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97- Area G PA

PERFORMANCE ASSESSMENT AND COMPOSITE ANALYSIS FOR LOS ALAMOS NATIONAL LABORATORY MATERIAL DISPOSAL AREA G

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EXECUTIVE SUMMARY

This report describes the Performance Assessment (PA) and Composite Analysis (CA) for the current solid low-level radioactive waste (LLW) disposal facility at the Los Alamos National Laboratory(LANL), Material Disposal Area (MDA) G. The PA and CA satisfy the following DOE requirement documents:

- DOE Order 5820.2A, Radioactive Waste Management (September 1988);
- "Guidance for a Composite Analysis of the Impact of Interacting Source Terms on the Radiological Protection of the Public from DOE LLW Disposal Facilities" (April 1996);
- "Revised Interim Policy on Regulatory Structure for Low-Level Radioactive Waste Management and Disposal" (July 1996); and
- "Interim Format and Content Guide and Standard Review Plan for U.S. Department of Energy Low-Level Waste Disposal Facility Performance Assessments" (October 1996).

The purpose of the PA is to determine if LLW generated since September 26, 1988 has been, and will continue to be, disposed of at MDA G in a manner that will not result in radiation doses to members of the public that exceed performance objectives specified by the DOE. In a complementary fashion, the CA is used to evaluate options for ensuring that exposures from all waste disposed of at MDA G will not impart doses to future members of the public in excess of specified limits.

MDA G has been used for disposal of the Laboratory's radioactive waste since 1957. The chemical, physical, and radiological characteristics of waste disposed of after September 26, 1988 have been reported and documented in accordance with the requirements of DOE Order 5820.2A. Characteristics of the inventory buried prior to September 25, 1988 are uncertain, although electronic records exist for disposals after 1971. Together, the PA and CA provide a comprehensive evaluation of the potential radiological exposures to future members of the public from past, present, and future disposals at MDA G. Doses are projected beyond 1,000 years after facility closure, which is assumed to occur in 2044. The results are compared with performance objectives provided by the DOE.
Radiological doses to future members of the public can result from the release and

- Maximum flux of radon gas (i.e., ^{220}Rn and ^{222}Rn) from the undisturbed disposal site of 20 pCi/m²/s (1.9 pCi/ft²/s).
- Maximum effective dose equivalent of 100 mrem/yr for continuous exposures of individuals who inadvertently intrude into the facility after the loss of active institutional control (100 years).
- Maximum effective dose equivalent of 500 mrem/yr for acute exposures of individuals who inadvertently intrude into the facility after the loss of active institutional control (100 years).
- Maximum effective dose equivalent of 4 mrem/yr to any member of the public from the consumption of drinking water drawn from wells outside of the land-use boundary.

The performance objective for the CA is the DOE primary annual dose limit of 100 mrem effective dose equivalent for members of the public. If the projected dose exceeds 30 mrem/yr, an options analysis must be prepared to consider actions that could be taken to reduce exposures, taking into account the cost of such actions. Compliance with performance objectives is evaluated over a 1,000-year post-closure period.

To model release and transport of radioactivity from MDA G, waste characteristics and natural processes were examined. Most waste disposed of at MDA G is slightly contaminated laboratory trash (e.g., paper, packaging materials, glassware, etc.) and debris from cleanup activities (e.g., building rubble, conduit, soil, etc.). The inventory includes large quantities of tritium, ^{60}Co (in activated metals), and ^{137}Cs (in irradiation sources); special nuclear materials (e.g., ^{239}Pu, ^{241}Am, and ^{235}U); and residues from medical radioisotope separations (e.g., ^{95m}Tc and ^{94}Nb).

The waste inventory for the PA and CA was divided into four segments, each of which was characterized separately according to availability of information. The four segments and the general method of characterization are:

- 1957 - 1970 Inventory: Radionuclide content extrapolated from records from the early 1970s;
- 1971 - September 25, 1988 Inventory: Radionuclide content obtained from electronic database;
- September 26, 1988 - 1995 Inventory: Radionuclide content obtained from electronic database; and

about 275 m (900 ft) above the regional aquifer, which supplies the drinking water for area residents. The climate is semiarid, the ecosystem is Piñon-Juniper woodland. There are natural processes somewhat unique to this setting that have important implications with respect to exposure pathways considered in the PA and CA, including:

- Evaporation at depths within the mesa;
- Slow moisture flux through the mesa;
- Surface water runoff from the mesa into the canyons; and
- Channeled winds within the canyons.

The MDA G inventory includes many waste forms contaminated with a wide variety of radionuclides. Three source term models were developed to account for possible releases. For the purpose of the PA and CA, releases of radioactivity were assumed to result from the following processes:

- Gas-phase diffusion;
- Translocation of radioactive materials by burrowing animals and deep-rooting plants; and
- Aqueous-phase leaching of soluble radionuclides.

A gas-phase diffusion model was used to calculate the time-dependent flux of radionuclides in the inventory that are either characteristically volatile (i.e., krypton and radon) or form gases (i.e., ^{14}C as $^{14}CO_2$) or vapors (i.e., ^{3}H as $^{3}H_2O$, H^3HO/HTO). A biotic translocation model was used to account for time-dependent surface-soil radionuclide concentrations as a result of burrowing animals excavating waste and plants assimilating radioactivity through roots penetrating waste, then depositing radioactivity on the surface with natural defoliation. Finally, an aqueous-phase release model was developed to simulate dissolution of radioactive materials into water percolating through the disposal units.

Gas-phase releases were transported offsite in air, producing inhalation doses. Surface contamination resulting from biotic intrusion was transported offsite in air and subsequent redeposition and in surface water, resulting in inhalation, ingestion, and external exposures. Aqueous-phase releases were transported vertically downward toward the

CA	All Pathways	Cañada del Buey	5.5 mrem/yr	30/100 mrem/yr
PA	Groundwater Protection	White Rock Pajarito Canyon	3.5×10^{-5} mrem/yr	4 mrem/yr
PA	All Pathways	White Rock Pajarito Canyon	1.0×10^{-4} mrem/yr	25 mrem/yr
CA	All Pathways	White Rock Pajarito Canyon	7.2×10^{-3} mrem/yr	30/100 mrem/yr
PA	Intruder	MDA G	12 to 30 mrem/yr	100 mrem/yr
PA	Radon Flux	MDA G	0.1 to 3.1 pCi/m²/s	20 pCi/m²/s

a. PA includes waste disposed of after September 26, 1988; CA includes all waste
b. Performance objective represents the maximum projected exposure from all releases at LANL.

Projected doses and radon fluxes were small in all cases considered, and well below the applicable performance objectives for the PA and CA. The peak PA dose for the air pathway analysis was a small contribution to the maximum annual dose of 3.5 mrem projected for other facilities at LANL. The projected doses for the CA were less than the 100 mrem/yr primary objective, as well as the 30 mrem/yr limit indicative of the need for an options analysis.

The uncertainties associated with the projected doses, and their impact on the ability of MDA G to comply with the performance objectives, are discussed. Uncertainties in inventory, environmental data, and modeling parameters are considered over a 10,000-year period to provide reasonable assurance that the performance objectives will be achieved. After accounting for the uncertainty in the dose analyses, all performance objectives are still likely to be met.

Analyses and field and experimental data will continue to be refined to support the maintenance of the site Performance Assessment, with an emphasis on reducing important uncertainties in the analysis. Waste Acceptance Criteria, waste characterization requirements, and waste disposal operations will be modified to reflect the results of the PA.