

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

**AUDIT REPORT**

**OF**

**LOS ALAMOS NATIONAL LABORATORY**

**LOS ALAMOS, NEW MEXICO**

**AUDIT NUMBER YM-ARP-95-06  
JANUARY 9 THROUGH 13, 1995**

Prepared by:

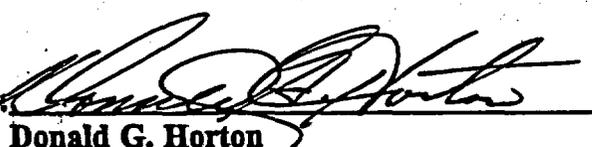


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Date:

2-08-95

Approved by:



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Director  
Office of Quality Assurance**

Date:

2/14/95

## 1.0 EXECUTIVE SUMMARY

As a result of Quality Assurance (QA) Audit YM-ARP-95-06, the audit team determined that the Los Alamos National Laboratory (LANL) is satisfactorily implementing an effective QA program in accordance with the U. S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM) Quality Assurance Requirements and Description (QARD) DOE/RW-0333P, Revision 1, and LANL's implementing procedures for QA Program Elements 4.0, 7.0, and 17.0. QA Program Element 15.0 was found to have had no implementation.

The audit team also conducted a performance based audit of the activities reported in "Utilization of Autoradiography to Study the Effects of Fracture Coatings on Radionuclide Transport," by D. Vaniman, A. Furlano, J. Thompson, and I. Triay. This report was delivered to the Yucca Mountain Site Characterization Office and satisfied LANL Milestone #3414. The audit team determined that the product (a new technique to evaluate heavy radionuclide migration) described in the milestone report is adequate and that the implementation of the QA program through procedural requirements and controls, is effective with regard to this product and the processes which produced it.

The performance based evaluation of process effectiveness and product acceptability was based on: 1) proper implementation of the procedures critical process steps; 2) use of trained and qualified personnel working effectively; 3) documentation and observation that substantiates the quality of the products; and 4) acceptable results and the quality of the end products.

No Corrective Action Requests (CAR) were issued as a result of this audit. The audit team did identify one deficiency during the audit that was corrected prior to the postaudit meeting and is described in Section 5.5.2 of this report. Additionally, there was two recommendations resulting from the audit which are presented in Section 6.0 of this report.

## 2.0 SCOPE

The audit was conducted in two parts. The first was a limited scope audit for compliance to the implementing procedures of four QA program elements. The second was a performance based audit focused on a completed technical milestone supporting Work Breakdown Structure (WBS) 1.2.3.4.1.

Please note that the scheduled performance based audit of products resulting from work described by WBS 1.2.3.2.1.1, has been deferred to a future audit when those products will be closer to completion and more susceptible to a meaningful audit.

## LIMITED SCOPE PROGRAMMATIC AUDIT

The limited scope programmatic audit evaluated the implementation of the following QA program elements/requirements in accordance with the approved audit plan.

### QA PROGRAM ELEMENTS

- 4.0 Procurement Document Control
- 7.0 Control Of Purchased Items And Services
- 15.0 Nonconformances
- 17.0 Quality Assurance Records

## PERFORMANCE BASED AUDIT OF A TECHNICAL PRODUCT

LANL Milestone #3414 is a report of technical activity conducted under WBS 1.2.3.4.1 and is titled: "Utilization of Autoradiography to Study the Effects of Fracture Coatings on Radionuclide Transport," by D. Vaniman, A. Furlano, J. Thompson, and I. Triay. The product that the report describes and the processes which contribute to it were the subject of our performance based audit.

The performance based evaluation of process effectiveness and product acceptability was based on: 1) proper implementation of the procedures critical process steps; 2) use of trained and qualified personnel working effectively; 3) documentation and observation that substantiates the quality of the products; and 4) acceptable results and the quality of the end products.

The processes evaluated during the audit, in accordance with the approved audit plan, were those reported in the milestone report as follows:

### PROCESSES

1. Thin Section Preparation
2. Preparation and Analysis of Plutonium (Pu) Solution
3. Autoradiography
4. Optical Examination of Radiograms
5. Quantitative X-Ray Diffraction

## QA PROGRAM ELEMENTS/REQUIREMENTS

In addition, a sample of the applicable QA program requirements and controls as applied to these processes was examined to evaluate the degree of compliance to them. This sample was taken from the following QA program elements:

- 1.0 Organization
- 2.0 Quality Assurance Program
- 3.0 Design Control
- 4.0 Procurement Document Control
- 5.0 Implementing Procedures
- 6.0 Document Control
- 7.0 Control Of Purchased Items and Services
- 12.0 Control of Measuring and Test Equipment
- 17.0 Quality Assurance Records
- 18.0 Audits

Supplement I, Software  
Supplement II, Sample Control  
Supplement III, Scientific Investigation

### **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>QA Program Elements/Requirements, Processes, Activities or End-products</u>
Thomas J. Higgins, Audit Team Leader (ATL) Yucca Mountain Quality Assurance Division (YMQAD)	Milestone #3414
Paul L. Cloke, Technical Specialist Management and Operating contractor /Science Applications International Corporation (SAIC)	Milestone #3414
Kenneth T. McFall, Auditor, YMQAD	Milestone #3414
Amelia I. Arceo, Auditor, YMQAD	15.0 and 17.0
Robert B. Constable, Auditor, YMQAD	4.0 and 7.0

#### **4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED**

The preaudit meeting was held at the offices of Los Alamos Technical Associates (LATA) in Los Alamos, New Mexico, on January 9, 1995. 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 LATA offices in Los Alamos, New Mexico, on January 13, 1995. 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**

With regard to the limited scope programmatic portion of the audit, the audit team concluded that, in general, the LANL QA Program is being satisfactorily implemented within the scope of this audit. Individually, QA Program Elements 4.0, Procurement Document Control; 7.0, Control of Purchased Items and Services; and 17.0, QA Records, are satisfactorily implemented. QA Program Element 15.0, Nonconformances, has had no implementation due to lack of activity.

As a result of the performance based audit of Milestone #3414, the audit team concluded that the processes reported in the milestone report are satisfactory and produced a satisfactory product. In addition, the applied quality related controls derived for ten QA program elements and Supplements I, II, and III, have been effective in their application to the five technical processes that were the subject to the audit. The list of technical processes appears on Page 3 and is followed by the list of applicable QA program elements and supplements.

##### **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 Limited Scope 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 that are kept and maintained as QA Records.

## 5.4 Performance Based Audit Activities

### TECHNICAL EVALUATION

The product and the supporting processes that produce it are all determined to be technically adequate and satisfactory. The evaluation of individual process adequacy is presented in Attachment 2. A brief description of audit team activities appears below.

**THIN SECTION PREPARATION:** The complete preparation of a new thin section was observed. During this process, all the pertinent checklist items were answered in a highly satisfactory manner. This operation proceeds in a routine manner and the quality of the observed work was satisfactory.

**PREPARATION AND ANALYSIS OF PLUTONIUM SOLUTION:** Radiological safety, special nuclear materials controls and security requirements made it impractical to observe actual preparation of plutonium solution. In addition, the actual preparation is quite lengthy. Consequently, it was decided to observe as much of the process as feasible and to assess whether this limited demonstration of the process sufficed. This examination was deemed successful. Details recorded in the laboratory notebooks and procedures demonstrated that the preparation process was fully under control and that the solution prepared was indeed what it was purported to be. The laboratory in which the solution was prepared was visited, and the taking of a spectrum to demonstrate the characteristics of a non-radioactive but chemically similar element, was observed. The operation appears to proceed in a routine manner in keeping with the state-of-the-art in preparing nearly pure solutions of essentially a single oxidation state. Because improvements may be possible and because it is chemically impossible to produce solutions which contain only a single species, this process should occasionally be audited in the future. This process and its product are satisfactory.

**AUTORADIOGRAPHY:** This process involves the thin section to the plutonium solution, applying a photographic emulsion and development of the tracks produced by the alpha irradiation. Several parts of this process are still under development. As for the preparation of the plutonium solution, only a limited observation of the process was feasible without radiological training, and the complete production process requires several hours. Instead, each step was demonstrated by setting up the apparatus and describing in detail how the step would be performed. This was found to be a satisfactory compromise. This process and its product are satisfactory.

**OPTICAL EXAMINATION OF AUTORADIOGRAMS:** The technical specialist personally examined some of the autoradiograms and thin sections. This confirmed the reported observations in respect to the mineralogy, and the abundances and locations of the tracks. The mineralogical determinations are routine. The observations and characterization of the alpha tracks are entirely adequate for the present purposes. A particularly valuable development would be devising a means of preventing the thin section of rock from separating from the glass slide during the exposure to the plutonium solution. This would greatly facilitate the observation of the tracks. This process is satisfactory.

**QUANTITATIVE X-RAY DIFFRACTION:** The mounting of a powder sample and the taking of a diffraction pattern were observed. In addition, the apparatus for fine grinding the sample and the one for particle size analysis, were examined but not operated. Careful investigation was made into the quantification of the results and of possible errors or contamination. No problems were identified; these operations are routine. In the event that it becomes feasible to place the Rietveld process under configuration management for use in this project, a check should be made to confirm that this was done satisfactorily. This process and its product are satisfactory.

#### **EFFECTIVENESS OF QA PROGRAM CONTROLS**

Verification of compliance to a sample of QA program controls as specified in implementing procedures was conducted. The source QA program elements are listed in Section 2.0 of this report and the results of verification are found in Attachment 2. Compliance to those controls where activity required implementation was satisfactory.

### **5.5 Summary of Deficiencies**

The audit team identified one deficiency during the audit that was corrected prior to the postaudit meeting. Additionally, there were two recommendations resulting from the audit which are detailed in Section 6.0 of this report.

A synopsis of the deficiency corrected during the audit is detailed below.

#### **5.5.1 Corrective Action Requests**

No CARs were issued as a result of this audit.

## 5.5.2 Deficiencies Corrected During the Audit

Deficiencies that are considered isolated in nature and requiring only remedial action may be corrected during the audit. One deficiency was identified and corrected during the audit as described below:

1. Contrary to the requirements of Paragraph 6.1.8 of Quality Procedure LANL-YMP-QP-3.5, Revision 4, "Documenting Scientific Investigations," no signature/initials or date were included in the individual entries into notebook LA-CST-NBK-94-005. This notebook is in three ring binder format and is generated from computer files. In preparation for the audit, the notebook owner had reprinted the entire notebook following the most recent entry. This removed the computer generated entry dates from each entry and supplied no signature. The notebook was recovered from archived computer files and the notebook returned to its previous condition. This condition was found in no other binder notebook and was satisfactorily corrected prior to the postaudit meeting.

## 5.5.3 Follow-up of Previously Identified CARS

Two previously issued CARs were ready for verification of completed corrective action at the time of this audit. The reported conditions were to have been satisfactorily corrected and both CARs were recommended for closure.

### CAR YM-94-079

This CAR was issued on August 25, 1994, following identification of the condition during OCRWM Audit YMP-94-08 of LANL. This CAR addressed a lack of compliance to procedure TWS-INC-DP-35, Revision 2, regarding the use of buffer solutions in pH measurements.

During the course of the performance based audit, the Technical Specialist reviewed the historic impact of this condition as recorded in Scientific Notebook TWS-INC-01-93-12, as well as Revision 3 to the procedure which related to the corrective action addressed by the CAR. Both were determined to be acceptable and this CAR was recommended for closure.

### CAR YM-94-081

This CAR was issued on August 25, 1994, following identification of the condition during OCRWM Audit YMP-94-08 of LANL. It identified lack of compliance to procedure LANL-YMP-QP-03.5, Revision 2, regarding the failure to attach a statement to data explaining the acceptance or rejection of that data.

During the course of the performance based audit, a member of the audit team reviewed the corrective action required by this CAR. A randomly chosen sample of two of the five cited scientific notebooks were examined. These notebooks were TWS-CST-02-94-03 and TWS-INC-01-93-10. Both were determined to be acceptable and this CAR was recommended for closure.

## 6.0 RECOMMENDATIONS

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

1. During the programmatic audit of QA Program Element 17.0, QA Records, the auditor noted that the tracking system used by LANL to manage its QA records provided satisfactory results. However, the system for tracking in-process training records was marginal. It is recommended that LANL management consider improving its system for tracking in-process training documentation.
2. During autoradiography, some of the thin sections do separate from the glass slide during their exposure to the Pu solution during immersion in it. It is recommended that consideration be given to devising a means to prevent this separation.

## 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>
Arceo, A.	YMQAD/Auditor	X		X
Bish, D.	LANL/Mineralogy - Petrology - Rock Chemistry Technical Coord.	X	X	X
Bolivar, S.	LANL/QAPL		X	
Canepa, J.	LANL/TPO	X	X	X
Chavez, P.	LATA/Training Coord.	X	X	X
Chipera, S.	LANL/Assoc. Investigator - X-Ray Diffraction		X	
Clark, D.	LANL/Assoc. Investigator - Species		X	
Clevenger, M.	LANL/Deputy QAPL	X	X	
Cloke, P.	SAIC/Technical Specialist	X		X
Constable, R.	YMQAD/Auditor	X		
Day, J.	LATA/Project Quality Liaison			X
Furlano, A.	LANL/Geochemical Research Tech.	X	X	X
Gillespie, P.	LATA/QA Engineer	X	X	X
Higgins, T.	YMQAD/ATL	X		X
Kluk, E.	LANL/Analytical Research Tech.		X	
Mann, D.	LANL/Mechanical Tech.		X	
Martinez, C.	LATA/QA Engineer		X	X
Martinez, S.	LATA/Records Processing Center Operations Coord.	X	X	X
Mercer-Smith, J.	LANL/Site and Regulatory Investigations Leader	X		X
McFall, K.	YMQAD/Auditor	X		X
Palmer, P.	LANL/Research Tech.		X	
Poths, J.	LANL/Geochemical Technical Coord.	X		
Romero, B.	LATA/Document Control Coord.	X	X	X
Shay, R.	LATA/QA Liaison	X	X	X
Sherman, R.	LANL/Technical Staff		X	
Strietelmeier, B.	LANL/Research (Tech. Transport)	X	X	X
Tait, C.	LANL/PI - Solubility Research	X	X	X
Thompson, J.	LANL/Technical Staff		X	
Triay, I.	LANL/PI - Dynamic Transport Columns			X
Vaniman, D.	LANL/PI - Transport Pathways	X	X	X
Weaver, S.	LANL/Technical Data Specialist	X	X	X
Wichman, L.	LATA/QA Liaison	X	X	X

**LEGEND:**

Assoc. = Associate

Coord. = Coordinator

LATA = Los Alamos Technical Associates

PI = Principal Investigator

QAPL = Quality Assurance Project Leader

Tech. = Technician

TPO = Technical Project Officer

Limited Scope Compliance Audit								
Checklist YM-AR-95-06-01								
QA Program Element Evaluated	PROCEDURE	Details (Checklist Item)	CAR	CDA (Report Section)	Recommendations (Report Section)	Adequacy	Compliance	Overall
4	LANL-YMP-QP-0.4.6, Revision 1	4-1 thru 4-31	N	N	N	na	SAT	S A T
7			N	N	N	na	SAT	
15	YAP-15.1Q, Revision 1	15-1 thru 15-4	N	N	N	na	NI	
17	LANL-YMP-QP-17.6, Revision 1	17-1 thru 17-22	N	N	6.0-1	na	SAT	

CDA = Corrective Action Completed During Audit    N = No    na = Not Applicable    NI = No Implementation    SAT = Satisfactory

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<b>Activity: Thin Section Preparation</b>		<b>Details (Technical Checklist YM-AR-95- 06-02 (T) Item)</b>	<b>CAR No. (Item)</b>	<b>CDA (Report Section)</b>	<b>Recom- mendation (Report Section)</b>	<b>Adequacy and Compliance</b>	<b>Evaluation</b>	
<b>Process Step Evaluated</b>	<b>Procedure / Lab Notebook</b>						<b>Individual</b>	<b>Overall</b>
Cut Sample Block	LANL-EES-DP-130	T-1	N	N	N	na	SAT	<b>SAT</b>
Shape & Smooth Block	LANL-EES-DP-130	T-1	N	N	N	na	SAT	
Mount on Glass Slide	LANL-EES-DP-130	T-1	N	N	N	na	SAT	
Slice Thin Section from Block	LANL-EES-DP-130	T-1	N	N	N	na	SAT	
Grind to Thickness	LANL-EES-DP-130	T-1	N	N	N	na	SAT	
Polish	LANL-EES-DP-130	T-1	N	N	N	na	SAT	

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Activity: Pu Solution Preparation/ Analysis		Details (Technical Checklist YMAR-95-06-02 (T) Item)	CAR No. (Item)	CDA (Report & Item)	Recom- dation (Report Section)	Adequacy and Compliance	Evaluation	
Technical Evaluation							Individual	Overall
Process Step Evaluated	Procedure / Lab Notebook							
Prepare Pu Solution	LANL-INC-DP-78 LANL-INC-DP-35 TWS-INC-01-93-12	T-2	N	N	N	na	SAT	S A T
Obtain UV Spectrum of Pu Solution	LANL-INC-DP-85 TWS-INC-01-93-12	T-2	N	N	N	na	SAT	
Calibrate UV Spectrometer	LANL-EES-DP-24 LA-CST-NBK-94.005	T-2	N	N	N	na	SAT	

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Activity: Autoradiography		Details (Technical Checklist YM-AR-95-06-02 (T) Item)	CAR No. (Item)	CDA (Report & Item)	Recom- dation (Report Section)	Adequacy and Compliance	Evaluation	
Technical Evaluation							Individual	Overall
Process Step Evaluated	Procedure / Lab Notebook							
Prepare Synthetic Ground Water Solution & Dilute Pu Solution	TWS-INC-01-93-08 TWS-CST-01-94-01	T-3, 4	N	N	N	na	SAT	S A T
Expose Thin Section to Pu Solution	LACST10-NBK-94-005	T-5	N	N	6.0-2	na	SAT	
Rinse & Dry	LACST10-NBK-94-005	T-5	N	N	N	na	SAT	
Make Rough Measurement of Alpha Radioactivity	LACST10-NBK-94-005	T-6, 7	N	N	N	na	SAT	
Coat Thin Section with Photographic Emulsion	LACST10-NBK-94-005	T-8 to 16	N	N	N	na	SAT	

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Activity: Optical Examination of Radiograms  Technical Evaluation		Details (Technical Checklist YM-AR-95-06-02 (T) Item)	CAR No. (Item)	CDA (Report & Item)	Recommendation (Report Section)	Adequacy and Compliance	Evaluation	
Process Step Evaluated	Procedure / Lab Notebook						Individual	Overall
Determine Mineralogy of Specimen through Optical Microscopy	LANL-EES-DP-03	T-17	N	N	N	na	SAT	S A T
Evaluate Location and Density of Alpha Tracks Relative to Sample Mineralogy and Physical Features	LA-EES-1-NBK-94-001	T-17	N	N	N	na	SAT	
Correlate and Evaluate the Above Results	LA-EES-1-NBK-94-001	T-17	N	N	N	na	SAT	

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Activity: Quantitative X-Ray Diffraction Technical Evaluation		Details (Technical Checklist YM-AR-95-06-02 (T) Item)	CAR No. (Item)	CDA (Report & Item)	Recom- dation (Report Section)	Adequacy and Compliance	Evaluation	
Process Step Evaluated	Procedure / Lab Notebook						Individual	Overall
Powder Sample & Add Reference Standard	TWSESS-1-389-17 LANL-EES-DP-56 TWS-ESS-1-8/86-57	T-18	N	N	N	na	SAT	S A T
Calibrate Diffractometer	LANL-EES-DP-24 TWS-ESS-1-1-90-1	T-20	N	N	N	na	SAT	
X-Ray Diffraction Spectrum	LANL-EES-DP-16 TWS-ESS-1-1-90-1	T-19	N	N	N	na	SAT	
Evaluate Spectrum Results	TWS-ESS-1-1-90-1	T-19	N	N	N	na	SAT	

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Application of QA Requirements								
QA Program Element Evaluated	Control Type	Details (Checklist YM-AR-95-06-02 Item)	CAR	CDA (Report Section)	Recommendations	Adequacy	Compliance	Overall
1	Interface: Information Transfer	R-4	N	N	N	na	SAT	E F F E C T I V E
2	Training, Reviews, Surveillance	R-1,2, 3, 4, 5, 9, 10, 15	N	N	N	na	SAT	
3	Planning Documents	R-2, 4, 6	N	N	N	na	SAT	
4	Procurement Document Control	R-15	N	N	N	na	NI	
5	Work to Procedures	R-6, 11	N	N	N	na	SAT	
6	Document Control	R-6	N	N	N	na	SAT	
7	Procurement Process Control	R-15	N	N	N	na	NI	
12	Instrument Control , Calibration	R-14	N	N	N	na	SAT	
17	QA Records	R-12	N	N	N	na	SAT	
18	Audit	R-1	N	N	N	na	NI	
S-I	Use of Software	R-13	N	N	N	na	SAT	
S-II	Sample Control	R-7, 8, 17	N	N	N	na	SAT	
S-III	Use of Scientific Notebooks, Planning, Notebook procedures, Record of Data	R-2, 4, 5, 6, 11, 12	N	5.5.2-1	N	na	SAT	