The Changing Adventures of Mixed Low-Level Waste Disposal at the Nevada Test Site

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ABSTRACT

After a 15-year hiatus, the United States Department of Energy (DOE) National Nuclear Security Administration Nevada Site Office (NNSA/NSO) began accepting DOE off-site generated mixed low-level radioactive waste (MLLW) for disposal at the Nevada Test Site (NTS) in December 2005. This action was predicated on the acceptance by the Nevada Division of Environmental Protection (NDEP) of a waste analysis plan (WAP). The NNSA/NSO agreed to limit mixed waste disposal to 20,000 cubic meters (approximately 706,000 cubic feet) and close the facility by December 2010 or sooner, if the volume limit is reached.

The WAP and implementing procedures were developed based on Hanford's system of verification to the extent possible so the two regional disposal sites could have similar processes. Since the NNSA/NSO does not have a breaching facility to allow the opening of boxes at the site, verification of the waste occurs by visual inspection at the generator/treatment facility or by Real-Time-Radiography (RTR) at the NTS. This system allows the NTS to effectively, efficiently, and compliantly accept MLLW for disposal.

The WAP, NTS Waste Acceptance Criteria, and procedures have been revised based on learning experiences. These changes include: RTR expectations; visual inspection techniques; tamper-indicating device selection; void space requirements; and chemical screening concerns. The NNSA/NSO, NDEP, and the generators have been working together throughout the debugging of the verification processes. Additionally, the NNSA/NSO will continue to refine the MLLW acceptance processes and strive for continual improvement of the program.

However, the NNSA/NSO has identified DOE complex-wide issues: (1) the temporary closure of the Hanford facility to off-site generators leaves the NTS as the only Federal facility able to dispose of MLLW. If the Hanford facility is not permitted to accept waste from off-site generators after December 2010, the DOE complex will have no Federal facility to accept higher activity MLLW. It is not known if commercial disposal options for higher activities MLLW will be available by December 2010. (2) MLLW forecasts to the NTS do not fully utilize the 20,000 cubic meter capacity within five years. The DOE has urged generator facilities to re-prioritize projects and has conducted planning meetings to identify actions to increase the use of the NTS disposal capacity. (3) Generators have requested disposal of classified material in the MLLW disposal cell, however closure, safeguard termination, and "irretrievability" issues must be resolved.

INTRODUCTION

The Pit 3 Mixed Waste Disposal Unit (MWDU), located in the Radioactive Waste Management Site (RWMS) at the Nevada Test Site (NTS) was constructed in 1985 and consists of one unlined trapezoidal disposal cell. In September 1987 the Nevada Division of Environmental Protection (NDEP) concurred that the MWDU met the regulatory requirements for interim status for the disposal of Mixed Low-Level Waste (MLLW). In 1990, in response to a Notice of Deficiency (NOD), acceptance of off-site generated MLLW was prohibited. When the Waste Management Programmatic Environmental Impact Statement Record of Decision was issued in 2000, the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) submitted an updated RCRA Part B permit application for the MWDU. NDEP also required a Waste Analysis Plan (WAP) and closure plan to be submitted and accepted in accordance with previous NODs.

In a June 6, 2005 letter, DOE and NNSA committed to limiting acceptance of MLLW in the MWDU to a period not-to-exceed five-years commencing on December 1, 2005 and dispose of not more than 20,000 m^3 (approximately 706,000 cubic feet) of MLLW (from on- and off-site generators) and close the unit. In response to these commitments and the submittal of an acceptable WAP, the NDEP removed the restriction prohibiting off-site generators from disposing of MLLW at the NTS. The closure plan was submitted on schedule and also accepted by NDEP. If further MLLW disposal capacity is needed, NNSA/NSO will submit a full RCRA Part B permit application for any proposed new unit.

Limitations to the MWDU

The MWDU is limited to acceptance of a maximum volume of 20,000 m^3 of waste within a five year period not to exceed November 30, 2010. Closure of the MWDU will be initiated if the volume limit is met or the five year period ends, which ever occurs first.

There are no permitted treatment capabilities or breaching facilities at the RWMS; therefore, on-site verification at the NTS is limited to a Real-Time-Radiography (RTR) unit. Other verification is conducted at the generator site or treatment facilities by NTS

Radioactive Waste Acceptance Program (RWAP) personnel prior to acceptance and shipment to the NTS for disposal.

Waste Analysis Plan Development

The WAP describes the NTS verification program for MLLW. The verification program establishes a process to confirm that the waste received at the NTS meets the NTS Waste Acceptance Criteria (NTSWAC). The NTSWAC establishes the requirements, terms and conditions under which generators can send radioactive waste to the NTS for disposal. During the fifteen years of only on-site MLLW acceptance, the WAP consisted of the Maintenance and Operations contractor conducting characterization activities, and the Waste Certification Official observing and reviewing those actions. A waste profile was then developed and sent through the NTSWAC approval process. Small volumes of MLLW are generated at the NTS, and any mixed waste requiring treatment is typically sent to a permitted off-site treatment facility.

A process was needed to verify MLLW compliance that did not require opening containers at the NTS. The initial idea for the NTS WAP was to have "tiers" of verification dependent upon generator performance, audit findings, waste stream attributes, and treatment standards. The tiers were going to be divided by either the type of treatment (encapsulation, stabilization) or verification technique (visual, chemical). The WAP, Waste Acceptance Criteria, and RCRA permits of Envirocare (now Energy Solutions), U.S. Ecology, Hanford, Pacific EcoSolutions, Barnwell, Waste Isolation Pilot Plant, and Perma-Fix were reviewed for precedence. Additionally guidance from the U.S. Environmental Protection Agency, Waste Isolation Pilot Plant (near Carlsbad, New Mexico), and Hanford was solicited. Although not all of the facilities had disposal sites, most of the documents had consistent content and requirements that were better structured and less complicated than the tier idea.

Since the NTS and Hanford already shared a common waste profile form, the NTS decided to mirror Hanford's "*Low-Level Burial Grounds Waste Analysis Plan"* to the extent possible. This enabled NTS to start with a robust, tested process, with the added benefit of not duplicating previous efforts. By keeping the two regional disposal facilities verifications systems as similar as possible, generators could profile their wastes to both facilities with little variation of paperwork. However the NTS framework still needed to incorporate a system of inspections at generator or treatment facilities.

The NTS system includes initial audits of the waste certification program, visual inspections of treatment and/or packaging, chemical screening, and the use of RTR. The process allows for use of varied combinations dependent upon the waste stream characteristics and treatment methodology.

The RWAP consisted of a waste generator auditing program for low-level waste since inception. MLLW was added to the program and includes a process for visual verification of the final waste form. The RWAP auditors needed a mechanism to visually inspect waste during treatment to identify any prohibited items or packaging problems.

The *Pre-Treatment Notification Form* was developed to help schedule these verification trips. The form, which includes preliminary data and a treatment schedule, allows RWAP to schedule verification while the treatment is ongoing. A waste profile for the final waste form is submitted for approval through the established NTSWAC process. The approval process includes review by the Waste Acceptance Review Panel (WARP) which consists of participates from NNSA/NSO, disposal operations, performance assessment, criticality, RWAP, and NDEP. The WARP decides and documents the type and amount of visual and/or chemical verification for each waste stream.

Visual inspections include opening containers and probing the contents to determine the presence of material not documented on the waste profile, improperly absorbed liquids, and prohibited items. If the waste is being treated, the treatment and container filling process is observed. An NDEP representative also accompanies RWAP personnel on some of the verification activities. Visual observations are compared to the waste profile and container-specific information and documented.

Since both Hanford and the NTS do not accept ignitable, corrosive, or reactive wastes it was determined that Hanford's chemical screening tests would be used by the NTS. The pH test was deleted since no liquid waste forms would be accepted at the NTS. However, these qualitative fingerprint analyses would be conducted at the generator or treatment facility and scheduled such that the results were obtained prior to waste shipment.

The NTS also does not have an on-site chemical laboratory. Therefore, verification or split sampling analyses could not be performed on-site. The NTS availed itself of the established DOE Consolidated Audit Program (DOECAP) to ensure data quality of sample results. DOECAP is a complex-wide program that uses a multi-checklist audit process. The program was already a requirement for treatment facilities and laboratories providing support to DOE and therefore not an added burden to the DOE complex. The program incorporates a national standard and reporting requirements consistent with regulatory requirements. Therefore, treatment facilities and laboratories used by generators are required to have a current DOECAP audit to ensure quality data.

With all the needed elements in the WAP, and with NDEP's approval, RWAP began translating the WAP requirements into the NTSWAC and implementing procedures.

Radioactive Waste Acceptance Program Changes

The NNSA/NSO incorporated the MLLW acceptance and verification program into the NTSWAC and existing RWAP process. RWAP verification procedures were developed and the NTSWAC updated to reflect the changes.

Minimum standards for physical and chemical verification are required per the WAP. The WARP determines how much verification is needed for each waste stream and how the verification is conducted. It is important to note that NDEP was involved during the development of the process and procedures. The minimum verification is 5% of the total waste stream physically verified through either on-site verification (RTR) or off-site

verification (at the generator site during treatment), and, if applicable, 10% of that 5% would be chemically screened. The WARP evaluates each MLLW waste stream and generator's performance on a monthly basis to determine if additional verification is required.

RWAP wanted a procedure that would meet the requirements of the WAP, be easy to comply with by both the generator and NNSA/NSO, and cost effective. The *Pre-Treatment Notification Form* allows RWAP to review preliminary data and schedule verification while treatment is ongoing. The *Pre-Treatment Notification Form* is reviewed by the WARP which determines if the waste can be physically and/or chemically verified, the percentage of the waste stream requiring verification and how the verification would be completed (on-site or off-site). A *Waste Stream Verification Frequency Evaluation and Screening Method* form was incorporated into process to document this evaluation. Once the *Pre-Treatment Notification Form* was formally approved, RWAP would work with the generator to schedule both physical and chemical off-site verification if needed. All verification of waste is completed by trained personnel and documented on a *Container Verification Record*, which is based on Hanford's form of the same name. 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 at NTS. In order for RWAP to perform chemical screening a hazardous material chemical screening kit was obtained and personnel trained in the use of the kit. All chemical verification is documented on a *MLLW Chemical Screening Record*, which is also based on a Hanford form. Tamper indicating devices (TIDs) are placed on each waste container verified at the generator site. This ensures no additional waste can be placed in the container.

After completing treatment the generator submits a final waste form profile for review and approval. Any additional verification for the final waste form is identified during the review process. Following profile approval the generator notifies NTS operations of the shipping schedule and schedules on-site verification if required. For those wastes verified using RTR at the NTS, if waste fails verification, a second sample set is processed. If the second sample set passes then the failure is considered an anomaly and the shipment is accepted but the failed container is returned. If the second sample set fails verification, all non-compliant waste is shipped back to the generator at their cost.

MLLW Lessons Learned

There have been several lessons learned involving the verification and receipt of MLLW at the NTS. The following lessons learned are of significant interest to the generator community.

Polychlorinated Biphenyl's (PCB): While preparing the WAP, PCB constituents were identified as a prohibited item. However, it was identified that MLLW could contain PCBs concentrations or specifications in 40 Code of Federal Regulations (CFR) Part 761 and Nevada Administrative Code (NAC) 444.9452 for disposal in a hazardous waste landfill. The NTS had to request a permit modification and revise the WAP and

NTSWAC. It is important to make sure all requirements are consistent with regulatory standards.

Tamper Indicating Devices (TID): The initial TID's procured and used by RWAP did not withstand normal container handling operations. These failures required RWAP to re-verify these containers and apply new TID's. RWAP procured more robust TID's capable of withstanding handling operations.

Chemical Screening: Generators had concerns regarding allowing RWAP to perform the chemical screenings (i.e., additional training requirements at each site, safety concern, contractual and site issues). Therefore, RWAP does not perform the chemical screening work at the generator facilities but observes the generator or treatment facility technicians performing the work per RWAP instructions.

Real-Time-Radiography (RTR): RTR provides an x-ray of the waste without intrusion, however, there are limitations. Recently a solidified grouted waste form (block of cement) was received and processed through the RTR for verification. As expected, the RTR did not show the waste components within the matrix. After verification, NDEP expressed concerns with the inability to see everything within the matrix. Photographs showing the waste components were supplied by the generator addressing the NDEP's concern regarding the waste stream. In consequence, RWAP either visually inspects the waste prior to grouting or requires the generator to photograph or video tape the waste components and the grouting process. The RTR can be an extremely valuable verification method; however, it is imperative that its limitations are understood.

Visual Records of Waste Processing: Recorded media (e.g., pictures, videos, etc.) of the waste being generated or treated is invaluable to the verification process. Media showing the process from start to finish, including the set-up, placement of waste, solidification, and completion of the waste packaging can be used in lieu of visual verification methods. The acceptance of recorded media was incorporated into the WAP as part of the PCB permit modification mentioned above. The NDEP has found this verification method to be acceptable.

Void Space: During an off-site waste verification visit, a generator expressed concern regarding settling of compactable waste during transportation. NDEP, RWAP, and the generator discussed the possibility that the waste would not meet the 40 CFR 265.315 requirement of being at least 90% full when placed in the MWDU. In attempt to minimize the effect of transportation, the generator filled all containers greater then 100%, and added different two types of filler material using two different methods, (layering and adding after waste placement). It was agreed that the four containers would be x-rayed at the NTS to demonstrate which method would meet the requirement.

NDEP, recognizing that this could be an on-going problem for the NTS, researched 40 CFR 265.315 which is based on subsidence avoidance and closure cap integrity. Taking into consideration the NTS strength requirement, NDEP developed a regulatory clarification. This clarification sets requirements for generators which allow NDEP to

accept waste packages less then 90% full but ensures the intent of the regulation is met. The requirements are outlined below:

- Each container is initially filled to greater than 100% prior to sealing, and a filler material (vermiculite, kitty litter, etc.) is added in generous amounts to decrease the void volume to the greatest extent possible;
- Pictures or video that clearly shows this filling process are taken and linked by a tracking number to each waste container;
- Procedures are in place that clearly demonstrate that containers are as full as practicable; and
- Each container meets the NTSWAC package strength requirement.

Due to the fact that most non-solidified waste forms settle to some degree, especially during transportation, it is critical to have documentation that every effort was made during filling to reach or exceed the 90% criteria. The most important aspect of this lesson is having a working relationship with your regulator that allows you to anticipate and resolve issues.

National Issues

There are three national issues regarding the future of MLLW disposal within the DOE complex are (1) The NTS is the only Federal facility disposing higher activity MLLW since the temporary closure of the Hanford disposal facility to off-site waste generators. If Hanford does not re-open prior to December 2010 and commercial options are not available, the DOE complex will be left without a higher activity MLLW disposal option. (2) MLLW forecasted volumes for disposal at the NTS do not utilized the 20,000 m^3 capacity within five years. (3) Generators have requested disposal of classified material, however closure, safeguard termination, and "irretrievability" issues must be resolved.

Hanford

As part of a settlement agreement with the Washington State Department of Ecology, Hanford is re-writing the *Tank Closure and Waste Management Environment Impact Statement (EIS) for the Hanford Site, Richland Washington* to provide a single, integrated groundwater analysis that will cover all of the waste types addressed in the Hanford Solid Waste EIS alternatives and cumulative impact analyses. The notice of intent was published February 2, 2006 and the EIS is expected to be complete in 2008. Until the EIS Record of Decision is published and accepted, Hanford will remain closed to off-site generators and the NTS will be the only Federal high activity MLLW disposal option. Hanford's EIS MLLW estimates should remain unaffected if the NTS closes with less than 20,000 m^3, as there was an unexpected five year time limit. It is not known if a commercial disposal option will be permitted and available to the DOE complex prior to 2010.

Forecasts and Summit

In December 2004, DOE Environmental Management estimated the total volume of higher activity MLLW requiring disposal, and found the majority of the volume was not scheduled to be generated until after 2010. The DOE complex was not ready to galvanize generators to ship MLLW within the five year limit set by the commitment letters. The first forecasts of MLLW identified only five percent of the capacity being used by 2010. This low percentage prompted an October 6, 2005 memorandum, from the Principal Deputy Assistant Secretary of Environmental Management urging the complex to make use of the limited NTS MLLW disposal capability.

DOE held a generator summit in Las Vegas, September 12 – 13, 2006 to identify barriers to MLLW disposal. The objectives of the summit were to: (1) Identify and discuss the known and potential volumes of MLLW that sites will generate through site closure or project completion; (2) Identify and document the issues and reasons limiting sites' MLLW disposal forecasts during the next four years; and (3) Develop potential solutions to enable increased MLLW disposal at the NTS.

Contracts and other regulatory commitments are focused on transuranic waste disposal, not MLLW. For these priorities to change within 5 years, DOE Headquarters must re-arrange incentives, budget, and baselines in the next two years. Since DOE is already working on the 2008 budget cycle, that leaves only two years for the accelerations to be implemented and the waste shipped.

Classified Material Storage

Currently, the NTS accepts radioactive classified material without hazardous constituents for indefinite storage. The material remains retrievable and has associated security measures. Generators have requested to indefinitely store classified material with hazardous constituents in the MWDU. However, the MWDU is for the **disposal of waste** not storage, and classified material is not considered waste until it is sanitized, demilitarized, or declassified. The MWDU will be closed in accordance with a RCRA closure plan, and the closure cap will not be disturbed for any retrieval action. Possible plans of action are being considered, but are dependent upon agreement between NTS, DOE, NNSA, and Site Office security agencies.

CONCLUSION

The NNSA/NSO has developed, implemented, and improved the MLLW acceptance process for the MWDU within the last year. Internal lessons learned and regulatory input and assistance has improved and refined the process. The NNSA/NSO will continue to advance its MLLW acceptance process as national issues are resolved and new issues are identified.

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