

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

AUDIT REPORT  
OF THE  
CIVILIAN RADIOACTIVE WASTE MANAGEMENT AND OPERATING  
CONTRACTOR

AT  
LOS ALAMOS NATIONAL LABORATORY  
LOS ALAMOS, NEW MEXICO

AUDIT NUMBER LANL-ARP-97-12  
JUNE 2-6, 1997

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ENCLOSURE

## 1.0 EXECUTIVE SUMMARY

As a result of Performance Based Quality Assurance (QA) Audit LANL-ARP-97-12, the audit team determined that the Los Alamos National Laboratory (LANL) is satisfactorily implementing an adequate and effective QA program and process controls for work performed under Work Breakdown Structure (WBS) number 1.2.3.3.1.3.1, "Site Saturated Zone Ground-Water Flow System," specifically, "Results, Analysis, and Interpretation of Tracer Tests in the Lower Bullfrog Tuff at the C Wells, Yucca Mountain, Nevada." 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 6. In addition, overall adequacy of and compliance with selected LANL implementing procedures were found to be satisfactory.

The audit team identified one deficiency during the audit that resulted in the issuance of Deficiency Report (DR) YM-97-D-061, described in Section 5.5.2 of this report. Additionally, there was one condition corrected during the course of the audit and three recommendations which are detailed in Sections 5.5.4 and 6.0 of this report.

## 2.0 SCOPE

The audit was conducted to evaluate the effectiveness of LANL's process controls associated with the milestone "Results, Analysis, and Interpretation of Tracer Tests in the Lower Bullfrog Tuff at the C Wells, Yucca Mountain, Nevada." The audit was intended to determine the degree to which the resultant product meets the program requirements and management commitments and expectations, as well as to determine that LANL completed the work in accordance with pertinent sections of the QARD.

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

### END PRODUCT

"Results, Analyses, and Interpretation of Tracer Tests in the Lower Bullfrog Tuff at the C Wells, Yucca Mountain, Nevada," Milestone SP2370M4; part of WBS # 1.2.3.3.1.3.1, "Site Saturated Zone Ground-Water Flow System" was selected for evaluation during the audit.

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

1. Satisfactory completion of the critical process steps;

2. Acceptable results and quality of the end product;
3. Documentation that substantiates the quality of the product;
4. Performance of trained and qualified personnel working effectively;
5. Implementation of applicable QA Program Elements

The LANL process controls for WBS 1.2.3.3.1.3.1 and its associated end-product, Milestone SP2370M4, were evaluated for the following critical process steps:

1. Selection of tracers
2. Selection of transport model(s)
3. Scoping calculations
4. Establishment of saturated zone steady state
5. Data analysis technique
6. Tracer testing
7. Data analysis
8. Reporting results

#### QA PROGRAM ELEMENTS

In addition, a sample of applicable program requirements and controls, as they applied to Milestone SP2370M4 was examined to evaluate the degree of compliance. The following QA Program Elements were evaluated:

2.0	Quality Assurance Program
5.0	Implementing Documents
6.0	Document Control
12.0	Control of Measuring and Test Equipment
17.0	Quality Assurance Records
Supp I	Software
Supp II	Sample Control
Supp III	Scientific Investigations

#### 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 of this report.

### **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 Process/Activities or End Products</u>
Kenneth T. McFall, Audit Team Leader, OQA	17.0, Supp I, Supp II, Supp III
Daniel J. Tunney, Auditor, OQA	2.0, 5.0, 6.0, 12.0
Keith M. Kersch, Technical Specialist CRWMS M&O	WBS# 1.2.3.3.1.3.1
Susan W. Zimmerman, Observer State of Nevada	

#### 4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

The preaudit meeting was held at the Quality Assurance Technical Support and Services (QATSS) contractors representative's offices in Los Alamos, New Mexico, on June 2, 1997. A daily debriefing and coordination meeting was held with LANL management and staff, and daily audit team meeting were held to discuss issues and potential deficiencies. The audit was concluded with a postaudit meeting held at the QATSS offices in Los Alamos, New Mexico on June 6, 1997. 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 1.2.3.3.1.3.1, "Site Saturated Ground-Water Flow System," specifically, "Results, Analysis, and Interpretation of Tracer Tests in the Lower Bullfrog Tuff at the C Wells, Yucca Mountain, Nevada" report were found to be effective.

##### 5.2 Stop Work or Immediate Corrective Action 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 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

The technical scope of the audit consisted of examination of the work leading to the production of the report: "Results, Analysis and Interpretation of Tracer Tests in the Lower Bullfrog Tuff at the C Wells, Yucca Mountain, Nevada."

Discussions were held with the Principal Investigator (PI), Paul Reimus, and with the following support staff: Dale Counts, Robb Habbersett, and Brad Gundlach. All of the people interviewed seemed well trained and technically qualified. They all were strongly committed to the concepts expressed in the quality assurance program.

LANL considers this a progress report on studies comparing transport of conservative and reactive tracers in the Lower Bullfrog Tuff. As a progress report, the analyses are not complete, and full quality assurance program implementation is not in place. This scientific investigation employs good test design, experimental techniques, and analysis.

In this study, a mixture of reactive and conservative tracers was injected into one well and the relative responses examined in a nearby well. Polystyrene microspheres with a fluorescent dye tag were used as one tracer, and the other tracers were pentafluorobenzoic acid (PFBA), and lithium bromide (lithium and bromide are separate ionic tracers). The micro spheres are a nonreactive colloid surrogate.

This study shows that even though flow occurs principally through fractures, there is significant retardation and diffusion of reactive tracers into the rock matrix. This confirms the conceptual model that there will be significant retardation of radio nuclides by the rock matrix.

Most of the discussions during the audit were with Paul Reimus. He is technically qualified and is doing a good job as the PI. His formulation of mathematical models for data analysis and his analysis techniques were discussed. He is using a customized model formulation with a Laplace Transform inversion, and a random search regression technique. The technique selects parameters in the mathematical model that produce a least squares best fit between observed and calculated values. The technique allows the user to specify constraints on the solution.

Dale Counts conducted most of the chemical analyses to determine the concentration of chemical tracers in the produced water. Lab notebooks, instrumentation manuals, and calibration records documenting the analyses were examined. The documentation seemed adequate to enable future reviewers to duplicate the types of measurements made.

Robb Habbersett set up the flow cytometer, which was used to determine concentration of microspheres in produced water samples. This is a unique, one-of-a-kind instrument capable of counting individual cells, microspheres or colloid particles. We reviewed the documentation on the instrument and published reports describing its operation. It appears that the instrument is accurate and capable of performing the measurements for which it is designed. Because it is such a unique instrument, it was felt that the procedure, LANL-EES-4-DP-803, Revision 0, "Use of a Flow Cytometer to Determine Particle Concentrations in Solution" and Scientific Notebook LA-EES-4-NBK-95-002 used in documenting the analysis may not include enough technical detail or marginally include enough detail to allow a qualified individual to duplicate the achieved results. It is recommended that more detailed documentation of the process be developed. (See Recommendation 6.3)

Brad Gundlach is in charge of software qualification. Los Alamos considered the product that was audited to be a progress report, so no software qualification was considered to be required at the present time. The software life cycle had not been initiated on the software that had been used in the analysis of the data for this activity. Brad Gundlach and Paul Reimus expect that software qualification will be completed later in this year. (See YM-97-D-061)

There are several references to information and/or data sources such as telephone conversations and personal communications mentioned in the milestone. Although these conversations and communications may involved qualified data, that data must be traceable to accepted documentation. Additionally, the quality status of the report (milestone) needs to be presented up front in the report with details differentiating what data is considered qualified and non-qualified. (See Recommendations 6.1 and 6.2). This designation will serve as a caveat to other users of the report/data.

## 5.5 Summary of Deficiencies

The audit team identified one deficiency during the audit for which one DR has been issued.

A synopsis of the deficiency documented as a Deficiency Report (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-061. Software requirements of Supplement I of the QARD for the codes "RELAP" and "RETRAN" were not completed or initiated prior to their use in the report on WBS 1.2.3.3.1.3.1.

**5.5.3 Performance Reports (PR)**

None

**5.5.4 Deficiencies Corrected During the Audit**

The use of PFBA standards was documented on pages 56 through 60 of laboratory notebook LA-EES-I-NBK-96-006. The preparation of these PFBA standards was not documented as required by procedure LANL-EES-4-DP-802, Revision 2, "Preparation of Standards for Tracer Concentration Measurement." To correct this, an entry describing the preparation of these standards was made on page 87 of this notebook.

**5.5.5 Follow-up of Previously Identified Deficiency Documents**

There were no previously identified deficiency documents pertaining to this Milestone.

**6.0 RECOMMENDATIONS**

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

- 6.1 Prior to the evolution of this deliverable to a Level 3 deliverable, it is recommended that all references to information and data sources such as telephone conversations and personal communications be detailed and traceable to accepted documentation.

- 6.2 It is recommended that the quality status of the results and data contained in the deliverable be clearly described in the front of the report. This declaration needs to be detailed, differentiating what is acceptable for licensing and what is not.

It was stated during the audit that the CRWMS M&O management directed the downgrading of the deliverable from a Level 4 to a status report.

- Quality determinations are not based on what level the deliverable is, but rather the end use of data -- and there is a process for that.
- What is the CRWMS M&O management going to do to preclude this from happening again?

- 6.3 It is recommended that the flow cytometer procedure (LANL-EES-4-DP-803, Revision 0), "Associated References" (Section 3), and Laboratory Notebooks contain sufficiently detailed instructions to enable the measurements to be repeated. More detail may be needed in the procedure, a separate report, or the scientific notebook. Currently, the reproducibility may be considered marginal.

## 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>
Gilles Y. Bussod	LANL/Project Leader	X		
Michael J. Clevenger	LANL/QA Project Leader	X	X	X
Dale Counce	LANL/Research Technician		X	
Brad Gundlach	LTA/QA Software Coordinator		X	X
Robb Habbersett	LANL/Flow Cytometer Specialist		X	
Cleoves B. Martinez	LATA/QA Technical Assurance	X	X	X
Sandra J. Martinez	LATA/Records Coordinator		X	
Paul W. Reimus	LANL/PI	X	X	X
Larry A. Souza	OQA/LANL Representative	X	X	X
Karen West	LANL	X		X

**Legend:**

LATA - Los Alamos Technical Associates

PI - Principal Investigator

ATTACHMENT 2

**AUDIT LANL-ARP-97-12 - DETAIL SUMMARY FOR PROCEDURAL COMPLIANCE EVALUATIONS**

PE	IMPLEMENTING DOCUMENTS	DETAILS (Checklist)*	PROGRAM IMPLEMENTATION	PROCEDURE IMPLEMENTATION	OVERALL
2	QP-02.7, Revision 4	Page 1	SAT	SAT	SAT
	QP-02.11, Revision 5	Page 2	SAT	SAT	SAT
5	QP-03.23, Revision 4	Pages 16-17	SAT	SAT	SAT
6	QP-06.1, Revision 8	Page 18	SAT	SAT	SAT
12	QP-12.3, Revision 3	Page 26	SAT	SAT	SAT
17	QP-17.6, Revision 5	Pages 27-30	SAT	SAT	SAT
SI	QP-03.21, Revision 7	Pages 34-40	SAT	UNSAT YM-97-D-061	SAT
SII	QP-08.1, Revision 5	Pages 19-25	SAT	SAT	SAT
SIII	QP-03.5, Revision 7	Pages 3-12	SAT	SAT Recs. 6.1, 6.2	SAT

\* Checklist pages 13-15 and 31-33 were not audited

Legend:

- N .... None
- PE .... Program Element
- REC .... Recommendation
- SAT .... Satisfactory

ATTACHMENT 2

**AUDIT LANL-ARP-97-12 - DETAIL SUMMARY FOR PRODUCT PROCESS EVALUATION**

QA ELEMENT/ ACTIVITIES	PROCESS STEPS/MGMT OBJECTIVES	DETAILS (Checklist)	DEFICIENCIES	REC	PROCESS EFF.	PRODUCT ADEQUACY	OVERALL
Results, Analysis, and Implementation of Tracer Tests in the Lower Bullfrog Tuff at the C Wells, Yucca Mountain, Nevada	Selection of Tracers	T-2, T-12	N	N	SAT	SAT	SAT
	Selection of Transport Models	T-5, T-13	N	N	SAT	SAT	
	Scoping Calculations	T-3, T-4, T-15	N	N	SAT	SAT	
	Establishment of Saturated Zone Steady State	T-9, T-10, T-11	N	N	SAT	SAT	
	Data Analysis Technique	T-8, T-13, T-14, T-19, T-20, T-21, T-22	N	N	SAT	SAT	
	Tracer Testing	T-14, T-16, T-6	N	N	SAT	SAT	
	Data Analysis	T-6, T-7, T-18	N	N	SAT	SAT	
	Reporting Results	T-1, T-8, T-17	YM-97-D-061	6.1, 6.2, 6.3	UNSAT	SAT	