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RED CANL TA-54 '98 #5

March 23, 1998

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Subject: **Performance Assessment and Composite Analysis for Los Alamos National Laboratory Material Disposal Area G, dated March 1997**

The New Mexico Environment Department DOE Oversight Bureau has reviewed the subject document. The enclosed comments, suggestions and requests for further information are non-regulatory in nature. The intent of these comments is to insure that New Mexico's environment and the health of its citizens are protected by the measures planned to be taken at Material Disposal Area G resulting from the Performance Assessment (PA). The PA is described as a 'living document' and will be modified over time as new information becomes available; likewise, these comments are open to change upon receipt of new information.

The conclusions of the PA are based on a mathematical model which is in turn based on the knowledge of many factors. Some factors do not seem to be sufficiently defined to justify the PA's conclusions.

- The rate and nature of 'biotic intrusion,' which leads ultimately to most of the predicted human exposures, does not appear to be known with a sufficient degree of confidence.
- The actions of human intruders are impossible to predict.
- The mechanisms cited for flux of water vertically downward through the mesa do not account for the levels of moisture found in the 'vapor phase notch' beneath MDA G or elsewhere on the Pajarito Plateau. Ground water flow paths other than those included in the model may play a significant role in contaminant transport.

It is probably not feasible to sufficiently reduce or eliminate uncertainties associated with these factors; therefore, DOE should consider more conservative measures to isolate wastes from the environment. Such measures might include engineered barriers (i.e., an environmental cap designed specifically for semi-arid conditions and equipped with an aggressive biotic barrier), additional waste containerization and stabilization, more stringent waste acceptance criteria, and/or waste removal.

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The above summary of our comments and suggestions has been included in the executive summary of the attached review. Inquiries regarding these questions and comments should be directed to Bruce Swanton or Tom Tatkin in our Santa Fe office at (505) 827-1536.

Sincerely,

Stephen Yanicak

Steve Yanicak, Program Manager
DOE Oversight Bureau

SY/bas
Enclosure

cc: Tony Stanford, EM-SWO MS-J595
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Review of *Performance Assessment and Composite Analysis for Los Alamos National Laboratory Material Disposal Area G,* dated March 1997

Tom Tatkin and Bruce Swanton
Department of Energy Oversight Bureau/New Mexico Environment Department
March 23, 1998

EXECUTIVE SUMMARY

The New Mexico Environment Department Oversight Bureau (DOE OB) has reviewed the subject document. The comments, suggestions and requests for further information, listed here are non-regulatory in nature. The intent of these comments is to ensure that New Mexico's environment and the health of its citizens are protected by the measures planned to be taken at Material Disposal Area G (MDA G) resulting from the Performance Assessment (PA). The PA is described as a 'living document' which will be modified over time as new information becomes available; likewise, these comments are open to change upon receipt of new information.

The conclusion of the LANL PA are based on a mathematical model, which is in turn based on knowledge of many factors. Some factors which are not sufficiently defined to justify the PA's conclusions include:

- The rate and nature of 'biotic intrusion,' which leads ultimately to most of the predicted human exposures, does not appear to be known with a sufficient degree of confidence.
- The actions of human intruders are impossible to predict.
- The mechanisms cited for flux of water vertically downward through the mesa do not account for the levels of moisture found in the 'vapor phase notch' beneath MDA G or elsewhere on the plateau. Ground water flow paths other than those included in the model may play a significant role in contaminant transport.

It is probably not feasible to sufficiently reduce or eliminate uncertainties associated with these factors; therefore, DOE should consider more conservative measures to isolate wastes from the environment. Such measures might include engineered barriers (i.e.,an environmental cap designed specifically for semi-arid conditions and equipped with an aggressive biotic barrier), additional waste containerization and stabilization, more stringent waste acceptance criteria and/or waste removal.

Additional measures which LANL should consider are:

- Large, weather resistant signs or monuments should be constructed, informing possible future intruders of the hazardous nature of the site.
- The rates of cliff retreat used in the PA should be validated isotopically, as has been done at TA-21.
- The NRC standard of 10,000 years should be applied in this PA rather than the 1,000 year projection currently used.

PERFORMANCE ASSESSMENT MODEL VARIABLES

1. **Land Use Plan** (Section 1.4.3, p.1-16 and Annex E)

   This section refers to Annex E, "Document of Understanding" (DOU), as the basis for the decision that an industrial-use scenario is appropriate for MDA G. We find no mention of MDA G in Annex E of the November 16, 1995 "Environmental Restoration Document of Understanding." The DOU is directed toward environmental restoration of RCRA wastes, not Low Level Waste (LLW), the waste type for which the PA was developed.

2. **Precipitation and Evapotranspiration** (Section 2.1.2.1, p.2-8)

   As the purpose of the PA is to project the potential dose posed by LLW over a period of 1,000 years, we would like to see LANL use the highest annual precipitation estimated to have occurred over the past 1,000 years as the maximum annual average precipitation, rather than the 400-year annual maximum rainfall currently used in the PA. We understand that dendrochronology was the dating method used to estimate the 400 year event. We were informed by the U.S. Forest Service that there may be 1000 year-old ponderosa in the Jemez. Other methods are also available, including caliche layer formation, quaternary sedimentation, and carbon dating.

3. **Groundwater Pathways Source Term Model** (Section 3.1.2.2, p.3-19 - p.3-22)

   We understood from LANL's PA Workshop presentation (December 4, 1997) that, for the purpose of the model, all wastes are considered to be distributed uniformly ("homogenized") throughout all Area G pits and shafts, and that the model also treats these wastes as surface-contaminated. This section includes additional types of wastes, e.g., sludge and bulk source terms. Please clarify.

4. **Parameter studies/Single Fracture Fills and Coatings** (Section 3.3.2.1.6, p.3-55)

   The following statement implies that the FEHM model was run to assume 100 days of saturated conditions directly over a coarse sand-filled fracture with a 5 mm aperture and that the result was that the fractures would not sustain liquid flow: "One [study] assumed a constant rate of 5 cm/day to represent an extreme event for a single day. However, this inflow rate was applied for the entire time period of the simulation, often up to 100 days." Is this correct?

BIOTIC INTRUSION

5. **Potential Pathway Sources** (Appendix 1b, p.11)

   MDA AB, the hydronuclear area at TA-49, is not considered in the PA as significantly contributing to the air pathway scenario, primarily because the shafts are stated as having

been filled with 60 feet of crushed tuff and sand. The RFI Workplan for TA-49 (1992, p.7-22) states that Area 2 of MDA-AB was capped with 1 to 6 feet of crushed tuff and gravel and then with an asphalt layer. This was apparently done to cover contaminated surface soils suspected to have been unearthed during a drilling event in 1960. More recently, surface soil monitoring has indicated levels as high as 1660 pCi/g ^{239}Pu and ^{240}Pu apparently brought to the surface by pocket gophers from under the 1- to 6-foot cap. This raises several questions:

a) To what depths have gophers been observed to penetrate soils at MDA AB?

b) If contamination has been brought to the surface at MDA AB over so short a period of time, might this MDA and others contribute to the air pathway over a 1000 to 10,000 year period?

c) If gophers were responsible for this degree of bioturbation at MDA AB, shouldn't they be included in the model for Area G?

d) How well have pre-Performance Assessment burial sites at Area G been characterized for depth of contaminants? We are aware of a 1996 incident at area G where shallow excavation for road development near one of the pre-1989 pits brought contaminated soils to the surface, potentially impacting airborne releases.

6. **Biotic Intrusion/Translocation** (Section 3.1.1.2.1, and Appendix 3b)

In discussions with LANL, we learned that the model's projected human exposure to radiation from LLW at Area G results almost exclusively from the actions of plants and burrowing animals, which transfer waste material from the subsurface to the soil surface. The fundamental importance of biotic intrusion to projected human exposures should be clearly stated in a lead paragraph in the PA such as at the beginning of Section 3.1.1.2.1.

7. **Biotic Translocation Model** (Section 3.1.1.2.1., and Appendix 3b)

Why does the biotic translocation model not mention the indigenous juniper tree, which commonly has a root system that can penetrate tens of feet in depth? Similarly, the pocket gopher may be a more conservative burrowing species. The use of data from a site in southeastern Idaho suggesting a maximum burrowing depth of five feet may not be representative locally. Actual measured depths found at random locations throughout the Pajarito Plateau and also in disturbed tuff may be a better approximation for the model . Consider, in particular the suggested burrowing situation noted in the 1992 RFI Report for MDA-AB, Area 2.

8. **Biotic Intrusion** (Section 3.1.1.2.1, and Appendix 3b)

The PA should describe how the Area G landfill is envisioned to appear, in terms of vegetation, at various times after the end of the period of administrative controls under the designated industrial land-use scenario. For example, what tree species will be allowed to

grow over the pits and shafts? If there are no specifically planned upkeep measures, then the model should allow incursion of all local plant and animal species. The PA is not clear whether this is or is not the case.

HUMAN INTRUSION

9. **Inadvertent Intruder Analysis** (Section 5.0, p.5-1)

An intruder scenario should be performed for MDAs outlying MDA G until and unless these outlying MDAs are removed or otherwise remediated. Please explain why human intrusion for these outliers was not considered.

10. **Inadvertent Intruder Analysis** (Section 5.0, p.5-1)

It is stated in Section 5 that, "...intrusion is a hypothetical event...applicable to the PA inventory." We presume the rationale for applying intruder scenarios only to the PA components of the facility while excluding the CA components is based on DOE guidance or orders stating that the analysis be done in this way. However, there seems to be no physical reason why the scenarios described here would not equally apply to human intrusion over and into the sites at Area G which are designated as belonging to the CA. Limiting possible intrusion to the PA facility areas does not appear to be reasonable unless there are also planned to be physical barriers making intrusion into the CA less likely than into the PA facility areas

PREFERENTIAL PATHWAYS

11. **Unit Hydraulic Gradient Approximations** (Section 2.1.5.6.2, p.2-51)

"One explanation [of the moisture disconnect between units 1vc/1g and the TCT]...is that water may be removed by evaporation and vapor-phase diffusion at intermediate depths." Another explanation may be that water is being conducted through the intermediate tuff via fractures during periodic storm events, delivering water to the upper zone to the vapor phase notch (VPN) without leaving residual water behind. This possibility should be investigated. Do salt residues along fracture faces bear on this possibility?

12. **Unit Hydraulic Gradient Approximations**
(Sections 2.1.5.6.2 and 2.1.5.6.3, pp. 2-51 - 53)

Figure 2-19 shows a Darcy flux of 5 cm/y at 30 meters below the surface. The text on page -51 states, "...the Tsankawi-Cerro Toledo and Otowi layers...match moisture with a much larger apparent recharge rate on the order of 10 mm/yr." The text on page 10 of Appendix 2a gives the depth of the Tsankawi as 30 meters. Which flux rate is correct and why is there this apparent five-fold contradiction?

13. **Moisture Profile Analysis** (Section 2.1.5.6.3, p. 2-54)

The following statement suggests that accumulation of fracture-flow water at the Bandelier tuff, vapor phase notch occurs generally around the Laboratory property: "While increased moisture at the vapor phase notch at MDA G may be interpreted as a moisture source from the relatively wet canyons, this hypothesis does not explain high moisture content values (10-20 percent volumetric) observed at the vapor phase notch at other locations throughout the Laboratory where the vapor phase notch is not coincident with a canyon bottom." Is this evidence that water is being conducted through fractures and should the fracture flow path be considered?

14. **Liquid Phase Transport in the Unsaturated Zone** (Appendix 2c, p.1)

"The analysis indicates a small average downward flux of 0.07 cm/yr in this region and suggests a local moisture source. This may indicate lateral flow, connectivity to alluvium of greater saturation in the adjacent canyon, or may signify the elevations of the bottom of a network of surface-connected fractures." Has any attempt been made to age-date the water found at the vapor phase notch?

15. **Existing Data**

There are several sources of data which describe the migration of radiological contaminants from Area G. Among these are: NPDES storm water monitoring data, ESH-20 Area G perimeter surface soil data, ESH-20 single-stage water and sediment data, and ER-program channel sediment data. The PA should include a summary of these data. The PA should also discuss how these data do or do not support the baseline assumptions in the model and/or the model's contaminant migration projections.

ENGINEERING DESIGN

16. **"Neutron Moisture Profile through Pit 37"** (Figure 2-23, pg. 2-70)

The datum elevation used for indicating depth is not given. At the time measurements were taken, the pit was active. Is the datum (the '0-foot level') set to be the base of Pit 37, the top or elsewhere?

17. **Completed depths for Pits and Shafts**

What was the basis for the USGS recommendation that the elevation of the bottom of all pits and shafts be 10 feet higher than the elevation of the adjacent canyon bottoms? If the bottoms of the two canyons that border a mesa are of different elevations, are the pits and shafts always shallower than 10 feet above the topographically higher canyon?

18. **Recharge Beneath MDA G** (Section 2.1.5.6, p.2-43)

Is there any way to prevent surface drainage from percolating through the floors of pits while they remain active? Why isn't a sump and pump used to prevent ponding?

LANDFILL CAP

19. **Disposal Unit Cover Integrity** (Section 2.2.2., paragraph 2, p. 2-71)

What is the measured compaction expected with a 50 ton bulldozer? What quantitative crushed tuff compaction tests were done during the investigations concerning its use inthe Area G pit caps?

20. **Operational Cap thickness**

In the past, a one-meter cap of crushed tuff seems to have been considered adequate. The current proposal calls for two-meter caps. Why not three meters? What is the basis for the '2-meter' decision?

21. **Cliff Retreat** (Section 2.1.4.1, p.2-29, and Section 3.1.1.2.2, p.3-13)

Given the long half lives of some of the wastes interred at Area G, we would like to discuss with LANL the potential of a study at TA 54 like that done by S.L. Renau[1] on the rate of cliff retreat at TA 21. The rate cited in the PA (7.2×10^{-4} ft/yr) seems to be taken from the Renau paper[2], and this rate appears to have been based on the assumptions that: 1) the current drainages appeared soon after the plateau was formed; and 2) that the rate of current cliff retreat is proportional to the current distance of a given cliff from the center of the current drainage. It may be possible to obtain better data without a high level of effort, for example, by employing cosmogenic isotopes to date "recently" exposed cliff face segments .

22. **Source Term Uncertainties** (Section 4.3.2)

This may be the appropriate section for stating that the biotic intrusion factors are those which lead ultimately to what the model projects will be the greatest human doses.

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[1]Earth Science Investigations for Environmental Restoration–Los Alamos National Laboratory, Technical Area 21, LA-12934-MS, pp.65-92.

[2]Ibid., p. 84.

23. **Inadvertent Intruder Warning**

In view of the long half lives of many of the radionuclides in MDA G, we suggest DOE/LANL consider including in the PA the commitment to construct large, weather resistant signs to warn possible future intruders as to what has been disposed of at the site. We further suggest these markers be in plain English, Spanish and commonly-used symbols and be placed so as to be visible by the most likely route(s) of egress to the facility, at some time prior to the end of the period of administrative controls.

24. **PA Study Period**

We recommend that the NRC standard of 10,000 years be used rather than the 1,000 year projection currently used in the PA.

25. **Natural Tracer Analyses** (Section 2.1.5.6.1, p.2-46)

Why is it highly unlikely that the chloride bulge is the result of climate change?

26. **Waste Acceptance Criteria**

Since initially developing the PA in 1988, what changes in waste acceptance criteria have been implemented?

27. **Area G- CA Inventory Calculations**

Please provide a detailed description of how the CA waste inventory prior to 1970 was estimated.

28. **DOE Review of PA**

In order that DOE OB may understand DOE's administrative procedures in the PA process, where is the PA, at present, in the DOE Headquarters approval process?

29. **Effect of NEPA Documentation on PA**What effect will the NEPA process, specifically the Site Wide Environmental Impact Statement, have on LANL's MDAs, including MDA G? Is the SWEIS the main NEPA action which may affect the disposition of MDA G?

30. **Dose Rate Exposure at Any Point in Time**

Does the model allow the modeler to determine the doses from the inventory at any point in time within the window of a 1,000 year and 10,000 year period? If one wanted to know what the dose contribution of the Area G landfill would be for the maximally exposed individual in, for example, 250 years after closure, could this be done?