Boyd & Julie

Richard

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
ALLIED BANK TOWER AT FOUNTAIN PLACE
1445 ROSS AVENUE
DALLAS, TEXAS 75202

October 27, 1987

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GROUND WATER/HAZARDOUS WASTE BUREAU

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GROUND WATER/HAZARDOUS WASTE BUREAU

Mr. Michael J. Burkhart, Director
Environmental Improvement Division
New Mexico Health and Environment Department
P.O. Box 968
Santa Fe, New Mexico 87504-0968

Re: Los Alamos National Laboratory, Los Alamos, New Mexico
Comprehensive Groundwater Monitoring Evaluation (CME)
EPA I.D. No. NM0890010515

Dear Mr. Burkhart:

The U.S. Environmental Protection Agency (EPA) conducted a review of documents for a CME for Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico. EPA is the lead agency for this study. Enclosed is EPA's evaluation report.

EPA concurs with the waiver granted by the New Mexico Environmental Improvement Division of the groundwater monitoring requirements of the main aquifer in the Puye and Tesuque Formations. This waiver is only for Technical Area 54, Areas G and L. No violations were identified in the reports received by the Region.

Thank you for your cooperation. If you have any further questions, please contact me or Erlece Allen of my staff at (214) 655-6790.

Sincerely,

WK Honker

for Sam Becker, P.E.
Chief
Hazardous Waste Compliance Branch (6H-C)

Enclosure

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U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION VI, DALLAS, TEXAS

Comprehensive Groundwater Monitoring Evaluation Report (CME)

Inspection Cover Sheet

EPA I.D. No. NMØ890010515

Name of Facility Los Alamos National Laboratory

Mailing Address P.O. Box 1663

Los Alamos, New Mexico 87545

Location Los Alamos Area Office, Los Alamos, New Mexico

Telephone (505) 667-5288

Type of Facility: Research facility containing areas designated to work on space technology, nuclear weapons, health and medical problems, nuclear reactors, basic nuclear and particle physics, and non-nuclear ordinance.

Date of Inspection: N/A

Type of Evaluation:

(Check One)		(Check One)	
Oversight:		Federal:	X
Lead:	EPA	Commercial TSD:	
Other:		Other:	Hydrogeolic Assessment and Document Review

The EPA lead CME conducted for Los Alamos National Laboratory (LANL) consisted of a document review. The facility has received a groundwater monitoring waiver from NMEID for Technical Area 54, Areas G and L, and does not have a groundwater monitoring system. An on-site field evaluation was not conducted.

Prepared by: Bobby Williams BW Date: September 4, 1987

Concurred by: Deborah Vaughn-Wright DVW Date: September 6, 1987

COMPREHENSIVE GROUNDWATER MONITORING EVALUATION REPORT

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Inspection Summary

General Comments:

The hydrogeologic assessment of Technical Area 54, Areas G and L, Los Alamos National Laboratory (LANL), Docket Number NMHWA001007; the Groundwater Monitoring Exemption Request dated November 1, 1984 along with miscellaneous file information were reviewed for this CME. Because LANL does not have a groundwater monitoring system and has received a waiver from NMEID, an on-site evaluation was deemed unnecessary.

Class I - Violations: None

Class II - Violations: None

Deficiencies:

1) Twenty-three sampling ports were installed in seven holes to test the vadose zone. The ports were packed with 80 silica sand. The areas above and below the ports were packed with dry bentonite. Various contaminants have been recorded in the different levels being sampled. The seal by the dry bentonite is thought to be leaking. LANL personnel believe that the contamination noted in the deeper zones of the holes is due to cross contamination from the upper zones. This cross contamination should be verified.

2) Site maps of Areas G and L need to be prepared locating all groundwater monitoring wells, core holes, and vadose zone bore holes; including the horizontal core holes.

3) Unless the horizontal core holes were plugged with an impermeable material, the possibility of potential contamination release to the groundwater in the alluvial valley below exists.

Summary Continued

New Mexico Environmental Improvement Division (NMEID) issued a Compliance Order/Schedule, dated May 7, 1985, requiring LANL to perform certain tests for a waiver of groundwater monitoring requirements. In late 1985, work was initiated to fulfill the testing requirements of the order. These tests include:

1. Eighteen 100-to about 135-foot deep boreholes were drilled into the Bandelier Tuff from the top of Mesita del Buey. Approximately 1700 feet of core were obtained. Selected core samples were analyzed, and hydrologic testing and geophysical logging were performed in the boreholes.

2. Selected boreholes were completed for pore gas sampling, neutron moisture monitoring, and psychrometer installation.

3. A 60-foot deep borehole was drilled near a surface impoundment at Area L. Hydrologic testing and geophysical logging were performed in the borehole.

4. Holes were drilled in the adjacent canyons, Canada del Buey and Pajarito Canyon, to investigate possible alluvial aquifers. The boreholes were completed for monitoring the groundwater in the alluvium.

Vadose Zone Test Holes

Field and laboratory procedures were utilized to determine the intrinsic permability (k) of the vadose zone at Areas G and L. The intrinsic permability was evaluated to determine the magnitude of fluid movement through the vadose zone. Field methods for determining intrinsic permability included air injection and vacuum tests. A water injection test was conducted on a borehole that is located between Areas G and L where potential mobilization of contaminants was not of great concern. The water injection tests yielded hydraulic conductivity measurements ranging from 1.0×10^{-3} cm/sec to 4.6×10^{-4} cm/sec with an average of 7.6×10^{-4} cm/sec. These measurements compare favorably to those determined by air injection and lend credibility to the air injection method. Vacuum test permabilities are generally lower than permabilities derived from air-injection tests although both methods indicate a decrease in permability with depth.

Laboratory permability tests were conducted on 20 core samples utilizing two methods: gas injection with correction for slippage (Klinkenberg Corrective Method), and the Dynamic Method to measure gas-water relative and effective permabilities. In general, the Dynamic Method yielded slightly lower results than the Klinkenberg Correction Method.

Laboratory derived intrinsic permeabilities do not appear to change systematically with depth. Laboratory derived permeabilities are generally lower than field derived values. This may be attributed to the fact that samples selected for laboratory analysis were those exhibiting the highest degree of consolidation and, thus, lower permeability.

Cores were collected and analyzed for moisture content by weighing samples soon after removal from the borehole and after oven-drying at 105°C. Moisture content for the Bandelier Tuff is typically 2 to 4 percent by volume with isolated intervals ranging to 10 to 28 percent. In many of the boreholes, the moisture content increases at an interval between 100 to 150 feet. This zone of increased moisture is in a zone of moderately welded tuff. Also, higher moisture contents occur in the vicinity of certain fractured intervals.

The average theoretically derived hydraulic conductivity for the minimum moisture conditions for which moisture content was measured is approximately 9.1×10^{-8} cm/sec at 36 percent moisture (volumetric). This value is on the same order of magnitude as values determined from measurement of permeability. Thus, the two methods of determining moisture content support each other for monitoirng capillary potential.

Neutron-moisture data show the following trends:

a) the moisture content of the tuff range from 2 to 5 percent with intervals ranging to 10 to 28 percent,

b) seasonal variation of moisture content occurs in the upper 10 to 20 feet of tuff, and

c) percipitation from monitored autumn storms does not infiltrate below approximately ten feet.

Empirical studies of neutron-moisture measurement indicate that the tuff is very dry and percipitation does not infiltrate to significant depth. Meteoric water is not a viable process for transport of waste constituents through the vadose zone.

Seven test hole locatons were selected for core and pore gas analyses of the Bandelier Tuff. Four test holes were drilled at Area L, two tests holes at Area G, and one background hole was drilled on the western end of the mesa. Core samples were collected from each ten foot interval in the test holes and analyzed for EP toxicity and volatile organic compounds.

Sampling ports were installed in the seven holes to collect samples of pore gas from the tuff at various depths. Samples were collected by pumping the pore gas through charcoal absorption tubes. Volatile organic analyses were subsequently preformed on the charcoal desorption solution. Volatile organic compounds were detected in Area L in part per million concentrations at all depths sampled. In Area G, volatile organic compounds were detected in part per billion concentrations at all depth sampled.

All EP Toxic metals for the test holes were below the EP Toxic regulated concentration except for one chromium measurement in the 10 to 20 foot depth from drill hole LLC-85-18 near the Area L surface impoundment. Chromium and cadmium concentrations were above the EP Toxic levels in the 8 to 29 inch depth interval. These samples were taken directly from the surface impoundment.

Twenty three sampling ports were installed in seven holes to test the vadose zone. The sampling ports were constructed using low-pressure mobile-phase filters welded to two-inch galvanized pipe. Filters consist of two-micrometer, porous, stainless steel elements. The ports are accessed on the surface via 1/4-inch stainless steel tubing. The sampling ports were installed by lowering the pre-assembled string of galvanized pipe downhole. The ports were packed with size 80 silica sand, isolated above and below with powdered bentonite. Due to concerns regarding the introduction of water into the vadose zone and the subsequent potential for mobilization of waste constituents, no water was mixed with the bentonite. As a result, possible communication occurred between different levels of the vadose zone. LANL personnel suspect that the contamination noted in the deeper zones of the holes is actually cross contaminated from the upper zones.

The results of the rock core and pore gas analyses indicate the following:

a) no EP Toxic metals were detected below a depth of 20 feet in Areas G or L in the cores analyzed,

b) volatile organic compounds are present in rock core samples at 100 feet at part per million concentrations in Area L. No volatile organic compounds were detected in rock core samples in Area G.

c) volatile organic compounds are present in pore gas samples at 100 feet at part per million concentrations in Area L and part per billion concentrations in Area G,

d) There is no apparent correlation between high pore gas concentrations and subsurface stratigraphy (ashflow interfaces) or structure (fractures), and

e) the highest pore gas concentrations of volatile organic compounds have been detected in test holes nearest organic disposal shafts.

Monitoring Well System in Perched Alluvial Waters in Canyon Adjacent to Mesita del Buey

Groundwater monitoring wells described below are not RCRA-regulated monitoring wells located for detection purposes along the waste management area boundary as described in 40 CFR 265.91. Because the depth

of the groundwater on the mesa is 850 to 950 feet, the wells were installed in the canyons below the mesa rim. The wells were drilled and completed as monitoring wells to determine:

a) if perched water is present in the alluvium and underlying tuff,
b) the horizontal and vertical extent of the perched water, and
c) the chemical qualtiy of the perched water.

Canada del Buey Alluvium

Four wells were drilled in Canada del Buey alluvium. Two upgradient monitoring test holes, CDBO-1 and CDBO-2, were drilled 2,400 feet upstream from Area L in the Canada del Buey alluvium. CDBO-3 was drilled 800' downstream from Area L and CDBO-4 is located 1,000 feet downstream from Area G. The alluvium of Canada del Buey where the four test holes are located is unsaturated. The holes were completed as monitoring wells and are checked regularily for groundwater.

The alluvium in Canada del Buey is derived from weathered Bandelier Tuff and is comprised of sands, silts, and clays with a few gravels. The alluvium is thin in the canyon, ranging from 9 to 12 feet in thickness. The stream channel in Mesita del Buey is not well-defined. The alluvium was relatively dry, estimated to contain ten percent moisture.

The four test holes were completed as monitoring wells in Canada del Buey. Screens were set opposite the alluvium in the wells. The wells are monitored quarterly, but no water was detected during the period from June 1985 through September 1986. Consequently, no water samples have been collected for chemical analyses.

Pajarito Canyon Alluvium

Seven test holes were drilled in the alluvium along the length of Pajarito Canyon next to Mesita del Buey. Three of the seven test holes PCO-1 through PCO-3, encountered perched water. The remaining four test holes, PCM-1 through PCM-4, were dry when drilled through the alluvium and completed into the tuff. The upgradient monitoring well, PCO-1, is located 2,000 feet upstream from Area L. The downgradient monitoring wells, PCO-2 and PCO-3, are located 2,800 feet downstream from Area L and 4,000 feet downstream from Area G, respectively.

To investigate the alluvial systems, holes were drilled and monitoring wells were installed. The test holes penetrated the alluvium and were drilled to various depths into the underlying Bandelier Tuff. The alluvium of Pajarito Canyon is derived from the Bandelier Tuff and Tschicoma Formation and is comprised of boulders, cobbles, and gravels in a silty sand matrix. The thickness of the alluvium ranges from 9 to 12 feet in the canyon channel and thins to the canyon flanks. The average moisture content in the cuttings was 11 percent, ranging from 6 to 16 percent.

Water levels in the monitoring wells located in Pajarito Canyon have been monitored quarterly since June 1985. The highest water levels occur during the summer months and the lowest water levels are measured during the winter months. The rate of movement of perched water in Pajarito Canyon ranges from 8 to 23 feet per day.

Summary Continued

Water samples are collected for inorganic and volatile organic analyses. The concentration of dissolved solids in the perched water in the alluvium of Pajarito Canyon increases downgradient. The water is characteristically sodium bicarbonate upgradient, sodium-calcium bicarbonate in the mid-reach area, and calcium bicarbonate downgradient. Dissolved metals and radiological parameters generally increase in concentration downgradient. All chemical and radiological constituents were detected at concentrations below the primary and secondary maximum concentration levels specified for drinking water, except for manganese, uranium, and total dissolved solids. None of the volatile organic compounds routinely analyzed have ever been detected in any of the wells.

Recommendations

The Region concurs with granting of a waiver for groundwater monitoring. Because of the secondary porosity of the bedrock and the detection of contamination in the vadose zone test holes, further vadose zone monitoring is recommended.

EPA I.D. # NM0890010515

CME Technical Report

Introduction

Facility: Los Alamos National Laboratory, NM

Facility Description:

Los Alamos National Laboratory (LANL) has operated two chemical waste disposal facilities (Areas G and L) on Mesita del Buey. Area G contains low-level radioactive materials and small quantities of asbestos, beryllium residues, empty pesticide containers, PCB contaminated solids, and solid trash-type waste contaminated with known or suspected carcinogens. The chemical wastes were buried in shafts, trenches, and pits dug in the Bandelier Tuff.

Area L served as LANL's primary chemical waste disposal area. A wide variety of organic and inorganic wastes was disposed in shafts, trenches, and pits excavated in the Bandelier Tuff.

Mesita del Buey, a small narrow mesa, is located near the eastern edge of the Pajarito Plateau and is approximately 150 feet higher than the surrounding southeast-trending intermittent streams. The small mesa is bounded on the north by Canada del Buey and on the south by Pajarito Canyon.

Waste Management Units with Groundwater Monitoring Waiver:

Unit Name	Waste Type	Size	Construction	Status/Age
Area G	Low-level radioactive materials, small quantities of asbestos, beryllium, empty pesticide containers, PCB contaminated solids, and solid waste contaminated with carcinogens.	63 acres.	31 pits; 4 trenches; +100 shafts, 10 shafts are lined with steel pipe and concrete.	Active and Inactive units since 1957.
Area L	Organic and Inorganic chemicals.	2.5 acres.	1 disposal pit, 1 surface impoundment, and 34 shafts.	Active and inactive units since 1964.

Section 2
p. 1 of 4

Applicabilty and Site Characterization
(§265.90/270.14(c))

I. Has a groundwater monitoring program (capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility) been implemented? 265.90 (a)

(Y/N) N/A
LANL has received a waiver

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 facilities property boundary.

II. Has the facility adequately identified the uppermost aquifer?
(Y/N) Y

III. Regional Geology

Formation: Bandelier Tuff-rhyolitic ashflow and ashfall is approximately 165 feet thick and thins eastward.

Lithology: Non-welded to moderately-welded rhyolitic ashflow tuff composed of glass shards, pumice, and small rock fragments.

Regional Gradient: 2-3 degrees to the southeast.

Comments: The Bandelier Tuff contains near-vertical fractures or joints possibly extending through more than one ashflow. The cooling fractures caused by cooling of the tuff may be as much as 2 inches wide, but most of them are less than 1/4 inch wide. They are usually filled with clay.

IV. Site Hydrogeology

A) Describe Site Stratigraphy: The Areas G and L are located on a mesa composed of the Bandelier Tuff. Three to four-feet of weathered material overlie the tuff. Steep bluffs surround the mesa on three sides. The volcanic tuff overlies the China Mesa Basalt which consists of dense flows of scoria interbedded with silts and clays. The uppermost aquifer in the area is the Puye Formation which underlies the China Mesa Basalt. The Puye is composed of poorly-consolidated conglomerates. The Tesuque Formation, composed of conglomerates, sandstones, and siltstones, underlies the Puye Formation and also serves as an aquifer for the area. The two aquifers are interconnected and are considered to be a single aquifer in the area.

B) Uppermost Aquifer: Puye and Tesuque formations combined.

Depth water: Water Table 850' - 950'

Potentiometric Surface 850' - 950'

Saturated thickness: 1,470 feet

Confined/unconfined: Confined

Horizontal Gradient: 0.015 foot per foot southeast

Permeability: Facility Calculated 40,000 gallons/day/foot

C) Comments: The extrusive volcanic ashflows and basalt flows of the Bandelier Tuff and China Mesa Basalt dip gently to the east-southeast and thin eastward. The perched water in the alluvial debris of the deeply incised valleys of Canada del Buey and Pajarito Canyon connects with the main aquifer of the Puye and Tesuque aquifer along the banks of the Rio Grande where it has eroded through the Bandelier Tuff and China Mesa Basalt, exposing the aquifers.

V. Review of Site Hydrogeologic Investigatory Techniques

A) Was the site investigation and/or data collection conducted by the facility performed by a qualified geologist? (265.90.c.) (Y/N) Y

B) Did the owner/operator survey the following existing regional data:

1. U.S.G.S. Maps? (Y/N) Y

2. Water supply well logs? (Y/N) Y

3. Other (specify) Detailed lithologic logs.

C) Did the owner/operator document and present the raw data from the site hydrogeologic assessment? (Y/N) Y

D) Did the owner/operator document methods (criteria) used to correlate and analyze the information? (Y/N) Y

E) Did the owner/operator obtain a regional map of the area and delineate the facility? (Y/N) Y

F) Did the owner/operator obtain a regional hydrogeologic map? (Y/N) Y

G) If yes, does this hydrogeologic map indicate:

1. Major areas of recharge/discharge? (Y/N) Y

2. Regional ground-water flow direction? (Y/N) Y

3. Potentiometric contours which are consistent with observed water level elevations? (Y/N) Y

H) Did the owner/operator prepare a facilaity site map? (Y/N) Y

I) Did the owner/operator present geologic cross sections of the site? (Y/N) Y

Comments: