

U.S. NUCLEAR REGULATORY COMMISSION  
OBSERVATION AUDIT REPORT 95-10  
OF THE  
U.S. DOE OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT  
AUDIT YM-ARP-95-19  
OF  
SANDIA NATIONAL LABORATORIES  
AND THE  
CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM  
MANAGEMENT AND OPERATING CONTRACTOR  
DESIGN SUPPORT ANALYSES

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ENCLOSURE

## **1.0 INTRODUCTION**

From August 21-25, 1995, the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), conducted a quality assurance (QA) audit of the Sandia National Laboratories (SNL) and the Civilian Radioactive Waste Management System Management and Operating Contractor (M&O). The audit, YM-ARP-95-19, was conducted on August 21-23, 1995, at SNL in Albuquerque, New Mexico, and on August 24-25, 1995, at the M&O offices in Las Vegas, Nevada. The performance-based audit evaluated the quality and effectiveness of various processes associated with the development of the SNL report, "Design Support Analyses: North Ramp Design Package 2C, Rev. 1." (The report is identified as Technical Data Information Form #303124.) The audit also examined the M&O utilization of the report as design input for the Exploratory Studies Facility (ESF) North Ramp. A State of Nevada representative participated as an observer.

This report addresses the effectiveness of the audit and the adequacy of implementation of the SNL and M&O QA programs.

## **2.0 OBJECTIVES**

The objectives of the audit team were to evaluate the quality of SNL report "Design Support Analyses: North Ramp Design Package 2C, Rev. 1," and to determine whether the report was developed in accordance with the SNL QA program. In addition, the audit team examined the flowdown of design inputs from the report into the M&O ESF North Ramp Design.

The NRC staff objective was to gain confidence that DOE, SNL, and the M&O are effectively implementing the requirements of their QA programs in accordance with the Quality Assurance Requirements and Description document (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).

## **3.0 MANAGEMENT SUMMARY AND CONCLUSIONS**

The audit was well organized and conducted in a thorough and professional manner. Audit team members were independent of the activities they audited. The audit team was well qualified in the QA discipline, the technical specialist was qualified, and the audit team assignments and checklist items were adequately described in the audit plan.

The audit team evaluated several activities at SNL. The following activities were determined to be adequate; design support analyses submittal, training of personnel, and qualification of personnel. The design support analyses review was found to be marginally effective. The design support analyses and implementation of work agreements were evaluated as technically adequate but programmatically marginal. At the M&O, the activities associated with design verification, specifications, technical documents, drawings, training, "to be verified" (TBV) designations, and "to be determined" (TBD) designations were evaluated as adequate. The activity identified as "provide technical direction" was evaluated as marginal. The review of the design control process was evaluated as marginal. The design analyses activity was evaluated as indeterminate. Five preliminary deficiency reports (DRs) were drafted at

the conclusion of the audit and discussed in the post-audit meeting. One of the DRs has subsequently been incorporated into a pre-existing corrective action report.

Several weaknesses in the audit process were noted and are presented as a means to improve future audit activities. These weaknesses concerned the lack of evaluating the complete process including Rev. 0 of the subject report, auditing procedures and products that have been replaced or superseded, inability to obtain some personnel qualifications records, and conclusions based on limited evaluation of the SNL and M&O QA programs as currently in place.

The SNL and M&O QA programs should continue to be monitored by DOE to ensure that the deficiencies identified during this audit and previous audits are corrected in a timely manner and 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 or verifications at a later date to assess implementation of the SNL and M&O QA programs.

#### **4.0 AUDIT PARTICIPANTS**

##### **4.1 NRC**

John T. Buckley	Observer	
Donald W. Dunavant	Observer	Center for Nuclear Waste Regulatory Analyses (CNWRA)
Sui-Min (Simon) Hsiung	Observer	CNWRA

##### **4.2 DOE**

Richard Weeks	Audit Team Leader (ATL)	Yucca Mountain QA Division (YMQAD)/QA Technical Support Services (QATSS)
John Pelletier	Auditor	YMQAD/QATSS
Frank Tsai	Technical Specialist	M&O/Woodward Clyde

##### **4.3 Other Observers**

Susan Zimmerman	Observer	State of Nevada
Charles Warren	Observer	YMQAD/QATSS

#### **5.0 REVIEW OF THE AUDIT AND AUDITED ORGANIZATION**

This audit was conducted in accordance with OCRWM Quality Assurance Procedure (QAP) 18.2, "Audit Program;" Administrative Procedure (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.

## **5.1 Scope of the Audit and Observations**

### **5.1.1 QA Programmatic Elements**

Audit YM-ARP-95-19 evaluated the effectiveness of selected processes associated with SNL and M&O activities performed under the QA program. The QA programmatic elements evaluated focused on QARD Criterion 2, "QA Program," and Supplement 3, "Scientific Investigation." The activities evaluated during the audit were:

#### **SNL Activities**

- Design support analyses submittal
- Training of personnel
- Implementation of work agreements

#### **M&O Activities**

- Technical documents
- Training
- TBV and TBD designations

### **5.1.2 Technical Areas**

The technical areas evaluated during the audit were those associated with the generation of SNL report, "Design Support Analyses: North Ramp Design Package 2C, Rev. 1" and the utilization of that analysis by the M&O as design input for the ESF North Ramp. These included:

#### **SNL Activities**

- Design support analyses
- Design support analyses review
- Qualifications of personnel

#### **M&O Activities**

- Design analyses
- Designs verified
- Specifications
- Design control process
- Provide technical direction
- Drawings

## **5.2 Timing of the Audit**

The NRC staff feels that the effectiveness of the audit of SNL would have been enhanced had the audit taken place prior to completion of "Design Support Analyses: North Ramp Design Package 2C, Rev. 1." A number of procedures reviewed during the audit process have been replaced or revised. The report will be superseded by newer information and will no longer be referenced in design documents.

### 5.3 Examination of Programmatic Elements

#### 5.3.1 General Observations

The audit team conducted the audit verifying both programmatic and technical performance simultaneously. The audit team, composed of the auditors and technical specialist, worked together effectively using accepted audit practices.

Throughout the audit, auditors utilized appropriate checklists when interviewing SNL and M&O personnel and reviewing objective evidence. Potential DRs or concerns were discussed at the audit team caucus each afternoon. The auditors documented objective evidence reviewed and listed the personnel interviewed.

The auditors went beyond checklist questions when necessary to assure complete understanding of the QA program and technical elements and processes.

The audit team expressed a number of technical concerns during the audit. These are discussed in the following section. Programmatic issues were also raised. In attempting to determine if the product delivered by SNL satisfied the stated requirements imposed by the M&O, the audit team established that there was no documented process for requesting and specifying work to be performed. This deficiency was documented in draft DR 01, issued to SNL for lack of a documented process for performance of the analyses and in draft DR 02, issued to the M&O for lack of a documented process to initiate and control such work. In reviewing the method used to control the technical document generated, the audit team determined that data contained in "Design Support Analyses: North Ramp Design Package 2C, Rev. 1" were retrieved by the M&O from the Technical Data Base (TDB) without complying with the requirements of Yucca Mountain Administrative Procedure (YAP)-SIII.2Q, Rev. 0, "Technical Information Flow To and From the Yucca Mountain Site Characterization Project Technical Data Base," which requires generation of a written request. This finding was documented on draft DR 03. It was also determined that the technical data which were provided to the M&O by SNL was not stamped "Preliminary - Information Only" as required by YAP-SIII.3Q, Rev. 0, "Control and Transfer of Technical Data on the Yucca Mountain Site Characterization Project." This was documented in draft DR 04. There was also no documentation that the data from the subject report received an adequate technical review prior to use for design input. This was addressed in draft DR 05.

#### 5.3.2 Specific Audit Team Observations

The audit team expressed concerns regarding the interpretation of several results presented in the "Design Support Analyses: North Ramp Design Package 2C (Rev. 1)." For example, the audit team indicated that the tensile failure assessment presented in Chapter 6 (Two-Dimensional Dynamic Analyses) appeared to be questionable and inadequate. The assessment was intended to determine if tensile failure zones exist surrounding a tunnel in the Topopah Springs-welded (TSw2) thermal-mechanical unit under combined *in situ*, seismic, and thermal loads. No analyses for tensile failure were performed for other

thermal-mechanical units. The approach taken, according to SNL personnel, was to examine only the combination of the maximum principal stresses of the three loading conditions at a location with the largest seismically-induced maximum tensile stress. Based on this assessment, it was concluded in the report that no tensile stress is experienced around the tunnel. The audit team considered that this localized evaluation may not be representative, since there may be locations or areas where the maximum stresses are tension for all three loading conditions while the seismically-induced maximum tensile stress at the location is not the largest.

Three computer codes were used in the "Design Support Analyses: North Ramp Design Package 2C (Rev. 1)." These were STRES3D, JAC2D, and PRONTO2D. The auditors reviewed the verification/validation QA records and the software use forms for these computer codes and no deficiency was noted. A nonlinear jointed rock model (compliant joint model) in JAC2D was used in the analyses (reported in Chapter 5.4, "Nonlinear Continuum Jointed Rock Model Analyses") to obtain insights to potential failure zones considering the possible effect of rock joints. Analysis on one cross section of each thermal-mechanical unit was conducted under combined loading conditions. Three of the four analyses did not reach a converged solution. Only the JAC2D analysis for the cross section of the Tiva Canyon-welded (TCw) unit yielded results. The lack of convergence was attributed by SNL personnel to the fact that, at the time these analyses were performed, the jointed rock model was not able to simulate joint dilation behavior, one of the important physical phenomena for joint deformation. As a result, unrealistically pervasive joint slipping around the opening was realized which might have caused a numerical instability that prevented an analysis from converging. Consequently, a more realistic insight into actual rock behavior could not be obtained using the jointed rock model in JAC2D. This shortcoming was acknowledged in the report. Nevertheless, the subject report concluded in Chapter 8, "Summary and Conclusions," that the Paintbrush Tuff (PTn), TSw1, and TSw2 units "may experience pervasive joint slippage when subjected to the appropriate load combinations." The audit team considered this conclusion to be unfounded. Another important issue is the potentially inadequate evaluation regarding the appropriateness and suitability of JAC2D for conducting the nonlinear analyses presented in this report. Given the fact that the jointed rock model in JAC2D does not have the capability for simulating joint dilation, the audit team questioned its usage.

The data input used in "Design Support Analyses: North Ramp Design Package 2C (Rev. 1)" was derived from cores of the NRG-6 borehole using an approach that requires statistical treatments for determination of rock mass property parameters. Given the limited number of data available from only one borehole, the audit team concluded that the applicability of the approach is questionable.

The audit team found that the M&O used the preliminary data from "Design Support Analyses: North Ramp Design Package 2C (Rev. 1)" to perform the TS North Ramp Scoping Analysis without sufficient review of the accuracy of the data. The preliminary data contained errors in the calculation of the modified Q values for the PTn thermal-mechanical unit. These errors were corrected in the final SNL report that was transmitted to the M&O on April 1,

1994. However, the correction was not pointed out to the M&O by SNL nor identified by the M&O itself. Consequently, this correction was not reflected in the TS North Ramp Scoping Analysis Report (Rev. 1) issued by the M&O in September, 1994.

#### 5.4 Qualifications of Audit Personnel

The qualifications of the ATL and auditors were found to be acceptable, each individual having met the requirements of QAP 18.1 Rev. 4, "Qualification of Audit Personnel." The technical specialist is qualified in accordance with Paragraph 6.3 of QAP 18.2 Rev. 6, "Audit Program."

#### 5.5 Audit Team Independence

The audit team was composed of QATSS personnel who support DOE and who were familiar with the M&O procedures under evaluation. The audit team members were assigned to areas where they did not have prior responsibility or involvement. The audit team members had sufficient independence to carry out their assigned functions without adverse pressure and influence. The technical specialist was from the Performance Assessment Section of the M&O-Woodward Clyde and had no prior involvement in the product evaluated.

#### 5.6 Summary of NRC Staff Findings

The NRC staff agrees with the following preliminary audit team findings:

##### SNL Activities

- Design Support Analyses Submittal — Effective
- Training of Personnel — Adequate
- Implementation of Work Agreements — Programmatically marginal, technically adequate; Reference DR 01
- Design Support Analyses — Marginally effective, technically adequate; Reference DR 04
- Design Support Analyses Review — Marginally effective
- Qualifications of Personnel — Adequate

##### M&O Activities

- Technical Documents — Adequate
- Training — Adequate
- TBV & TBD Designations — Adequate
- Design Analyses — Not evaluated
- Designs Verified — Adequate
- Specifications — Adequate
- Design Control Process — Review was marginal; Reference DR 05
- Provide Technical Direction — Marginal; Reference DRs 02 and 03
- Drawings — Adequate

The NRC staff concludes that the audit team was thorough in its conduct of this audit. The audit team reviewed a sufficient amount of documentation and interviewed the appropriate SNL and M&O personnel to make valid judgements on the adequacy of the SNL report and the SNL and M&O QA programs. The audit team was thorough and carefully reviewed a wide spectrum of objective evidence before drawing its conclusions. The DRs generated by the audit team were thoroughly discussed during the daily team caucuses. Although the DRs document deficiencies in the SNL and M&O QA programs, these deficiencies do not have a significant impact on the overall quality of the SNL and M&O programs since the Design Support Analyses: North Ramp Design Package 2C (Rev. 1) will not be referenced in the revised Design Package.

#### 5.6.1 Good Practice

The audit team effectively integrated the programmatic compliance and performance-based portions of the audit. Interviews were conducted professionally and efficiently resulting in very little wasted time for audit participants.

#### 5.6.2 Weaknesses

A number of weaknesses were identified in the audit process. These weaknesses are noted below as ways to improve future audits.

1. The staff believes the DOE preliminary conclusion that overall SNL and M&O are adequately implementing their QA programs is unjustified. This audit included an examination of one technical product - the "Design Support Analyses: North Ramp Design Package 2C, (Rev. 1)." As a result of the audit, the audit team identified several technical concerns with the document and five deficiencies in the document development process. Since the audit examined only one product, and since concerns were identified with the development process and the quality of the resultant product, the staff believes that there is insufficient evidence to conclude that overall the SNL and M&O QA programs are being adequately implemented.

2. The audit team did not review the qualification records for the Agapito & Associates employees that worked on the analyses. SNL told the audit team that personnel records for Agapito & Associates employees were proprietary records and, therefore, not available for review. Previous audit teams conducting audits at SNL have requested and received Agapito & Associates employee personal qualification records for review.

3. The audit team did not examine the procedures for conducting the analyses at SNL. The audit team was told by SNL staff that the Design Support Analyses: North Ramp Design Package 2C (Rev.1) were controlled by Supplement III of the QARD. Therefore, the analyses should have been performed using scientific notebooks, technical implementing documents, or a combination of both. While at SNL, the audit team examined the "task file" for the analyses. The task file did not meet the requirements of a scientific notebook; therefore, the analyses should have been performed using technical implementing documents. There was no evidence presented to show that these documents exist.



4. The audit scope did not afford the audit team an opportunity to evaluate the effectiveness of the current SNL and M&O QA programs. According to the audit plan, the objective of the audit was to "evaluate the effectiveness of selected processes, and the quality of resultant end products ... associated with the generation of SNL report 'Design Support Analyses: North Ramp Design Package 2C' and the utilization of the analysis by the CRWMS/M&O as design input for the north ramp." The Design Support Analyses: North Ramp Design Package 2C (Rev. 1) will be superseded in the very near future and, therefore, not utilized as design input in M&O design documents. The audit team was repeatedly told by SNL staff that the process has been greatly improved. Since the audit evaluated a document that will soon be designated "non-quality affecting" and that was developed under a process which has undergone major revisions, very little can be concluded about the current state of SNL and M&O current QA programs.

### 5.7 Audit Team Findings

The five preliminary DRs discussed at the close of the audit are presented below.

1. Draft DR 01 documented the fact that the process which controlled development of "Design Support Analyses: North Ramp Design Package 2C (Rev. 1)" is indeterminate and, therefore, it is not possible to evaluate compliance to an implementing procedure. This is contrary to the requirements of QARD Section 5.2 which states: "Work shall be performed according to controlled implementing documents", and Section 2.2.4 which states: "Planning shall be performed to ensure work is accomplished under suitably controlled conditions. Planning elements shall include, as appropriate: ... identification and selective application or development, of appropriate implementing documents."

2. Draft DR 02 documented that the initiation and control of work for the generation of "Design Support Analyses: North Ramp Design Package 2C" was not conducted in accordance with an approved and controlled procedure. The M&O utilized a letter to initiate and describe the work that was to be completed by SNL. This is contrary to the requirements of the QARD Section 5.2 which states: "Work shall be performed according to controlled implementing documents."

Note: This DR was subsequently not issued because the subject was already addressed in a previous Corrective Action Request.

3. Draft DR 03 documented that there is no objective evidence that "Design Support Analyses: North Ramp Design Package 2C Rev. 1" was retrieved from the TDB in accordance with the procedural requirements of YAP-SIII.2Q, Rev. 0, Section 5.4.1 which states: "To request or retrieve data from the YMP TDB, the Affected Organization ... submits a written request for information to the appropriate YMP TDB Administrator."

4. Draft DR 04 documented the fact that the technical data provided to the M&O for scoping analyses studies for "Design Support Analyses: North Ramp Design Package 2C, Rev. 1" was transferred to the M&O contrary to the requirements of YAP-SIII.3Q, Rev. 0. This procedure requires that design

information transmitted across interfaces shall be controlled and that preliminary data provided to other YMP investigators be transferred under a cover letter which states that the data have not received complete technical and quality checks and are considered preliminary. In addition, all data sheets are to be stamped "PRELIMINARY - INFORMATION ONLY."

In this case, preliminary data was transferred to the M&O and subsequently utilized as design input without including the required statement or being stamped "PRELIMINARY - INFORMATION ONLY."

5. Draft DR 05 documented that the technical review for the selection of data from the audited report for the TS North Ramp Ground Support Scoping Analysis was inadequate. This resulted in the use of (unreviewed) preliminary data for the design input. This is contrary to the requirements of QARD Section 3.2.1A which states: "Design inputs shall be identified and documented, and their selection reviewed and approved by those responsible for the design."