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RETURN RECEIPT REQUESTED

TA-16

May 30, 1995

Mr. Larry Kirkman,
Acting Area Manager
Department of Energy
Los Alamos Area Office
528 35 Street
Los Alamos, New Mexico 87545

RE: Denial of the Los Alamos National Laboratory's Ground-Water Monitoring Waiver Requests

Dear Mr. Kirkman:

As stated in the New Mexico Environment Department's **(NMED's)** May 5, 1994 letter regarding ground-water monitoring waiver documentation, NMED deferred a decision regarding ground-water monitoring waivers pending reevaluation of the hydrogeologic conditions beneath the facility and consideration of new ground-water data. Closure plans for the below named units have been submitted to NMED for closure under 20 NMAC 4.1, Subpart VI, 40 CFR 265 Subpart G:

TA-54 Areas G & L (March, 1987)
TA-16 Surface Impoundment & Area P Landfill (December, 1987)
TA-35-125 & 85 Surface Impoundments (March, 1989)
TA-53 Surface Impoundments (1992)

Through evaluation of the submitted supporting documentation, NMED has determined that the information provided does not fulfill Part 265 standards. This letter serves to document the bases for regulatory denial of ground-water monitoring waiver proposals [20 NMAC 4.1 Subpart VI, 40 CFR 265.90] as submitted by Los Alamos National Laboratory **(LANL)** to NMED. General technical rationale, specific waiver requests, and reasons for denial of the ground-water monitoring waivers are provided in the enclosed Attachment.

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Because these demonstrations, have not met the technical standards necessary for approval of ground-water monitoring waivers at the sites listed above, ground-water monitoring program plans will be required for LANL to be in compliance with 20 NMAC Subpart VI, 40 CFR 265 Subpart F regulations.

Although NMED does not relinquish any of New Mexico's regulatory or statutory authorities, these denials do not require immediate submittal of ground-water monitoring program plans for each closure. Instead, in light of DOE/LANLs budgetary constraints, a comprehensive ground-water monitoring program plan should be developed which addresses both site-specific and site-wide ground-water monitoring objectives. This may be achieved by modifying the existing site-wide Groundwater Protection Management Program Plan, Revision 1.0, March 6, 1995 to include regulatory site-specific considerations. NMED intends to coordinate with DOE/LANL in this site-wide approach. If DOE or LANL staff wish to discuss this issue, please contact Ronald Kern, manager of the RCRA Technical Compliance Program, to arrange a meeting. If you have any questions regarding this matter, please contact Ms. Lee Winn or Ms. Teri Davis of my staff at (505) 827-4308.

Sincerely,

Benito J. Garcia, Chief
Hazardous & Radioactive Materials Bureau

CC: Ron Kern, Manager, RCRA Technical Compliance Program
LANL 1995 Red File
Barbara Hoditscheck, Manager, RCRA Permitting Program
Neil Weber, DOE Oversight Bureau
Marcy Leavitt, Ground Water Protection & Remediation Bureau

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ATTACHMENT

GENERAL TECHNICAL RATIONALE FOR DENIAL OF GROUND-WATER MONITORING WAIVERS

Los Alamos National Laboratory **(LANL)** has provided inadequate and incomplete information pertaining to the unsaturated and saturated conditions across the Parajito Plateau in support of ground-water monitoring waivers for the various RCRA-regulated units (TA-54 Area G & L, TA-16 Surface Impoundment & Area P Landfill, TA-35-125 & 85 Surface Impoundments, and TA-53 Surface Impoundments). Basic geology, hydrogeology, and pathways for contaminant transport have not been adequately addressed to date. Listed below are the general technical concerns of LANL, U.S. Environmental Protection Agency **(EPA)**, and the New Mexico Environment Department **(NMED)** regarding the lack of understanding of the hydrogeologic system at this facility. These technical concerns and data gaps support denial of LANL's ground-water monitoring waiver requests.

1. LANL's Installation Work Plan Revision 3, November 1993

Within LANL's Installation Work Plan Revision 3, November 1993, specific data gaps were listed and data needs were identified explicitly throughout the environmental setting section of this document. These data gaps are relevant to the ground-water monitoring waiver issue. These are specifically:

- Absence of facility-wide geologic mapping . The lack of geologic mapping in the intervening areas causes the validity of the correlations to be uncertain. [section 2.6.1.2.9]

  "Stratigraphic features in the tuff, such as volcanic surge deposits, ***may locally provide a preferential migration pathway for moisture and contaminants in the subsurface*** [emphasis added] (Purtymun 1973, 0710; Crowe et al. 1978, 0041). Purtymun (1973, 0710) noted increased rates of vapor phase migration of tritium away from storage shafts at TA-54 along a stratigraphic boundary that includes surge layers. Individual flow units in the Tshirege Member contain vertical cooling joints that may or may not cross flow unit boundaries. In ash flow tuffs, cooling joints spacing varies primarily with the thickness of the unit, emplacement temperature, substrate temperature, and topography. Joint density tends to be greatest in welded tuff and least in non welded tuff. Hydraulic conductivities are generally greatest in the fractured, welded parts of ash flow tuffs and least in the non-welded parts (Crowe et al. 1978, 0041)."(Section 2.6.1.2.9, page 2-17).

- "Dransfield and Gardner (1985, 0082) integrated a variety of data to produce structure contour and paleogeologic maps of the pre Bandelier Tuff surface beneath the Pajarito Plateau. Their maps reveal that subsurface rock units are cut by a series of down-to-the-west normal faults; the overlying Bandelier Tuff is not obviously displaced by these buried faults. However, where detailed fracture studies have been done on the

plateau, they have shown that fracture abundances and apertures increase in the Bandelier Tuff over fault projections, which indicates tectonic fracturing mentioned above (Vaniman and Wohletz 1990, 0541). In addition, small-scale offsets along fractures have been observed in various parts of the Laboratory, including ***Area G at TA-54*** [emphasis added] (Rogers 1977, 0216), that suggest additional unmapped fault zones. Unfortunately, detailed fracture studies on the Pajarito Plateau are few." (Section 2.6.1.4, page 2-19).

- "Perched water bodies occur in the conglomerates and basalts beneath the alluvium in the mid and lower reaches of Pueblo and Los Alamos canyons and in the lower reach of Sandia Canyon. Depth to perched water ranges from about 90 ft in the midreach of Pueblo Canyon to about 450 ft in lower Sandia. ***The vertical and lateral extent of the perched groundwaters, the nature and extent of perching units, and the potential for migration of perched water to the main aquifer is not fully understood by investigators to date.*** [emphasis added] " (Section 2.6.2.3.2, page 2-29).

2. LANL's Groundwater Protection Management Program Plan, 1995

Comments and Recommendations found in LANL's "Groundwater Protection Management Program Plan, Appendix I" - (March 6, 1995, Revision 1.0) identified numerous deficiencies in the conceptual hydrogeological understanding at LANL. Major concerns and recommendations are listed below:

Appendix I - Los Alamos National Laboratory E S & H Self-Assessment Report (August 91):

"Not enough is yet known about the fundamental processes controlling movement of water or contaminants through the unsaturated zone to completely understand whether contamination could ever reach the main aquifer." (3.2.4, par.2)

"Fundamental research is necessary in basic geology, unsaturated zone geology and hydrology, and saturated zone geology and hydrogeology." (3.2.4, par. 5)

"Basic Geology: Basic geology of the Laboratory area includes structural features, stratigraphy, fracture and fault zone (knowledge of both the Pajarito fault zone on the western margin of the plateau and the plateau itself where faults and fractures may control erosional patterns and potential infiltration zones are crucial to understanding ground water recharge), geomorphology, seismic history, and geochemistry. (3.2.4, 1st bullet)

"Saturated Zone Geology and Hydrology: Information on recharge of the main aquifer and lithology is incomplete; knowledge of the upper surface of the main aquifer, especially toward

the west, is incomplete; temporal variation of the ground water surface is not well described; information is lacking on vertical and horizontal permeability variation, horizontal and vertical pore-water velocities, pore-water flow gradients, extent of phreatic versus confined zones, geologic structure beneath the Bandelier tuff, spatial variations of natural ground water quality, and areal continuity of data." (3.2.4, 2nd bullet)

"Unsaturated or Vadose Zone Geology and Hydrology: Unsaturated hydrologic property measurements are lacking for the Otowi and Guaje Members of the Bandelier tuff, the Chino Mesa Basalts, the Puye conglomerate, and the unsaturated portions of the Santa Fe group sediments." (GW.2 Implementation of Ground Water Protection Programs)

Appendix I - Hydrogeologic Review for the Environmental Restoration Program at Los Alamos National Laboratory. LANL Hydrogeology Panel Final Report, Summary of Comments on Issues Identified by the Program:

"Issue 3: Do we know enough about the role of fractures?

"The panel is somewhat divided on this question. On one hand, some geologic evidence suggest that fractures lack connectivity over great depths and fractures may provide capillary barrier to unsaturated flow. On the other, roots and weathering patterns suggest that some fractures on the mesa tops may be preferential paths for infiltration. Our primary concern for liquid flow in fractures is in canyon bottoms where fractures in bedrock may intersect perched alluvial aquifers. There are few field data on the role of fractures, but there is also very little one can do to adequately and quantitatively characterize variably saturated fracture flow and transport coefficients. At small site scales, the role of fractures as transport pathways and their connections to regional pathway will likely have to be addressed for each site individually."

The above statement about the uncertainty of location and connection, and flow in fractures is important reasoning for requiring ground-water monitoring wells to detect releases.

"Issue 4: Can we defensibly model LANL hydrogeology using a porous continuum model?

"Much of the experimental and environmental monitoring data suggests that a porous media flow model would be appropriate. However, porous media models should be used to predict observed behavior in order to validate the model and to confirm the validity of the porous medial approach."

Because of fractures, cooling joints, faults, bedding planes, a porous media model seems flawed. The above statement, suggest the need for empirical data to confirm modeling information. The complexity of the vadose zone supports the rejection of porous media flow conceptual models presented in the ground-water monitoring waiver requests.

"Issue: 5: Are we sufficiently certain of ground water flow direction regionally that we can know ground water flow direction at a specific OU? Additionally, is there any reason to believe that there are local ground water gradients?

"Local effects undoubtedly occur near the well fields, and it is possible that small perturbations may occur in the main aquifer beneath perched aquifers or other potential recharge areas. Additional information is required to monitor horizontal and vertical pathways and to confirm sources of recharge. Mapping details of drawdown and "zones of capture" around the well fields would add to this knowledge base.

"Issue 6: Can we defensibly state there is no connection between any perched zones and the main aquifer?

"Existing data are insufficient to state that no perched water percolates to the main aquifer. In fact, recent work at Mortandad Canyon shows that vertical transport has occurred in the Bandelier Tuff to at least 150 ft (46m) beneath the perched alluvial aquifer. Little is known of vapor phase transport in these areas.

"Issue 8: Do we know enough that modeling as a homogeneous, steady state system adequately defines the system? Alternatively, do we know enough to model as a nonhomogeneous, transient system?

"Except for scoping calculations, field observations and model studies show that some degree of heterogeneity will need to be incorporated into the conceptual models of flow and transport in the vadose zone, in the perched aquifers, and in the main aquifer. Transient effects will need to be considered to simulate transport at least within perched alluvial aquifers, and in pumping scenarios for the main aquifer.

"Available data are scarce, and details of experimental procedures need to be published. A model study using existing sorption data underestimated observed radionuclide transport. Available data do not appear to be sufficient to defend ER objectives."

3. EPA Concerns

Major relevant EPA concerns, as documented in the March 16, 1994 Comprehensive Ground Water Monitoring Evaluation **(CME)**, are expressed in the following questions:

1. "Has a ground water monitoring program (capable of determining the facility's impact on the quality of ground water in the uppermost aquifer underlying the facility) been implemented as per 40 CFR subparagraph 265.90? Uppermost aquifer means the geologic formation nearest the natural ground surface that is an aquifer as well as

lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

"No, the facility does not have a ground water monitoring program capable of determining all of the facility's impact on the uppermost aquifer. LANL has ground water monitoring waivers on file for each unit requiring ground water monitoring"

2. "Has the facility adequately identified the uppermost aquifer?

"No, based upon the reviewed documents, the uppermost aquifer has not been adequately characterized. Additional studies are required. Each ground water monitoring waiver needs to be evaluated to determine its appropriateness. If the ground water monitoring waiver does not meet the requirements of 40 CFR 265.90(c), LANL will be required to submit additional information or install ground water monitoring wells at each regulated unit."

4. State Concerns

In addition to the specific data gaps and needs described by LANL and EPA above, the state has additional concerns:

- Water-level contour maps presented in the submitted supporting ground-water monitoring waiver documentation are not adequate. The ground-water elevation data obtained from supply and test well data has been compiled together. It is generally not accepted practice to contour such data. The test wells are screened over short intervals (10 feet), presumably at the top of the aquifer, whereas the production wells are screened over much greater lengths (1500-2500 feet), starting typically hundreds of feet below the presumed top of the aquifer. Compiling such data may give a nonrepresentive picture of the hydraulic head distribution within the aquifer(s). Additionally, elementary contouring errors have apparently been reproduced from document to document, which have resulted in compounded errors in water-level contours.

- Individual zones of saturation beneath LANL have not been adequately delineated, and the "hydraulic interconnection" between these is not understood. Inadequate and incomplete knowledge concerning the geometries and boundary conditions of the zones of saturation beneath the facility exists. A facility-wide description of the hydrogeologic characteristics affecting ground-water flow beneath the facility can not be made without adequate delineation of the perched-intermediate aquifer(s) beneath LANL.

- The recharge area(s) for the main and perched-intermediate aquifers have not been identified. It is unknown at this time if any significant quantity of water is recharging the main aquifer through the fracture-fault zones which occur on the Pajarito Plateau. Characterization of these site-wide fault zones as potential pathways for aqueous migration is not complete. It is unknown what effect, if any, these zones may have on the direction of ground-water flow and hydraulic gradient of the main and perched-intermediate aquifers.

- The ground-water flow direction(s) of the main aquifer and perched-intermediate aquifer(s), as influenced by pumping of production wells are unknown.

- Detection of low-level tritium in the main aquifer in Los Alamos, Pueblo, and Mortandad Canyons (all of which have monitoring wells in them) refutes fundamental assumptions supporting low or no potential of migration of constituents of concern to the uppermost aquifer.

SITE-SPECIFIC GROUND-WATER MONITORING WAIVER REQUESTS & DENIALS

1. March 1987, *"Hydrogeologic Assessment of Technical Area-54 Area G & L, Los Alamos National Laboratory"*

In addition to the general technical reasons listed in the previous section, denial is based on the following observations:

- The presence of an alluvial aquifer in lower Pajarito Canyon is of concern from a horizontal contaminant transport standpoint. The continuing degradation of water quality within Pajarito Canyon from PCO-1 to PCO-3 is of concern. No apparent principal release site other than Area G & L exist that may account for the observed change in water quality.

- Section 3.0 Hydrologic Characterization of the Vadose Zone, page 3-1, first paragraph which states, "No perched water has been detected above the main aquifer; therefore, studies of moisture movement have been concentrated on unsaturated flow processes." As noted by N.D. Rosenburg and H.J. Turin (1993), Summary of Area G Geology, Hydrogeology, and Seismicity for Radiological Performance Assessment, a seismic hole drilled by J. Gardner in 1993 recorded wet core approximately 125 to 145 feet below ground-level, suggesting the possible existence of a perched-intermediate aquifer. The seismic drill hole is located approximately 700 feet NW of production

well PM-2 which is located immediately downstream of the confluence of the Pajarito and Three Mile Canyons (TA-18).

- The potential for perched water below the base of the basaltic units beneath Areas G & L is of concern. Springs 4A discharge near the basalt - Santa Fe Group contact in Pajarito Canyon at an elevation hundreds of feet above the surface of the Rio Grande. The river is believed to represent the surface of the top of the main aquifer through this stretch of the Rio Grande (Cushman, 1965). As noted in LANL's May 1993 OU 1148 RFI Workplan: "Perched (intermediate) aquifers, recharged from the alluvial aquifer in Pajarito Canyon, may exist in the subsurface in the southern vicinity of OU 1148, although no drill holes are available to determine if they exist."

U.S. EPA's 1994 CME supports these reasons by relating the following:

> "The ground water monitoring waiver for TA 54 Area L & G states: 1) there is not a perched water table at these areas, and 2) there is not any hydraulic connection to the main aquifer. However, there are not any ground water monitoring wells in the vicinity of Area L & G which verify this statement. It is understood that LANL was preparing to install a monitoring well penetrating the main aquifer, just east of TA 54, which could have been used to provide this information. However, it is also understood that due to budget constraints, the proposed installation of this well has been halted. It is recommended that this well be installed as expeditiously as possible in order to verify the ground water conditions in this area."

2. **December 15, 1987, *"Supporting Documentation for the Ground-Water Monitoring Waiver at the TA-16 Surface Impoundment".***

The above referenced documentation for the ground-water monitoring waiver at TA-16 Surface Impoundment has been reviewed. In addition to the general technical reasons listed in the previous section, the following technical issues support denial of the ground-water monitoring wavier at this RCRA regulated unit:

- Contaminant transport through the tuff is probable, based on field observations in Mortandad Canyon and low-level detection of tritium in the main aquifer.
- Recharge to the main aquifer is likely from the Pajarito fault zone and associated fracture-fault zones across the Plateau.
- Canon de Valle surface water is perennial within this stretch of the canyon. In addition, the wetlands in Canon de Valle appear to bisect the toe of the landfill. The wetlands areas could be in direct communication with a potential migration pathway.
- The depth to the uppermost aquifer is unknown.

Furthermore, the site has a documented release which requires a corrective action program plan be implemented.

3. **March 1989, *"Supporting Documentation for the Ground-Water Monitoring Waivers at the TA-35 TSL-85 and TSL-125 Surface Impoundments".***

In addition to the general technical reasons listed in the previous section, denial of the ground-water monitoring waiver request is based on inadequate documentation. A general technical reason which is particularly relevant to this site is that in nearby Mortandad Canyon, low levels of tritium have been detected at a depth of 200 feet in the Bandelier Tuff. This finding indicates that there is vertical transport within the tuff and therefore a potential for migration which must be addressed.

4. **April 1992, *"Ground-Water Monitoring Waiver Demonstration for Surface Impoundments at Technical Area-53".***

LANL 's reasoning for demonstrating "low potential for migration of hazardous waste or hazardous waste constituents to the uppermost aquifer" is described as:

> "(1) the unsaturated characteristics of the vadose zone below the TA-53 surface impoundments on Mesita de Los Alamos demonstrate low gravimetric moisture content..., and
>
> "(2) the annual evaportranspiration equals or exceeds the annual mean precipitation, resulting in a negative annual infiltration at TA 53."

In addition to the general technical reasons listed in the previous section, denial of the waiver is based on the following:

(a) There has been no site characterization to determine the uppermost aquifer below the site. The two canyons adjacent to Mesita de Los Alamos, Los Alamos and Sandia, both have perched water beneath the canyon bottoms.

(b) In point (1) quoted above, saturated porous media flow is assumed as the only transport model. Vapor phase flow of contamination and fracture flow are not adequately characterized or addressed in the supporting documentation, and

(c) Regarding point (2) quoted above, using a mean annual precipitation to calculate evapotranspiration is not adequate to account for all possible water balance at the site. Recharge mechanisms are also inadequately understood.