

**Closure Optimization for the 37.2 Hectares Area at the  
Nevada National Security Site Area 5 Radioactive Waste Management Site – 11151**

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**ABSTRACT**

The original 37.2 hectares area of the Nevada National Security Site (NNSS) Area 5 Radioactive Waste Management Site (RWMS) consists of several engineered shallow-land burial disposal cells along with deep disposal (greater confinement disposal) boreholes. The Area 5 RWMS is well suited for the disposal of U.S. Department of Energy- and U.S. Department of Defense-generated low-level radioactive waste (LLW) as it is located in an access-controlled government facility far removed from population centers. Its windy, arid climate features an average annual precipitation far less than the average annual potential evapotranspiration. Depth to groundwater is approximately 234.7 meters. The groundwater gradient is nearly flat, with calculated flow velocities less than 0.15 meters per year. Sampling data indicate that the groundwater is unaffected by current and/or historical waste management activities.

Radioactive waste disposal has been ongoing in the 37.2 hectares area since the 1960s. Waste types encompass LLW, asbestiform LLW, mixed low-level radioactive waste (MLLW), and a small amount of transuranic (TRU)/mixed TRU. Permanent closure of the 92-acre area will be accomplished through the installation of an evapotranspiration cover.

An initial evapotranspiration design was developed for a continuous cover over much of the area. However, this design would direct stormwater into narrow channels, increasing the potential for erosion, and also would require a significant amount of imported fill material. Therefore, the cover design was optimized to maintain the protective features of the cover, but to reduce the area covered. Instead of large covers, several smaller covers will be used with wide areas between the cover areas. Stormwater is no longer directed into narrow channels, and the amount of fill required is significantly reduced. In addition, the material used for the cover was changed to more closely reflect the native soils in the area. This change will result in a less-compacted soil that is expected to improve the viability of the native vegetation used for the evapotranspiration cover by allowing infiltration of water into the root zone.

These changes result in significant cost savings because very little additional fill will be required, and armoring the channels is minimized. In addition, the performance of the cover will be enhanced by changes in compaction and soil gradation, allowing a more hospitable environment for the native vegetation used for the evapotranspiration cover.

**BACKGROUND**

The 37.2 hectares area of the Nevada National Security Site (NNSS) Area 5 Radioactive Waste Management Site (RWMS) consists of several engineered shallow-land burial disposal cells along with deep disposal (greater confinement disposal [GCD]) boreholes. The Area 5 RWMS is well suited for the disposal of U.S. Department of Energy- and U.S. Department of Defense-generated low-level radioactive waste (LLW) as it is located in an access-controlled government facility far removed from population centers. Its windy, arid climate features an average annual precipitation far less than the average annual potential evapotranspiration. Depth to groundwater is approximately 234.7 meters. The groundwater

gradient is nearly flat, with calculated flow velocities less than 0.15 meters per year. Sampling data indicate that the groundwater is unaffected by current and/or historical waste management activities.

Radioactive waste disposal has been ongoing in the 37.2 hectares area since the 1960s. Waste types encompass LLW, asbestiform LLW, mixed low-level radioactive waste (MLLW), and a small amount of transuranic (TRU)/mixed TRU. The waste is covered by operational covers, primarily consisting of native material.

Closure will be performed in accordance with Title 40 *Code of Federal Regulations* (CFR) Part 265, “Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities” [1]. After closure activities are complete, a request for the modification of the *Resource Conservation and Recovery Act* Permit that governs waste management activities at the NTS will be submitted to the Nevada Division of Environmental Protection to incorporate the requirements for post-closure monitoring.

### **BASIS FOR OPTIMIZATION OF THE DESIGN**

An initial evapotranspiration design was developed in compliance with closure requirements of 40 CFR Part 265 [1]. However, the completed design resulted in a continuous cover over much of the area, requiring a large volume of fill material to construct. In addition, the large cover area increased the runoff areas, and funneled the resulting stormwater and runoff through narrow, armored channels. Also, the screening and compaction requirements would not result in a hospitable environment to establish native vegetation. Because of the large amount of fill material that would be required and the material required to armor the channels, implementation of this design was expected to be costly.

Therefore, an optimization study was initiated to enhance cover performance and to provide the most efficient approach to construction. The optimization goals were as follows:

- Comply with closure requirements of 40 CFR Part 265 [1] to
  - provide long-term minimization of migration of liquid through the landfill,
  - function with minimum maintenance,
  - promote drainage and minimize erosion of the cover, and
  - accommodate settling and subsidence to maintain the cover’s integrity.
- Reduce the volume of fill material/reduce the area of the cover.
- Improve stormwater drainage.
- Increase the evapotranspiration potential of the cover material.

### **OPTIMIZED DESIGN**

The optimized design is based on regrading and augmenting the existing operational covers. The original intent of the cover was not changed: to maintain at least 2.5 meters of cover at all locations over the waste containers. The optimized design was developed with the input and participation from the Nevada Division of Environmental Protection to ensure that the cover is in compliance with requirements. See Figures 1 and 2 showing the original design and the new design.

### **Compliance with 40 CFR Part 265**

The optimized evapotranspiration cover design will perform similar to the existing evapotranspiration covers at the NNSC that have been in place since the 1990s. These existing covers have been monitored

and documented for more than 16 years. These data show zero drainage below 2 meters, indicating that all precipitation infiltrating is removed by evapotranspiration. Water balance measurements and the lysimeter measurements collected at the mostly bare-soil operational covers at the Area 5 RWMS for 10 years demonstrate the evapotranspiration cover performance in the NNSS climate in eliminating percolation into the waste zone [2, 3].

Vegetation is the primary factor controlling the removal of water. Three of the drainage lysimeters at the Area 3 RWMS have been operating to simulate enhanced precipitation conditions, irrigated with three times the normal precipitation. This demonstrates that even under wetter conditions, vegetated covers will effectively prevent the potential percolation into the waste zone.

The evapotranspiration cover will be constructed of native soils. Maintenance is expected to be minimal and can be readily accomplished using the existing equipment at the Area 5 RWMS.

### **Reduction in Fill Material**

The cover was configured to provide a minimum of 2.5 meters of fill material over all waste containers, but the cover no longer extends significantly past the waste trenches except where required for construction or maintenance efficiency. Instead of three large covers, five smaller covers will be used. Much of the cover can be constructed by regrading the operational covers already in place. The need for fill material was reduced from greater than 191,139 cubic meters to less than 76,455 cubic meters. Much of the material is already available within the operational covers or from construction activities at the active RWMS disposal cells.

### **Improved Stormwater Drainage**

The optimized design utilizes the natural drainage patterns at the site. The reduction in the area of the cover allows construction of wide, mildly sloped earthen channels for drainage without impacting the side slopes of the covers. These milder channel slopes and wider channel widths between the covers will reduce flow depth and velocities below erosive levels. The amount of rip-rap required was reduced because of the change in depth and velocity.

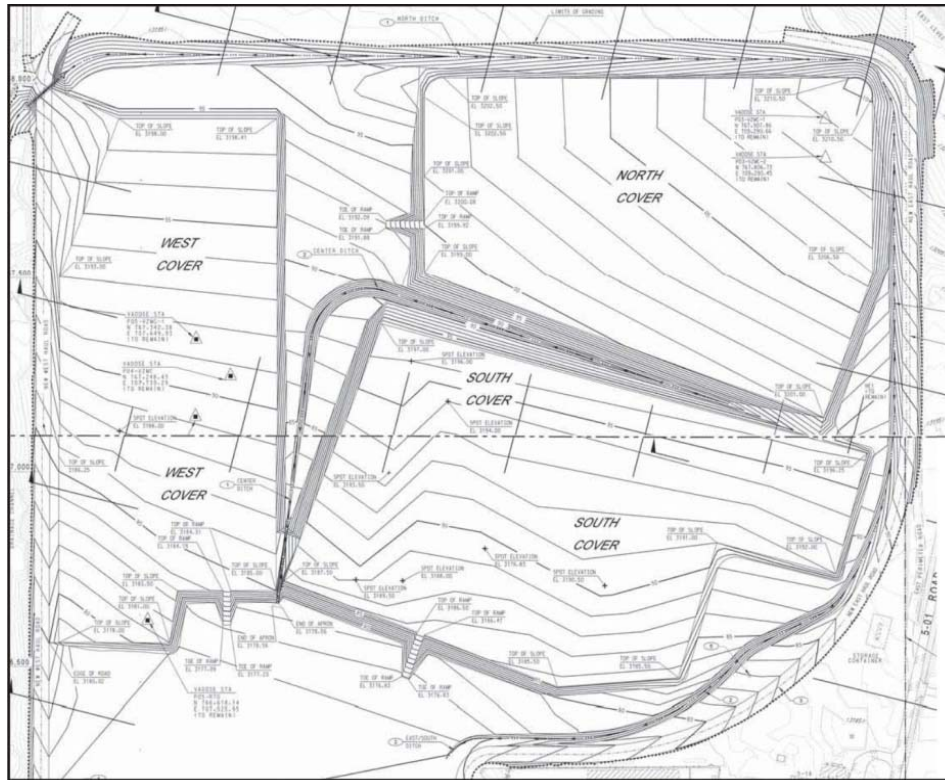
Drainage structures were eliminated, including three 35.02 meter-long corrugated metal pipe arches and 60.96 meters of precast concrete channel. The inspection and maintenance requirements for these stormwater structures also were eliminated.

### **Increased Evapotranspiration Potential**

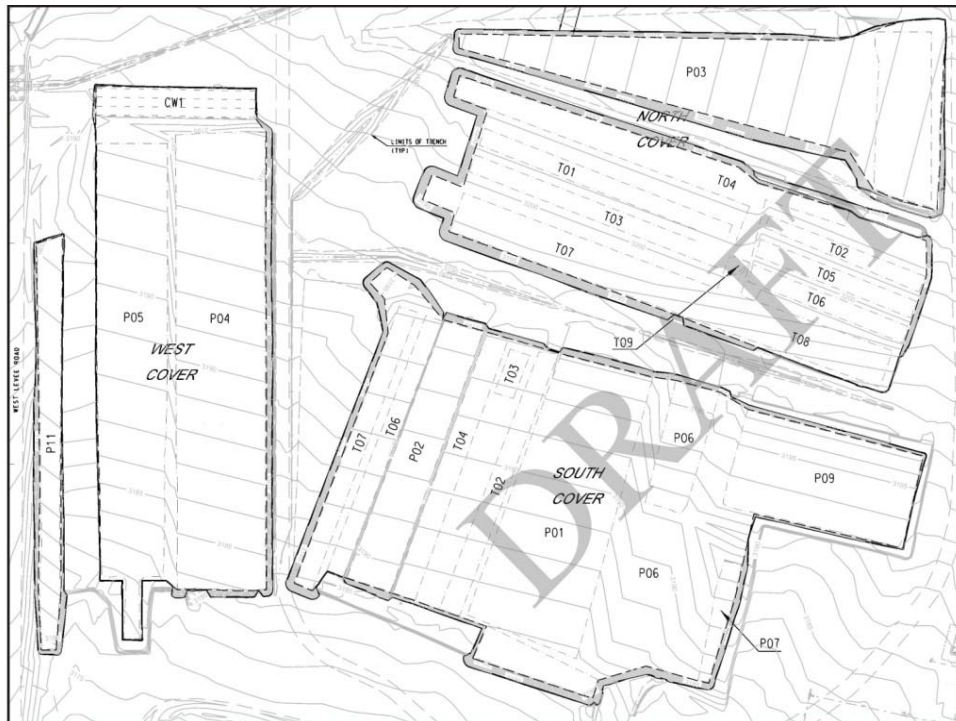
The material used for the cover was changed to more closely reflect the native soils in the area. Compaction requirements were reduced from 95 percent to between 78 and 85 percent. The requirement to screen all fill material was eliminated. This change will result in a less-compacted soil that holds moisture near the surface and is expected to improve the viability of the native vegetation used for the evapotranspiration cover by allowing infiltration of water into the root zone.

The vegetation seeding specification was changed to add a specification for temporary erosion and sediment control for the period between construction of the cover, and seeding. The seeding effort will be performed in the late fall or winter when there is expected to be moisture available from storms to support the vegetation.

**Fig. 1. Showing the original design of the cover.**



**Fig. 2. Showing the new design of the cover.**



## CONCLUSION

The initial cover design for closure of the 37.2 hectares area met the requirements of 40 CFR 265 [1]. Identifying the goals for the cover allowed the initial cover to be optimized, resulting in increased construction efficiency and enhanced cover performance. Like the original design, this cover also meets the requirements in 40 CFR 265 [1], including the following:

- Provides long-term minimization of migration of liquid through the landfill.
- Functions with minimum maintenance.
- Promotes drainage and minimizes erosion of the cover.
- Accommodates settling and subsidence to maintain the cover's integrity.

## REFERENCES

1. CODE OF FEDERAL REGULATIONS, Title 40, Part 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," Washington, DC: U.S. Government Printing Office (2006).
2. U.S. DEPARTMENT OF ENERGY, NATIONAL NUCLEAR SECURITY ADMINISTRATION NEVADA SITE OFFICE, *Corrective Action Decision Document/Corrective Action Plan for the 92-Acre Area and Corrective Action Unit 111: Area 5 WMD Retired Mixed Waste Pits, Nevada Test Site, Nevada*, DOE/NV--1326, Las Vegas, NV (2009).
3. U.S. DEPARTMENT OF ENERGY, NEVADA OPERATIONS OFFICE, *Closure Plan for Corrective Action Unit 110: Area 3 RWMS U-3ax/bl Disposal Unit, Nevada Test Site, Nevada*, DOE/NV--647, Las Vegas, NV (2000).

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