Preparations for Mixed Waste Disposal at the Nevada Test Site

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ABSTRACT

The Radioactive Waste Management Complex (RWMC) at the Nevada Test Site (NTS) is preparing for the receipt and disposal of low-level mixed waste (MW) generated within the U.S. Department of Energy (DOE) complex. The NTS maintains and develops disposal locations to accommodate various waste forms, and is engaged in developing verification and handling processes to ensure proper acceptance and disposal. Operations at the RWMC are focused on ensuring future disposal needs can be accommodated with a maximum benefit to risk ratio. This paper addresses the programmatic developments implemented at the NTS to accommodate the receipt, verification, and disposal of MW.

The Radioactive Waste Acceptance Program (RWAP) has incorporated aspects of the Waste Analysis Plan (WAP) into the Nevada Test Site Waste Acceptance Criteria (NTSWAC). The verification program includes statistical sampling components that take into account waste form, program reliability, and other factors. The WAP allows for a conglomerate of verification techniques including visual examination, non-destructive examination, and chemical screening ensuring compliance with the NTSWAC. The WAP also provides for the acceptance of MW with most U.S. Environmental Protection Agency waste codes. The MW sent to the NTS for disposal must meet Land-Disposal Restriction standards.

To support the verification processes outlined in the WAP, a Real-Time-Radiography (RTR) facility was constructed. Using a 450 keV, 5-mA tube-head system with a bridge and manipulator assembly, MW packages can undergo non-destructive examination (x-ray) at the RWMC. Prior to the NTS accepting the waste shipment, standard waste boxes, drums, and nominally sized bulk items can be manipulated on a cart and examined directly or skewed in real-time to ensure compliance with NTSWAC requirements

An existing MW disposal cell at the RWMC has been tailored to meet the requirements of a Category 2 non-reactor Nuclear Facility. In retrofitting an existing facility to meet new requirements, several considerations were analyzed and incorporated into the final design. For Example, seismic loading considerations for disposal location performance during a postulated event resulted in several calculations and physical modifications to the existing facility.

In addition to instituting changes required for MW disposal, the NTS continues to overcome unique challenges associated with handling and disposing low-level radioactive waste (LLW). As a Nuclear Facility, the RWMC has the capabilities required to manage all types of LLW/MW,

meeting the disposal needs integral to clean up the DOE complex. With the advent of the accelerated cleanup schedule, the increase in waste generation has required a facility that can handle unique disposal requirements in a safe manner for the public, the workers, and the environment.

GENERAL INFORMATION

Nevada Test Site (NTS)

The NTS is located in Nye County, Nevada and is a portion of federally owned land withdrawn from public domain under Public Land Order 805, issued in 1952, and Public Land Order 2568 in 1961. In 1999, DOE acquired additional land for the NTS in the northwest corner of the site. In its new configuration, the NTS encompasses a 3,561 square-kilometer (km^2) [1,573-square-mile (mi^2)] area located 105 km (65 mi) northwest of Las Vegas, Nevada, in a sparsely populated region of the Great Basin desert. The NTS supports DOE waste management activities and national security-related research, development, and testing programs.

The NTS is bounded on the north, east, and west by the Nevada Test and Training Range (NTTR). The northwestern portion of the NTTR is occupied by the Tonopah Test Range. The use of the land and air space is controlled by the U.S. Air Force by a DOE Memorandum of Understanding between DOE and the U.S. Air Force (DOE, 1981) that excludes public use or access. These ranges, particularly to the north and east, provide a buffer zone between the NTS and public lands. Lands administered by the Bureau of Land Management and the National Park Service make up most of the area to the south and west. Access on and off the NTS is tightly controlled, restricted, and guarded on a 24-hour basis.

The NTS environment ranges from the Mojave Desert zone in the lower basins (elevations of 3,000 feet [ft] above mean sea level), to a transitional zone in the upper basins, and to a great basin zone at the higher elevations. Elevations range from 914.4 m (3,000 ft) at Frenchman Flat to 2256 m (7,400 ft) on top of Rainer Mesa.

Area 5 Radioactive Waste Management Complex (RWMC)

The Area 5 RWMC encompasses 2.96 km^2 (732 acres) north of Frenchman Flats in the southeast corner of the NTS. It is approximately 23 kilometers (km) (14 miles [mi]) north of Mercury, Nevada. The closest staffed facility is the Area 5 HAZMAT Spill Center, located approximately 5.4 km (3.4 mi) to the south. At the Area 5 RWMC Low-Level and Low-Level-Mixed Radioactive Waste are indefinitely stored within shallow disposal cells on the 0.57 km^2 (140 acres) currently being used for disposal activities. The Area 5 RWMC began operations in 1961 and began accepting off-site radioactive waste in 1978. The estimated closure date of the facility is 2021.

Currently there is one Low-Level-Mixed-Waste disposal cell at the Area 5 RWMC. This disposal cell has been modified to accommodate 20,000 m^3 of waste while providing maximum flexibility on size and shape constraints for waste forms. Waste received at the RWMCs is not processed, modified, or altered prior to burial. Waste and shipment containers may be added and/or excavated for retrieval, but the waste itself is disposed in the same physical and chemical state in which it is delivered.

Radioactive Waste Acceptance Program

The Radioactive Waste Acceptance Program mission is to facilitate the management of radioactive waste in a safe and compliant manner ensuring the integrity of the Nevada Test Site disposal operations while maintaining the protection of the public, the workers, and the environment.

Approval to ship waste to the Nevada Test Site is granted only after the waste generator demonstrates, compliance to Nevada Test Site Waste Acceptance Criteria (NTSWAC). The criteria consist of specific requirements for waste form, characterization, packaging, and transportation. Radioactive Waste Acceptance Program personnel provide assistance, interpretation, guidance, and technical expertise on waste acceptance criteria. Program personnel are also responsible for verifying, through on-site audits, the waste generator facility has established a program that complies with regulations regarding the management and transportation of radioactive waste. Waste is not accepted at the Nevada Test Site unless the generator meets the prescribed approval process [2].

Low-Level-Mixed Waste Disposal Operations

Subsequent to receipt, waste shipment vehicles containing waste packages that have been determined to be compliant with the NTSWAC are escorted to a disposal cell or to a designated off-loading area[1]. A radiation survey is performed to verify and document waste package exposure rates. If waste packages exhibit high radiation dose rates (> 100 mr/hr dose rate taken at 30 cm), special provisions are made for handling (e.g., use of cranes or remote handling devices). The waste packages are then off-loaded directly into a disposal cell or into a designated staging area. High radiation waste that is off-loaded directly into a disposal cell is typically nested between containers or covered immediately to reduce radiation shine and exposure to nearby workers. High radiation waste that is placed in a segregated staging location is posted accordingly. RWMS personnel then complete the radioactive waste package checklist for each package off-loaded from the shipment [1]. Waste containers placed in a designated staging area remain there until they are placed into their final location within a cell.

If RWMS personnel determine that any package is damaged or breached during off-loading or staging, work activities are halted immediately and the LLW Operations Supervisor and a Radiological Control Technician (RCT) are notified. Off-loading is temporarily suspended until satisfactory personal protective equipment (PPE) and/or threshold levels are obtained. Off-loading operations may resume once safety, containment, and handling concerns are addressed.

Prior to release, the shipping vehicle is surveyed for radiological contamination. Contamination levels must be verified to be below the release criteria listed in the Nevada/Yucca Mountain Project (NV/YMP) Radiological Control Manual (DOE/NV 2000).

WASTE ACCEPTANCE CRITERIA

DOE/NV-325 establishes the U.S. Department of Energy (DOE), National Security Administration Nevada Site Office (NNSA/NSO) waste acceptance criteria (WAC). The WAC provides the requirements, terms, and conditions under which the Nevada Test Site (NTS) will accept low-level radioactive (LLW) and mixed waste (MW) for disposal. It includes requirements for the generator waste certification program, characterization, traceability, waste form, packaging and transfer. The criteria apply to radioactive wastes received at the NTS Area 5 Radioactive Waste Management Complex (RWMC) for storage or disposal.

MW accepted for disposal must meet the applicable characterization, treatment, packaging and disposal requirements of the NTSWAC, Title 40 CFR, state of Nevada, and state-of-generation regulations. MW must meet the Land Disposal Restrictions (LDR) treatment standard requirements in Nevada Administrative Code (NAC) 444.8632 (incorporating Title 40 CFR 268.40 and 268.45), including standards for underlying hazardous constituents (UHCs). Waste meeting the alternative LDR treatment standard for contaminated soil, as defined by NAC 444.8632 (incorporating Title 40 CFR 268.49) is also accepted.

MW accepted for disposal must have one or more of the following EPA hazardous waste numbers or must be considered a hazardous waste in the state of generation. Waste Codes accepted at the NTS are D004 through D043, F001 through F009, F039, P001 through P205, U001 through U249, U271, U278, U279, U280, U328, U353, U359, U364, U367, U373, U387, U389, U394, U395, and U404.

VERIFICATION PROGRAM

Verification frequencies and methods for MW profiles are determined by the NTS Waste Acceptance and Review Panel (WARP) in accordance with RWAP procedures. The methods include: split sampling, field chemical screening, visual inspection and/or Real-Time Radiography (RTR) at the generator or treatment facility, and RTR at the NTS. A minimum of 5 percent of waste containers per the MW profiles must be physically screened by either visual inspection or RTR. Unless exempted, a minimum of 10 percent of containers physically screened must be chemically screened. Chemical screening of waste container contents will be performed by RWAP personnel at the generator's site. If a container offered for disposal is too large to be subject to RTR at the NTS, then the waste will be visually verified at the generator's site.

Visual Examination

Visual examination of MW will be performed at the generator's site during packaging operations. Visual examination will confirm that there are no prohibited items and that the waste in the container meets the requirements of the approved MW profile. Visual examination requires that the container be opened and the contents removed as needed. Homogenous loose solids shall be probed to determine the presence of material not identified on the shipping documentation or for improperly absorbed liquids. Visual observations are compared with the applicable profile information and the container-specific information in the shipment documentation. If the contents of the internal containment can be visually examined without opening to determine compliance with the above criteria, then internal containment need not be opened.

In all cases where the outermost container is a drum, 100 percent of internal contents will be examined unless safety and/or ALARA (As Low As Reasonably Achievable) situations prevent doing so, in which case the reasons for the deviation will be documented in the verification records. In all cases where the outermost container is a box (larger than 1 m3), at a minimum, 50 percent of contents within internal containment and 50 percent of bulk items present in the waste matrix will be examined. If a compliance issue occurs during the examination, further examination of waste contents must be conducted to the extent necessary to determine whether the issue is an anomaly or not. In cases where safety and/or ALARA situations prevent proper examination, the reasons will be documented.

Non-Destructive Examination

Non-destructive examination (NDE) at the NTS is achieved through the use of a 450 keV, 5 mA Real-Time-Radiography (RTR) cabinet X-ray unit. The purpose of the RTR facility is to allow visual examination, characterization, and verification of previously certified MW without physical intrusion into the packaging. Non-destructive examination at the generator's site or treatment facility is dependent on available facilities. There is no minimum standard for those systems but each facility must be able to clearly identify all items within the package offered for disposal. All containers undergoing NDE must be 100% scanned. RTR performed at the point of generation or treatment facility must provide NTS with both videotape of the container and still photos of any item that could potentially be suspect during NTS review of the video. Quality Assurance (QA) measures including, but not limited to, "lines-pair gage" and/or "step-wedge" checks (or equivalent X-Ray imaging quality indicators) shall be utilized during equipment startup. For verification activities utilizing NDE, data is observed on a video monitor and captured on videotape.

The NTS RTR x-ray system can penetrate 80 millimeters (3 inches) of Fe (iron), examine containers as large as 1.77 x 1.77 x 3 meters (70x70x120 inches), and weighing as much as 4,989 kilograms (11,000 pounds). It can also handle up to three, 321-liter (85 gallon) drums. The image intensifier converts the x-rays into black and white images in real time, providing immediate feedback to the inspector. Free liquids, pressurized containers, void space and other suspect items are quickly identified for further evaluation. Suspect items are compared to the approved waste profile and the NTSWAC for compliance. Prohibited items are videotaped and photographic prints are made for presentation to the generator for review. Waste containers determined to contain prohibited items will be returned to the generator for repackaging or forwarded to an appropriate Treatment, Storage, Disposal facility (TSDF).

Chemical Screening

NTS Verification personnel perform chemical screening on the waste streams selected during the WARP process. The chemical screening tests are designed to indicate inconsistencies with generator documentation, as well as prohibited waste characteristics. Ignitable, Corrosive, and Reactive waste characteristics can be identified with the chemical screening process. Positive indicators during the chemical screening process would indicate these characteristics and result in a failure of the container.

Chemical screening will be performed prior to the waste being shipped to the NTS. Sampling for chemical screening will be performed on only those waste forms from which a representative sample can be obtained without employing destructive measures such as grinding or size reduction. When screening is performed, at least one tamper-resistant seal/device is applied to containers deemed acceptable so that the container may not be reopened unless the seal/device is broken.

Chemical screening methods include screening for peroxides, paint filters, pH, oxidizers, water reactivity, cyanide, and sulfides. Screening methods and applications are based on the waste codes accepted for disposal. All samples must be representative and a matrix-specific method will be utilized when feasible. The chemical screening tests are designed to indicate prohibited waste characteristics. Ignitable, Corrosive, and Reactive waste characteristics can be identified with the chemical screening process. Positive indicators during the chemical screening process would indicate these characteristics and result in a failure of the container

NTS REAL-TIME-RADIOGRAPHY (RTR) UNIT

The RTR facility consists of the outer building shell, a staging area, the RTR system components, a lead shield vault, a control room, an open unused area, and support facilities. All RTR system components are located within the outer structure.

The outer building (Building 05-6) is a single-story pre-engineered steel structure defined as a radiological, nonreactor nuclear facility per DOE Guide 420.1 2 (DOE 2000) and classified as a Performance Category 2 (PC 2) facility. The original design criteria specified a 20-psf-wind load and seismic Zone 3 requirements per the 1976 UBC (UBC 1976). The building design meets the current criteria for wind and seismic natural phenomena hazard (NPH) associated with the PC 2 classification with the possible exception of the overhead components (Hand 2002b). It measures approximately 12 m (40 ft) wide by 19 m (60 ft) long, with an eave height of 4 m (12 ft). The building covers approximately 238 m2 (2,400 ft2). It is constructed of 26 gauge metal-insulated siding over steel columns and 24 gauge standing-seam metal roof-panels on steel beams. The structure sits on a reinforced concrete slab. Building 05-6 also contains an epoxy-sealed floor and sealed perimeter curbing.

The RTR components utilize approximately one-half of the building's interior space. The major RTR system components include a lead-shielded vault, waste container transfer carts, a manipulator bridge, an x ray generator, an image intensifier, a remote visual system, electronic controls and interlocks for remote control, and video recording capabilities.

A 2.5-cm (1-in.) lead-lined free standing vault houses the RTR operational components. The vault measures approximately 3.6-m (12-ft) wide by 5.5-m (18-ft) long by 2.5-m (8-ft) high. This shielding configuration reduces the measurable radiation at the exterior surfaces to less than 5 uSv/Hr (micro sieverts/hour). The vault is constructed of 2.5-cm (1-in.) thick 1.2-m (4-ft) by 2.5-m (8-ft) lead plates supported by structural steel beams and channel. The vault construction and assembly aids in minimizing the potential leakage of x ray radiation during operation by using a system of overlapping seams and labyrinth penetrations.

Monitoring the operation during container movement is performed by the use of closed circuit television cameras. One camera monitors the vault entrance and loading area. Two more cameras are placed inside the vault, on opposite sides. These cameras monitor clearances as the container transport cart moves into and out of the vault. Additionally, these cameras assist the RTR operator with positioning of the tubehead and image intensifier during x-ray generation.

The x-ray operation is controlled by an RTR operator in a freestanding, air-conditioned control room supplied with the x-ray system. From here the RTR operator has complete control over the vault, container transport cart, tubehead and image intensifier manipulation, and x-ray generation. Four 9-inch CCTV monitors present the RTR operator with real time images from the 3 CCTV cameras and the x-ray image from the image intensifier. The image intensifier converts the x-rays into black and white images in real time, providing immediate feedback to the inspector. Free liquids, pressurized containers, void space and other suspect items are quickly identified for further evaluation. Suspect items are compared to the approved waste stream and the NTSWAC for compliance. Prohibited items are videotaped and photographic prints are made for presentation to the generator for review. Waste containers determined to contain prohibited items will be returned to the generator for repackaging or forwarded to an appropriate Treatment, Storage, Disposal facility (TSDF).

DISPOSAL CELL MODIFICATIONS

Pit 3 has been partially filled and sitting idle since the late 1980's, but was identified as a disposal area for a future waste stream. Changes in regulatory requirements (DOE 1996 and DOE 2000) as well as facility designations and site requirements dictated a slope stability analysis of the existing Pit 3 sidewall slopes prior to re-opening the pit for waste disposal.

Pit 3 was constructed in the mid 1980's, with the original sidewall slopes constructed at a horizontal-to-vertical ratio (H:V) of 0.5 to 1. The slopes were excavated in alluvial material consisting of a surficial layer of silty sand underlain by inter-layered sand and gravel (RSN, 1993 and WTI, 1994). The coarse-grained (gravelly) units appear to be weakly cemented. Operations in Pit 3 were halted in 1989, and the site has remained essentially unused since then.

The sidewall slopes within Pit 3 appeared to be grossly stable, but a significant amount of surficial raveling and toppling of the slope has occurred over time. Slope materials were breaking loose within the upper half of the slope along vertical failure planes, and were being deposited as talus across the lower portions of the slope face. Portions of the top half of the slope were standing nearly vertical, whereas the lower half of the sidewall slope was considerably shallower than the original 0.5:1 (H:V) slope.

A site study commenced that involved stability of the slopes and any potential impacts to adjacent waste cells, worker safety during waste placement, and performance of the slopes under DOE seismic criteria. NTS geologists and engineers completed both the field and office portions of the study. A brief summary of the study is presented below.

- The observed failures within the slopes at Pit 3 are not deep-seated rotational type failures, but consist of surficial raveling and toppling failures.

- Raveling due to wind, water and gravity has eroded the sand layers, and as the overlying gravel or silty sand layers become undermined, a toppling failure occurs. This raveling process is common in steep slopes excavated in cohesionless materials, and typically continues until a H:V slope ratio approximately equivalent to the angle of internal friction of the material is achieved. Surficial raveling does not appear to be the controlling factor for instability within the silty sand unit. Failures within this unit appear to be exclusively surficial toppling failures controlled by vertical or near vertical failure surfaces.

- Safety concerns did not allow a hands-on inspection of the slope materials, but a review of the available data (RSN, 1993 and WTI, 1994) indicated that a surficial layer of silty sand exists around the perimeter of Pit 3, and is exposed in the upper portions of the sidewall slopes. Laboratory analyses indicate that this material contains 16 percent of the size fraction passing a #200 sieve (WTI, 1994). This percentage of silt and clay sized material is the most likely reason why the surficial layer of silty sand is capable of standing vertical for short periods of time, and why the failure mode for the this unit is primarily toppling events bounded by near vertical failure surfaces.

An important consideration in this evaluation is the determination of the most likely configuration of a failure surface within the slope that will control future slope instability at the site. Deep-seated rotational failures are typically a phenomenon that occurs in weak, fine-grained (cohesive) materials, and not in dry, coarse-grained cohesionless materials. The stability of slopes constructed in cohesionless soils is governed by the relationship between the angle of internal friction of the soil and the constructed slope angle (NAVFAC, 1986).

The Naval Facilities Engineering Command Design Manual 7.01 considers two scenarios for slopes constructed in coarse-grained soils. One scenario allows for some cohesion, the other does not. Failures within dry granular soils with some cohesion occur on shallow, vertical or slightly curved surfaces. The presence of tension cracks along the top of slope influences the location of the failure surfaces. Failures within dry granular soils with no cohesion occur as surface sloughing (raveling) which continues until the slope angle flattens to the angle of internal friction (NAVFAC, 1986).

The probability of a large-scale, deep-seated rotational failure occurring within the Pit 3 sidewalls was considered to be very low. Instead, the likely method of failure will be the continuation of surficial sloughing and toppling. These surficial failures will continue until a H:V slope angle equal to the angle of internal friction of the slope materials is achieved, or remedial earthwork designed to maintain a slope angle steeper than the friction angle has been completed. Large-scale wedge type failures could occur under loads provided by strong ground motion occurring during a nearby seismic event.

Slope stability analyses were completed using the computer software package Slide Version 5.0. Analyses included both planar and rotational failure surfaces. Planar type failure surfaces were evaluated using peak horizontal ground accelerations as high as 0.3g (USGS 1995, USGS 2002, Smith 2003). Parameters used during the analyses included:

- Cohesion 150
- Phi angle 420

Using the results of the slope stability analyses, remedial earthwork for the Pit 3 side slopes was designed, and resulted in a stability fill for the southern slope, and slope re-grading for the northern slope. Final H:V slope angles for the buttress fill on the south slope was 3:1 with the north side of Pit 3 re-graded at 2:1.

Re-grading of the area 5 Pit 3 was started in summer of 2005, and the corrective grading earthwork and site access controls construction was completed in early fall of 2005.

SITE CHARACTERISTICS

There are no liners or special materials used for confinement systems. Analyses performed on the disposal location demonstrate the value of using in-situ materials opposed to liners. Site characteristics, such as evapotranspiration and groundwater depth, offer low potential for groundwater contamination. Additionally, the NTS geologic settings provide minimum potential for seismic disruptions. All material used as cover and closure are in-situ soils excavated from the disposal location.

Meteorology

The climate of Frenchman Flat (where the Area 5 RWMC is located) is arid. The majority of rain falls during two seasons, with the larger amount occurring in winter and the smaller amount occurring during summer. Snowfall rarely occurs. The average annual precipitation, based on a 37-year record at a station located 6.4 km (4 mi) southwest of the RWMC, is 126 mm per year (5.0 in. per year). In the year 2000, Area 5 RWMC meteorology station received a total precipitation of 122 mm (4.8 in.) (DOE/NV 2001). Average annual evapotranspiration at the Area 5 RWMS is 1,620 mm (64 in.). In the year 2000, the total potential evapotranspiration was 1627 mm (64 in.) (DOE/NV 2001). This is about 13 times the annual average precipitation (DOE/NV 2001)

Hydrology

Sampling and analysis of the uppermost alluvial aquifer near the Area 5 RWMS were initiated in 1993. This corresponded with the completion of the three pilot wells UE5PW 1, UE5PW 2, and UE5PW 3. Sampling and analysis of these wells are conducted to comply with the detection monitoring requirements for Resource Conservation and Recovery Act (RCRA) interim status for treatment, storage, and disposal facilities. Each well is screened over the first 15 m (49 ft) of the uppermost aquifer. The two pilot wells east of the site (UE5PW 1 and UE5PW 2) are completed in unconsolidated alluvial sediments. The well to the northwest at the base of the Halfpint Range (UE5PW 3) is completed in a tuffaceous unit.

The depth to water at the Area 5 RWMS ranges from approximately 235 m (770 ft) to 271 m (890 ft) below the surface, based on measurements recorded at three pilot wells (UE5PW-1, UE5PW-2 and UE5PW-3) developed as part of site characterization activities. The elevation of the groundwater under the site is approximately 734 m (2,407 ft). Depth to water, at 213 m (700 ft) below the surface, is the least in the playa lake area (approximately 3.5 km [2.2 mi] south of the RWMS).

The vadose zone beneath the Area 5 RWMS is the primary barrier between the site and the uppermost aquifer. This zone ranges between 235 m (771 ft) on the southeast side of the facility, near UE5PW 1, and 271 m (889 ft) northwest of the facility, near UE5PW 3 (DOE/NV 2001). Its physical, chemical, and hydrologic properties are described in four investigative reports: Blout et al. 1995, REECo 1993a, REECo 1993b, REECo 1994.

Past and on-going soil monitoring efforts have not indicated the presence of surface or subsurface radiological migration pathways at Area 5 RWMC (DOE/NV 2002). Climate and vegetation strongly control the movement of water in the upper few meters of the alluvium. Except for periods following precipitation events, water contents in this near-surface region are quite low. Below the near-surface is a region where relatively steady upward movement of water by evaporation is occurring (Tyler et al. 1996). Next, water potential measurements indicate the presence of a static region, about 40 to 90 m (131 to 295 ft) below the surface (Shott et al. 1998). In this static region, essentially no vertical liquid flow is currently occurring. Below this static region, flow is steady and downward due to gravity. If water were to migrate below the current static region, movement to the groundwater would be extremely slow due to the low water content of the alluvium. Estimates of unretarded (zero upward flux) travel time to the groundwater are in excess of 50,000 years (Shott et al. 1998).

Confinement Systems

Soil overburden serves as the primary long-term confinement system. Waste packages function as barriers between the waste material and on-site personnel and the environment during handling. Bulk items that cannot be placed in standardized packages may be wrapped in plastic or have fixatives applied to prevent the release of radioactive contamination. Bulk items are covered with soil after placement in the disposal cell. The operational cover and final disposal cell closure cap will serve as an additional barrier between the waste and the surface environment. Based on the meteorology, hydrology and vadose zone flux, there is no need for any additional lining system in the Area 5 RWMC MW disposal unit.

CONCLUSION

With the advent of the accelerated cleanup schedule, the increase in waste generation has required a facility that can handle mixed waste disposal requirements in a safe manner for the public, the workers, and the environment. As a Nuclear Facility, the RWMC has the capabilities required to manage all types of LLW/MW, meeting the disposal needs integral to clean up the DOE complex. Modifications to the waste acceptance program in conjunction with physical modification of the disposal location has prepared the NTS to safely, efficiently, and quickly receive the amount of MW the NTS is permitted to receive.

REFERENCES

1. Bechtel Nevada, 2002. *Documented Safety Analysis for the NTS Area 5 Radioactive Waste Management Complex*, DSA-2151.100 Rev 0, October
2. DOE/NV, 2005, *Nevada Test Site Waste Acceptance Criteria*, DOE/NV-325 Rev. 6, October
3. General Electric Inspection Technologies, 2004, *Seifert X-ray Tubehousing Isovolt 450/5*, GEIT-30040GB, April
4. Bechtel Nevada, 2003. *Review of Site Conditions and Slope Stability Analyses – Disposal Unit P03U (Pit 3) Sidewall Slopes, Area 5 Radioactive Waste Management Site, Nevada Test Site, Nye County, Nevada*, B502-MT-03-0011, May.
5. Blout et al. 1995. *Site Characterization Data from the Area 5 Science Boreholes, Nevada Test Site, Nye County, Nevada.* U.S. Department of Energy, Nevada Operations Office Report DOE/NV11432-170. Las Vegas, NV.
6. DOE/NV 2001. *Nevada Test Site 2000 Waste Management Monitoring Report, Area 3 and Area 5 Radioactive Waste Management Sites.* DOE/NV 11718-582. Las Vegas, NV.
7. DOE/NV 2002. *2001 Data Report: Groundwater Monitoring Program Area 5 Radioactive Waste Management Site*. DOE/NV 11718-694. Las Vegas, NV.
8. REECo 1993a. *Hydrogeologic Data for Existing Excavations at the Area 5 Radioactive Waste Management Site, Nevada Test Site, Nye County, Nevada.* Report No. DOE/NV/11432-40. Las Vegas, NV.
9. REECo 1993b. *Hydrogeologic Data for Science Trench Boreholes at the Area 5 Radioactive Waste Management Site, Nevada Test Site, Nye County, Nevada.* Report No. DE-AC08-94-NV11432. Las Vegas, NV.
10. REECo 1994. *Site Characterization and Monitoring Data From Area 5 Pilot Wells, Nevada Test Site, Nye County, Nevada.* Report No. DOE/NV/11432-74. Las Vegas, NV.
11. Shott et al. 1998. *Performance Assessment for the Area 5 RWMS at the NTS, Nye County, Nevada.* Revision 2.1. Bechtel Nevada, Las Vegas, NV.
12. Tyler et al. 1996. “Soil-Water Flux in the Southern Great Basin, United States: Temporal and Spatial Variations Over the Last 120,000 Years.” *Water Resources Research* 32(6):1481-1499.