous Classified Waste**

Since 2009, radioactive classified waste has been permanently buried at the RWMS. However, generators continued to request a disposal method for non-radioactive and non-radioactive hazardous classified waste streams.

To allow non-radioactive classified matter to be buried at the RWMS, a series of permit and waste acceptance criteria modifications were necessary. The permitting representative developed the proposed solid and hazardous waste permit modifications and worked with NDEP to ensure all necessary changes were incorporated to allow non-radioactive waste to be disposed in the RWMS. In April 2011, NDEP issued NEV HW0101 (a RCRA part B permit) allowing non-radioactive hazardous classified waste to be buried in the mixed waste disposal cell. In February, 2012 the NNSSWAC was revised to include requirements for classified non-radioactive, non-hazardous and classified matter to be buried. And in July 2012, the solid waste permit allowing non-hazardous, non-radioactive classified waste was issued.

Additionally, working closely with NDEP, the RWAP team determined that some classified non-radioactive hazardous wastes are macroencapsulated as manufactured and would not need additional treatment to meet the RCRA land disposal restrictions. The RWAP issued guidance to the generators on the requirements and documentation needed to make these determinations.

### **THE WEST VALLEY MELTER**

The West Valley Melter and its two vessels (hereafter the Melter) are pieces of radioactive equipment used in a West Valley, New York demonstration project that solidified high-level radioactive waste in underground tanks. This demonstration project was directed by the West Valley Demonstration Project (WVDP) Act of 1980. The Melter meets the waste incidental to reprocessing (WIR) requirements of DOE Order 435.1 and is therefore LLRW waste. However, the WIR determination, which requires public comment and DOE Headquarters approval, was concluded in 2012, more than five years after the waste was first proposed for disposal.

The PA team has conducted three special analyses for this waste stream because of the time frame discussed. As the RWMS accepts more waste streams each year, the special analyses needed to be updated periodically to verify the Melter was still acceptable for safe disposal. All three analyses show the Melter meets the NNSSWAC and the RWMS will continue to meet the DOE Order 435.1 Performance Objectives.

The Melter will require waste stream-specific disposal procedures; however since shipping decisions are still ongoing, the M&O contractor has postponed this work.

### **CONCLUSION**

Radioactive waste management involves multiple disciplines to ensure safety to the worker, public, and environment. Even the smallest LLRW stream can involve several different teams to ensure its safe disposal. Without these teams of dedicated individuals, LLRW could accumulate

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at the generator sites causing stakeholder concerns. The NNSA/NSO continues to use experienced, subject matter expert, multi-discipline teams to meet DOE's disposal needs.

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