Permit 3/19/10

ENTERED

STATE OF NEW MEXICO
BEFORE THE SECRETARY OF ENVIRONMENT

IN THE MATTER OF:	)	
	)	
APPLICATION OF THE UNITED STATES DEPARTMENT OF ENERGY AND LOS ALAMOS NATIONAL SECURITY LLC FOR A HAZARDOUS WASTE FACILITY PERMIT FOR LOS ALAMOS NATIONAL LABORATORY, and the NOTICE OF INTENT TO DENY A PERMIT FOR OPEN BURN UNITS TA-16-388 AND TA-16-399 FOR LOS ALAMOS NATIONAL LABORATORY.	)	**Nos. HWB 09-37 (P)** **HWB 10-04 (P)** **Consolidated**

MAR 2010
DOCKETED BY THE HEARING CLERK BEFORE THE SECRETARY OF ENVIRONMENT

WRITTEN TESTIMONY OF JERZY KULIS

My name is Jerzy Kulis. I am an Environmental Scientist with the Permits Management Program of the New Mexico Environment Department (the Department) Hazardous Waste Bureau.

I am presenting this written testimony on behalf of the Department in the hearing concerning the issuance of a renewal permit for storage and treatment of hazardous waste at Los Alamos National Laboratory (LANL), and the denial of a permit to treat hazardous waste at open burn units at LANL. This testimony is marked as **NMED Exhibit 168**.

I. Qualifications

I have a degree of Bachelor of Science in Liberal Studies, with concentration in physics and geology, from Regents College, 1994, and Master of Science in Geochemistry from New Mexico Institute of Mining and Technology, 1999. My graduate school coursework was not restricted to geochemistry but also included Groundwater Hydrology, Environmental Chemistry, Soil & Groundwater Remediation, and Radioactive Waste Management.

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Since completion of graduate school, I have been working for the New Mexico Environment Department as an environmental scientist, with emphasis on groundwater protection. For the first 8 years, I worked for the Ground Water Quality Bureau and the Solid Waste Bureau where I was responsible for ensuring regulatory compliance of over 60 groundwater discharge permits and over 20 solid waste permits, including analysis and interpretation of environmental data, approval of location and construction of groundwater monitoring wells, review of permit applications and other submittals, field inspections, and enforcement actions. I also managed several EPA-funded projects that focused on water-quality issues in New Mexico and groundwater/surface water interaction. For the last two years, I have been working for the Hazardous Waste Bureau as a hydrologist and groundwater protection specialist on issues related to groundwater monitoring and contamination, mainly at LANL. In that role, I review drilling work plans, groundwater investigation work plans, groundwater monitoring plans, and other submittals to determine their technical feasibility and compliance with regulations. I also review groundwater monitoring reports, well completion reports, investigation reports, and other submittals for completeness and to identify potential impacts on ground water quality.

Throughout my tenure with the Department, I have served as an in-house expert in the areas of hydrogeology, groundwater contamination and groundwater monitoring, including design and installation of monitoring wells. I also testified on behalf of the Department as an expert witness in hydrogeology and groundwater protection at six public hearings on solid waste permit applications. I am current in my understanding of these fields, and continually educate myself through workshops, conferences, and readings. A copy of my vita is **NMED Exhibit 169**. It is accurate and up-to-date.

II. Summary

This testimony provides the basis for the requirements included in February 2, 2010 Proposed Permit, Part 11, Section 11, which discusses the installation and abandonment of groundwater monitoring wells. This part of the Proposed Permit closely follows, with a few exceptions, the March 1, 2005 Consent Order (NMED Ex. 26)(Consent Order) Section X (Monitoring Well Construction Requirements).

III. Types of Monitoring Wells

Under Permit Section 11.11.1, two types of groundwater monitoring wells may be installed under Department supervision at the LANL facility: single screened wells (containing one screened interval) and, with Department approval, double-screened wells (containing two screened intervals). This Permit condition differs from the Consent Order Section X in that the Proposed Permit does not allow for installation of wells with more than two screened intervals, which are permitted under the Consent Order. This prohibition is based on the demonstrated problems at LANL with previously installed multi-screened wells that were equipped with a multiport sampling system named Westbay®. Due to the improper construction and development of a number of LANL wells where the Westbay system was installed, many of these wells required rehabilitation or conversion to a different sampling system. The Department is no longer approving new Westbay installations at LANL, and the remaining Westbay systems are being evaluated on a case-by-case basis. Additionally, in a letter dated February 11, 2010, The Department directed LANL to conduct a reliability assessment of multi-screened wells that are still using Westbay system. This letter is marked as **NMED Exhibit 170 (AR 33161).**

Multi-screened wells, which includes double-screened wells, are allowed by EPA and are mentioned, for example, in *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris,*

H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, EPA 600/4-89/034 (1989) **(AR 9545)**, and in *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992) (NMED Ex. 142).

Double-screened wells provide twice as much information as single-screened wells installed in the same boreholes. Because of that, more possible pathways for contaminant transport can be monitored. Double-screened wells also allow measurement of vertical components of groundwater flow, thus providing information on the potential of migration of contaminants deeper into the aquifer.

IV. <u>Drilling Methods</u>

Under Permit Section 11.11.2, the general requirements for design and construction of groundwater monitoring wells are as follows: (1) they must produce representative groundwater samples, (2) they must last the duration of the project, and (3) they must not serve as a conduit for contaminant migration between different stratigraphic units or aquifers.

Permit Section 11.11.2 also requires groundwater monitoring wells to be designed and constructed in accordance with EPA RCRA guidelines, including, but not limited to:

(1) *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992);

(2) *U.S. EPA, RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1 (September 1986) (NMED Ex. 170); and

(3) *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989).

A variety of methods are available for drilling monitoring wells. Under this Permit Section, the selection of the drilling method should be based on the site-specific geologic conditions and on the following factors:

(1) drilling should be performed in a manner that minimizes impacts to the subsurface formations and avoids contamination and cross contamination (*i.e.,* among aquifers) of groundwater;

(2) the drilling method should allow the collection of representative samples of subsurface formations and groundwater;

(3) the drilling method should allow the proper location of screened interval(s) and the proper placement of a filter pack and annular sealants;

(4) drilling fluids (which include air) should have minimal impact upon the subsurface formations and groundwater.

The factors listed above are based on the *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992) (NMED Ex. 142).

Permit Sections 11.11.2.1 through 11.11.2.6 describe a number of drilling methods that may be appropriate for the construction of monitoring wells at the LANL Facility. Many of these methods may be used alone, or in combination, to install monitoring wells. Justification for the method selected must be provided by the Applicants to the Department under Permit Section 11.11.2.

The wide assortment of drilling methods listed in the Proposed Permit allows flexibility to accommodate the highly variable subsurface conditions encountered beneath the Pajarito Plateau. Some of these methods, like hollow-stem auger or resonant sonic, do not require any drilling fluids, while others require air, water, or mud to remove drill cuttings from a borehole.

Although any use of drilling fluids creates a potential for altering the natural properties of the subsurface formations, only the methods that use drilling fluids, like air or water, are suitable for installation of deep monitoring wells at LANL, because they can reach depths of 1000 feet or more below the ground surface and can accommodate the complex subsurface conditions at LANL.

The drilling method currently most often used for deep drilling at LANL, and which has been approved by the Department under the terms of the Consent Order, is fluid assisted air rotary, either with casing advance or open borehole, depending on the subsurface formations encountered during drilling. This drilling method strikes a good balance between maintaining borehole stability and providing an opportunity to detect perched intermediate groundwater zones. With that method, certain drilling additives, for example, foaming agents, may be used in the drilling interval above the expected groundwater table. In the last 100 to 150 feet above the water table, and below the water table, only municipal water may be used as a drilling additive. Only under exceptional circumstances does the Department allow use of additional drilling additives or another drilling method that uses drilling fluids other than air.

The wide assortment of drilling methods specified in the Proposed Permit also allows the Applicants to cope with even the most difficult drilling conditions without having to modify the Permit to include a suitable drilling method. The listing of a particular drilling method in the Proposed Permit does not mean that the Department recommends or endorses that particular method. On the contrary, the Proposed Permit specifically discourages the mud rotary method in Permit Section 11.11.2.3, despite its being listed as a drilling method available to the Applicants. The Department may also require additional sampling and testing to ensure that the collected data are not affected by residual drilling fluids under Permit Section 11.11.2.3.

The description of drilling methods in the Proposed Permit follows the same description in the Consent Order Section X, with the following modifications: (1) the Proposed Permit discourages mud rotary drilling method if the well is to be used for monitoring of water quality (Permit Section 11.11.2.3), and (2) the Permit requires the Applicants to demonstrate that data acquired from wells drilled with drilling fluids are representative of subsurface conditions and not affected by drilling fluids. (Permit Section 11.11.2.3).

The drilling methods listed in the Permit, except for resonant sonic and cryogenic methods, are described in the following EPA RCRA guidance documents: *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992); *U.S. EPA, RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1 (September 1986); and *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989). The resonant sonic and cryogenic methods are described in the following DOE documents, among others: *DOE, Resonant Sonic Drilling, Innovative Technology Summary Report* (April 1995) **(NMED Exhibit 172, AR 33160)** and *DOE, Cryogenic Drilling*, DOE/EM-0382 (October 1998) **(NMED Exhibit 173, AR 33159)**.

V. <u>Well Construction Materials</u>

Under Permit Section 11.11.3.1, well construction materials must be selected based on the type of contaminants of interest in groundwater and the geologic conditions at the site. The preferred well construction material should be chemically inert, which means that it will not leach foreign constituents into groundwater or remove contaminants of interest from it. Other factors to consider include the structural strength of the material, length of time the monitoring well will be in service, and resistance of the material to chemical and microbiological corrosion.

Generally, if the monitoring program requires the analysis of trace concentrations of organic constituents, stainless steel should be used. However, if the monitoring program requires only analyses of inorganic constituents, polyvinyl chloride (PVC) materials may be used. PVC should not be used for monitoring wells where trace concentrations of organic constituents will be analyzed due to its potential for sorption and leaching of organic contaminants.

Permit Section 11.11.3.1 provides that well screen and casing materials acceptable for the construction of monitoring wells include stainless steel (304 or 316), rigid PVC, and fluoropolymers. Other materials available for the construction of monitoring wells, like ABS, fiberglass-reinforced plastic (FRP), black iron, carbon steel, and galvanized steel are not recommended for use in long term monitoring wells due to their low resistance to chemical attack and potential for sorption or leaching of contaminants. However, these materials may be used in the construction of these parts of monitoring wells that will not be in contact with groundwater.

Due to structural strength requirements, stainless steel is the only viable option for deep monitoring wells at LANL. It is also the most suitable material for detection of trace concentrations of organic contaminants. Although stainless steel may corrode under certain geochemical and microbiological conditions and may absorb or leach some inorganic constituents, proper sampling procedures can minimize the contact time between the water sample and the stainless steel screen and, therefore, can help to maintain representativeness of the samples.

Description of properties of different well construction materials and recommendations regarding their use as well construction material, presented in the Permit, are based largely on *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001

(November 1992), and on *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989).

VI. Well Construction Techniques

Permit Section 11.11.3.2 provides details of construction for single-cased wells, double-cased wells, and bedrock wells. Single-cased and double-cased wells have similar construction, the only difference being an additional outer casing in the double-cased wells to isolate subsurface formations that could cause borehole instability or cross-contamination. Both types of wells are shown on NMED Ex. 108. Their typical design consists of a borehole which has diameter at least 4 inches larger than the diameter of the well casing to allow for placement of well completion materials around the casing. The casing column, also called the riser, consists of a bottom sump, one or two well screens, and well casing, and is centered within the borehole by centralizers. The empty space between the riser and the borehole wall, also called an annular space, is progressively filled with a filter pack, which is placed within the screened interval, a bentonite seal above the filter pack, an annular seal (also called grout), and a surface seal. A concrete surface pad and a protective, locking shroud are installed around the riser. Bumper guards are also installed, if necessary, to prevent damage from vehicles.

Bedrock wells are drilled into hard, stable rock layers and can maintain an open borehole without the help of a casing. The whole open borehole interval can serve as a monitoring zone. However, since in most situations the length of the monitoring zone should be kept to a minimum, usually no more than 10 or 20 feet, bedrock wells are usually completed as cased wells.

The typical monitoring well design, presented in the Permit, is based largely on *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992), and on *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989).

VII. Well Screen and Filter Pack Design

Permit Section 11.11.3.3 states that well screens and filter packs should be designed to sample the targeted aquifer zone (or zones) accurately, minimize the passage of formation materials into the well, and ensure structural integrity of the intake structure. Monitoring wells are usually constructed with screens between five to ten feet long, but longer screens may be appropriate in certain geohydrologic settings, for example when there is uncertainty regarding the exact location of the water-producing zone or when the targeted zone has low water production and a longer screen is necessary to achieve sufficient water flow from that zone. All well screens must be factory wire-wrapped or machine slotted.

Permit Section 11.11.3.3 states that filter pack materials usually consist of clean, uniformly-sized quartz sand. The grain size of a filter pack material should correspond to the screen slot size and to the grain size of aquifer materials. In some circumstances, a natural aquifer formation can be used as a filter pack if the formation materials are relatively coarse-grained, permeable, and uniform in grain size. The screen slot size must be selected to retain from 90 to 100 percent of the filter pack material in wells with artificially packed filters and from 50 to 100 percent of the formation material in wells with naturally packed filters. The Applicants may propose to use a pre-determined well screen slot size and filter pack for monitoring wells in the site-specific work plans submitted to the Department.

The filter pack should extend below and above the screened interval to prevent the bottom fill and bentonite seal material from migrating into the screened interval, and to compensate for compression of the filter pack by the weight of annular seal above it. Prior to installing the bentonite seal, a one to two-foot layer of fine quartz sand must be placed over the filter pack to prevent the intrusion of annular sealants into the filter pack. This additional layer of sand is sometimes called a secondary filter pack.

The well screen and filer pack design presented in the Permit is based on *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992), and on *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989).

VIII. <u>Annular Sealant</u>

Under Permit Section 11.11.3.4, the annular space between the well casing and the borehole must be properly sealed to prevent migration of contaminants, surface water, or perched groundwater along the well casing. The bentonite seal, which is placed on top of the filter pack, must be at least two feet thick and must consist of a high solids (10-30 percent) bentonite material in the form of bentonite pellets, granular bentonite, or bentonite chips. The grout seal, also called the annular seal, must be installed on top of the bentonite seal. The grout seal may consist of a high solids (30 percent) bentonite grout, a neat cement grout, a cement/bentonite grout, or other suitable grout material that is approved by the Department. The grout must be pumped under pressure (not gravity fed) into the annular space by a tremie pipe equipped with a side discharge port. The grout seal must be allowed to cure for a minimum of 24 hours before the surface seal and the surface pad are installed.

The annular sealant emplacement procedures, described in the Permit, are based on *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992).

IX. Well Development

Permit Section 11.11.4 provides that all monitoring wells must be developed to create an effective filter pack around the well screen, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. During development, loose fines, silts, and clays from the formation around the screen, as well as from the filter pack, are pulled into the well and removed. Development is also used to remove water, drilling mud and any other foreign materials that may have been introduced into the borehole during the drilling and well installation activities. The development of a well is important to ensuring the collection of representative groundwater samples.

A newly installed monitoring well must be allowed to cure for at least 48 hours after the installation of the surface pad, and then be developed until the well water is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. If the well contains drilling mud in the form of a mud cake, or formation soils that have not yet been removed, continuous flushing over a period of several days may be necessary to complete the well development.

The most effective well development methods include pumping, over-pumping, bailing, surging, or a combination of these methods. Well development methods and equipment that alter the chemical composition of the groundwater must not be used. Development methods that involve adding water or other fluids to the well or borehole or that use air to accomplish well

development should be avoided, if possible. Approval must be obtained from the Department prior to introducing air, water, or other fluids into the well for the purpose of well development. If water is introduced to a borehole during well drilling and completion, then the same or greater volume of water should be removed from the well during development. The Applicants should also use their best efforts to avoid pumping wells dry during development activities.

The well development procedures described in the Permit are based on *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992), and on *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989).

X. <u>Surface Completion</u>

Permit Section 11.11.5 provides that monitoring wells may be completed either as flush-mounted wells or as above-ground wells. A concrete surface seal must be installed over the grout seal and extended up to the land surface. In above-ground completions a concrete surface pad must be installed around the well at the same time when the locking protective shroud is installed. If the well is located in an area with vehicular traffic, a minimum of three bumper guards should be installed.

If flush-mounted completions are required (for example, in an active roadway or a parking lot), a protective, watertight structure such as a utility vault or meter box should be installed around the well casing.

The surface completion described in the Permit is based on *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992), and on *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and*

Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, EPA 600/4-89/034 (1989).

XI. Well Abandonment

Permit Section 11.11.6 requires that all well abandonment must be conducted in accordance with the Office of the State Engineer regulations,19.27.4 NMAC (Well Driller Licensing; Construction, Repair and Plugging of Wells), and with current EPA well abandonment guidance. Wells are usually abandoned when they are no longer required in the monitoring network or when they are damaged beyond repair. The goal of well abandonment is to seal the borehole so that the well cannot act as a conduit for migration of contaminants from the ground surface to the aquifer or between aquifers. To properly abandon a well, the preferred method is to remove the well casing and screen completely from the borehole, clean out the borehole, and backfill it with grout.

Well abandonment procedures described in the Permit are based on *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989).

XII. Documentation

Permit Section 11.11.7 provises that all information on the design, construction, and development of each monitoring well should be recorded and presented on a boring log, a well construction log, and well construction diagram. The required documentation follows *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992).

XIII. Recommendations for Changes to the Permit

The Department has noted a few technical errors in Section 11.11 of the February 2, 2010 Proposed Permit. Accordingly, the Department recommends making the following changes to the text of the Proposed Permit:

1. Change the fourth sentence of the first paragraph of Permit Section 11.11.3.1 as follows:

   Generally, if the monitoring program requires the analysis of organic constituents, stainless steel should be used.

   Justification: Fluoropolymer materials may sorb/desorb organic constituents from/into the solution (for example, see *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992), (page 6-28) and *Schalla, R., Webber, W.D., and Smith, R.M., Selection of Sampling Pumps Used for Groundwater Monitoring at the Hanford Site*, PNNL-13690, **(NMED Exhibit 171, AR 33162)** (Table 4.1 and Appendix A)). For that reason, fluoropolymer materials are not recommended when sampling for organic constituents.

2. Change the second sentence of the last paragraph of Permit Section 11.11.3.3 as follows:

   These include multi-level borehole completion systems (*e.g.*, Westbay MP System®) and pneumatically deployed inverting PVC membranes (*e.g.*, FLUTe).

   Justification: The SEAMIST system is no longer manufactured and has been replaced by the FLUTe system.

3. Change the second sentence of the last paragraph of Permit Section 11.11.3.4 as follows:

   The grout seal may consist of a high solids (30 percent) bentonite grout, a neat cement grout, ~~or~~ a cement/bentonite grout, or other suitable grout material that is approved by the Department.

Justification: The new language allows flexibility in choosing new or improved grout materials that may offer better performance than the currently used materials.

4. Change the fourth sentence of the last paragraph of Permit Section 11.11.3.4 as follows: The tremie pipe shall be equipped with a side discharge port to minimize damage to the filter pack or filter pack annular bentonite seal during grout placement.

   Justification: EPA RCRA guidance documents, like *U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance*, EPA/530-R-93-001 (November 1992) (page 6-43), and *Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*, EPA 600/4-89/034 (1989)(page 109) recommend side-discharge tremie pipe for placement of annular sealants in slurry form.

I, Jerzy Kulis, swear under penalty of perjury that the foregoing is true and correct.

Jerzy Kulis

Jerzy Kulis
Hazardous Waste Bureau
New Mexico Environment Department
Santa Fe, New Mexico

Subscribed and sworn to before me this 19th day of March, 2010 by Jerzy Kulis

Notary Public

My commission expires:

April 3, 2011