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

LOS ALAMOS NATIONAL LABORATORIES
LOS ALAMOS, NEW MEXICO

AUDIT NUMBER LANL-ARP-97-01
DECEMBER 9-12, 1996

Prepared by: Donald J. Harris Date: 1/7/97
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Approved by: [signature] Date: 1/9/97
Donald G. Horton
Director
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Enclosure

1.0 EXECUTIVE SUMMARY

As a result of Performance Based Quality Assurance (QA) Audit LANL-ARP-97-01, the audit team determined that the Los Alamos National Laboratories (LANL) is satisfactorily implementing an adequate and effective QA program and process controls for work performed under Work Breakdown Structure (WBS) 1.2.3.2.1.1.2, "History of Mineralogic and Geochemical Alteration of Yucca Mountain, Volume II." The LANL program examined during this audit was in accordance with the U.S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management Quality Assurance Requirements and Description (QARD) DOE/RW-0333P, Revision 5. In addition, overall adequacy of and compliance to selected LANL implementing procedures were found to be satisfactory.

The audit team identified two deficiencies during the audit that resulted in the issuance of Deficiency Report (DR), YM-97-D-019 described in Section 5.5.2 of this report. Additionally, there were 15 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 effectiveness of LANL's process controls associated with Mineralogy and Petrology studies, the audit evaluated compliance to the Office of Quality Assurance (OQA) QA Program, as described in the QARD and LANL Technical Procedures.

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

PROCESS/ACTIVITY/OR END-PRODUCT

Activities involving development of the Summary and Synthesis Report on Mineralogy and Petrology Studies for the Yucca Mountain Site Characterization Project, Volume II, History of Mineralogic and Geochemical Alteration of Yucca Mountain, Milestone 3665, were selected for evaluation from WBS element 1.2.3.2.1.1.2.

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

1. Satisfactory completion of the critical process steps;

2. Acceptance results and adequate end product;

3. Performance of trained and qualified personnel working effectively;

4. Implementation of applicable QA Program elements.

The LANL process controls for WBS 1.2.3.2.1.1.2 and its associated end-product, were evaluated for the critical process steps listed below:

1. Sample Control
2. Data Control
3. Analytical Method
4. Software Control
5. Model Output
6. Data Update and Changes.

QA PROGRAM ELEMENTS/REQUIREMENTS

In addition, a sample of applicable QA program requirements and controls, as they applied to Volume II of the History of Mineralogic and Geochemical Alteration of Yucca Mountain Report was examined to evaluate the degree of compliance. These QA elements were evaluated for applicability and compliance.

4.0	Procurement Document Control
6.0	Document Control
7.0	Control of Purchased Items and Services
12.0	Control of Measuring and Test Equipment
16.0	Corrective Action
17.0	QA Records
Supp I	Software
Supp II	Sample Control
Supp III	Scientific Investigation

TECHNICAL AREAS

The audit included a technical evaluation of process effectiveness and product acceptability. Details of the technical evaluations 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 responsibilities:

Name/Title/Organization	QA Program Elements/Requirements, Processes, Activities or End-products
Donald J. Harris, Audit Team Leader, OQA	SII, SIII
Daniel J. Tunney, Auditor, OQA	4.0, 6.0, 7.0, 12.0, 16.0, 17.0, SI, SII & SIII

Stephen T. Nelson, Technical Specialist,
CRWMS M&O WBS 1.2.3.2.1.1.2

Dr. Bret W. Leslie, Observer,
U.S. Nuclear Regulatory Commission

Susan Zimmerman, Observer
State of Nevada

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

The preaudit meeting was held at the LANL office in Los Alamos, New Mexico, on December 9, 1996. A daily debriefing and coordination meeting was held with LANL management and staff, and daily audit team meetings were held to discuss issues and potential deficiencies. The audit was concluded with a postaudit meeting held at the LANL office in Los Alamos on December 12, 1996. 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 the LANL process controls are effectively being implemented for areas identified in the scope of this audit. The process controls for performing work under WBS 1.2.3.2.1.1.2, History of Mineralogic and Geochemical Alteration of Yucca Mountain, Volume II, report were found to be 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

Technical Evaluation of Alteration History Studies

This section of the audit report represents a technical evaluation of Alteration History studies and associated work being conducted at LANL. Rather than focussing on compliance with applicable QARD requirements and procedures, this activity represents an evaluation of the technical quality of the science being conducted in this area.

It was abundantly clear from this audit that activities at LANL have been affected by reduced funding and reduced staffing levels. Although it is not the purpose of this report to comment on whether such reductions were necessary or appropriate, it has nonetheless had an impact on the conduct of this audit and on the quality of the LANL QA and technical program. First, it was not possible to answer several of the checklist questions, or the answers were incomplete because trained staff and associate investigators were no longer working on YMP. In particular, this affected questions about sample preparation prompted by Detailed Procedure (DP)-130, Revision 0, "Geologic Sample Preparation," questions related to the generation and interpretation of K/Ar analyses of zeolite materials, and the status of sample control. However, staff that were available were very cooperative with the conduct of the audit.

The conduct of the technical portion of the audit was centered around three primary activities. First, a set of questions regarding good laboratory practice and the acquisition of basic data were prompted by the DPs that govern the conduct of this work. Second, as a set of questions prompted by the report, "Summary and Synthesis of Mineralogy-Petrology Studies, Volume II," were investigated. Finally, the history of a sample [LANL #880] for which Q data had been acquired and reported was chosen at random and tracked through documentation in scientific notebooks, sample logbooks, and databases. The Technical Specialist (TTS) concluded that this last activity was most effective in judging the adequacy of the LANL sample tracking program and helping LANL improve its QA program with respect to data collection and sample tracking.

Laboratory Work and Sample Handling

From the areas of work that the TTS was able to observe, it was quite clear that a sincere effort is being made to exercise good laboratory practices and follow all applicable QA procedures governing that work. By posing questions and observing laboratory practices, it was hoped that an overall feel for the adequacy of this part of the program could be evaluated. Unfortunately, it was not possible to question trained sample preparation personnel on DP-130, because all have reportedly been released from YMP service due to reduction in funding. Thus, no conclusions can be reached regarding this part of the LANL program. However, the TTS was particularly impressed by the analytical facilities laboratory. The labs appeared to be clean, well organized, and well run. Requested information regarding sample logs, analytical results, and calibration status were provided

nearly instantaneously and were always in order. This particular aspect of the LANL program is to be commended and is deserving of recognition.

It is somewhat ironic that part of the substance of the deficiency finding is related to an honest effort to do good science. The National Institute of Standards and Technology [or National Bureau of Standards (NBS)] standards that were submitted with duplicate LANL tracking numbers were done so in an effort to hide the identity of the standards from the vendor. Hiding the identity of the standards prevents the vendor from giving extra care and diligence that is not given to unknown samples. Thus, although the duplication of sample tracking numbers is something that needs to be remedied, it is not a symptom of a cavalier attitude toward good scientific practice.

Alteration History Report and Effectiveness of the Scientific Program

The purpose of the report was to capture, in one place, the state of knowledge of mineralogy/petrology studies that have been conducted at LANL over the years. Volume II of the report appears to fulfill that criterion. At the beginning of the report is a tabulation of specific requirements of the acceptance criteria and the location within the text of where those criteria are met. It is left to the individual reader/reviewer to judge to what extent those criteria were met, as well as determine where additional work may be needed to accomplish project goals. The purpose of the audit was not to judge the acceptability of the report against those established criteria, nor was it to provide a programmatic review of the fulfillment of technical objectives. The purpose of the audit was judge whether sound science is being practiced in terms of both the process of gathering data and interpreting those data. Regarding those areas the TTS was able to investigate, it appears that sound science is being conducted within and in support of the Alteration History study at LANL. An attempt was made, nonetheless, to investigate issues of obvious importance to the performance of a potential repository or the suitability of the Yucca Mountain site.

There is a tendency within Volume II of the report for the purpose of certain passages of text to be a little obscure, or to leave the reader unsure what the authors conclusions or hypotheses are. In fact, such passages prompted a number of the checklist questions. The TTS has attempted to point out these cases in the formal responses as well as listing them as recommendations (Section 6.0 of this report). These may serve as a guide to the author in identifying areas within the report that would benefit from clarification to the extent that future revisions permit. In addition, as the study proceeds, thought might be given to the way in which more explicit information from the study can be used to bound conceptual models, provide input parameter to models, or otherwise provide direct support for a safety case or waste isolation strategy for Yucca Mountain. At the present time, some of the work has the feel of "background" information.

Overall, it is my judgement that reasonable and careful science is being practiced within the areas of Alteration History studies that could be examined during the audit. That does not mean that the TTS would necessarily agree with all of the interpretations made by the

scientists involved [although if the TTS had spent as much time working on these topics as they, the TTS very well might agree], however, their interpretations are generally reasonable and based upon viable interpretations of existing data. The TTS views this as a normal situation among earth scientists. It is also probably a healthy situation as it will promote the reexamination of hypotheses and conclusions as more information is obtained.

5.5 Summary of Deficiencies

The audit team identified two deficiencies during the audit that for which one DR have been issued.

Synopses of the deficiency documented as a DR is presented below. The DR has been transmitted under a separate letter.

5.5.1 Corrective Action Requests (CAR)

None

5.5.2 Deficiency Reports (DR)

YM-97-D-019. The National Bureau of Standards (NBS) and the Green River (SGR) standards were submitted as blind samples with LANL sample numbers assigned. These numbers are derivatives of actual physical samples from the field and are not tracked in the main menu sample tracking system or Sample Tracking Log Notebook, nor are the Control of Standards addressed in LANL procedures. In addition, the YMP sample control storage area was consolidated with the LANL Environmental Earth Science (EES) Sample Storage Area and the tracking systems were not updated to reflect the new sample locations.

5.5.3 Performance Reports (PR)

None

5.5.4 Deficiencies Corrected During the Audit

None

5.5.5 Follow-up of Previously Identified DRs

YM-96-D-064. FEHM code in final package review, action due December 30, 1996.

YM-96-D-073. Modified response will be submitted. Similar conditions were found where procurements were performed without requiring the

supplier to have a QA program. Revision to QARD is pending to allow this type of procurement.

YM-96-D-105. Action due March 30, 1997. No similar cases were found where notebooks associated with Milestone 3655 were not submitted to RPC.

YM-96-D-106. Action due December 27, 1996. Milestone 3665 was "in process" and therefore the independent review may not have occurred. No similar conditions were identified for the review of notebooks.

YM-96-D-107. Action due July 30, 1997. Milestone 3665 was "in process" and therefore any discrepancy would be corrected during the review. No discrepancies were noted in the evaluation of qualification status of data.

YM-96-D-108. Action due July 30, 1997. Milestone 3665 was "in process" and therefore discrepancy could be corrected during the review. No data discrepancies were noted during the audit.

6.0 RECOMMENDATIONS

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

6.1 Once sample thin sections and micro probe samples have been analyzed and the results documented, it appears that these samples should be archived and tracked in the event subsequent questions arise or the analytical results are challenged.

6.2 The EES Sample Storage Room contains a cabinet marked with the word "flammable." This cabinet and any flammable materials should be removed from the sample storage area because the samples and sample logbooks are contained in wood cabinets and could potentially be lost to the project.

6.3 Once a sample is assigned the next subsequent log number from the main menu sample tracking system (computer program), there is no mechanism contained in the procedure QP-08.1, Revision 5, "Identification and Control of Samples," that assures that the sample data is entered into the Sample Log Book. In fact, one instance was observed that an entry was made into the log book for the Procurement of Analytical Services on a sample split several months after the analytical results had actually been received. Consider a requirement in the main menu Sample Tracking System that requires acknowledgment that the Sample Log book has been posted with the sample number.

6.4 Revise QP-03.5, Revision 7, "Documenting Scientific Investigations," to include a focal point in which to obtain scientific notebook control numbers. This would provide a method for accountability of notebooks and provide a mechanism to retrieve notebooks in the event of another reduction of the technical work force.

6.5 Review the proposed changes to the QARD sections 4.0, "Procurement Document Control," and 7.0, "Control of Purchased Items and Services." This proposed change deals with analytical services. LANL's technical and QA personnel need to be in agreement with the change, especially in regards to using a nationally recognized standard as a guide.

6.6 In addition to logging samples prepared for analysis and subsequently analyzed, consider logging the samples into the laboratory and out of the laboratory back into the possession of the Principal Investigator. The X-ray diffraction subsplit for sample 880 was still found to be in the possession of the X-ray lab more that 4 years after analysis.

6.7 The inability to locate certain requested data is a good reason for LANL to verify whether the records of persons who have left the Project have been properly captured.

6.8 Obtain and analyze internal standards data from Instrumental Neutron Activation Analysis (INAA) vendor. This would provide insight into the long-term analytical performance of the vendor as well as providing a long-term record of reproducibility.

6.9 Sensitivity studies of changes to transport properties of the rocks by mineralogic changes to determine the magnitude of parameter variations or processes needed to affect performance would serve as a useful tool to guide further research and foster integration with transport modelers.

6.10 It seems that the idea of acid leaching from the vitrophyre is little more than speculation. It should be identified more clearly as such in the report unless or until this is investigated further.

6.11 More careful caveats should be made regarding the utility of tridymite as an indicator of the paleo-static water level.

6.12 The descriptions of breccia, in some instances, predominantly refer to thin sections, with some statements relevant to the outcrop scale. Portions of the report need some modifications to clarify what is being described and at what scale.

6.13 The genetic relationships of breccias are not well expressed in the report, and it is recommended that they be given further consideration.

6.14 The fact that the large inferred differences in the properties of gels are due to desiccation is not clear in the text.

6.15 Provide some specific instances in which the assumptions of U-series may not be met at Yucca Mountain if the validity of the technique is to be questioned to be in agreement with the change, especially in regard to using a nationally recognized standard as a guide.

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

Name	Organization/Title	Preaudit Meeting	Contacted During Audit	Postaudit Meeting
David L. Bish	LANL/Associate Investigator		X	
Gilles Y. Bussod	LANL/Project Leader	X		X
Julia A. Canepa	LANL/LAB Lead	X		
James W. Carrey	LANL/PI		X	
Steve S. Chipera	LANL/Associate Investigator		X	
Michael J. Clevenger	LANL/QA Project Leader	X		X
Paul R. Dixon	LANL/Associate Investigator		X	
John C. Friend	LATA/QA Support	X	X	X
Andrew E. Gallegos	LATA/QA Support			X
Brad Gundlach	LATA/QA Software Corrdinator		X	X
Schon S. Levy	LANL/PI	X	X	X
Cleovis B. Martinez	LATA/QA Support	X	X	X
Sandra J. Martinez	LATA/Records, Training & Document Control	X		
Angela Sanchez Pope	LANL/QA Support			X
Marjorie G. Snow	LANL/X-Ray Research Technician		X	
David T. Vaniman	LANL/PI		X	
Karen West	LANL/Project Leader	X		
Jim Young	LATA/QA Support	X	X	

Legend:
PI - Principal Investigator
LATA - Los Alamos Technical Associates

ATTACHMENT 2
Summary Table of Audit Results
For Procedural Compliance Evaluations

ELEMENT	IMPLEMENTING DOCUMENTS	DETAILS (Checklist)	DEFICIENCIES	RECOMMEND-ATIONS	PROGRAM ADEQUACY	PROCEDURE COMPLIANCE	OVERALL
4	QP-04.6, R4	Page 5		Rec. 6.5	SAT	SAT	SAT
6	QP-06.1, R8 QP-06.2, R5 QP-06.3, R5	Page 4			SAT	SAT	SAT
12	QP-12.3, R3	Page 6			SAT	SAT	SAT
15	YAP-15.1Q, R2	Page 15			SAT	SAT	SAT
16	AP-16-1Q, R1 AP-16.2Q, R1	Page 15			SAT	SAT	SAT
17	QP-17.6, R5	Page 7			SAT	SAT	SAT
Supp I	QP-03.20, R5 QP-03.21, R6	Page 8			SAT	SAT	SAT
Supp II	QP-08.1, R5 YAP-SII.1Q, R1 YAP-SII.2Q, R2	Page 14 and 14a	YM-97-D-019	Rec. 6.1, 6.2, 6.3, 6.6	SAT	SAT	SAT
Supp III	QP-03.5, R7 QP-03.23, R4 QP-03.25, R3 QP-08.3, R4 YAP-SIII.3, R1	Page 10, 11, 13		Rec. 6.4, 6.7	SAT	SAT	SAT

Note: Checklist Pages 1-3, which contained questions from LANL Procedures QP-02.7, 02.11, 06.2, and 06.3, were not evaluated.

ATTACHMENT 2
Summary Table of audit Results For Process/Product Evaluations

ACTIVITY	PROCESS STEPS	DETAILS (Checklist)	DEFICIENCIES	RECOMMEND-ATIONS	PROCESS EFF.	PRODUCT ADEQUACY	OVERALL
Scientific Investigation	Sample Control	Pages 1-4			N/A	N/A	N/A
	Data Control	Pages 5-6			SAT	SAT	SAT
	Analytical Methods	Pages 7-9		6.8, 6.9, 6.10, 6.11	SAT	SAT	SAT
	Software Control	Page 10			SAT	SAT	SAT
	Model Input/Output	Pages 11-25			SAT	SAT	SAT
	Data Update/Changes	Pages 26-27		6.12, 6.13, 6.14, 6.15	SAT	SAT	SAT

TOTAL	Pages - Program 15 Pages - Process 27			*SATISFACTORY*

"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
SAT ..... Satisfactory
UNSAT ..... Unsatisfactory

ADEQUACY ..... Meets Requirements or Expectations
COMPLIANCE ..... Procedures Implemented
EFF ..... Effectiveness - Satisfies Measurement Criteria
OVERALL ..... Summary of Element or Process
N/A ..... Not Applicable
MARG ..... Marginal