UNIQUE LOW-LEVEL WASTE DISPOSAL CHALLENGES AT THE NEVADA TEST SITE

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ABSTRACT

Radioactive Waste Management at the Nevada Test Site (NTS) continuously evolves to meet the growing needs for disposal of low-level waste (LLW) and intermediate level waste (ILW). Over the past 40 years, the Radioactive Waste Management Complex (RWMC) has transformed from a local depository for waste generators within the confines of the NTS to a prime location for the nationwide Department of Energy (DOE) Complex. The RWMC has recently been classified as a Hazard Category 2 Non-reactor Nuclear Facility, which allows the NTS to meet all future LLW/ILW disposal needs. In particular, the NTS is the principal destination for Class B, Class C, and Greater Than Class C DOE LLW/ILW.

The NTS maintains and develops permitted disposal locations to accommodate various waste forms, and is engaged in developing characterization and handling processes to ensure proper disposal. The RWMC has pioneered new disposal techniques, developed unique disposal locations, and actively engages in ensuring future disposal needs can be accommodated with maximum benefit to risk ratio. The RWMC excels at handling unique shapes, sizes, weights, dose rates, and disposal restrictions in a safe manner. This includes package weights in excess of 100-tons, very large manufactured items, high-dose rate packages, and combinations of all. Occasionally, unique issues require additional handling measures be taken to meet the needs of the waste generator.

The RWMC has utilized big-hole drilling, (boreholes with diameters in excess of 10 feet) for disposal of remote-handled waste. Subsidence craters from Nuclear Weapons Testing are used for LLW/ILW disposal. However, the primary method for LLW disposal is shallow-land disposal cell excavations.

Regardless of disposal method, the locations of each package are recorded with the package characterization data and activity maintained within a database. The NTSWAC requires package labels with barcodes to assist in the monitoring. This feature allows Radioactive Waste Management at the NTS to operate with each package being theoretically retrievable. In 40 yrs of operation, no package has had to be retrieved after having been covered with soil, although plans have been developed as a contingency for that requirement.

The NTS continues to overcome the unique challenges with the handling and disposal of Low-LevelWaste. As a Nuclear Facility, the RWMC has the ability to handle all types of LLW and to meet the disposal requirements integral to the cleanup of 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; the RWMC is that facility.

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. A detailed site description is included in Volume 1 of the *Final Environmental Impact Statement For The Nevada Test Site And Off-Site Locations In The State Of Nevada* (DOE, 1996).

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 Mixed-Low-Level 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.

Area 3 Radioactive Waste Management Site (RWMS)

The Area 3 RWMS is located approximately 43 km (27 mi) north of Mercury, Nevada and 150 km (93 mi) northwest of Las Vegas, Nevada. It encompasses a total area of approximately 0.5

km^2 (125 acres) and is situated in the central section of Area 3. The mission of the Area 3 RWMS is to serve as a disposal site for LLW generated from DOE and DOD facilities. Beginning in 1979, the Area 3 RWMS was used to dispose of radioactive waste from the cleanup of underground tests (tunnel debris) and later from aboveground testing locations associated with the Atmospheric Test Debris Disposal Program. Presently, Area 3 RWMS accepts waste from other NTS activities and from off-site DOE locations.

Processes and Operations

The RWMCs are dedicated to the receipt, transport, off-load, external inspection, placement, and burial of approved LLW. Disposal operations generally occur below surface grade in an appropriate disposal cell. Waste is placed in a specified location within the disposal cell and documented by grid location. Each waste tier is covered with a layer of soil until the cell is filled to capacity, at which time an operational cover (cap) is placed over the cell.

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.

Waste container handling equipment is used to off-load and position waste for burial. Container-handling equipment includes standard industrial items such as cranes, forklifts, and hand tools. Heavy equipment, such as bulldozers, front end-loaders, and water trucks are used during soil overburden and disposal cell construction. Radiological survey equipment is used to detect surface contamination and monitor site conditions.

Waste disposed at the RWMCs may vary in form, quantity, composition, and activity. However, all waste received at the RWMCs must be approved and accepted in accordance with the requirements specified in the *Nevada Test Site Waste Acceptance Criteria* (NTSWAC) (DOE/NV 2002).

Off-Loading of a Shipment Vehicle

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. 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 (BN, 2001). 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 Forms

The majority of the LLW disposal at the existing facilities typically consists of contaminated laboratory waste, soil, process waste, and construction debris. Common radioactive constituents of this waste are depleted and enriched uranium, mixed fission products, high-specific activity tritium, and waste containing TRU nuclides at concentrations of less than 100 nanocuries per gram. LLW/ILW packages range from intermodal containers to unpackaged materials to sacrificial packaging including waste buried in metal and wood boxes or drums.

Intermodal container waste ranges from scrap metals and soils to high dose LLW and ILW. DOE and the NTSWAC do not identify ILW and use the broad definition of LLW that includes the ILW sub-categorization. Intermodal containers are reusable containers that have been designed for a multitude of transportation methods. These containers are suitable for railroad transport, maritime use, or for loading onto standard freight trucks. The majority of intermodal containers are reused due to the amount of shielding required and the engineering associated with DOT Type-A and Type-B package certifications. Other use for intermodal containers is to transport soil and scrap metal that due to weight loading considerations cannot easily be placed into standard disposal packages without generating large amounts of void spaces. Type-A containers are the most common intermodals processed at the RWMCs. These containers range from cargo containers (8ft x 8ft x 20ft) rated as DOT Type 7A weighing as little as 10,000 lbs to transportation shielding casks configured for specific inner liners (e.g. 10-160A cask) that can weigh 100,000 lbs or more.

Sacrificial packages can encompass standard waste boxes and Type-A drums, but the alternative packaging typically used includes soft-sided plastic liners, hard plastic liners, and epoxy resin coatings over transport skids. Sacrificial packages are the preferred method of disposal due to the ability to recover any package after burial. Most of these sacrificial packages meet or exceed the NTSWAC strength requirements of 3,375 lb/ft^2 for packaged waste. There is a general exemption for bulk waste that due to differences in the handling, DOT strength requirements are sufficient. This strength requirement is required to support other waste packages and earth cover without crushing during stacking and covering operations. The NTSWAC also requires various package requirements for handling, specifically that waste packages must be provided with cleats, offsets, rings, handles, permanently attached or removable skids, other auxiliary lifting devices to allow handling by means of forklifts, cranes, or similar handling equipment.

Unpackaged materials normally accepted for disposal at the RWMC are activated blocks of concrete and process machinery. Activated materials are typically shipped under the Radioactive Low-Specific-Activity (LSA) exemption for DOT. Surface contaminated objects (SCO) must have an overpack of some sort. SCO materials that are too large for sacrificial packaging to be feasible are typically covered with a self-hardening epoxy that hardens to package-like strength and meet the DOT requirements for strong-tight containers. All materials and packaging must meet DOT shipping requirements and the NTSWAC.

Innovative Handling and Disposal Methods

Package weights in excess of 50-tons, very large manufactured items, high-dose rate packages, and combinations of all require special handling and disposal considerations. Occasionally, unique issues require additional handling measures be taken to meet the needs of the waste generator. These can be cosmetic, political, or socio-economical based on where the waste originates, the characteristics of the package, and the demographics of the transport route. These additional handling measures are always above and beyond the DOT requirements and are done at the request of the waste generator.

Area 5 RWMC Disposal Cells

There are 31 cells and trenches at the Area 5 RWMC, eight of which are currently open to receive waste. Currently there are four active disposal cells for the storage of general LLW (e.g. unmixed, non-asbestos, and unclassified LLW). These cells receive the majority of waste that is disposed of in the Area 5 RWMC. There is a current 5-year plan that incorporates the inclusion of future disposal cells. These additional cells will be virtually identical to the existing disposal cells but can be tailored depending on waste stream characteristics.

The RWMC has utilized big-hole drilling, (boreholes with diameters in excess of 10 feet) for disposal of remote-handled waste. These boreholes are referred to as the greater confinement disposal (GCD) holes. The 10 greater confinement disposal holes are currently inactive due to classification as injection wells by the state of Nevada.

Currently there are 23 inactive disposal cells. These consist of 7 classified disposal cells (or trenches), 1 asbestiform disposal cell, 15 general disposal cells, plus the 10 GCD holes. Inactive disposal cells have their complete LLW inventory covered by a cap of natural soil that was removed when the cells were excavated. This cap extends 4 feet above natural grade. As the capacity of the currently active disposal cells is exhausted and new disposal locations are created, these cells will be added to this category.

Currently there is one MLLW pit. Waste is covered the same day as it is received. The MLLW pit is RCRA certified and has a sump-pump with a run-off protection berm. At this time only mixed waste generated on the NTS is accepted for disposal. A permit application for accepting mixed waste from outside sources is currently pending. To this effect a real-time-radiography (RTR) unit has been installed at the Area 5 RWMC for verification purposes.

Currently there is one active and one inactive Asbestos LLW disposal cell. Waste received is primarily in transportainers and access to the disposal cells are controlled with gates on the access ramps. All containers are marked with Asbestos Notification and Warning Stickers. Additionally, the disposal cell is marked when asbestiform material is present.

Area 5 RWMC disposal cells have various shapes and sizes. Lengths range from 400 ft to 1000 ft with widths typically ranging from 150 ft to 200 ft. Depth of the cells can be varied based on waste form, but the standard depth is 22 ft. With 2-3 disposal cells being excavated each year, that creates approximately 275,000 yd^3 of spoils each year. With only 125,000 yd^3 of soil being used as the cell cover material there is an excess 150,000 yd^3 of soil that will have to be used in alternative means. One proposed method of utilizing the excess spoils is to extend the disposal cell covers to 4m (13 ft) of soil overburden. Additional uses have been to create flood protection berms and soil embankments for radiation protection during remote handling of high-dose LLW.

Area 3 RWMS Disposal Cells

The disposal cells are accessible beyond a check-in point and gate that is locked during non-work hours. The gate is located adjacent to the administrative support structures on the eastern side. Controlled access and facility configuration assists in the identification of unauthorized personnel and mitigates accidental trespassing.

The disposal cells were developed from seven subsidence craters previously created by prior underground nuclear tests. The subsidence craters that were formed from these nuclear detonations are circular in shape and conical in depth. The craters are designated as U-3ax, U-3bl, U-3ah, U-3at, U-3az, U-3bg, and U-3bh and were selected for use as disposal cells based upon site geology and the depth at which the nuclear devices were detonated. Within the Area 3 RWMS there are four other nuclear test locations (U-3AK, U-3BM, U-3EC and U-3BI) that have not subsided and will not be used as disposal cells.

Five of the original subsidence craters (U-3ax, U-3bl, U-3ah, U-3at, and U-3bh) were re-contoured to create three of the current disposal cells (U-3ax/U-3bl, U-3ah/U-3at, and U-3bh), while two subsidence craters (U-3az and U-3bg) remain unmodified and are unused at this time. Creation of disposal cells by re-contouring and excavation of subsidence craters is generally preformed in accordance with guidance provided by governing standard *A Policy on Geometric Design of Highways and Streets* (AASHTO, 2001) and Code of Federal Regulations (CFR), 29 CFR 1926, Subpart B (CFR, 2002), to the degree that it is practical.

Two sets of craters (U-3ax/U-3bl and U-3ah/U-3at) were combined by excavation during disposal operations to form two separate cells (U-3ax/bl and U-3ah/at). Combining the craters created disposal cells that are oval in shape. Subsidence crater U-3bh was re-contoured to create a single disposal cell and remains in a circular shape and will not be combined with other craters. The two remaining craters (U-3az and U-3bg) may eventually be joined to form one new disposal cell in the future.

Disposal cell U-3ax/bl is closed and regulated as a historic Resource Conservation and Recovery Act (RCRA) disposal unit based on the presence of RCRA regulated hazardous constituents (lead). The unit ceased operation in 1987 and final closure as a RCRA regulated disposal unit was completed in 1999. The final closure cap consists of 2.4 m (8 ft) vegetated native alluvium.

However, the primary method for LLW disposal is shallow-land disposal cell excavations. This allows for customization to a certain degree. The depth of the cell in addition to the capacity can be tailored to ensure the performance assessment for the facility is maintained. For example, natural thorium wastes generate significant amounts of radon that must be attenuated to ensure the flux of radon through the soil meets all applicable regulations.

Challenges and Solutions

Remote Handling of High-Dose LLW

One available option to maintain exposure ALARA is to minimize the time spent in direct line of site with the material. The NTS used the GCD boreholes to this effect with great success. The GCD boreholes were surrounded with earthen mounds that shielded all personnel from direct exposure to high-activity LLW allowing completely remote handling of various wastes. Cranes and type-B forklifts outfitted with remote control units were operated from a trailer protected by the earthen mound. Although this method was ideal for mitigating exposure, these systems were extremely temperamental given the harsh environment of the NTS. The amount of dust and heat that is abundant at the NTS resulted in severe degradation of the equipment over a short period of time. Ultimately the demand within the DOE complex for this capability could not offset the costs associated with maintaining that ability. Subsequently new materials and methods have been employed that render this the requirement for remotely operated equipment obsolete.

Big hole drilling has benefited the NTS and the RWMC in numerous ways. Although the use of the GCD boreholes has been suspended, the big hole drilling program left another added benefit. The NTS has numerous custom made cranes with enormous capacities including ringer cranes in addition to primary cranes. Several of the cranes on the NTS exceed 300 ton capacity and can handle boom lengths over 300 ft. This ability allows personnel to be in direct control of the equipment and removes the electronic dependence associated with truly remote handling. The RWMC successfully employed a 200+ crane to offload ~100 LLW containers with dose rates in excess of 10 R/hr with upper range of 25 R/hr for a total job dose less than 0.5 man-Rem. Spotters placed in manlift baskets could maintain line of sight and still ensure no personnel were within the 100-ft exclusion zone. The containers were placed into prepared pockets in a dedicated disposal cell. The dedicated disposal cell was pre-filled with LLW arranged in a stacked-T pattern that created individual pockets which allowed the ~100 shipments to arrive over the course of a year without sacrificing disposal space. Based on the success achieved with the implementation of this technique the RWMC will repeat this process to handle 1300 R/hr LLW. Other waste streams with exposure rates approaching 10,000 R/hr were evaluated and for the purpose of a nuclear facility documented safety analysis were determined to have excessive risk and will therefore be buried inside their DOT compliant shipping casks.

Handling Weights in Excess of 50 Tons

Large pieces of process machinery, which have become contaminated to LLW levels, are often considered for disposal intact. In addition to the typically large sizes of these pieces of equipment, significant weights expound after packaging the piece for shipment. Typical packaging is either self-hardening epoxy instant coating or custom fabricated overpack containers that may include lead shielding. Package geometries are rarely symmetrical, rarely have normal centers of gravity, and routinely exceed 15 ft in their narrowest dimension giving rise to numerous handling concerns in addition to the transportation concerns. Sizes have ranged from 8' x 8' x 20' weighing 100,000 lbs to 20' x 14' x 40' weighing 230,000 lbs to 15' x 10' x 15' weighing in excess of 400,000 lbs with each package being unique.

Given the range of sizes of these items in addition to their weights, the trailers are usually custom configured for each of the loads. With each new trailer design comes several concerns. The routes taken to the NTS are typical two-lane roads and the terrain is rough, but regardless of how the load is transported to the NTS, once on the NTS the same problems abound. The NTS paved road has a gate that does not have sufficient clearance for most of these loads, so other gates must be used that either have dirt or gravel roads. The other roads on the NTS are chip-seal two-lane roads with dirt shoulders and are not designed for heavy loading. Hence, ground loading becomes a significant issue, especially once the load reaches the disposal location. Each load must have its ground loading evaluated by the NTS engineering department to ensure the trailers will not become stuck in the natural alluvium.

Trailer configuration also plays a critical role in the development of disposal cells. The critical factors involved in designing a disposal location for a heavy load is the size of the cell and the design of the ramp. The break-over and the break-under of a typical disposal cell ramp would cripple most heavy load trailers so custom ramps are designed using the ground loading specifications. Also, these packages are relatively small compared to the size of their conveyances, so the area is designed for the trailer and not the package. For a 15 ft cube package weighing 200 ton, the tractor-trailer combination can exceed 175 ft long and 20-ft wide with a turning radius of 300 ft. These packages need to be offloaded on the floor of the disposal cell with the trailer, crane, and load all within the cell for hoisting and rigging requirements at nuclear facilities to be satisfied, so all these factors are taken into consideration when choosing the disposal location. The Area 5 RWMC routinely probes the DOE LLW generator community and includes anticipated shipments in disposal cell design as part of the 5-year plan. The current heavy load disposal cell is a 200 ft x 600 ft x 15 ft deep with a 500 ft long ramp tapered at the ends and is set to receive approximately 10 heavy loads in calendar year 2005.

The NTS uses numerous large cranes that are both crawlers and truck-mobile. Since many of the cranes were custom built to reach remote NTS locations, the majority of the crane fleet is truck-mobile. This allows NTS operations the ability to quickly move cranes across the geographic expanse of the NTS but precludes the ability to move with suspended loads. Simply put, the NTS will not "walk" loads of LLW/ILW. Also the NTSWAC imposes strength requirements on all rigging apparatuses, fixtures, chokers, slings, etc. A 5:1 strength requirement is required for all picks at the NTS. Hence if a package weighs 200 ton, the ultimate breaking strength of all lifting eyes, slings, spreader bars, etc must be 1000 ton. Additionally the NTS conforms to the critical lifts requirements. Critical lifts are defined as lifts with the potential to release significant amounts of radioactive material, require more than one piece of equipment, or exceed the 80% of the capacity of any piece of equipment. These conditions impose stringent requirements and evaluations coupled with step-by-step procedures to mitigate the risks associated with critical lifts. Thus to lift a 200 ton package that is radioactive SCO or LSA, a minimum 250-ton crane is required after all other aspects of the waste have been evaluated to mitigate the risks associated with this lift.

Trailers for large size packages are sometimes built around the package and must be disassembled to remove the container. Other trailers are simply disassembled to avoid special permitting the return trip. NTS operations strongly discourage the use of trailers requiring disassembly for package removal due to requirements that personnel be placed beneath these enormous suspended loads to place cribbing. NTS operations embraces a "zero accidents" policy and will not take risks that could be mitigated by utilizing a better trailer configuration. Only as a last resort will trailer disassembly around a LLW package be considered after all other options have been exhausted.

Intermodal containers are used to transport SCO and LSA materials while attempting to minimize packaging costs. Intermodal containers are best used for soils and other items that have no sharp edges because these types do not lodge or damage the container as readily. Intermodal containers have been used for transporting scrap metal and demolishing debris with the intent of reusing the container. The pros of using this method of disposal is that the package is reused saving on the costs associated with disposal of steel containers, but the cons include increased handling time, rental charges, dual transportation and survey requirements, labeling verification, inability to recover material after disposal, multiple package integrity verifications, and the personnel exposure to unpackaged LLW.

Typical intermodal use at the NTS is for Low-Level Radioactive & CERCLA Waste where the majority of waste is compacted metal consisting of 50% Aluminum, 45% Carbon Steel (including Ni Plated Carbon Steel), 4% Copper, & 1% Monel. The primary isotopes involved are uranium and plutonium with an average volume per shipment of 449 ft3, average weight per shipment of 32,485 lbs (upper weight limit is 35,000 lbs), and an average activity per container of 1.25 GBq or 0.034 Ci. In order to prevent jamming, nominal diameters of all materials are limited to 3 ft in any direction and containers are filled no more than 75% of capacity. Each intermodal container needs an inner liner. These liners need to be at least 16 mil thickness to minimize tearing. The liners need to be securely closed with ties or fasteners/glue to prevent material from falling out and depending on the material, a 30-80 mil substrate or sand substrate needs to be placed beneath the load to aid offloading. Precaution needs to be taken since the liners cannot be secured to the inside of the intermodal container.

Various problems include that since intermodal containers are routinely within contamination areas, the rollers beneath the containers have a tendency to become contaminated. Although this contamination is fixed and allowable under DOT regulations this fixed contamination is not usually detectible until contents have been offloaded where the container may no longer be within DOE release limits. Efficiency of cell space utilization is also limited because space between intermodals is lost due to the limitations of the container doors and the inability to push plastic bags full of steel waste with dirt moving equipment. End dump trailers increase space utilization efficiency and decrease offloading complications since they are usually half-round end dumps that do not have corners or lids that allow the material to hang up during off-loading.

Lessons learned in the DOE complex have included that the roll-off truck needs to be appropriately sized for the intermodals to be off-loaded since insufficient lift capacity can lead to container and vehicle damage based on inability to handle load shifts. Load shifts that can occur during transport can leave large pieces of material resting against the container door. When retention devices are loosened, those pieces can fall out endangering personnel. Pieces loaded by compactor are more likely to pile up against the door due to initial randomization settling during transportation. Pieces loaded by hand tend to be in a more stable initial configuration reducing potential load shifting, but hand loading of containers is labor-intensive and personnel can load containers with pieces that will not come out on their own.

Anticipated & Unique Disposal Requirements

As the DOE complex cleanup is accelerated, the demand for handling large numbers of unique packages increases exponentially. The frequency of shipments to meet milestone dates and production schedules dictates quicker turnaround with disposal operations. Waste generators initiate shipping campaigns that can have durations as short as 4 weeks to as long as 18 months with massive numbers of shipments to process during the campaign. One potential waste stream campaign involves the shipment of 7,500 containers within 12 months with each container weighing 20,000 lbs and consisting of a 6-ft cylinder to be grappled from the top. This campaign includes radon-attenuation requirements that include 24 ft of soil cover and has contact dose rates approaching 100 mR/hr. With the weight loading restrictions the generator is limited to 2 containers per conveyance thus the campaign would incorporate 3,750 shipments in 1 year. The record number of shipments received at the NTS within a single year is less than 2,500. The frequency of this campaign will require massive coordination and the logistics are compounded by the utilization of custom trailers with only 100 trailers in the fleet.

Other campaigns have been suggested to coincide with the aforementioned campaign. One of these campaigns includes the shipment of 1,300 containers that only weigh 10,000 lbs each, but are 3 ft cylinders 40-ft long. Since size and not weight is the limiting factor on these shipments, once again only 2 containers can be loaded per conveyance. This campaign would last approximately 9 months and have 650 shipments in addition to the normal loads anticipated for the NTS. Contrasting the handling methods required between the campaigns actually results in handling times driving the reliability of consistency associated with each campaign that is paramount to successful completion of the campaign. Whereas the 3,750 shipment campaign is massive, the handling time per shipment is approximately 15 minutes opposed to the handling time per shipment of the other campaign is approximately 45 minutes. This handling time per shipment coupled with the shipment survey requirements are used to determine the staffing requirements for NTS disposal operations to handle the workload.

Typical campaigns in the past have been driven by the ability of the NTS to receive containers. Given the fact that there is only so much that can be done with a given amount of resources, unwillingness on the generators part to increase the resources of the NTS leads to compromise. One such campaign included 12,000 standard waste boxes shipped over the course of 1 year. There were numerous logistical requirements incorporated with this campaign that were not associated with the actual handling of the waste. These shipments were limited to 5 shipments per day because that was all that could be processed during a workday given all the additional formalities associated with the operation imposed by the generator. NTS operations has and will always take whatever measures necessary for the good of the DOE complex provided the necessary resources are provided in a timely manner.

Maintaining an Inventory

Regardless of disposal method, the locations of each package are recorded with the package characterization data and activity maintained within a database. The NTSWAC requires package labels with barcodes to assist in the monitoring. This feature allows Radioactive Waste Management at the NTS to operate with each package being theoretically retrievable.
Waste packages are stacked and assigned location coordinates. A compass coordinate system or an alphanumeric coordinate grid system, including an alpha zone, a numeric zone or quadrant, and a tier number, is used to record the location of disposed waste packages. The waste package data and coordinates are entered into the Low Level Waste Information System (LLWIS) Oracle® database for inventory control and tracking.

The alphanumeric coordinate grid system consists of an alpha zone, a numeric section, and a tier designation. An example of a location designation is A-01-01, which indicates that the package is stored in Zone A, Section 01, Tier 01. In Area 3 the grid system employs 50-ft intervals resulting in a 2,500 ft^2 quadrant where in Area 5 the grid systems uses 20-ft intervals resulting in 400 ft^2 quadrants. The reason for the difference is that bulk waste in Area 3 could not be compacted to the extent that standardized packages could be in Area 5. Once the coordinate system is established for a disposal location it is not altered to ensure continuity of the data within LLWIS. In 40 yrs of operation, no package has had to be retrieved after having been covered with soil, although plans have been developed as a contingency for that requirement

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.

CONCLUSION

The NTS continues to overcome the unique challenges with the handling and disposal of Low-Level Waste. As a Nuclear Facility, the RWMC has the ability to handle all types of LLW and to meet the disposal requirements integral to the cleanup of 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; the RWMC is that facility.

REFERENCES

1 Bechtel Nevada, 2002. “Documented Safety Analysis for the NTS Area 5 Radioactive Waste Management Complex”, October 2002