



U.S. Department of Energy
Office of Inspector General
Office of Inspections and Special Inquiries

Inspection Report

Characterization Wells at Los Alamos National Laboratory

DOE/IG-0703

September 2005



Department of Energy

Washington, DC 20585

September 30, 2005

MEMORANDUM FOR THE SECRETARY

FROM:


Gregory H. Friedman
Inspector General

SUBJECT:

INFORMATION: Inspection Report on "Characterization Wells at Los Alamos National Laboratory"

BACKGROUND

Throughout its history, Los Alamos National Laboratory (Los Alamos) has conducted experimental research on the development of nuclear weapons and explosive materials that has resulted in the generation and disposal of a variety of hazardous, radioactive, and solid wastes. Los Alamos has disposed of these wastes in septic systems, pits, surface impoundments, trenches, shafts, landfills, and waste piles at the facility. Los Alamos has also discharged industrial wastewater and other waste into many of the canyons at the facility. Contaminants such as plutonium, americium, and tritium have been detected in soils and sediments at the facility and in alluvial groundwater beneath the facility.

Pursuant to a Hydrogeologic Workplan, Los Alamos was required to install 32 regional aquifer wells, commonly referred to as characterization wells, to characterize the hydrogeologic setting beneath Los Alamos. Consideration is being given to converting some or all of the Los Alamos characterization wells to groundwater monitoring wells under a March 1, 2005, Compliance Order on Consent entered into by the Department of Energy, the New Mexico Environmental Department, and the University of California. The construction of the wells is covered by the requirements of the Resource Conservation and Recovery Act (RCRA).

As a result of receiving specific allegations regarding the construction of the wells, the Office of Inspector General initiated an inspection to determine if: (1) the use of mud rotary drilling methods during the construction of the wells at Los Alamos violated RCRA; and (2) associated muds and other drilling fluids adversely affected groundwater chemistry and compromised the reliability of groundwater contamination data collected by Los Alamos.

RESULTS OF INSPECTION

We concluded that the allegations we received were partially substantiated. Specifically, we found that:

- The use of mud rotary drilling methods by Los Alamos during well construction was allowable under applicable RCRA guidance; however, Los Alamos did not adhere to specific constraints established in the RCRA guidance when using muds and other drilling fluids, and, as a result, Los Alamos could not assure that certain residual drilling fluids were fully removed; and



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- Muds and other drilling fluids that remained in certain wells after construction created a chemical environment that could mask the presence of radionuclide contamination and compromise the reliability of groundwater contamination data.

The Department is voluntarily providing radionuclide contamination data to the State of New Mexico under its long-standing policy in this area. This data has been collected in accordance with procedures the Department has developed pursuant to the Atomic Energy Act and its implementing regulations, orders, and guidance documents. The current requirements for a groundwater surveillance monitoring program are required to be implemented by December 31, 2005. As Los Alamos works to meet this deadline, we believe that the Laboratory should, as the Hydrogeologic Workplan wells are converted to monitoring wells, ensure that monitoring data are reliable. We also believe that particular attention should be given to well development and purging methods, the quality of radionuclide data, and any qualifications on that data.

We made several recommendations to the Manager of the Los Alamos Site Office to address our findings.

MANAGEMENT REACTION

In responding to a draft of this report, management stated that the recommendations contained in the draft report were appropriate and would be implemented. Management noted that all the wells had been purged, but certain residual drilling fluids could not be fully removed. Management stated that the potential impacts of these fluids and the effectiveness of additional development on their removal are currently being evaluated. Management's comments, which are provided in their entirety in Appendix B of the report, were responsive to our recommendations.

Attachment

cc: Deputy Secretary
Administrator, National Nuclear Security Administration
Under Secretary for Energy, Science and Environment
Chief of Staff
Director, Office of Program Liaison and Financial Analysis

CHARACTERIZATION WELLS AT LOS ALAMOS NATIONAL LABORATORY

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Overview

INTRODUCTION AND OBJECTIVES

The Los Alamos National Laboratory (LANL), located on the Pajarito Plateau in Northern New Mexico, has been in operation since the early 1940's. LANL is a U.S. Department of Energy (DOE) research and development facility operated by the University of California. Throughout its history, LANL has conducted experimental research on the development of nuclear weapons and explosive materials that has resulted in the generation and disposal of a variety of hazardous, radioactive, and solid wastes. LANL has disposed of these wastes in septic systems, pits, surface impoundments, trenches, shafts, landfills, and waste piles at the facility. LANL has also discharged industrial wastewater and other waste into many of the canyons at the facility.

Contaminants such as plutonium, americium, and tritium have been detected in soils and sediments at the facility and in alluvial groundwater beneath the facility. In 1998, LANL developed a Hydrogeologic Workplan that established the basis for characterizing the hydrogeologic system beneath the facility, determining whether the concentration of contaminants in groundwater exceeded regulatory limits, and determining if characterization information was sufficient for establishing a groundwater monitoring program. Implementation of the Workplan required the installation of 32 regional aquifer wells, commonly referred to as characterization wells, to characterize the hydrogeologic setting beneath the Pajarito Plateau.

Consideration is being given to converting some or all of the LANL characterization wells to groundwater monitoring wells under a March 1, 2005, Compliance Order on Consent¹ entered into by DOE, the New Mexico Environmental Department, and the University of California. The requirements of the Resource Conservation and Recovery Act (RCRA) for the construction of monitoring wells also apply to the construction of the characterization wells as established by the Workplan.

The Office of Inspector General received an allegation that the wells constructed at LANL were not constructed in accordance with the requirements of RCRA. Because of significant problems associated with stuck casing, unstable boreholes, and lost circulation in the earliest wells that were constructed, subsequent

¹ This Order was issued pursuant to the New Mexico Hazardous Waste Act for the purpose of fully determining the nature and extent of releases of contaminants at or from LANL and to identify, evaluate, and implement corrective measures to prevent or mitigate the migration of contaminants from the site. The requirements of the Order do not apply to radionuclides.

well construction included the use of muds and other drilling fluids. It was specifically alleged that (1) the use of mud rotary drilling methods violated RCRA; and (2) the use of muds and other drilling fluids during well construction had an adverse affect on groundwater chemistry, masking the presence of radionuclides and causing groundwater contamination data to be unreliable.

The objectives of our inspection were to determine if: (1) the use of mud rotary drilling methods during the construction of the wells at LANL violated RCRA; and (2) muds and other drilling fluids adversely affected groundwater chemistry and compromised the reliability of groundwater contamination data collected by LANL.

OBSERVATIONS AND CONCLUSIONS

We concluded that the allegations were partially substantiated. Specifically, we found that:

- LANL's use of mud rotary drilling methods during well construction was allowable under applicable RCRA guidance, as well as the Compliance Order on Consent. However, LANL did not adhere to specific constraints established in the RCRA guidance when using muds and other drilling fluids, and, as a result, LANL could not assure that certain residual drilling fluids were fully removed; and
- Muds and other drilling fluids that remained in certain wells after construction created a chemical environment that could mask the presence of radionuclide contamination and compromise the reliability of groundwater contamination data.

We note that DOE is voluntarily providing radionuclide contamination data to the State of New Mexico under a long-standing DOE policy. This data has been collected in accordance with procedures DOE has developed pursuant to the Atomic Energy Act and its implementing regulations, orders, and guidance documents. The current requirements for a groundwater surveillance monitoring program are found in DOE O 450.1, "Environmental Protection Program," which LANL has until December 31, 2005, to implement. As LANL works to meet this deadline, we believe that the Laboratory should, as the Hydrogeologic Workplan wells are converted to monitoring wells, ensure that monitoring data are reliable. We also believe that particular attention should be given to well development and purging methods, the quality of radionuclide data, and any qualifications on that data.

Details of Findings

MUD ROTARY DRILLING

We found that LANL's use of mud rotary drilling methods during well construction was allowable under applicable RCRA guidance, as well as the Compliance Order on Consent. However, LANL did not adhere to specific constraints established in the RCRA guidance when using muds and other drilling fluids, and, as a result, LANL could not assure that certain residual drilling fluids were fully removed.

According to the Environmental Protection Agency (EPA) Regional Office in Dallas, Texas, a document titled "RCRA Ground-Water Monitoring: Draft Technical Guidance" (guidance) addresses monitoring well design and construction. The RCRA guidance is used to meet the requirements of 40 CFR 264.97, "General ground-water monitoring requirements," and addresses nine commonly used methods for drilling groundwater monitoring wells. Chapter Six of the guidance, "Monitoring Well Design and Construction," identifies mud rotary drilling as one of those commonly used methods.

However, the guidance recognized that ". . . mud rotary [drilling] creates a high potential for affecting aquifer characteristics and groundwater quality." As a result, the guidance provided specific constraints on the use of mud rotary drilling, stating that "If the mud rotary method is used, the drilling mud(s) should not affect the chemistry of ground-water samples from the borehole, or adversely impact the operation of the well." In addition, the guidance stated that "Drilling fluids, drilling fluid additives, or lubricants that impact the analysis of hazardous constituents in ground-water samples should not be used." Further, LANL's Hazardous Waste Permit, Module VIII, "Hazardous and Solid Waste Amendments to RCRA," states "Development procedures include purging of the well until contaminants introduced during drilling can be assured of being removed." Module VIII is also referenced in the Workplan.

In the case of several of the wells constructed to date at LANL, the above required assurance was not provided. We determined that certain wells were constructed without muds and other drilling fluids being totally purged. Documentation indicates that LANL used muds and other drilling fluids during the drilling of 24 of the 32 characterizations wells. For example, 28,250 pounds of bentonite clay were used during the drilling of well R-14, and 51,100 pounds of finely ground sodium bentonite (Quick Gel) were used during the drilling of well R-16.

LANL stated that they found it necessary to use drilling fluids at certain well locations in order to construct the desired wells given the extreme depths and complex geology encountered and that not using drilling fluids would result in failure to establish wells in certain locations. LANL stated that the majority of the wells were not impacted by residual muds and drilling fluids, but LANL recognized that muds and drilling fluids had consequences, which are discussed in the next section, and/or were not completely removed at several locations, to include wells R-7, R-12, R-16, R-19, and R-22.

**MASKING THE
PRESENCE OF
CONTAMINANTS**

We identified through documentation reviews that muds and other drilling fluids that remained in certain wells after construction created a chemical environment that could mask the presence of radionuclide contamination and compromise the reliability of groundwater contamination data. The RCRA guidance specifically states that bentonite muds, which were used during the drilling of certain wells at LANL, may adsorb metals, potentially reducing contaminant concentrations and affecting the reliability of sampling results. In addition, in a December 23, 1999, report, a team of experts known as the External Advisory Group (EAG)² found that the use of muds during drilling “carries the risk of adsorbing contaminants . . . onto the bentonite that penetrates into pore space around the well screen and is not removed by well development.” The EAG stated that “Should this occur, it could result in reduced concentrations or non-detects on contaminants that are actually present in the vicinity of the well.” The EAG reported in December 1999 that “The use of mud rotary drilling techniques is largely inappropriate for the goal of the LANL Hydrogeologic Workplan.” In subsequent reports, however, the EAG did recognize that drilling through certain “stratigraphic” zones might not be possible without the use of drilling fluids under some circumstances and that “[i]ncreasing the number of tools in the well drilling ‘toolbox’ by adding a mud rotary drilling option” was a positive thing.

A February 8, 2002, report entitled “Assessment of Regional Aquifer Well-Development Techniques at Los Alamos National Laboratory and Impacts on Sampling” that was prepared by independent consultants concluded that “Improving the development [e.g. process to repair damage done during drilling] would be useful in particular because the boreholes seem to be retaining quantities of drilling fluid residues that are impacting the quality of collected groundwater samples.” This assessment stated that changes in groundwater chemistry “result in poor

² The EAG was established to review activities conducted under the Hydrogeologic Workplan.

understanding or misinterpretation of the presence of contaminants and their transport and fate.”

Also, a September 2004 LANL assessment of concerns about the quality of groundwater data obtained from the wells at LANL stated that organic-based drilling fluids provided a nutrient source that allows naturally occurring microbes to grow and that the consumption of the organic portions of the drilling fluid by these microbes changed the groundwater chemistry. As a result, metals such as plutonium, strontium, and americium are adsorbed onto precipitates created by the changed chemical environment, so decreased concentrations of these radionuclides would occur if present in the groundwater.

LANL has recognized that wells R-7 and R-22 had uranium concentrations below the background level of uranium in the groundwater. LANL stated that these “very low uranium values suggest uranium precipitation and are most likely caused by the presence of residual drilling fluids.” As a result, LANL has recognized that data from certain wells are not yet reliable due to the presence of residual drilling fluids. Documentation suggests that the amount of time required for the affect of drilling fluids on the reliability of contamination data to dissipate and for the groundwater chemistry to return to its pre-drilling condition ranges from 15 months to 10 years.

DOE is voluntarily providing radionuclide contamination data to the State of New Mexico under a long-standing DOE policy described in a 1998 agreement with the National Association of Attorneys General and a November 2000 Agreement-in-Principle between DOE and the State of New Mexico. This data, which is provided in annual reports, has been collected in accordance with the procedures in DOE implementing regulations, orders, and guidance documents. The current requirements and guidance are found in DOE O 450.1 and its associated guide, DOE G 450.1-6, “Groundwater Surveillance Monitoring Implementation Guide for Use with DOE O 450.1.” The guide states that each site should prepare a site-wide groundwater surveillance monitoring plan and that the plan should “indicate how data is classified according to any qualifications on its accuracy and precision.” Based upon the results of our review, we believe that, as DOE voluntarily provides radionuclide contamination data to the State of New Mexico, it should also provide any applicable qualifications on the accuracy and precision of contamination data that comes from wells where the affects of residual drilling fluids are or may be present.

RECOMMENDATIONS

We recommend that the Manager, Los Alamos Site Office, ensure that:

1. As the Hydrogeologic Workplan wells are converted to monitoring wells under the Compliance Order on Consent, LANL should ensure that monitoring data are reliable.
2. If LANL uses mud rotary drilling techniques for any future installation of monitoring wells constructed under the Compliance Order on Consent, LANL strictly follows all RCRA guidance on the use of these techniques.
3. As LANL implements a groundwater surveillance monitoring program pursuant to DOE O 450.1 and DOE G 450.1-6 by December 31, 2005, particular attention is given to well development and purging methods, the quality of radionuclide data, and any qualifications on that data.
4. The voluntary reporting of radionuclide contamination data contains appropriate qualifications on the accuracy and precision of that data, with particular attention to data that may be impacted by the effects of residual muds and other drilling fluids.

**MANAGEMENT
COMMENTS**

In comments on the draft report, management stated that the recommendations contained in the draft report were appropriate and would be implemented. Management also stated that all wells were purged under specific criteria in accordance with the guidance contained in RCRA, but despite this, “in certain screened intervals residual drilling fluids could not be fully removed during the development process.” Management further stated that “The potential impacts of these fluids and the effectiveness of additional development on their removal are currently being evaluated.” Management’s response also included an attachment with technical comments. Management’s comments are included in their entirety at Appendix B.

**INSPECTOR
COMMENTS**

We found management’s comments to be responsive to the report recommendations. Regarding management’s comments about purging drilling fluids, although LANL took action to purge the wells, LANL acknowledged its efforts were not effective in all cases. RCRA guidance clearly states that “If the mud rotary method is used, the drilling mud(s) should not affect the chemistry of ground-water samples from the borehole, or adversely impact

the operation of the well” and “Drilling fluids, drilling fluid additives, or lubricants that impact the analysis of hazardous constituents in ground-water samples should not be used.” In addition, the LANL Hazardous Waste Permit states that “Development procedures include purging of the well until contaminants introduced during drilling can be assured of being removed.” In the case of certain wells at LANL, (1) muds and drilling fluids did affect the chemistry of ground-water, (2) drilling fluids, drilling fluid additives, or lubricants that impact the analysis of hazardous constituents in ground-water samples were used, and (3) well development procedures, including purging, did not assure that contaminants introduced during drilling were totally removed.

Management’s technical comments were addressed, as appropriate, in the body of this report.

Appendix A

SCOPE AND METHODOLOGY

We completed our initial inspection fieldwork in February 2005. We interviewed LANL officials regarding the LANL characterization well program and reviewed DOE and LANL policies, procedures, and records regarding well construction, use of muds and other drilling fluids, and drilling techniques and methods. We also interviewed LANL, DOE, and State of New Mexico officials regarding implementation of the Hydrogeologic Workplan. In addition, we reviewed RCRA and EPA guidance and DOE orders regarding groundwater monitoring and environmental protection.

This inspection was conducted in accordance with the “Quality Standards for Inspections” issued by the President’s Council on Integrity and Efficiency.

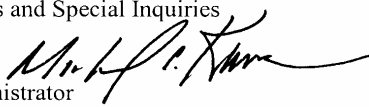


Department of Energy
National Nuclear Security Administration
Washington, DC 20585



SEP 14 2005

MEMORANDUM FOR Alfred K. Walter
Assistant Inspector General
for Inspections and Special Inquiries

FROM: Michael C. Kane 
Associate Administrator
for Management and Administration

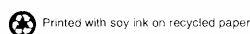
SUBJECT: Comments to IG Draft Report on Characterization
Wells; S04IS016/2004-15216

The National Nuclear Security Administration (NNSA) appreciated the opportunity to have reviewed the Inspector General's (IG) draft report, "Characterization Wells at Los Alamos National Laboratory." We understand that this inspection was based on an allegation that wells at the Laboratory were not constructed in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA). More specifically, the allegation was that the use of mud rotary drilling methods violated the Act and that the use of muds and other drilling fluids during well construction has an adverse affect on groundwater chemistry.

While the report refutes the allegation related to mud rotary drilling methods (acceptable under the Act and the Consent Order issued by the New Mexico Environment Department as opposed to unacceptable), the IG concludes that there was adverse effect on the groundwater chemistry. It is the opinion of NNSA that each well was, in fact, purged under specific criteria in accordance with the guidance contained in the Act.

We believe that despite following RCRA well development guidance for purging of drilling fluids, in certain screened intervals residual drilling fluids could not be fully removed during the development process. The potential impacts of these fluids and the effectiveness of additional development on their removal are currently being evaluated.

NNSA agrees that the recommendations contained within the draft report are appropriate and we will implement them. Additionally, we are providing technical comments to provide clarification and/or corrections to specific areas of the report.



Appendix B

Should you have any comments to this response, please contact Richard Speidel, Director, Policy and Internal Controls Management.

Attachment

cc: Edwin Wilmot, Manager, Los Alamos Site Office
Robert Braden, Senior Procurement Executive
Karen Boardman, Director, Service Center

Technical Comments
IG Draft Inspection Report
Characterization Wells at Los Alamos National Laboratory

General Comments (throughout)

The chemical process discussed with reference to potential masking of contamination is “adsorption”, not “absorption” as written in the draft. The term “adsorption” should be used for technical correctness.

Comment 1. Page 2, Observations and Conclusions, first bullet.

The last phrase of this bullet contains the word “requirement.” However, RCRA guidance cannot include requirements. This is more than semantics as the word requirement has specific legal meaning when used in describing compliance with environmental law. The word requirement should be struck or replaced.

Comment 2. Page 2, Observations and Conclusions, first bullet.

The draft IG report conclusion that the Laboratory did not adhere to specific constraints established in RCRA guidance concerning the purging of drilling fluids is incorrect. Specifically the phrase “to include the requirement that drilling fluids be purged,” appears to claim that no purging was performed at some or all of the wells. However, each and every well constructed under the Hydrogeologic Workplan was purged during the “well development” phase. This purging was continued until specific criteria (described below) were met. LANL did adhere to the specific regulatory permit conditions regarding purging and followed the RCRA guidance for using drilling fluids, even though these are guidelines and not regulatory requirements.

The draft IG report states that LANL did not adhere to the RCRA guidance that drilling fluids be purged. This is incorrect. Drilling plans for each well stipulate that well development methodology is in accordance with RCRA guidance. Upon completion of the construction of each well, an aggressive development program was initiated at every well. Development methods used included, swabbing, bailing, and pumping. Adequate purging was ensured when the following specific criteria were met: pH, specific conductance, and temperature had stabilized; turbidity was below 5 nephelometric turbidity units (NTUs); and three consecutive samples provided acceptable measurements (see well completion reports for documentation at each well).

We believe that despite following RCRA well development guidance for purging of drilling fluids, in certain screened intervals residual drilling fluids could not be fully removed during the development process. The potential impacts of these fluids and the effectiveness of additional development on their removal are currently being evaluated.

Comment 3. Page 2, Observations and Conclusions, second bullet.

The phrase: “that remain in *the* wells” (italics added) could be read that all Hydrogeologic Workplan wells have muds and drilling fluids in them. As is stated elsewhere in the draft report, only certain wells can possibly be impacted.

Comment 4. Page 2, Observations and Conclusions, last paragraph.

In discussing radionuclide monitoring under DOE Order 450.1, the draft IG report recommends that “the Laboratory should ensure that none of the characterization wells are converted to monitoring wells until there is assurance that these wells are capable of providing reliable contamination data”. This statement could better reflect technical facts in that all wells provide some reliable and useful data regardless of potential drilling fluids impacts. For example, monitoring for tritium, a key radionuclide that does not chemically react with any of the drilling fluids, provides data that are reliably free of impacts from drilling fluids. Other radionuclides and chemicals of interest have weak chemical attraction to the drilling fluids and their detection is not expected to be much affected. In addition, all of the wells may be used to monitor water level data regardless of drilling fluids impacts. The gathering and reporting of water levels is considered a part of monitoring under the Consent Order.

One alternative wording that we believe is consistent with the thrust of the draft IG report, and with the technical facts stated above is “the Laboratory should, as the Hydrogeologic Workplan wells are converted to monitoring wells, ensure that monitoring data are reliable.” This will allow for monitoring to occur in a graded manner and we note that recommendation number 4 on page 6 addresses the case where unacceptable are to be flagged with qualifiers.

Comment 5. Page 3, Mud Rotary Drilling, first paragraph

This important summary omits the fact that the mud rotary method is allowed by the NMED Consent Order (see Consent Order X.B.3, Water Rotary and Mud Rotary, page 191). Because the draft IG Report prominently refers to the Consent Order (twice in the recommendation section), it would contain a major flaw if the report should stay silent on the question “does the Consent Order allow use of the mud rotary method?”

Comment 6. Page 3, Mud Rotary Drilling, first paragraph

(repeat of Comment 2)

The draft IG report states that “LANL did not adhere to specific constraints established in the RCRA guidance when using muds and other drilling fluids, to include the requirement that drilling fluids be purged.” This is incorrect. LANL followed RCRA guidelines.

Comment 7. Page 3, Mud Rotary Drilling, last paragraph

(repeat of Comment 2)

The draft IG report states that “We determined that certain wells were constructed without muds and other drilling fluids being purged.” This is incorrect. LANL

has performed purging of drilling fluids at each well.

Comment 8. Page 3, Mud Rotary Drilling, last paragraph

The draft IG report lists a number of wells where LANL has recognized impacts from residual drilling fluids. Six wells are listed; among these, R-15 should not be included because the chemistry of samples collected from R-15 does not show the influence of residual drilling fluids. Since the statement is summarizing LANL's conclusions, it is more accurate to eliminate R-15 since LANL believes it to be providing representative samples free of impacts.

Comment 9. Page 3, Mud Rotary Drilling, all paragraphs

Interested readers will have a major question that is not clearly answered by this document –why use drilling fluids including mud? Or phrased a different way -if drilling fluids causes problems, why does RCRA guidance and the Consent Order allow their use? The draft IG report does provide a partial answer to this question in the introduction. However, a more complete answer is called for. A concise answer is that LANL found it necessary to use drilling fluids at certain well locations in order to construct the desired well given the extreme depths and complex geology encountered. Not using drilling fluids would result in failure to establish wells in certain locations (see EAG statement provided in Comment 10). While not ideal, the fluids do allow a well to be established that can be developed, and over time provide reliable data.

Comment 10. Page 4, Masking the Presence of Contaminants first paragraph.

In reference to the December 1999 report by the External Advisory Group, which quoted “The use of mud rotary drilling techniques is largely inappropriate for the goal of the LANL Hydrogeologic Workplan.” The EAG statement is out of date and therefore misrepresents what the EAG advised LANL. We request that the draft IG report include the following more recent EAG statements:

- *Listed as **Positives** in the April 2002 Semi-annual EAG report, page 16. Increasing the number of tools in the well drilling “toolbox” by adding a mud rotary drilling option and the option of casing off troublesome zones above the aquifer.*
- *June 2002 Semi-annual EAG report, page 22. “. . . we also realize that drilling through certain stratigraphic zones might simply not be possible without the use of drilling fluids under some circumstances.”*

Clearly the EAG updated its advice to include use of drilling fluids in some circumstances. It is important that the IG include EAG statements that are more recent than the 1999 statement. The later statements by the EAG recognize the necessity of using drilling fluids in some circumstances.

Comment 11. Recommendations

(Repeat of comment 4)

Appendix B

We request that this recommendation be restated as “the Laboratory should, as the Hydrogeologic Workplan wells are converted to monitoring wells, ensure that monitoring data are reliable.”

Comment 12. Page 7, Appendix A – Scope and Methodology

The draft IG report does not document the specific LANL records for well construction, use of muds, and other drilling fluids, and drilling techniques and methods.

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