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U.S. NUCLEAR REGULATORY COMMISSION

OBSERVATION AUDIT REPORT OAR-99-01

OF THE YUCCA MOUNTAIN QUALITY ASSURANCE DIVISION

AUDIT LANL-ARP-99-01

OF THE

LOS ALAMOS NATIONAL LABORATORY

11/19/98
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Enclosure

1.0 INTRODUCTION

Members of the U.S. Nuclear Regulatory Commission (NRC) Division of Waste Management Quality Assurance (QA) staff observed the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), Office of Quality Assurance (OQA), Yucca Mountain Quality Assurance Division (YMQAD) performance based audit of the Los Alamos National Laboratory (LANL). The audit, ARP-99-01, was conducted on October 19-23, 1998.

The NRC staff objective was to gain confidence that OQA and LANL are properly implementing the requirements of their QA programs in accordance with OCRWM Quality Assurance Requirements and Description (QARD): DOE/RW-0333P) and Title 10 of the Code of Federal Regulations (10CFR), Part 60, Subpart G (which references 10 CFR Part 50, Appendix B).

This report addresses the effectiveness of the OQA audit and the adequacy of implementation of QA controls in the audited areas of the LANL QA program.

2.0 MANAGEMENT SUMMARY

The NRC staff has determined that the OQA Audit ARP-98-20 was useful and effective. The audit was organized and conducted in a professional manner. Audit team members were independent of the activities they audited. The audit team was well qualified in the QA and technical disciplines, and its assignments and checklist items were adequately described in the audit plan.

Three conditions adverse to quality were identified. One condition was corrected during the audit and the corrective action for the other two conditions will be addressed in the responses to the recently issued OCRWM Deficiency Reports (DR) LANL-99-D-006 and LANL-99-D-007. Seven recommendations were made in the report with respect to the quantification of the sensitivity and uncertainty and the LANL program documentation. OQA also requires a formal response to the recommendations identified in the audit report. The NRC staff agrees with the audit team finding and recommended actions.

3.0 AUDIT PARTICIPANTS

3.1 NRC

Ted Carter	QA Observer
Jeff Ciocco	QA Observer

3.2 STATE OF NEVADA

Susan Zimmerman	Observer

3.3 AUDIT TEAM

Donald Harris	OQA/Quality AssuranceTechnical Support Services (QATSS), Las Vegas, NV	Audit Team Leader (ATL)
Kenneth McFall	OQA/QATSS, Las Vegas, NV	Auditor
Keith Kersch	OQA/QATSS, Las Vegas, NV	Auditor

4.0 REVIEW OF THE AUDIT AND AUDITED ORGANIZATION

This OQA audit of LANL was conducted in accordance with OCRWM Quality Assurance Procedure (QAP) 18.2, "*Internal Audit Program*," QAP 16.1Q, "*Performance/Deficiency Reporting*" and AP 16.2Q, "*Corrective Action and Stop Work.*" The NRC staff's observation of this audit was based on the NRC procedure, "Conduct of Observation Audits," issued October 6, 1989.

4.1 Scope of the Audit

The Audit team conducted a performance based audit of activities supporting the following:

- Work Breakdown Structure (WBS) 1.2.3.3.1.3.1 - *Reactive Tracer Testing C-Wells, Milestone SP32E2M4SZ, Reinterpretation of the Reactive Tracer Test in the Bullfrog Tuff and Results of Laboratory Testing (C-Holes Update Report)*

The Milestone Report and associated data inputs were evaluated for the critical process steps identified below:

1. Scientific Investigation Planning.
2. Identification, Traceability and Control of Data.
3. Data Analysis, Review and Interpretation.
4. Control of Software.
5. Model Development Code, Validation, Calibration and Output Reporting.
6. Independent Review of Study Results.
7. Data Input to Genesis.
8. Identification/Submittal of cited References to the Technical Information Center (TIC).

A performance based audit evaluates products and associated processes to determine the degree to which they meet program requirements and management commitments and expectations. This performance based evaluation of process effectiveness and product acceptability was based upon:

- Satisfactory completion of the critical process steps.
- Acceptable results and quality of the end product.
- Documentation that substantiates quality of data.
- Performance of trained and qualified personnel.
- Implementation of applicable QA program elements.

4.2 Conduct and Timing of the Audit

The audit was performed in a professional manner and the audit team was well prepared and demonstrated a sound knowledge of the LANL and DOE QA programs. Audit team personnel were persistent in their interviews, challenged responses when appropriate, and performed an acceptable audit.

The NRC staff believes the general timing of the audit was appropriate for YMQAD to evaluate the pertinent LANL activities associated with the ongoing activities and implementation of the QA program. The DOE audit team and NRC observers caucused at the end of each day during the

week of October 16, 1998. Also, meetings of the audit team and LANL management (with an NRC observer present) were held each morning to discuss the current audit status and preliminary findings.

4.3 Examination of QA Programmatic Elements

The NRC staff observed that each of the auditors reviewed related documentation and interviewed a representative sample of LANL personnel to determine their understanding of implementing procedures and processes. Checklists were used effectively and the NRC observer was provided ample opportunities to provide comments and ask questions.

Training, education, and experience records were reviewed to assure LANL personnel were in compliance with their individual position descriptions. Objective evidence was provided and reviewed by the auditor and it was determined that all personnel were in compliance.

4.4 Examination of Technical Activities

As part of this performance based audit, a technical evaluation was conducted on the Level 4 Milestone SP32E2M4, *"C-Holes Update Report: Reinterpretation of the Reactive Tracer Test in the Bullfrog Tuff and Results of Laboratory Testing, September 03, 1998."* A later version of the document, Milestone SP32E2M4SZ dated September 15, 1998, was delivered to the audit team at the audit opening meeting. This document had gone through an internal peer review and incorporated some of the reviewers suggested changes. A quick perusal by the audit team revealed there were additional figures and text added to the milestone report but no changes were made to the conclusions.

The audit team's technical specialist prepared a comprehensive checklist to evaluate the Milestone report. LANL personnel were interviewed, scientific and laboratory notebooks were reviewed, and references checked as part of the audit. The audit was greatly facilitated by the LANL's staff cooperation and candidness. Unfortunately, only two of the six coauthors were available during the audit. In addition, several of the original scientific notebooks were either off-site with a graduate student at New Mexico Tech in Socorro, New Mexico or were in the field as part of the on-going Prow Pass reactive tracer tests.

The report audited supports Work Breakdown Structure element 1.2.3.3, Saturated Zone Hydrologic Testing. Milestone SP33PLM4 addressed three elements related to the saturated zone advective and mass transport characterization and accomplished the following: (1) provided an update of the results and interpretation of the reactive tracer test conducted in the Bullfrog Tuff at the C-wells complex (groundwater wells UE-25c#1, UE-25c#2, and UE-25c#3) in 1997; (2) presented an update of all laboratory testing (batch sorption experiments, dynamic laboratory transport experiments of crushed tuff columns and fractured core columns, and diffusion cell experiments) conducted to date in support of reactive tracer testing at the C-well complex; and (3) predicted the tracer transport in the upcoming (now ongoing) reactive tracer testing in the Prow Pass Tuff.

The technical specialist investigated with the primary author the key parameters that were requested by the saturated zone flow and transport modelers and the performance assessment modelers. Although not well documented, the key parameters needed and provided from this investigation for the transport process modeling were matrix diffusion, colloidal transport, dispersion (longitudinal only, the test configuration would not allow for the evaluation of

transverse dispersion), effective porosity, and laboratory sorption. The audit team then determined whether the conclusions of the field reactive tracer testing were supported and justified by the data. The conclusions were (1) a dual porosity conceptual transport model is consistent with field transport data in the saturated zone in the vicinity of Yucca Mountain, (2) potential exists for colloid transport over significant distances in the saturated zone, and (3) field-derived lithium sorption parameters are in good agreement with laboratory measurements. Two of the three conclusions were adequately supported by data. The dual porosity conceptual model was not thoroughly developed and the author agreed that more information is needed to deduce a dual-porosity conceptual model is valid for the site.

The audit team traced through the available scientific and laboratory notebooks. Minor errors in the text and equations were reconciled during the audit. All data was not found to be qualified as stated in the report. In particular, the laboratory experiments were performed on non-qualified C-wells core. Thus the acceptability of the laboratory core experimental results are questionable regarding it's usage for license application. A discussion with the Yucca Mountain Sample Management Facility indicated the core was known to be non-qualified and was to be used only collaboratively and not for license application data. The report did not state the limitations of the core and the experimental results obtained from it.

The auditors could not track all of the data used in the report with the data located in the project's technical databases and scientific notebooks. Grain density had varying numbers in the report which affect on the calculation of the retardation factors. The author explained the grain densities used in the calculation had a range of 10-20% which shouldn't affect the retardation factor significantly. The purpose of the testing was to get a rough, homogenized lithium retardation factor over a thirty meter distance. The author and auditors felt the objective was accomplished. It was further explained the densities were point estimates of bulk densities. There was also an issue of non-uniqueness of the curve fitting analysis that was not adequately addressed in the report. The duration of the field test, if extended over a longer period, may have helped to resolve the problem of linear dependence of the breakthrough curves.

The report's assumptions inherent in the mathematical formulation of the physical problem was discussed. Questions were raised as to the validity and usefulness of the calculated parameters which assumed an isotropic, homogeneous, and porous medium. Yucca Mountain is generally considered to be heterogeneous, anisotropic, and predominantly fractured in the volcanic tuffs. The report did appropriately caveat the calculated parameters with a caution to the end-users (i.e. flow and transport modelers and performance assessment modelers) . A rigorous quantification of the uncertainty regarding the calculated parameters was not performed. All parties acknowledged that the quantification should be performed.

LANL is commended for their efforts to conduct field-scale tracer tests and laboratory tests. The calculated advective and mass transport parameters are essential to accurate modeling of the saturated zone. No major technical deficiencies were detected in the work product. Overall the report was a careful and thorough analysis of the tracer tests and laboratory work. The key

conclusion of the report was that matrix diffusion is a process that has observable effects on solute transport in fractured tuffs at Yucca Mountain.

4.5 Summary of OQA Findings

The audit team identified three conditions adverse to quality during the audit. Corrective action for two conditions will be addressed in response to the OCRWM Deficiency Reports (DR) LANL-99-006 and LANL-99-D-007. One condition adverse to quality was corrected during the course of the audit

DR LANL-99-D-006
Acquired and modified DIFCEL software was utilized to perform interpretation of data for the milestone report. The software has not been qualified and does not meet the requirements of the Quality Assurance Requirements and Description (QARD) document.

DR LANL-99-D-007
The milestone report contains Q data which may be relied upon to address safety and waste isolation issues. LANL derived laboratory test data from unqualified C-Well Core.

Condition Adverse to Quality Corrected During the Audit
Scientific Notebooks *LA-EES-4-NBK-96-002(b), Microspheres, and LA-EES-4-NBK-96-003, Reactive Tracer Testing*, had technical reviews completed on May 28, 1997 and a closure statement by the Principal Investigator. No later entries were in the Scientific Notebooks. They were sitting on the shelf and no copies had been submitted to the Records Processing Center (RPC). The SNs were processed through Technical Assurance Reviews and submitted to the RPC.

4.6 NRC Staff Findings

The NRC staff determined that the audit was effective in assessing LANL compliance with requirements in the areas examined. The audit was conducted in a professional manner and the audit team adequately evaluated activities and objective evidence. The ATL was extremely effective in his daily presentation to the M&O management and staff in providing guidance to the audit team. The checklist questions provided a sound basis to conduct the audit.

The NRC staff agrees with the technical findings of the audit team. However, the following were noted:

- It was not clear to an independent reviewer how work is planned, executed, and reported through the scientific notebook process and deliverable milestones. Several scientific notebook and laboratory notebooks were not available to the audit team during the audit.

- Coordination with other entities, such as the USGS and other LANL divisions, are not well documented in Scientific Notebooks and reports.

- There was a weakly developed conclusion that the dual-porosity model is valid for the Yucca Mountain saturated zone.

- The report should clearly develop and elicit the assumptions and limitations of the parameters calculated for the end-users (i.e. the saturated zone flow and transport modelers and the performance assessment modelers).

- Caution using the USGS assumption that the tested interval can be treated as a horizontally continuous, isolated interval. This assumption may over-estimate the effective porosity of the saturated zone in the vicinity of the C-wells.

- The uncertainty in the calculated parameters should be quantified so the data set is properly utilized by the saturated zone flow and transport modelers.

- Caution using the discussion of "future work plans and activities" throughout the text. The authors describe, not recommend, future tracer work they plan to do directly related to this milestone report. It is misleading to the reader that there will be more related follow-on work when there may not be. Recommendations for follow-on activities should be consolidated and summarized at the end of the report.