U.S. NUCLEAR REGULATORY COMMISSION

OBSERVATION AUDIT REPORT OA-96-06

OF THE YUCCA MOUNTAIN QUALITY ASSURANCE DIVISION

AUDIT YM-ARP-96-13

OF THE LAWRENCE BERKELEY NATIONAL LABORATORY

08/8/96
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ENCLOSURE

1.0 INTRODUCTION

Members of the U.S. Nuclear Regulatory Commission Division of Waste Management quality assurance (QA) and geosciences staff observed the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), Office of Quality Assurance, Yucca Mountain Quality Assurance Division (YMQAD) audit of the QA program of the Lawrence Berkeley National Laboratory (LBNL). This performance-based audit, YM-ARP-96-13, was conducted on July 8-11, 1996, at LBNL offices in Berkeley, California. The State of Nevada was not represented at this audit.

The audit evaluated the adequacy and effectiveness of the LBNL QA program for selected activities that relate to Work Breakdown Structure 1.2.3.11.2, "Surface-Based Geophysical Testing." These activities are scheduled to result in a synthesis report at the end of fiscal year 1996 that presents the geologic model of Yucca Mountain and its vicinity as determined from the interpretation and integration of the available geophysical data. The data used for generating the model include seismic reflection, gravity, magnetotelluric, vertical seismic profile, magnetic, and data from borehole geophysical logs.

The objectives of this audit by YMQAD were to evaluate the quality of the activities leading to the synthesis report of the geologic model of Yucca Mountain and its vicinity and to determine whether the LBNL QA program and its implementation meet the applicable requirements of the OCRWM Quality Assurance Requirements and Description document (QARD: DOE/RW-0333P) and associated LBNL implementing procedures.

The principle objective of the NRC staff was to evaluate the quality of the geologic modeling of Yucca Mountain as it relates to the Key Technical Issue of "Structural Deformation and Seismicity." A second objective was to gain confidence that YMQAD and LBNL are properly implementing the requirements of their QA programs in accordance with the OCRWM QARD and Title 10 of the Code of Federal Regulations (10 CFR), Part 60, Subpart G (which references 10 CFR Part 50, Appendix B).

This report addresses the effectiveness of the YMQAD audit and the adequacy of implementation of QA controls for the geologic modeling of Yucca Mountain.

2.0 MANAGEMENT SUMMARY

This performance-based audit evaluated the adequacy and effectiveness of the LBNL QA program for selected activities that relate to Work Breakdown Structure 1.2.3.11.2, "Surface-Based Geophysical Testing." These activities are scheduled to result in a synthesis report at the end of fiscal year 1996 that presents the geologic model of Yucca Mountain and its vicinity.

The audit team's overall finding was that the audit showed satisfactory LBNL technical and QA performance with no deficiencies noted.

The NRC staff has determined that the audit was useful and effective. The audit was organized and conducted in a thorough and professional manner and was generally effective. Audit team members were independent of the activities they audited, they were well qualified in their disciplines, and

their assignments and checklist items were adequately described in the audit plan. The NRC staff agrees with the YMQAD audit team's overall finding.

3.0 AUDIT PARTICIPANTS

3.1 NRC

John G. Spraul	Observer
Abou-Bakr Ibrahim	Observer

3.2 DOE

Dennis Threatt	Audit Team Leader (ATL)	YMQAD/QA Technical Support Services (QATSS)
Pat Auer	Auditor	YMQAD/QATSS
John Nicholl, Jr.	Technical Specialist (TS) (Geophysicist)	Civilian Radioactive Waste Management and Operating Contractor (M&O)/Woodward Clyde Federal Services

4.0 REVIEW OF THE AUDIT AND AUDITED ORGANIZATION

4.1 Auditing Procedures

This YMQAD audit of LBNL was conducted in accordance with OCRWM Quality Assurance Procedure QAP 18.2, "Audit Program" and Administrative Procedures AP-16.1Q, "Performance/Deficiency Reporting," and AP-16.2Q, "Corrective Action and Stop Work." The NRC staff observation of this audit was based on the NRC procedure, "Conduct of Observation Audits," issued October 6, 1989.

4.2 Scope of the Audit

The audit plan identified this as a performance-based audit to evaluate the effectiveness of implementation of the M&O's QA program at LBNL for selected activities related to Work Breakdown Structure 1.2.3.11.2, "Surface-Based Geophysical Testing." These activities are scheduled to result in a synthesis report at the end of fiscal year 1996 that presents the geologic model of Yucca Mountain and its vicinity.

The NRC's primary interest in observing this audit was to gain information regarding the Key Technical Issue of "Structural Deformation and Seismicity," and the technical portion of the audit received most of the NRC staff's attention. Some NRC staff time was spent, however, observing each of the audit team members.

4.2.1 Technical Area

The Key Technical Issue associated with the audit is "Structural Deformation and Seismicity."

The technical portion of this audit of LBNL evaluated the adequacy and effectiveness of the LBNL QA program for selected activities that relate to

Work Breakdown Structure 1.2.3.11.2, "Surface-Based Geophysical Testing." These activities are scheduled to result in a synthesis report at the end of fiscal year 1996.

4.2.2 QA Programmatic Elements

The audit team also evaluated implementation of the M&O's QA program at LBNL to determine whether the program meets the requirements and commitments imposed by OCRWM. This was done by determining, within the scope of the technical portion of the audit, the adequacy of LBNL's QA program, its implementation, and its effectiveness as well as verifying compliance with requirements. The QA portion of the audit checklist addressed the QA programmatic elements and QARD supplements listed below:

1.0	Organization
2.0	Quality Assurance Program
5.0	Implementing Documents
6.0	Document Control
7.0	Control of Purchased Items and Services
12.0	Control of Measuring and Test Equipment
16.0	Corrective Action
17.0	QA Records
Supplement I	Software
Supplement III	Scientific Investigation

4.3 Conduct Of Audit

The TS on the audit team had prepared his portion of the audit checklist (YM-ARP-96-13-02) prior to the audit. The TS was the primary interviewer during the technical portion of the audit, and he made the technical evaluations. Similarly, the QA portion of the audit checklist (YM-ARP-96-13-01) was prepared and used by the ATL and auditor who made the QA evaluations.

The YMQAD audit team and the observers caucused at the end of each day's audit. Also, the ATL met daily with LBNL management (with observers present) to discuss the then-current audit status and preliminary findings of the audit team.

The audit was performed in a professional manner and previously recognized good audit practices were followed. The members of the audit team were well prepared and demonstrated a sound knowledge of their assigned audit areas.

4.4 Timing of the Audit

The audit was timely because it was conducted after several data reports were issued but before the issue of the borehole and surface geophysics synthesis report scheduled for the end of fiscal year 1996.

4.5 Examination of Audited Areas

The interview method of auditing, combined with periodic checking of objective evidence, allowed for thorough responses to the checklist questions and

permitted additional questions to be answered. Members of the audit team were persistent in their interviews, challenged responses when necessary, and performed an acceptable audit.

Section 4.5.1 of this report addresses the technical portion of the audit. Section 4.5.2 addresses the audit of the QA programmatic elements.

4.5.1 Examination of Technical Activities

The purpose of the "Surface-Based Geophysics Synthesis Report" that is scheduled for the end of fiscal year 1996 is to present the results of geophysical work performed by LBNL during fiscal years 1994 and 1995. The synthesis report will present the geologic model of Yucca Mountain and its vicinity as determined from the LBNL interpretation and integration of the available geophysical data. The data to be used for generating the model include seismic reflection, gravity, magnetotelluric, vertical seismic profile, magnetic, and data from borehole geophysical logs.

The TS used his checklist while auditing the Principal Investigator (PI) and other involved LBNL staff members. In addition to the checklist questions, the TS posed several questions to the PI and other LBNL staff about data gathering and processing. He asked the PI about the types of field tests performed to optimize data acquisition parameters such as filter setting and instrument configuration and spreading. He also posed questions to the PI about the type of processing and the software used in processing the data. The PI summarized the steps used to process the data and showed the audit team (and observers) how LBNL qualified the code. The TS was satisfied with the response. After some of the general questions were responded to, the TS dealt with each geophysical method separately as discussed below.

• Seismic Reflection Data - LBNL shot several short, high-resolution seismic reflection lines. The target depth was from 100 meters to repository depth (about 300 meters). The seismic reflection lines were shot to image faulting, fracturing, and the water table gradient at the repository site. The TS asked questions of the PI about the energy source/sources used for collecting the data. The PI responded by indicating that a Bison EWG-4 accelerated weight drop was used for most of the lines but a hammer source was used for rough terrain. The PI indicated that LBNL used the Bison instead of a vibrator due to the high frequency content of the Bison. The TS then posed a question about the steps used in processing the seismic data and the PI indicated that LBNL used ProMAX and Focus software for the processing. The TS questioned the PI about the velocity used in stacking the seismic data and how these values were obtained. The PI responded by saying that a velocity picking program, VELDEF, had been used to pick the stacking velocity. After discussing the processing sequence, the PI presented the results of a stacked section and its interpretation. The PI indicated that the structures in the region are very complex and much of the difficulty in obtaining a "good" section can be attributed to side-scattering, fractures, and faults. The PI identified on the seismic line the location of the Ghost Dance fault and indicated that he does not notice any indication of increase in offset on the fault as a function of depth.

• Gravity Data - LBNL collected gravity data for twelve lines which coincide with seismic reflection lines. The purpose of these lines, which crossed mapped faults, is to determine if gravity anomalies can place constraints on the location and amount of offset on the faults. Also, the gravity data will complement the other geophysical data. The gravity was measured using two LaCoste and Romberg Model gravity meters. The TS questioned the LBNL staff about the procedure used for the calibration loop. The LBNL staff stated that the meter calibration was determined on the basis of four different runs on the Charleston Peak gravity calibration loop. The TS then asked about the gravity data reduction procedures. The LBNL staff responded by explaining how it was done. The LBNL staff indicated that after correcting for the effect of earth tides, a drift correction was estimated for each meter for each day and then all measurements were referenced to the value at the MERCA base station. The LBNL staff then indicated that, in order to interpret the gravity data, one has to assume a density/depth function. The LBNL staff's assumption of density as a function of depth is based on sampling of surface rocks, drill hole data, gamma ray logs, and bore hole gravity measurements. The LBNL staff then used standard methods to convert the observed gravity values into a Bouguer gravity anomaly that was used in the calculations to obtain the geologic interpretation along the different lines. The LBNL staff later presented its interpretation and showed how the gravity data correlate with the seismic reflection data. In the interpretation, when the gravity line crosses a well-defined fault, a negative anomaly is exhibited in the data. For example, at the crossing of the Bow Ridge fault, a one-milligal can be seen in the data.

• Magnetotelluric Data - The intent of collecting these data was to complement the gravity, magnetic, and seismic reflection data. A two-mile line was covered using a high frequency multi-channel magnetotelluric system. The TS asked the PI several general questions on the subject, and the PI responded acceptably. The PI showed a final magnetotelluric section and identified areas where faults could be expected.

• Vertical Seismic Profile (VSP) Data - LBNL staff collected VSP data in seven wells and the Colorado School of Mines in one well (UZ-16). LBNL staff indicated that the VSP data from UZ-16 had not been received by LBNL for inclusion in its synthesis report. LBNL staff pointed out that the UZ-16 data should be of high quality because the geophones were cemented to the wall of the borehole.

• Magnetic Data - LBNL staff also indicated that the magnetic data collected by USGS had not been received by LBNL.

• Data from Borehole Geophysical Logs - The TS inquired about the status of incorporating the interpreted data from borehole geophysical logs with the other geophysical data. The PI indicated that LBNL is waiting for the results from USGS which is in charge of analyzing and interpreting the well logs.

LBNL indicated that, as more data become available, the intention is to incorporate it into the synthesis report. However, this may not be possible because of schedule and financial restraints. The TS indicated that he will

stress the missing data in his input to the audit report and point out how the exclusion of these data can affect the quality of the synthesis report.

The question of how to combine non-qualified and qualified data in the synthesis report was discussed during the audit. This issue needs OCRWM attention with a description/procedure of how non-qualified data can be combined with qualified data and how the results will be used in a license application.

Overall, the technical portion of the audit went very well and the TS asked the appropriate questions. No nonconformances were found.

4.5.2 QA Programmatic Elements

The QA portion of the audit checklist (YM-ARP-96-13-01) contained questions regarding the QA programmatic elements listed in Section 4.2.1. No nonconformances regarding the QA programmatic elements were found by the auditors during this portion of the audit. This portion of the audit was performed in an acceptable manner using the checklist questions prepared prior to the audit.

4.6 Audit Team Qualifications and Independence

The qualifications of the ATL and auditor were found to be acceptable in that each met the requirements of QAP 18.1, "Auditor Qualification." The qualifications of the TS was found to be acceptable in that he met the requirements of QAP 18.2, "Internal Audit Program," Section 6.3, "Qualification of Technical Specialists."

Although this was the first YMQAD audit in which the TS participated, he was well prepared for conducting the audit with a reasonable checklist and questions. The audit checklist was adequately formulated and covered the subject matter well. The TS posed several questions during the audit indicating that he was very familiar with the subject matter and was well prepared for the audit. He made several recommendations during the course of the audit that should be reflected in LBNL activities leading to the synthesis report and in the report itself.

The audit team members did not have prior responsibility for performing the activities they audited. Although the TS is an M&O employee who is familiar with the technical activities audited, he had no prior direct or oversight responsibility for these activities. The audit team members had sufficient independence to carry out their assigned functions without adverse pressure or influence. The audit team was well qualified in the QA and technical disciplines, and the assignments and checklist items were adequately described in the audit plan.

4.7 Review of Previous Audit Findings

Several previous QA audits of LBNL were conducted by DOE in fiscal year 1996 during which deficiencies were identified. The corrective action for these deficiencies were either verified previously by DOE or had not been completed at the time of this audit. Therefore, this audit did not address the open deficiencies.

4.8 NRC Staff Findings

The technical and QA programmatic portions of the audit were conducted in a professional manner, and the audit team adequately evaluated activities and objective evidence. The audit was effective in determining the adequacy and degree of implementation of the LBNL QA program as it applied to the technical activities audited.

The initial checklist questions provided an adequate technical basis to conduct a thorough audit of the Work Breakdown Structure 1.2.3.11.2, "Surface-Based Geophysical Testing," for Yucca Mountain. The TS went into sufficient detail during the audit to examine the planning assumptions, the bases for technical analyses, and the adequacy of numerical modeling performed at LBNL. Based on the discussions, it appeared that the technical personnel audited were knowledgeable in their respective fields. The method used by the TS to perform the audit was an appropriate combination of technical discussions with the LBNL staff and reviews of project files and other reference material requested by the audit team and provided by LBNL.

Previously recognized good auditing practices were followed by the ATL and the audit team, and the NRC staff did not observe any deficiencies in the audit process. The ATL, auditor, and TS worked well as a team in that they audited items of mutual interest together but separated to audit items that were only within one's area of interest.

The NRC staff agrees with the YMQAD audit team overall finding noted below.

4.9 YMQAD Audit Team Findings

The audit team's overall finding was that the audit showed satisfactory LBNL technical and QA performance.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 9, 1996

Mr. Ronald A. Milner, Director
of Program Management and Integration
Office of Civilian Radioactive Waste Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585

SUBJECT: OBSERVATION AUDIT OF LAWRENCE BERKELEY NATIONAL LABORATORY

Dear Mr. Milner:

I am transmitting the U.S. Nuclear Regulatory Commission Observation Audit Report OA-96-06 of the U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Office of Quality Assurance, Yucca Mountain Quality Assurance Division (YMQAD) audit of the quality assurance (QA) program of the Lawrence Berkeley National Laboratory (LBNL). This performance-based audit, YM-ARP-96-13, was conducted on July 8-11, 1996, at LBNL offices in Berkeley, California. The audit evaluated the adequacy and effectiveness of the LBNL QA program for selected activities related to Work Breakdown Structure 1.2.3.11.2, "Surface-Based Geophysical Testing." These activities are scheduled to result in a synthesis report at the end of fiscal year 1996 that presents the geologic model of Yucca Mountain and its vicinity as determined from the interpretation and integration of the available geophysical data. The data to be used for generating the model include seismic reflection, gravity, magnetotelluric, vertical seismic profile, magnetic, and data from borehole geophysical logs.

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YMQAD should continue to closely monitor implementation of the LBNL QA program to ensure that future QA program implementation is effective. The NRC staff expects to participate in this monitoring as observers and may perform its own independent audits at a later date to assess LBNL implementation of its QA program.

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A written response to this letter is not required. If you have any questions, please call Jack Spraul of my staff on (301) 415-6715.

Sincerely,

[Original signed by]

John H. Austin, Chief
Performance Assessment and High-Level
Waste Integration Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

cc:
C. Johnson, State of Nevada
M. Murphy, Nye County, NV
B. Mettam, Inyo County, CA
V. Poe, Mineral County, NV
L. Bradshaw, Nye County, NV
W. Barnard, NWTRB
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Sincerely,

[Original signed by]

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Performance Assessment and High-Level
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Enclosure: As stated

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