

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

LAWRENCE LIVERMORE NATIONAL LABORATORY
LIVERMORE, CALIFORNIA
AND
LAS VEGAS, NEVADA

AUDIT NUMBER LLNL-ARP-97-20
SEPTEMBER 15 THROUGH 19, 1997

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Approved by: R. W. Horton Date: 10/24/97
For Donald G. Horton
Director
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1.0 EXECUTIVE SUMMARY

As a result of performance-based Quality Assurance (QA) audit LLNL-ARP-97-20, the audit team determined that the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) at the Lawrence Livermore National Laboratory (LLNL) is satisfactorily implementing the QA program and effective process controls for two synthesis reports developed under Work Breakdown Structure (WBS) 1.2.3.12.5, "Characteristics and Effects of Man-Made Materials and Chemicals." This conclusion was based on evaluations of the two technical synthesis reports designated as M&O Level 3 milestones assigned to LLNL: "Near Field and Altered Zone Environment Report (NFER), Volume I: Technical Bases for EBS Design," Revision 1; and "Synthesis Report on Thermally Driven Coupled Processes (TDCP)," Revision 0. These reports will be identified as milestones SP3000M3 and SP3005M3, respectively, when submitted to the Yucca Mountain Project Office.

The audit team identified one programmatic deficiency that was corrected during the audit. It concerned the lack of a formal technical review of the NFER report, as required by the LLNL procedure for "Q" technical documents. Details of this deficiency are documented in Section 5.5.4. Two recommendations, presented in Section 6.0 of this report, were generated to strengthen compliance with QA Program requirements.

The audit team determined that the LLNL staff involved in both reports were highly qualified and had competently performed the technical activities required to produce the reports. No technical inadequacies were identified. The Technical Specialist determined that no technical recommendations were warranted.

2.0 SCOPE

The audit was conducted to evaluate the adequacy and effectiveness of LLNL controls for development of two technical reports:

- "Near Field and Altered-Zone Environment Report
Volume I: Technical Basis for EBS Design," Revision 1.
- "Synthesis Report on Thermally Driven Coupled Processes," Revision 0.

The audit was intended to establish confidence in the reports by determining the level of compliance with QA Program requirements and technical criteria for WBS 1.2.3.12.5 as set forth in the Participant Planning Sheets (PPS). The audit team conducted interviews and documentation reviews to evaluate the processes and activities used by LLNL to produce the reports.

Both technical reports were expected to be "Q" documents, based on the PPS issued to LLNL via the M&O Contractor, which indicated that the QARD was applicable to the two activities. However, the PPS Statement of Work for the NFER described the deliverable as a "Q/non-Q product," leaving the document preparer with the impression that the status could be determined by the relative predominance of "Q" versus "non-Q" data used in the report. The decision to designate the NFER as "non-Q" led to an initial informal review instead of the formal technical review required for "Q" products. Correction of this deficiency was done before completion of the audit, and is documented in Section 5.5.4 of this report.

The processes and activities associated with the end-products were evaluated in accordance with the approved audit plan.

PROCESS/ACTIVITY/END-PRODUCT

The following deliverables for WBS element 1.2.3.12.5 were evaluated during the audit.

- "Near Field and Altered Zone Environment Report, Volume I: Technical Bases for EBS Design," Revision 1.
- "Synthesis Report on Thermally Driven Coupled Processes," Revision 0.

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

1. Satisfactory implementation of the critical process steps
2. Acceptable results and quality of the end product
3. Documentation that substantiates quality of products
4. Performance of trained and qualified personnel
5. Implementation of applicable QA Program elements

The LLNL activities for preparing Revision 1 of the NFER, Volume I, were evaluated for the critical process steps listed below.

1. Planning
2. Data Selection
3. Data Integration
4. Report Development
5. Report Reviews

The LLNL activities for preparing the TDCP were evaluated for the critical process steps listed below.

1. Planning
2. Data Collection
3. Data Analysis (extracting applicable data)
4. Report Development
5. Report Reviews

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 Requirements/ Processes or Products</u>
James E. Clark, Audit Team Leader, Office of Quality Assurance (OQA)	Supplement III as applicable to NFER and TDCP Critical Process Steps
Michael Malone, Auditor, OQA	Supplement III as applicable to NFER and TDCP Critical Process Steps
Chao-Hsiung Tung, Technical Specialist, CRWMS M&O/SAIC	NFER and TDCP Critical Process Steps
Susan Zimmerman, Observer, State of Nevada	

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

The audit was conducted at two locations: at Livermore, California, to evaluate the NFER report; and at Las Vegas, Nevada, to evaluate the TDCP report.

The initial preaudit meeting was held at the LLNL office in Livermore, California, on September 15, 1997. Daily debriefing and coordination meetings were held with LLNL management and staff, and daily audit team meetings were held to discuss audit status. The Livermore portion of the audit was concluded with a preliminary exit meeting held on September 17, 1997, at the LLNL Livermore office.

The second preaudit meeting was held at the LLNL offices in Las Vegas, Nevada, on September 18, 1997. No debriefing/coordination meeting was necessary with LLNL management and staff on September 19, 1997, prior to the postaudit meeting, as no issues were identified. The audit was concluded with a postaudit meeting held on September 19, 1997, at the LLNL Las Vegas office.

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, process controls are being effectively implemented by LLNL for WBS 1.2.3.12.5 activities in the areas within the scope of this audit. Applicable elements of QARD Supplement III were implemented effectively.

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 checklists are kept and maintained as a QA Record.

5.4 Technical Audit Activities

Near-Field and Altered-Zone Environment Report, Volume I: Technical Bases for EBS Design, Revision 1

LLNL representatives Dale Wilder and Michael Fernandez were interviewed using Technical Checklist LLNL-ARP-97-20-02 during the technical audit of the NFER report. Most of the discussions were with Dale Wilder, the preparer of the document. Based on their in-depth responses to questions regarding the report, both individuals were deemed highly qualified technically, and both expressed strong commitment to the concept of quality assurance.

The NFER is a two volume set. Volume I provides the technical basis for design of the engineered barrier system (EBS). It was initially published in April, 1993, as a preliminary report because the design and characterization studies were not mature. It is being updated to Revision 1 to reflect more recent, more detailed information contained in Volume II, which was published in August, 1996. Volume II documents the state of knowledge of relevant processes, conditions and properties as of August, 1996, and constitutes the basis for the material presented in Revision 1 of Volume I. There were no new data or conclusions generated as a result of this synthesis report.

A discussion of the altered zone (AZ) environment was added in Revision 1 of this document. The AZ is defined as the environment that develops away from the waste packages (WP) and impacts the waste and its containers only in terms of its influences on the WP environment. This combining of information recognizes the interdependence of the WP and AZ environments, as discussed in Volume II.

The technical criteria for the revised NFER, presented in the Participant Planning Sheet (PPS) issued to the M&O, were apparently met as specified. Selection and extraction of data from Volume II for inclusion in the Volume I revision was also appropriately conducted, based on the scarcity of significant review comments generated. Each Principal Investigator who contributed data extracted from Volume II was given the opportunity to check the integrity of data transfer into Volume I; first by informal review and subsequently via a formal technical review in accordance with LLNL procedure 033-YMP-QP 3.3, "Review of Technical Publications," Revision 4.

As required, the status of data and models is clearly identified to reflect their quality assurance pedigree. No attempt was made to qualify any non-qualified data or model. Though no formal "data call" was initiated during the development

stage of the report, constant interactions amongst the Principal Investigators who were data sources in Volume II and other technical staff provided an effective mechanism to integrate pertinent data. Data from Los Alamos National Laboratory were added into this revision of the report as the result of such interactions.

Because the PPS listed the NFER as a "Q/non-Q product," the report preparer initially made the decision to designate the document as "non-Q." However, the standardized statement indicating "Q" status for the activity was evident on the PPS, and the status of the report was changed to "Q" during the audit. Objective evidence of an informal review was apparent by reviewing the draft report, but a subsequent formal review during the audit revealed no technical concerns.

Synthesis Report on Thermally Driven Coupled Processes, Revision 0

This report is a synthesis topical report to document the current understanding of the rock properties under heated conditions. It summarizes observations and data on thermally-coupled processes for conditions that are expected to occur within and around a repository at Yucca Mountain. Acquisition of the thermal-related information was started only after FY96. Ernest Hardin and Dwayne Chestnut were the contacts for the technical portion of the audit. Both demonstrated their technical competence in responses to checklist questions.

Real time data and laboratory data were incorporated into the report where possible. Progress reports on the single heater test and information from the large block test were identified as valuable input. The data are predominately from LLNL, while LANL, LBNL and other sources were also identified as data sources. Qualified and non-qualified data were clearly identified in the report. Technical judgement was often involved in data selection while site-specific and site-related information were given higher priority for inclusion in the report. Potential impact on repository design was used as the criteria to decide data applicability.

Development of the report was very well planned and executed. The types of input required and the development schedule were established in the Annual Planning System. A checklist was developed identifying all acceptance criteria, and the criteria were systematically met in the preparation of the report. Compliance with acceptance criteria was confirmed through a formal review cycle.

The document developers, Ernest Hardin and Dwayne Chestnut, are both cognizant that many uncertainties exist in the data. It is expected that any pertinent data from studies underway in the ESF and Fran Ridge will be incorporated into future revisions of this report.

5.5 Summary of Deficiencies

The audit team identified one deficiency that was corrected during the audit. See Section 5.5.4 for details.

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

Deficiencies considered isolated in nature and only requiring remedial action can be corrected during the audit. The following deficiency was identified and corrected during the audit:

1. No documented technical review had been conducted on Revision 1 of the NFER at the onset of the audit. Because the PPS directions were confusing, the NFER preparer had designated the report as "non-Q" and had conducted only an informal technical review, using all Principal Investigators who had contributed data extracted from Volume II. Reviewers had marked comments on the draft copies, but had not placed comments on forms required by procedure 033-YMP-QP 3.3 when a publication is "Q." Upon clarification that the report was to be designated "Q" despite the presence of unqualified data, LLNL subjected the report to a documented technical review during the audit. The informal review resulted from a misunderstanding as to the quality status of the report, and was considered an isolated case requiring only remedial action. LLNL had no previous deficiencies similar to this situation.

Documentation of the technical review, conducted in accordance with LLNL procedure 033-YMP-QP 3.3, Revision 4, was presented to the audit team before audit completion. No new technical comments emerged as a result. There was no adverse impact on the quality of the report because the technical review had already occurred via the informal review.

5.5.5 Follow-up of Previously Identified Deficiency Documents

None

6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for consideration by management. Recommendation #1 is directed to the Yucca Mountain Project Office and the M&O.

1. The quality-affecting status ("Q" or "non-Q") of deliverables should be explicitly stated by the M&O in the PPS acceptance criteria. Although planning procedures specify that "Q" status is established for all products in that WBS subaccount when a standardized statement is included in the PPS Statement of Work, confusion was created in WBS 1.2.3.12.5 when the NFER description referred to the report as a "Q/non-Q product." An undocumented technical review resulted when the preparer made a decision to treat the document as "non-Q."
2. An expanded process for technical document development should be included in the LLNL procedure for review of technical publications (033-YMP-QP 3.3) or in a separate procedure. LLNL used a commendable process for developing both reports, which included identifying acceptance criteria and establishing a checklist, developing and obtaining approval of an outline, then preparing and reviewing the report in accordance with the approved acceptance criteria. This logical process provided structure to the report development stage, ensuring confidence in the technical acceptability of the report. Therefore, it is recommended that those steps be proceduralized to achieve a consistent level of quality in future technical reports.

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>
Barbara Alegre	LLNL/Records Coordinator	X ¹	X	
James Blink	LLNL/Deputy Lab Lead			X ²
Cami Brumburgh	LLNL/Admin. Specialist	X ¹	X	
Dwayne Chesnut	LLNL/PI		X	X ²
Willis L. Clarke	LLNL/Lab Lead			X ¹
Michael Fernandez	LLNL/Deputy PM	X ¹	X	
Ernest Hardin	LLNL/Physicist	X ²	X	X ²
Karen Lew	LLNL/Technical Editor		X	
Royce Monks	LLNL/EA	X ¹	X	X ¹
Bimal Mukhopadhyay	MTS/Geochemist			X ²
Pamela Stanworth	LLNL/Training Coordinator	X ¹	X	
Charles Warren	OQA/QATSS/Audit Lead			X ²
Dale G. Wilder	LLNL/TAL	X ¹	X	X ¹
James Ziemba	OQA/QATSS/QA Spec.	X ¹		X ¹
Susan Zimmerman	Observer, State of Nevada	X ^{1,2}	X	X ¹

LEGEND

- 1 -- Livermore Meetings
- 2 -- Las Vegas Meetings

EA	Engineering Assurance
MTS	Management Technical Services (DOE Contractor)
PI	Principal Investigator
PM	Program Manager
QATSS	Quality Assurance Technical Support Services (DOE Contractor)
TAL	Technical Area Lead

**ATTACHMENT 2
 AUDIT LLNL-ARP-97-20
 DETAIL SUMMARY OF AUDIT RESULTS**

QA ELEMENT/ACTIVITY	PROCESS STEPS	DETAILS Checklist Page(s)	DEFICIENCIES	RECOMMENDATIONS	PROCESS EFFECTIVENESS	PRODUCT ADEQUACY	OVERALL
Supp. III: Near Field and Altered Zone Environment Report, VOL. I, Rev. 1	Planning	Prog. Page 1; Technical Page 1	N	Rec.#1	SAT	SAT	SAT
	Data Selection	Prog. Pages 2; Technical Pages 1-3	N	N	SAT	SAT	
	Data Integration	Prog. Page 3; Technical Pages 2-3	N	N	SAT	SAT	
	Report Development	Prog. Pages 4-5; Technical Pages 3-5	N	Rec.#2	SAT	SAT	
	Report Reviews	Prog. Pages 6-8	CDA	N	SAT	SAT	

**ATTACHMENT 2
 (Continued)
 AUDIT LLNL-ARP-97-20
 DETAIL SUMMARY OF AUDIT RESULTS**

QA ELEMENT/ACTIVITY	PROCESS STEPS	DETAILS (Checklist)	DEFICIENCIES	RECOMMENDATIONS	PROCESS EFFECTIVENESS	PRODUCT ADEQUACY	OVERALL
Supp. III: Synthesis Report on Thermally Driven Coupled Processes	Planning	Prog. Page 9; Technical Page 6	N	N	SAT	SAT	SAT
	Data Collection	Prog. Page 10; Technical Pages 6-7	N	N	SAT	SAT	
	Data Analysis	Prog. Page 11; Technical Page 7-9	N	N	SAT	SAT	
	Report Development	Prog. Pages 12 - 14	N	Rec. #2	SAT	SAT	
	Report Reviews	Prog. Pages 15-16	N	N	SAT	SAT	

LEGEND: CDA = Corrected During Audit
 N = None
 SAT = Satisfactory