

**U.S. DEPARTMENT OF ENERGY  
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT  
OFFICE OF QUALITY ASSURANCE**

**AUDIT REPORT**

**OF**

**SANDIA NATIONAL LABORATORIES**

**LAS VEGAS, NEVADA AND ALBUQUERQUE, NEW MEXICO**

**AUDIT NUMBER YM-ARP-95-03  
NOVEMBER 14 THROUGH 30, 1994**

Prepared by:

*Richard L. Weeks*

Date: 2/3/95

**Richard L. Weeks  
Audit Team Leader  
Yucca Mountain Quality  
Assurance Division**

Approved by:

*Donald G. Horton*

Date: 2/7/95

**Donald G. Horton  
Director  
Office of Quality Assurance**

## **1.0 EXECUTIVE SUMMARY**

The performance-based audit YM-ARP-95-03 was conducted to evaluate the technical adequacy and the effectiveness of Sandia National Laboratories (SNL) controls for the generation and issuance of Sandia Letter Report (SLTR)94-0001, "Geoengineering Characterization of Nonlithified Tuffs to be Encountered by the North Ramp West of the Bow Ridge Fault." The results of the audit indicate that implementation of specific portions of the SNL Quality Assurance (QA) program used to control the generation of SLTR94-0001 were marginally effective based on the combined impact of the conditions adverse to quality identified in Corrective Action Requests (CAR) YM-95-014 through YM-95-019.

The performance based evaluation of process effectiveness and product acceptability was based on 1) proper implementation of the procedure's critical process steps; 2) use of trained and qualified personnel working effectively; 3) documentation that substantiated the quality of procured items and services; and 4) acceptable results and the quality of the end product.

The audit team identified six deficiencies during the audit that resulted in the issuance of six CARs. CAR YM-95-014, Work Agreement did not adequately define scope of work. CAR YM-95-015 identified the fact that a technical review did not identify inaccuracies in SLTR94-0001. CAR YM-95-016 addressed inaccuracies in the examined Scientific Notebook (SN). CAR YM-95-017 addressed inconsistencies between the procedure used for load bearing capacity test and the pertinent American Society for Testing and Materials (ASTM) standard. CAR YM-95-018 addressed acquired data sets not having Technical Data Information Form (TDIF) assigned to them. CAR YM-95-019 addressed qualified and unqualified data being mixed under the same TDIF. There were two deficiencies identified by the audit team and corrected prior to the postaudit meeting. These conditions are described in Section 5.5.2 of this report. Additionally, there were eight recommendations, resulting from the audit, which are detailed in Section 6.0 of this report.

## **2.0 SCOPE**

The audit was conducted to evaluate the technical adequacy and the effectiveness of SNL controls for the generation and issuance of SLTR94-0001, "Geoengineering Characterization of Nonlithified Tuffs to be Encountered by the North Ramp West of the Bow Ridge Fault" which supports study objectives defined in Study Plan 8.3.1.14.2, Revision 0, "Studies to Provide Soil and Rock Properties of Potential Locations of Surface and Subsurface Access Facilities," Sections 2.3.1.3 and 2.3.2.3.

The processes/activities/end products evaluated during the audit, in accordance with the approved audit plan, are as follows:

## PROCESS/ACTIVITY/OR END-PRODUCT

1. Generation and issuance of SLTR94-0001, "Geoengineering Characterization of Nonlithified Tuffs to be Encountered by the North Ramp West of the Bow Ridge Fault."
2. Technical review of SLTR94-0001 and SN, "Characterization of Nonlithified Tuffs, Rainier Mesa and Pre-Rainier Mesa on the West Side of Exile Hill."
3. Controls related to data identification to provide traceability, indicate useability and input of data to the project data management system.
4. Surveillances, Certification and Qualification of Personnel, Control of Contracted Services, Implementing Documents, Document Control, Identification and Control of Items (Samples), Measuring and Test Equipment, Corrective Action and QA records related to the generation and issuance of SLTR94-0001.

## TECHNICAL AREAS

Work Breakdown Structure (WBS) 1.2.3.2.6.2.1 - Surface Facilities Exploration Program

The accuracy, completeness and appropriateness of technical inputs to SLTR94-0001 and the scientific notebook utilized for this study were evaluated.

### 3.0 AUDIT TEAM AND OBSERVERS

The following is a list of audit team members and their assigned areas of responsibility:

<u>Name/Title/Organization</u>	<u>OA Program Elements/Requirements, Processes, Activities or End-products</u>
Richard L. Weeks/Audit Team Leader (ATL)/ Yucca Mountain Quality Assurance Division (YMQAD)	Records related to interface between SNL and M&O, Identification and Control of Samples
Patout H. Cotter/Auditor/YMQAD	Certification and Qualification of Personnel, Control of Contracted Services, Activities Prescribed by Implementing Documents, and Surveillances

John R. Matras/Auditor/YMQAD

Software and controls related to technical data used by and generated from SLTR94-0001.

William R. Sublette/Technical Specialist/  
YMQAD

Technical issues related to SLTR94-0001

#### 4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

The audit was conducted in two sessions: at the Las Vegas offices from November 14 through 18, 1994, and Albuquerque, New Mexico offices from November 28 through 30, 1994. The preaudit meeting was held at the SNL office, in the Bank of America Center in Las Vegas, Nevada, November 14, 1994. Debriefing and coordination meetings were held with SNL management and staff as needed and audit team meetings were held to discuss issues and potential deficiencies throughout the audit. A second preaudit meeting was held at the SNL offices in Albuquerque, New Mexico, November 28, 1994 and included a summary of the results of audit activities conducted at the Las Vegas office. The audit was concluded with a postaudit meeting held at the SNL office in Albuquerque, New Mexico, on November 30, 1994. Personnel contacted during the audit are listed in Attachment 1. The list includes those who attended the preaudit and postaudit meetings.

#### 5.0 SUMMARY OF AUDIT RESULTS

##### 5.1 Program Effectiveness

The audit team concluded that the SNL process controls implemented for the technical activity evaluated during this audit were marginally effective. This conclusion is based on the fact that although no significant CARs were issued, the cumulative effect of the individual CARs indicated QA controls were marginally effective resulting in specific portions of the SLTR being of indeterminate quality.

NOTE: The U. S. Department of Energy recognizes that the preliminary conclusion discussed during the Postaudit conference indicated that implementation was satisfactory. Upon further review after issuance of the CARs, the audit team decided that the overall evaluation needed to be changed to "marginally effective."

##### 5.2 Stop Work or Immediate Corrective Actions Taken

There were no Stop Work Orders, immediate corrective actions or related additional items resulting from this audit.

**5.3 QA Program Audit Activities**

A summary table of audit results is provided in Attachment 2. The details of the audit evaluation, along with the objective evidence reviewed, are contained within the audit checklists. The checklists are kept and maintained as QA Records.

**5.4 Technical Audit Activities**

SLTR94-0001, "Geoengineering Characterization of Nonlithified Tuffs to be Encountered by North Ramp West of the Bow Ridge Fault," was evaluated to determine compliance to selected programmatic requirements and for technical content.

**5.5 Summary of Deficiencies**

The audit team identified six deficiencies during the audit for which six CARs have been issued. Two additional deficiencies were identified and corrected prior to the postaudit meeting.

Synopses of deficiencies documented as CARs and those corrected during the audit are detailed below. The CARs were sent to SNL under separate letter (Spence to Shephard, 12/16/94).

**5.5.1 Corrective Action Requests**

**CAR YM-95-014**

The SNL Work Agreement (WA) to conduct testing activities did not adequately define the scope of work, nor was the WA revised to incorporate important tests needed to meet the stated objectives; specifically, tests to determine bearing capacity and stand-up time under saturated conditions, and grouting tests.

**CAR YM-95-015**

Values for displacement, pressure, and modulus, presented in SLTR94-0001 were inconsistent with the recalculated checking analysis values presented in the SN and Standard Penetration Test blow count data was not corrected for overburden pressures.

CAR YM-95-016

Traceability for deformation modulus and cohesion values provided in SLTR94-0001 could not be verified because either original calculations were missing, or no calculations were included in the SN.

CAR YM-95-017

The procedure used to perform in-situ plate load bearing capacity test was not consistent with referenced ASTM procedures in the SN and the most appropriate ASTM standard was not utilized.

CAR YM-95-018

Acquired data sets included in SLTR94-0001 did not have a TDIF assigned to them.

CAR YM-95-019

Qualified and unqualified data were mixed under TDIF #303453.

**5.5.2 Deficiencies Corrected During the Audit**

Deficiencies which are considered isolated in nature and only requiring remedial action can be corrected during the audit. The following deficiencies were identified and corrected during the audit:

1. Contrary to the requirements on Exhibit YAP-SIII.3Q, Revision 1 for completing a TDIF, the comments section of TDIF 303453 stated that DTN:SNF29041993002.002 was used as "collaborative data" and was not used as source data while Part III A of the TDIF identified DTN:SNF29041993002.002 as source data. This was corrected by removing DTN:SNF29041993002.002 as source data from Part III A of TDIF 303453.
2. Contrary to the requirements on Exhibit YAP-SIII.3Q, Revision 1 for completing a TDIF, STLR94-0001 identified SNF29041993002.025 as source data for the report, but the TDIF for this report (TDIF 303453) did not identify SNF29041993002.025 as source data in Part III A. The Principal Investigator (PI) confirmed SNF29041993002.025 was a source so the TDIF was changed to reflect this.

### 5.5.3 Follow-up of Previously Identified CARS

Verification of completion of corrective action to CARS YM-94-097 and YM-94-098 was not completed. CARS YM-94-097 and YM-94-098 address the same quality records, however, YM-94-097 identifies violations of procurement requirements while YM-94-098 identifies Measuring and Test Equipment (M&TE) requirement violations. Calibration records generated by MTL Systems Corporation for the equipment identified in the CARS was examined and found to be incomplete; specifically, procedure identification and revision was not provided. Other identified deficiencies, quantitative statement of accuracy and precision of the device, indications that instrument was within tolerance and corrections to record were found to be acceptable. Based on this, an extension request to December 16, 1994 was submitted by SNL prior to the conclusion of the audit.

## 6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for consideration by the SNL management.

1. A project level procedure should be generated to establish minimum requirements regarding the interface of work between Affected Organizations; currently, an interface process between affected organizations is not proceduralized. The following two examples illustrate the need for this procedure:
  - a. An evaluation of the process steps that resulted in the generation of SLTR94-0001 did not produce objective evidence of a direct interface between the M&O and SNL but rather, various correspondence documenting meetings was generated by Los Alamos National Laboratory and provided by SNL to the audit team.
  - b. There is no clear definition of SNL's interface with Raytheon Services Nevada (RSN) for work done at the Material Test Laboratory (MTL). An SNL CAR was issued and later voided and replaced by a Yucca Mountain Site Characterization Office (YMSCO) Nonconformance Report (NCR) in order to obtain resolution of a deficient condition related to sample testing.
2. A follow-up surveillance should be conducted of the M&O design organization to determine how data generated from SLTR94-0001 was utilized as design input and to evaluate the interface controls followed by the M&O and SNL. Additionally, this surveillance should track specific data to insure that a distinction is made between qualified and unqualified data when used for design input.
3. Guidelines should be established in the documentation of the use of unqualified and corroborating data in data reports. Data was used as corroborating data in support of the qualified data set developed in SLTR94-0001. The corroborating

data was not used to derive the qualified data set, only to confirm the results derived in the report. The quality control checks performed by the Automated Technical Data Tracking (ATDT) Administrator do not allow for the referencing of non-qualified data as source information. It is not clear how corroborating data should be referenced.

4. SNL should clarify in Quality Assurance Implementation Procedure (QAIP) 6-2, Revision 03, "Preparing, Reviewing, Approving, and Issuing Technical Information Documents" which report format, Sandia Report (SAND) or a SLTR, is appropriate for transferring design inputs to other participants. The SLTR goes through a very simple review process so that information can be passed on quickly. Reviews required during the SAND review are not required during the SLTR review. An example is that the SLTR requires one independent technical review while the SAND report requires two independent technical reviews in addition to editorial, reference and QA reviews.
5. Procedure QAIP 7-1, "Procurement Acceptance Verification," should be revised to clarify that acceptance of contractors work can be documented by the use of Letter Report Review Sheets for those cases when the product is in the form of a Letter Report.
6. Procedure QAIP 10-1, "Surveillances," should be revised to require the identification of documents reviewed and activities observed. This could be added as a bullet in Step 2 below the bullet "Name(s) of personnel contacted and their organization." Also, the use of technical personnel should be mandatory when surveillances are performed of scientific investigation activities.
7. Procedure QAIP 1.5 should be revised to require that WAs scope be revised to reflect changes resulting from meetings at which study objectives and technical criteria are established or changed.
8. The determination of the cohesion intercept described on Page 5-19, paragraph 2, and Page A-2, Section A.1.3 of SLTR94-0001 should be reconsidered. Equation A13 shows that  $C = \mu_s \tan \phi$ . Since this is a partially saturated cohesionless soil,  $\phi$  should be the angle of friction relative to matric suction ( $\phi^b$ ). In this instance the author assumed  $\phi$  to be equal to the effective angle of friction ( $\phi'$ ) instead of  $\phi^b$ . Generally  $\phi^b$  is noticeably less than  $\phi'$ . Examples of this can be seen on Table 9.1 of Page 229 in "Soil Mechanics for Unsaturated Soils" by Fredlund and Rahardjo.

## 7.0 LIST OF ATTACHMENTS

- Attachment 1: Personnel Contacted During the Audit
- Attachment 2: Summary Table of Audit Results

**ATTACHMENT 1**

**Personnel Contacted During the Audit**

<u>Name</u>	<u>Organization/Title</u>	<u>Preaudit Meeting</u>		<u>Contacted During Audit</u>	<u>Postaudit Meeting</u>
		<u>LV</u>	<u>ABQ</u>		
Brechtel, C.	SNL-Agapito/Support	X		X	
Doyle, J.	YMQAD/			X	
Ericson, J.	REECO/Cal Lab Supervisor			X	
Friend, J.	SNL/Mactec/QA Specialist	X	X	X	X
Garcia, N.	SNL/Lead Record Technician			X	
Gerstner-Miller, G.	SNL/Record Clerk			X	
James, E.	SNL/Geo-Centers/Records Technician		X		X
Jaramillo, C.	SNL-Technadyne/QA Coordinator		X		
Kessel, D.	SNL/Principal Investigator	X	X	X	X
Richards, R.	SNL/QA Manager		X	X	X
Riggins, M.	SNL/Principal Investigator	X		X	X
Shephard, L.	SNL/Technical Project Officer		X		
Spencer, R.	M&O/SAIC/Geotech III			X	
Voigt, J.	SNL/Mactec/QAE		X		

**LEGEND:**

Mactec ..... Mac Technical Services Company  
 REECO ..... Reynolds Electrical and Engineering Company, Inc.  
 QAE ..... Quality Assurance Engineer

**ATTACHMENT 2**  
**Summary Table of Audit Results**

<b>AUDIT YM-ARP-95-03 DETAIL SUMMARY</b>								
<b>QA ELEMENT/ACTIVITIES</b>	<b>PROCESS STEPS</b>	<b>DETAILS (Checklist)</b>	<b>CAR</b>	<b>CDA</b>	<b>RECOM-MENDATION</b>	<b>ADE-QUACY</b>	<b>COM-PLIANCE</b>	<b>OVER-ALL</b>
Interfaces Between Affected Organizations Described	Input from M&O	Items 1, 2, 4, & 5	N	N	6.0, 1	N/A	N/A	N/A
	Establish Field Tests	Item 3	N	N	N	N/A	SAT	EFF
	Establish Lab Tests	Item 3	N	N	N	N/A	SAT	
	Input to TPP	Item 6	N	N	N	N/A	SAT	
	Input to JP	Item 6	N	N	N	N/A	SAT	
	Test Results Incorporated into Design	Item 19	N	N	N	N/A	N/A	N/A
Personnel Selection, Indoctrination Training, and Qualification	Personnel Qualified Prior to Starting Work	Item 14	N	N	N	N/A	SAT	EFF
	Verified Personnel Qualifications	Item 14	N	N	N	N/A	SAT	

**ATTACHMENT 2**  
Summary Table of Audit Results

<b>QA ELEMENT/ ACTIVITIES</b>	<b>PROCESS STEPS</b>	<b>DETAILS (Checklist)</b>	<b>CAR</b>	<b>CDA</b>	<b>RECOM- MENDATION</b>	<b>ADE- QUACY</b>	<b>COM- PLIANCE</b>	<b>OVER- ALL</b>
Surveillance and Audit Related to the Activities that Resulted in Generation and Issuance of SLTR94-0001	Activity was Surveilled	Item 12	N	N	6.0, 6	N/A	SAT	EFF
	Evaluated Compliance to Requirements	Item 12	N	N	N	N/A	SAT	
	Monitored Drilling Activities	Item 17	N	N	N	N/A	SAT	
Control of Contracted Services	Contract Issued and Approved	Item 11	N	N	N	N/A	SAT	EFF
	Contact Monitored for Compliance	Item 11	N	N	N	N/A	SAT	
	Product Accepted	Item 11	N	N	6.0, 5	N/A	SAT	
Work Done in Accordance with Implementing Approved Documents	WA Generated and Approved	Item 15 & 8	YM-95-014	N	6.0, 7	N/A	MARGINAL	EFF
	SN Utilized	Item 15	N	N	N	N/A	SAT	
	TP Utilized	Item 15	N	N	N	N/A	SAT	

**ATTACHMENT 2**  
Summary Table of Audit Results

<b>QA ELEMENT/ACTIVITIES</b>	<b>PROCESS STEPS</b>	<b>DETAILS (Checklist)</b>	<b>CAR</b>	<b>CDA</b>	<b>RECOM-MENDATION</b>	<b>ADE-QUACY</b>	<b>COM-PLIANCE</b>	<b>OVER-ALL</b>
	ASTM Procedures Utilized	Item 15	YM-95-017	N	N	N/A	UNSAT	
Generated Documents were Reviewed	SLTR was Formally Reviewed	Item 16	YM-95-015, 016, 017	N	N	UNSAT	UNSAT	MAR-GINAL
	Review Documents were Completed	Item 16	N	N	N	N/A	SAT	
	Technical Reviews	Item 23	YM-95-015, 016, 017	N	N	N/A	MARGINAL	
Core Samples Controlled	Samples Requested	Item 9	N	N	N	N/A	SAT	EFF
	Request Approved	Item 9	N	N	N	N/A	SAT	
	Special Packaging	Item 9	N	N	N	N/A	SAT	
	Samples Transferred	Item 9	N	N	N	N/A	SAT	

**ATTACHMENT 2**  
Summary Table of Audit Results

<b>QA ELEMENT/ACTIVITIES</b>	<b>PROCESS STEPS</b>	<b>DETAILS (Checklist)</b>	<b>CAR</b>	<b>CDA</b>	<b>RECOM-MENDATION</b>	<b>ADE-QUACY</b>	<b>COM-PLIANCE</b>	<b>OVER-ALL</b>
	Sample Documents to SMF	Item 10	N	N	N	N/A	SAT	
Controls of M&TE	Instrument included in M&TE program	Item 13	N	N	N	N/A	SAT	EFF
	Instrument Calibrated	Item 13	N	N	N	N/A	SAT	
Corrective Actions related to Activities that Resulted in the Generation and Issuance of SLTR94-0001	Problems Identified as Deficiencies	Item 7	N	N	6.0, 1	N/A	SAT	EFF
	NCR's Generated	Item 7	N	N	N	N/A	SAT	
Records have been Reviewed and Submitted	Review Record Packages	Item 18	N	N	N	N/A	SAT	EFF
Control of Software	SES Software	Item 29 & 34	N	N	N	N/A	N/A	N/A

**ATTACHMENT 2**  
Summary Table of Audit Results

QA ELEMENT/ACTIVITIES	PROCESS STEPS	DETAILS (Checklist)	CAR	CDA	RECOM-MENDATION	ADE-QUACY	COM-PLIANCE	OVER-ALL (
Control of Data	Opening a PDA Data Set	Item 24	YM-95-018 & 019	N	N	N/A	UNSAT	EFF
	WA and Data Identification	Item 20	N	N	N	N/A	SAT	
	Analysis Documentation	Item 21	YM-95-014	N	6.0, 7	N/A	UNSAT	
	Technical Reviews Performed	Item 22	N	N	N	N/A	SAT	
	Data Status Identified in the TDIF	Item 25a	YM-95-019	N	N	N/A	UNSAT	
	Data Transfer	Item 25b & 25c	N	N	6.0, 4	N/A	SAT	
	Updating a PDA Data Set	Item 25	N	5.5.2, 1 and 2	6.0, 1	N/A	SAT	
	TDIFs	Items 26 and 28	YM-95-019	5.5.2, 1 and 2	6.0, 2, & 3	N/A	SAT	

**ATTACHMENT 2**  
Summary Table of Audit Results

<b>QA ELEMENT/ACTIVITIES</b>	<b>PROCESS STEPS</b>	<b>DETAILS (Checklist)</b>	<b>CAR</b>	<b>CDA</b>	<b>RECOM-MENDATION</b>	<b>ADE-QUACY</b>	<b>COM-PLIANCE</b>	<b>OVER-ALL</b>
	Use of Qualified and Unqualified Data	Items 25a and 26	YM-95-019	5.5.2, 1 and 2	6.0, 2, 3, & 4	N/A	SAT	EFF
	Submittal of Data to TDB	Item 27	N	N	N	N/A	N/A	
	TDIFs Quality Control Checks	Item 28	N	N	6.0, 3	N/A	SAT	
Scientific Investigation	Adequacy of WA	Item T1	YM-95-014	N	N	MAR-GINAL	SAT	EFF
	Request of Data from A/E Designers	Items T2 and T3	N	N	6.0, 2	N/A	N/A	
	SLTR meets Data Requirements of A/E	Item T4	N	N	6.0, 2	N/A	N/A	
	Data Provided to A/E in Timely Manner	Item T5	N	N	6.0, 2	N/A	N/A	
	Status of Data Adequately Identified	Item T6	N	N	N	SAT	SAT	

**ATTACHMENT 2**  
**Summary Table of Audit Results**

<b>QA ELEMENT/ACTIVITIES</b>	<b>PROCESS STEPS</b>	<b>DETAILS (Checklist)</b>	<b>CAR</b>	<b>CDA</b>	<b>RECOM-MENDATION</b>	<b>ADE-QUACY</b>	<b>COM-PLIANCE</b>	<b>OVER-ALL</b>
	Process Adequately Documented and Accurate	Item T7	YM-95-015, 016 & 017	N	6.0, 8	MAR-GINAL	MARGINAL	
	Sample Population Adequate	Item T8	N	N	N	SAT	SAT	
<b>TOTAL</b>								<b>MARG-INAL</b>

**LEGEND:**

- A/E Architect/Engineer
- TPP Test Planning Package
- JP Job Package
- TBD To Be Determined
- TDB Technical Data Base
- TP Technical Procedure
- PDA Participant Data Archive
- SMF Sample Management Facility
- SES Scientific Engineering Software