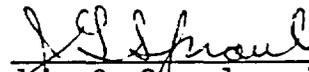


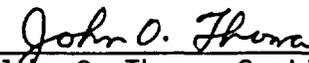
U.S. NUCLEAR REGULATORY COMMISSION  
OBSERVATION AUDIT REPORT OA-96-02  
OF THE YUCCA MOUNTAIN QUALITY ASSURANCE DIVISION  
AUDIT YM-ARP-96-05  
OF THE SANDIA NATIONAL LABORATORIES

  
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## 1.0 INTRODUCTION

Members of the Nuclear Regulatory Commission Division of Waste Management quality assurance (QA) and geotechnical engineering 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) audit of selected technical activities of the Sandia National Laboratories (SNL). The audit, YM-ARP-96-05, was conducted on January 22 through 26, 1966, at SNL offices in Albuquerque, New Mexico. The State of Nevada was not represented at this audit.

The objective of this performance-based audit by YMQAD was to evaluate the implementation of the SNL QA program and the quality of the resultant end products associated with the in situ thermo-mechanical properties of Yucca Mountain to determine the degree to which they meet program requirements and commitments. The scope of the audit is identified in Section 4.1 of this report.

The NRC staff objective was to gain confidence that YMQAD and SNL are properly implementing the requirements of their QA programs in accordance with the OCRWM Quality Assurance Requirements and Description (QARD: DOE/RW-0333P) and Title 10 of the Code of Federal Regulations (10 CFR), Part 60, Subpart G (which references 10 CFR Part 50, Appendix B). A second objective of the staff was to evaluate the quality of resultant end products associated with the in situ thermo-mechanical properties of Yucca Mountain.

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

## 2.0 MANAGEMENT SUMMARY

This audit evaluated the implementation of the SNL QA program for activities associated with the in situ thermo-mechanical properties of Yucca Mountain.

The NRC staff determined that the audit was effective. The audit team found that the SNL QA program had been satisfactorily implemented in the areas audited except for the activities associated with the review of work agreements that were judged to be marginal. The NRC staff agrees with these conclusions. One preliminary Deficiency Report (DR) and one preliminary Performance Report (PR) were initiated by the audit team. DRs are used to report nonsignificant deficiencies, and PRs are used to report isolated conditions that require only remedial actions or minor improvements to meet requirements. The preliminary DR related to the lack of objective evidence of acceptable review and comment resolution of work agreements. The preliminary PR was written because the customer of a work agreement had signed it, indicating approval and that all comments had been resolved, prior to the time that the technical reviewer/quality assurance reviewer had signed it to document the review and resolution of comments.

### 3.0 AUDIT PARTICIPANTS

#### 3.1 NRC

John G. Spraul           QA Observer  
Mysore S. Nataraja      Technical Observer

#### 3.2 DOE

Kenneth T. McFall	Audit Team Leader (ATL)	YMQAD/QA Technical Support Services (QATSS)
John R. Doyle	Auditor	YMQAD/QATSS
Ronald E. Smith	Technical Specialist (Civil/Geotechnical)	Civilian Radioactive Waste Management and Operating Contractor (M&O)

### 4.0 REVIEW OF THE AUDIT AND AUDITED ORGANIZATION

This YMQAD audit of the SNL was conducted in accordance with OCRWM Quality Assurance Administrative Procedure (QAAP) 18.2, "Audit Program" and QAAP 16.1, "Corrective Action." The NRC staff 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 following technical area concerned with the in situ thermo-mechanical properties of Yucca Mountain was identified in the Audit Plan and was audited by the YMQAD audit team:

- Work Breakdown Structure 1.2.3.2.7.3.2 - In situ Thermo-mechanical Properties

The following technical documents were audited by the YMQAD audit team:

- SNL Department 6302 Letter Report, "ESF Thermal Test Design: Analysis Status," SLTR95-0013, September 29, 1995
- SNL draft report, "In Situ Thermomechanical Properties Study Plan 8.3.1.15.1.6," John Pott, Rev. 0, October 30, 1995

In addition, the following six QA program elements were audited:

<u>Criterion</u>	<u>Subject</u>
1.0	Organization
2.0	Quality Assurance Program
5.0	Implementing Documents
6.0	Document Control
16.0	Corrective Action
17.0	QA Records

The Key Technical Issue associated with the audit is "Repository Design and Thermo-Mechanical Effects."

## 4.2 Conduct Of Audit

The audit was performed in a professional manner and the audit team was well prepared. The audit plan identified this as a performance-based audit in which the evaluation of process effectiveness and product acceptability would be based upon 1) satisfactory completion of the critical process steps based on QA checklist YM-ARP-96-05-01, 2) acceptable results and quality of the end product, 3) documentation that substantiates quality of products, 4) performance of trained and qualified personnel, and 5) implementation of applicable QA program elements.

In addition to being performance-based, this audit was also a technical audit, with technical evaluations being made by the civil/geotechnical technical specialist. The five bases noted above for the evaluations were generally addressed. This performance-based technical audit appeared to focus on all points in the process at which technical judgements were made, and the important technical and performance-related audit criteria were assessed.

The DOE audit team and the NRC observers caucused at the end of each day's audit. Also, meetings of the ATL and SNL management (with an NRC observer present) were held daily to discuss the then-current audit status and preliminary findings. Previously recognized good audit practices were followed.

## 4.3 Timing of the Audit

Initially, the timing of the audit appeared to be inappropriate because both of the audited documents address thermo-mechanical tests that are no longer planned for Yucca Mountain. However, as the audit proceeded, it was found that the thermo-mechanical testing currently planned for Yucca Mountain is very similar to the testing described in these documents. In addition, during the audit the auditors were able to review and provide comments on drafts of later, timely, documents. The insight provided to SNL by the audit team during the audit should improve the draft documents (and other subsequent SNL documents) before they are finalized and issued.

## 4.4 Examination of Audited Areas

During the audit, the audit team interviewed the writers of the two technical documents listed in Section 4.1 and other SNL personnel involved in the planning for the in situ thermal tests. Objective evidence of the technical work involved in the planning process was also reviewed by the Technical Specialist. The scope of the in situ thermal testing was discussed, as were

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<sup>1</sup> The critical process steps defined by DOE were 1) product based on needs identified in the Site Characterization Plan, 2) process used to start work identified, 3) personnel conducting work trained and qualified, 4) appropriate and effective reviews conducted, 5) QA concerns addressed, 6) Work Agreements controlled, 7) records controlled, 8) planning documents identified, 9) software controlled, 10) interfaces controlled, and 11) QA oversight of work.

report and data submittal schedules. The SNL staff pointed out that the scope of testing has changed from what was originally conceived in the site characterization plan (SCP). The study plan (SP) audited during this audit is being updated to reflect the current approach. The revised SP is expected to be finalized by March 1996. This resulted in the audit team looking at two other draft reports that are currently under preparation (see section 4.4.3 of this audit report).

The technical specialist on the audit team had prepared a checklist of twenty-five questions prior to the audit. The questions covered planning, procedures, instrumentation, analyses methods, peer reviews, and associated documentation for the proposed in situ thermal testing. Some of the questions dealt with thermo-hydrologic issues which are the responsibility of Lawrence Livermore National Laboratory (LLNL) and could not be addressed by the SNL personnel. At the observer-audit team meeting preceding the start of the audit, the NRC staff suggested additional questions to be discussed/examined during the audit. These questions were accepted by the audit team and addressed during the audit. The attachment to this report lists the NRC staff questions and the staff's assessment of the quality and adequacy of responses by SNL. The audit team and the staff judged the SNL responses to be satisfactory.

In addition to the questions developed before the audit, questions were also asked regarding the allocation of resources to the thermal studies in view of the importance of the studies and the limited time available to finalize the test plans. In response to these questions, the SNL management outlined the funding constraints that have resulted in limiting the number of SNL personnel and their involvement in the current studies.

Sections 4.4.1 and 4.4.2 of this report address the audit of the two technical reports listed in Section 4.1. Section 4.4.3 addresses the review of two other SNL documents by the audit team, and Section 4.4.4 addresses the audit of the six QA program elements listed in Section 4.1.

#### **4.4.1 SNL Department 6302 Letter Report, "ESF Thermal Test Design: Analysis Status," SLTR95-0013, September 29, 1995**

This report presents SNL's approach to focus the in situ thermal investigations to be compatible with a narrowed scope consisting of three segments: (1) those characterization activities required to make an "investment decision," (2) those data required for completing a conceptual design of the repository along with a sufficiently detailed waste package design, and (3) other data necessary to show compliance with pre-closure and post-closure design and performance requirements. The first two segments are of immediate concern. The internal SNL report of the preliminary analyses of a single heater test was audited for its technical contents.

The Technical Specialist (civil/geotechnical) was the primary interviewer during this portion of this audit, using the technical checklist (YM-ARP-96-05-01) and NRC staff technical questions while interviewing the writers of the document and other SNL staff members.

Scientific notebooks were not being used to document the analyses. The audit team noted that the notebooks used were loose leaf notebooks (three-ring binders) and judged that this was acceptable. The audit team found the quality of documentation was also acceptable and that the analyses and the associated results could be followed by knowledgeable individuals not involved in the work.

Qualifications of personnel responsible for the reviewing this document were reviewed and found acceptable by the audit team. The audit team also found the review process for this report to be acceptable.

The SNL staff interviewed were receptive to the questions and comments of the audit team and were open and frank in their responses. The NRC staff agrees with the audit team's conclusion that, for this portion of the audit, SNL had implemented an adequate QA program.

#### 4.4.2 SNL draft report, "In Situ Thermomechanical Properties Study Plan 8.3.1.15.1.6," John Pott, Rev. 0, October 30, 1995

This SP describes a set of thermal experiments to be conducted in the ESF along with detailed rationale for conducting the tests. The information to be obtained from the tests described in this SP will be used to (1) determine in situ rock mass thermal, mechanical, and thermo-mechanical properties, (2) evaluate drift stability under thermal loading, (3) evaluate the interaction of ground support in underground openings with surrounding rock mass under thermal loading, and (4) examine the near-field thermal-mechanical-hydrological environment.

The Technical Specialist (civil/geotechnical) was the primary interviewer during this portion of the audit also, again using the technical checklist and NRC staff technical questions while interviewing the writers of the document and other SNL staff members.

Qualifications of personnel responsible for the reviewing this document were reviewed and found acceptable by the audit team.

The SNL staff interviewed were receptive to the questions and comments of the audit team and were open and frank in their responses. The NRC staff agrees with the audit team's conclusion that, for this portion of the audit, SNL had implemented a satisfactory QA program.

#### 4.4.3 Additional SNL Documents

In addition to auditing the two SNL technical documents as planned before the audit and as discussed above, the audit team also reviewed and commented on preliminary drafts of two other SNL technical documents:

- SNL (Brady) letter to M&O (Statton), SNL input for thermo-mechanical aspects for the Thermal Test Design, December 14, 1995

- SLTR96-XXXX, "Operational Plan and Schedule for the First Exploratory Studies Facility Thermal Test at Yucca Mountain," L. S. Costin, Draft dated 2/15/96

The first of these two documents provides the latest thinking on the currently planned two-phase in situ thermal testing program. The two phases are called the shakedown phase and the drift-scale phase. The shakedown phase is a single-element heater test that is intended to provide preliminary data on ground support/rock interaction at elevated temperatures. The drift-scale phase is a plate-source thermal test that is intended to provide the primary information on the near-field thermal environment.

The second of these two documents is a draft of the operations plan and schedule for the two test phases. It provides a detailed schedule of activities and events along with sequencing of events best suited to accomplish the goals.

Although these two documents were outside the scope of the audit, the audit team found them to be helpful in understanding the plans and status of the in situ thermal testing program.

#### 4.4.4 QA Programmatic Elements

The QA portion of the audit checklist (YM-ARP-96-05-01) contained questions regarding the QA programmatic elements listed in Section 4.1. The audit team compiled a list of personnel involved in the areas audited in order to evaluate their training, experience, and qualifications. Both the ATL and the involved Technical Specialist reviewed these attributes for the writers of the reviewed documents and for a sample of other individuals involved in the audited activities. Minor deficiencies were identified. A DR was not developed because 1) SNL QA personnel had previously identified deficiencies in the area of training and 2) SNL issued an internal DR that incorporated the audit team findings prior to the end of the DOE audit.

The auditor audited the other QA programmatic elements relatively independently of the technical specialist. The critical process steps were evaluated as a part of this portion of the audit. These steps are listed in the footnote on page 3, and they were addressed in the QA portion of the audit checklist.

The audit team found a lack of objective evidence of review, comment, and comment resolution for work agreements regarding the in-situ thermal testing. The deficiencies were identified in a DR and a PR. These documents are discussed in Section 4.8 of this report. No other discrepancies regarding the QA programmatic elements were found.

This portion of the audit dealing with the QA programmatic elements was performed in an acceptable manner using the checklist questions prepared prior to the audit. The staff agrees with the preliminary audit team finding of satisfactory compliance with the QA programmatic elements audited except for the activities associated with the review of work agreements that were judged to be marginal.

#### 4.5 Audit Team Qualifications and Independence

The qualifications of the ATL and audit team members were found to be acceptable in that they each met the requirements of QAAP 18.1, "Qualification of Audit Personnel."

Although this was the first YMQAD audit in which the Technical Specialist 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 Technical Specialist posed several questions during the audit indicating that he was familiar with the subject matter and was well prepared for the audit. He made several suggestions that should be reflected in documents that supersede the documents audited.

The audit team members did not have prior responsibility for performing the activities they audited. The Technical Specialist is an M&O employee. While he was familiar with the technical activities audited, he had no prior direct or oversight responsibility for the audited 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.

#### 4.6 Review of Previous Audit Findings

Several audits of SNL were conducted by DOE in 1995 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 Corrective Action Requests.

#### 4.7 NRC Staff Findings

The QA programmatic and technical 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 SNL QA program as applied to planning for the in situ thermal testing at Yucca Mountain.

The initial checklist questions along with the questions suggested by the NRC staff (see the attachment) provided an adequate technical basis to conduct a thorough audit of the SNL ESF in situ thermal testing program. The technical specialist 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 SNL. Based on the discussions, it appeared that the technical people audited were knowledgeable in their respective fields. The method used by the technical specialist to perform the audit was an appropriate combination of technical discussions with the SNL staff and reviews of project files and other reference material requested by the audit team and provided by SNL.

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 auditor and the technical specialist 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 will follow the issue of thermal load selection by DOE and will observe how the preliminary results from the shakedown phase will be input into the conceptual design of the repository and into the waste package design. The NRC staff will also follow the construction and layout of the thermal test alcove and will provide timely feedback on resolving issues related to test-to-test and construction-to-test interference.

The NRC staff agrees with the preliminary YMQAD audit team findings of satisfactory compliance with the SNL QA program except for the activities associated with the review of work agreements that was judged to be marginal.

#### 4.8 Summary of YMQAD Audit Findings

The application of QA controls was determined to be satisfactory except for the activities associated with the review of work agreements that was judged to be marginal.

At the post-audit meeting the audit team presented the preliminary DR and PR listed below.

##### 4.8.1 DR

One preliminary DR was initiated by the audit team. DRs are used to report nonsignificant deficiencies. The preliminary DR related to the lack of objective evidence of acceptable review and comment resolution of work agreements.

##### 4.8.2 PR

One preliminary Performance Report (PR) was initiated by the audit team. PRs are used to report isolated conditions that require only remedial actions or minor improvements to meet requirements. The preliminary DR also related to the lack of objective evidence of acceptable review and comment resolution of work agreements. The PR was written because the customer of a work agreement had signed it, indicating approval and that all comments had been resolved, prior to the time that the technical reviewer/quality assurance reviewer had signed it to document the review and resolution of comments.

### NRC TECHNICAL STAFF QUESTIONS

- (1) What specific analyses were conducted to study and document the test-to-test and construction-to-test interference?
- (2) How were the test locations selected and what were some of the selection criteria?
- (3) What is the status of verification and validation of the computer programs being used in the thermal studies?
- (4) What are some of the lessons learned from the G-Tunnel and such other thermal tests from other programs and how are they being factored into the current program?
- (5) What performance confirmation considerations are being given to the current suite of ESF thermal testing?
- (6) How are all the technical issues from the Site Characterization Plan being traced while going from the originally scheduled eight tests in the SCP, to the three in the program approach, and currently to a single test (with two phases)?
- (7) How do the various team members (SNL, LLNL, Lawrence Berkeley Laboratory, Los Alamos National Laboratory, and the M&O), physically located in different geographic locations, interface and how are the technical activities coordinated?
- (8) How are the numerous past conclusions drawn and recommendations made by various studies and investigations factored into the current program?

### RESPONSE ASSESSMENT

The NRC technical observer and the technical specialist on the audit team were satisfied with SNL responses to these questions. SNL personnel were able to explain verbally (and, when appropriate, provide objective evidence to substantiate) the SNL views and positions.