

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

AUDIT REPORT

OF THE

CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM
MANAGEMENT AND OPERATING CONTRACTOR

AT THE

SANDIA NATIONAL LABORATORIES
ALBUQUERQUE, NEW MEXICO

AUDIT NUMBER SNL-ARP-97-02
OCTOBER 28 THROUGH 31, 1996

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Enclosure

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1.0 EXECUTIVE SUMMARY

Performance Assessment (PA) activities are currently classified as "non-quality affecting," since much of the preliminary PA studies will not be directly used in the License Application (LA). This audit of PA activities was a preparatory step toward imposing Quality Assurance (QA) program requirements on subsequent work that is potentially input to the LA. As a baselining effort, this audit was conducted to determine whether present controls are sufficient for data acceptability when the PA activities become "quality affecting."

As a result of performance-based QA audit SNL-ARP-97-02, the audit team determined that the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) at the Sandia National Laboratories (SNL) is implementing adequate process controls, with the exception of those areas where recommendations were generated by the audit team, for work performed under Work Breakdown Structure (WBS) 1.2.5.4.4, "Flow Calculations for Yucca Mountain Groundwater Travel Time (GWTT-95)." The work performed under WBS 1.2.5.4.1, "Scenarios Constructed for the Effects of Tectonic Processes on the Potential Nuclear Waste Repository at Yucca Mountain," is judged by the audit team to be indeterminate. The indeterminate status is mainly due to the preliminary nature of the work thus far, and the absence of documented source materials to substantiate the quality of the work completed at this point. In addition, overall adequacy of and compliance to selected SNL implementing procedures were found to be marginal.

The audit team identified no deficiencies during the audit; however, six conditions were identified which would be QA program implementation deficiencies if the activities were subject to the Quality Assurance Requirement and Description (QARD), DOE/RW-0333P, Revision 5. The conditions identified as potential QA program deficiencies were documented as recommendations. Seven programmatic recommendations and one technical recommendation were generated, which are presented in Section 6.0 of this report.

2.0 SCOPE

The audit was conducted to evaluate adequacy and effectiveness of SNL's controls for development of two technical reports supporting Total System Performance Assessment:

- SAND96-0819, "Flow Calculations for Yucca Mountain Groundwater Travel Time (GWTT-95)" (WBS 1.2.5.4.4, "Site Performance Assessment")

- SAND96-1132, "Scenarios Constructed for the Effects of Tectonic Processes on the Potential Nuclear Waste Repository at Yucca Mountain" (WBS 1.2.5.4.1, "Total Performance Assessment")

The audit was intended to determine the degree to which the resultant products meet the program requirements and management commitments and expectations, as well as to determine that SNL completed the work in accordance with pertinent sections of the QARD.

Both technical reports were produced as "non-Q" documents. Participant Planning Sheets (PPS) issued to SNL indicated that the QARD was not applicable to the two activities. However, the audit was requested by SNL and Department of Energy representatives to determine whether internal controls exercised to produce the two reports would suffice for data acceptability when subsequent PA reports directly support the licensing process. In Work Agreements (WA) governing the two activities, SNL elected to use existing QA program procedures to control the work, where applicable. Along with QARD requirements, the SNL QA implementing procedures cited in the WAs were the measurement standards for the compliance evaluation results presented in Attachment 2.

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

PROCESS/ACTIVITY/END-PRODUCT

Activities involving development of SAND96-0819, "Flow Calculations for Yucca Mountain Groundwater Travel Time (GWTT-95) and SAND96-1132, "Scenarios Constructed for the Effects of Tectonic Processes on the Potential Nuclear Waste Repository at Yucca Mountain" were selected for evaluation from WBS elements 1.2.5.4.4 and 1.2.5.4.1, respectively.

The performance-based evaluation of process effectiveness and product adequacy was based upon:

1. Satisfactory implementation of the critical process steps
2. Uses of trained and qualified personnel working effectively
3. Documentation that substantiates the quality of products
4. Acceptable results and adequate end-products
5. Effectiveness of corrective action

The SNL activities for WBS 1.2.5.4.4 (Ground Water Travel Time Analyses) and their associated end-product were evaluated for the critical process steps listed below.

1. Identify acceptance criteria for the deliverable
2. Identify a specific problem to model (based on regulatory or program requirements)
3. Select an appropriate model
4. Develop a set of analysis parameters meaningful for the problem
5. Perform the analysis
6. Report analysis results

The SNL activities for WBS 1.2.5.4.1 (Seismic Activity Scenarios) and their associated end-product were evaluated for the critical process steps listed below.

1. Identify acceptance criteria for the deliverable
2. Identify Features, Events and Processes (FEP) important to seismic activity relevant to repository performance (safety)
3. Develop scenarios (details of FEPs and linkage among them)
4. Report preliminary results
5. Review FEP diagrams (models) with subject matter experts*
6. Revise FEP diagrams (models) to emphasize most credible scenarios*
7. Assign probability of occurrence*
8. Report results*

* These steps have not yet occurred

In addition, a sample of the applicable QA program requirements and controls as they applied to each process was examined to evaluate the degree of compliance. The following QA program elements and supplements selected are directly related to SNL's PA activities in developing the two reports. These elements and supplements were evaluated during the audit for comparison purposes only:

- 2.0 Quality Assurance Program (Training, Work Planning)
- 5.0 Implementing Documents
- 6.0 Document Control
- 16.0 Corrective Action
- 17.0 Quality Assurance Records
- Supplement I. Software
- Supplement III. Scientific Investigation (Work Planning, Model development and Use)

TECHNICAL AREAS

The audit included a technical evaluation of the development process and adequacy of the two reports. Details of the technical evaluation are included in Section 5.4.

3.0 AUDIT TEAM AND OBSERVERS

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

<u>Name/Title Organization</u>	<u>QA Program Elements/Requirements Processes, Activities, or End-Products</u>
Kristi A. Hodges, Audit Team Leader, Office of Quality Assurance (OQA)	2.0, 5.0, 6.0, 16.0, 17.0, Supplement III WBS 1.2.5.4.1
James E. Clark, Audit Team Leader in Training, OQA	2.0, 5.0, 6.0, 16.0, 17.0, Supplement III WBS 1.2.5.4.4
Stephen D. Harris, Auditor, OQA	Supplement I, WBS 1.2.5.4.1 and WBS 1.2.5.4.4
Dwight T. Hoxie, Technical Specialist, CRWMS M&O/U.S. Geological Survey	WBS 1.2.5.4.1 and WBS 1.2.5.4.4
Susan Zimmerman, Observer, State of Nevada	

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

The preaudit meeting was held at the SNL office in Albuquerque, New Mexico, on October 28, 1996. Daily debriefing and coordination meetings were held with SNL management and staff, and daily audit team meetings were held to discuss issues and potential recommendations. The audit was concluded with a postaudit meeting held on October 31, 1996, at the SNL office in Albuquerque, New Mexico. 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, overall, SNL process controls are effectively being implemented for WBS 1.2.5.4.4 activities in the areas within the scope of this audit. Effectiveness of SNL process controls for WBS 1.2.5.4.1 is judged by the audit team to be indeterminate. Work in this WBS area is very preliminary; however, little documentation exists to substantiate decisions made to this point.

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 checklist. The checklist is kept and maintained as a QA Record.

5.4 Technical Audit Activities

The performance-based QA audit was conducted at the SNL office in Albuquerque, New Mexico. The audit focused on those processes and activities associated with development of two technical reports.

SAND96-0819, "Flow Calculations for Yucca Mountain Ground Water Travel Time (GWTT-95)" (WBS 1.2.5.4.4)

This document was expected to describe the computational models, model domains, model parameters, and results of the ground water travel time - 95 analyses. This pre-waste emplacement analysis was to include discussions on: 1) the effects of heterogeneity for both unsaturated zone (UZ) and saturated zone (SZ) groundwater flow; 2) techniques and methods for tracking "Water Particle" movement in relation to "Fast Paths" in the UZ and SZ; and 3) preliminary implications with respect to the GWTT regulation. A technical checklist was prepared addressing these deliverable acceptance criteria and other elements deemed crucial by the technical specialist in substantiating the technical adequacy of the report. The technical checklist examined specific assumptions, data, and conclusions in the report.

This activity was controlled by SNL WA-0181 (effective January 31, 1995) and WA-0316 (effective September 3, 1996). WA-0181 controlled the analysis activities, while WA-0316 controlled work documentation, review, and submittal of the report into the DOE cycle for acceptance of deliverables. Approval of WA-0316 postdated submittal of this report. The absence of a valid WA for report documentation and submittal purposes was discovered in the audit scoping stage, and SNL staff took the initiative to prepare an internal DR SNL 96-D007. Although the activity is not quality affecting, SNL elected to use a formal method to track completion of corrective action. The DR was closed 10/24/96. An evaluation of the effectiveness of the corrective action is presented in Section 5.5.5.

The technical portion of the audit began with an evaluation of the bases for assumptions. SNL personnel were able to provide memoranda and SNL Letter Reports outlining criteria for the selection of specific FEPs modeled in the study. Specific FEPs concerned with spatial heterogeneity and fast-pathway flow were examined as selected from SNL Letter Report "Reference Hydrologic Scenarios from the Nominal Scenarios Report [Barr, et al, 1995, SAND92-2186]." The FEPs selected were judged appropriate for water flow in the UZ in the absence of a repository or disturbed zone, but the technical specialist noted that the input source should have been referenced in the GWTT-95 report.

The technical specialist likewise examined the criteria used to include or exclude site information used to guide development of the GWTT-95 UZ and SZ model domains. The data selected was deemed appropriate, and was substantiated by objective evidence of a deliberation process via technical meetings. Again, the memoranda resulting from the meetings were available as records, but were not referenced in the GWTT-95 report. Other forerunner reports and memoranda served to substantiate decisions questioned by the technical specialist, e.g., as to whether the Equivalent Continuum Model or Dual Permeability Model should represent water flow in the UZ, how an established reduction factor was selected to achieve agreement and consistency with saturation-profile data from borehole UZ-16, why the van Genuchten formulation was selected to represent the water-retention and relative permeability relations in the UZ, and why the geostatistical simulation approach was needed to represent spatial heterogeneity.

Objective evidence was readily produced by the Principal Investigators to substantiate assumptions, calculations, and conclusions, mainly due to conscientious preparation of an Analysis Notebook in accordance with SNL QAIP 2-4. All checklist items had satisfactory responses; however, Recommendation #8

in Section 6.0 of this report documents the need to cite more reference material in the resulting report.

SAND96-1132, "Scenarios Constructed for the Effects of Tectonic Processes on the Potential Nuclear Waste Repository at Yucca Mountain" (WBS 1.2.5.4.1)

This activity was expected to develop representative sets of FEPs depicting scenarios to be modeled for seismic activity. The resulting report was also expected to outline a methodology for integration into the Total System Performance Assessment effort.

This activity was performed under SNL WA-0171 (draft with no effective date) and WA-0323 (effective August 16, 1996). No specific procedures were invoked to control the work except for required training on procedures, which included QAIP 6-1, "Document Control," and QAIP 6-2, "Preparing, Reviewing, Approving, and Issuing Technical Information Documents." The latter WA was approved after the date of the report's submittal, and was included in the internal DR number SNL 96-D007, written by SNL to address deficiencies in implementation of the SNL Work Agreement process. See Section 5.5.5.

A technical checklist was prepared addressing the acceptance criteria and other elements deemed crucial by the technical specialist in substantiating the technical adequacy of the report.

Evaluation of the activity focused on the steps taken to ensure development of a "comprehensive" set of scenarios, credibility of the scenarios and their associated generalized event trees, the sources of specific FEPs selected for inclusion, and the documentation of activities completed thus far. It was noted that the principle source of input to the report was from the expertise of its authors, together with information assembled from meetings and informal elicitations. The collection of information was not well documented and no Analysis Notebook was developed and maintained. A trial-and-error method was used to select the specific FEPs, based on historical knowledge of FEPs from previous studies. Evidence existed to substantiate a formal review cycle for the preliminary report; however, the technical specialist could not ascertain the credibility of assumptions or the adequacy of the report from the limited documentation available. The technical recommendation presented in Section 6.0 addresses the documentation weakness.

5.5 Summary of Deficiencies

The audit team identified no deficiencies during the audit. QARD Section 16, Corrective Action, does not apply to non-quality affecting activities. Conditions

identified as potential QA program deficiencies were documented as recommendations.

5.5.1 Corrective Action Requests (CAR)

None

5.5.2 Deficiency Reports (DR)

None

5.5.3 Performance Reports (PR)

None

5.5.4 Deficiencies Corrected During the Audit

None

5.5.5 Follow-up of Previously Identified Deficiency Documents

SNL DR 96-D-007

This internal DR was closed October 24, 1996, after verification of corrective action by SNL staff. Following audit team evaluation of remedial and corrective actions, it was determined that SNL was effective in investigating and addressing the deficiency cited.

6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for consideration by Project Office/CRWMS M&O/SNL management. Due to the fact that many of the recommendations would be deficiencies if the QARD applied to these activities, a formal response to each recommendation is requested.

1. Much of the documentation presented in response to technical checklist questions had been entered into the records systems as "non-Q." Considering the impending purge of "non-essential" non-Q records, SNL should take steps to ensure that critical non-Q records supporting performance assessment activities are preserved. A method of identifying key supportive information should be developed to consistently capture and preserve critical non-Q records.

2. WA-0181 specified that SNL staff involved in GWTT analysis activities be trained on QAIP-2-4, "Conducting and Documenting Analyses/Calculations." Although an Analysis Notebook had been prepared in full compliance with the procedure, there was no evidence that the notebook preparer (a primary author of the GWTT-95 report) had been assigned or completed training on the QAIP. Whenever WAs are approved, SNL should place stronger emphasis on training staff and documenting staff training on applicable procedures before work is initiated.
3. All SNL staff reviewed for maintenance of training on AP-16.1Q, "Performance Deficiency Reporting" and AP-16.2Q, "Corrective Action and Stop Work," had not been trained on the most recent revision of the two procedures. Training for all SNL procedures reviewed had been updated effectively and in a timely manner. SNL should establish a stronger interface with the Project Office/CRWMS M&O document control function to facilitate the application of SNL's effective training maintenance system to external procedures. In conjunction with this, SNL should ensure that the responsible Project Office/CRWMS M&O organizations specify which procedures require training maintenance.
4. The GWTT-95 report was initially rejected by DOE and subsequently accepted after revision. SNL QAIP-6-2, "Preparing, Reviewing, Approving, and Issuing Technical Information," was used to revise and resubmit the report, but the procedure has no mechanism for changing documents after initial approval. QAIP 6-2 should be revised to include a process for reviewing and approving document changes when documents have been rejected.
5. QAIP 1-5, "Establishing Work Agreements," states in the Purpose section that it is to implement QARD requirements for planning, yet the procedure does not address all QARD requirements applicable to work planning. QAIP 1-5 should be revised to implement all elements of QARD Section 2.2.5 and Supplement III.2.1 applicable to planning.
6. For the process evaluation associated with performance based auditing, software codes TOUGH2 and FEHMN, as applied to GWTT activities, appear to have been sufficiently documented to meet process requirements. A step-by-step comparison for compliance to QAIP 19-1, Revision 2, "Software Quality Assurance," was not performed during the audit. If these two codes are intended for use to support licensing efforts, SNL should perform a more detailed compliance review to determine whether the documentation meets all applicable QAIP 19-1 requirements.

7. SNL should update their implementing procedures to meet Revision 5 of the QARD, Supplements I and V. After the procedure updating, SNL should determine what codes, if any, used in the GWTT studies, need to be placed under the Revision 5 controls.

8. **Technical Recommendation:** SNL should ensure that the technical basis of and rationale for all assumptions made during analyses and the conclusions drawn from these analyses are fully documented. The documentation preferably should be provided directly within the technical reports describing the analyses, such as SAND96-0819 or SAND96-1132, or by citation within these reports to the open published literature. Analysis Notebooks or other ancillary supporting documents should be provided, as appropriate.

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>
Susan Altman	SNL/PI	X	X	X
Bill Arnold	SNL/PI		X	
George Barr	SNL/PI	X	X	X
Ralston Barnard	SNL/PI	X	X	X
Michael Brady	SNL/Lab Lead	X	X	
Holly Dockery	SNL/PA Manager			X
Cliff Ho	SNL/PI	X	X	X
Amy Martinez	SNL/Training & DCC	X	X	X
Sean McKenna	SNL/PI		X	
Susan Pickering	SNL/QA Manager	X	X	X
Joe Schelling	SNL/QA Lead	X	X	X
Eric Smistad	DOE/Project Office PA		X	
Peggy Warner	SNL/Records Manager	X	X	X

Acronyms

DCC Document Control Coordinator
PA Performance Assessment
PI Principal Investigator

ATTACHMENT 2
Summary Table of Audit Results
Process/Product Evaluations

ACTIVITY	PROCESS STEPS	DETAILS Checklist Page(s)	DEFICIENCIES	RECOMMENDATIONS	PROCESS EFFECTIVENESS	PRODUCT ADEQUACY	OVERALL
<u>GWTT-95</u> WBS: 1.2.5.4.4	Identify Acceptance Criteria	1, 2, 8; Technical 1-3	N	REC#5	SAT	SAT	SAT
	Identify Specific Problem for Modeling	3 Technical 4-17	N	REC#6,7	SAT	SAT	
	Select Appropriate Modeling Tool	3, 4, 10, 11,12; Technical 18-28	N	REC#6,7	SAT	SAT	
	Develop Meaningful Analysis Parameters	4, 5, 10,11, 12; Technical 29-38	N	N	SAT	SAT	
	Perform Analysis	6, 7, 9	N	REC#1, 2,8	SAT	SAT	
	Report Analysis Results	8	N	Rec #3,4	SAT	SAT	

ACTIVITY	PROCESS STEPS	DETAILS (Checklist)	DEFICIENCIES	RECOMMENDATIONS	PROCESS EFFECTIVENESS	PRODUCT ADEQUACY	OVERALL
<u>Seismic Scenarios</u> WBS: 1.2.5.4.1	Identify Acceptance Criteria	13, 14; Technical p.39	N	REC#5	SAT	SAT	INDET.
	Identify FEPs	14; Tech 40-42	N	REC#8	INDET	INDET	
	Develop Scenarios	15, 16; Technical 40-46	N	REC#8	INDET	INDET	
	Report Results	16	N	N	SAT	INDET	

ATTACHMENT 2
Summary Table of Audit Results
For Procedural Compliance Evaluations

Note: QA program compliance was not required for the non-quality affecting activities evaluated during this audit. However, since the audit purpose was to compare existing controls to QA program controls, these evaluations reflect the degree of compliance with a QARD-based QA program.

ELEMENT	DOCUMENTS REVIEWED	DETAILS (Checklist)	DEFICIENCIES	RECOMMENDATIONS	PROGRAM ADEQUACY	PROCEDURE COMPLIANCE	OVERALL
2	QAIP 1-5, R10 QAIP 2-5, R4 QAIP 2-6, R4	1,2,9,13	N	REC#2, 3, 5	UNSAT	UNSAT	UNSAT
5	QAIP 5-1, R5	1,2, 8,11,12	N	REC#4	UNSAT	UNSAT	UNSAT
6	QAIP 6-1, R3 QAIP 6-2, R3 QAIP 6-3, R3	4,7,8,16	N	REC#4	UNSAT	UNSAT	UNSAT
16	AP 16.1Q, R1	2,13	N	N	SAT	INDET	INDET
17	QAIP 17-1, R2	4,7,15	N	REC#1	SAT	SAT	SAT
Supp. I	QAIP 19-1,R2	10,11,12	N	REC#6, 7	SAT	SAT	SAT
Supp.. III	QAIP 1-5, R10 QAIP 2-4, R3	1,2, 13	N	REC#5, 8	SAT	SAT	SAT
TOTAL	Pages = Programmatic: 16 Technical: 46		N	8			

DOCUMENTS REVIEWED includes the referenced procedure or process step and the associated records/objective evidence.
 CARs.....Corrective Action Requests
 DRs.....Deficiency Reports
 PRs.....Performance Reports
 CDA.....Corrected During Audit
 REC.....Recommendation
 ADEQUACY.....Meets Requirements or Expectations
 COMPLIANCE..Procedures Implemented
 EFF.....Effectiveness - Satisfies Measurement Criteria
 OVERALL.....Summary of Element or Process
 N.....None
 INDET..... Indeterminate