



Department of Energy

Washington, DC 20585

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**OCRWM QA AUDIT YM-ARP-96-14 OF THE CIVILIAN RADIOACTIVE WASTE
MANAGEMENT SYSTEM MANAGEMENT AND OPERATING CONTRACTOR'S
SUPPORT OF THE YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT AT
LANL**

Enclosed is the report of the Office of Civilian Radioactive Waste Management (OCRWM) Quality Assurance (QA) Audit YM-ARP-96-14. The audit was conducted by Yucca Mountain Quality Assurance, Office of Quality Assurance (OQA) at the Los Alamos National Laboratory offices in Los Alamos, New Mexico, and Las Vegas, Nevada, during the period of September 16-23, 1996.

During the course of the audit, the audit team identified six deficiencies for which four OCRWM Deficiency Reports (DR) have been issued. Responses to the DRs are due by the dates indicated in Block 12 of the DRs. One deficiency was identified and corrected prior to the post-audit meeting and one deficiency will be resolved by an open OCRWM DR. Five recommendations also resulted from the audit, four of which were presented for consideration by Project Office management. A response to this audit report and any documented recommendations is not required.

The audit is considered completed and closed as of the date of this letter; however, the open DRs will continue to be tracked until they have been closed to the satisfaction of the QA representative and the Director, OQA.

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OCT 28 1996

If you have any questions, please contact either James Blaylock at (702) 794-1420 or Stephen R. Dana at (702) 794-1496.

James Blaylock for
Donald G. Horton, Director
Office of Quality Assurance

OQA:JB-0131

Enclosure:
Audit Report YM-ARP-96-14

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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

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO
AND
LAS VEGAS, NEVADA

AUDIT NUMBER YM-ARP-96-14
SEPTEMBER 16 THROUGH 23, 1996

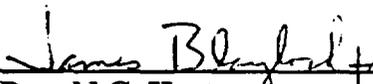
Prepared by:


Stephen R. Dana
Audit Team Leader
Yucca Mountain Quality Assurance

Date:

10/23/96

Approved by:


Donald G. Horton
Director
Office of Quality Assurance

Date:

10/25/96

Enclosure

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1.0 EXECUTIVE SUMMARY

As a result of performance-based Quality Assurance (QA) audit YM-ARP-96-14, the audit team determined that the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) at the Los Alamos National Laboratory (LANL) is satisfactorily implementing an adequate and effective QA Program and process controls, with the exception of those program areas where deficiencies exist for work performed under Work Breakdown Structure (WBS) 1.2.3.2.5.1.1, "Probability of Volcanic Eruption," 1.2.3.2.5.1.2, "Effects of a Volcanic Eruption Penetrating the Repository," and WBS 1.2.3.2.5.5.1, "Characterization of Volcanic Features." Areas judged by the audit team to be marginally effective include technical review of the 1996 Volcanism Synthesis Report (1996 VSR), identification of data qualification status in the 1996 VSR, independent review of data in scientific notebooks, and turnover of scientific notebooks to the Records Processing Center (RPC). The LANL QA Program examined during this audit is 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 5.

The audit team identified six deficiencies that resulted in the issuance of four Deficiency Reports (DR) described in Section 5.5.2.

DR YM-96-D-105: Scientific notebooks were identified with dates that would indicate they are complete, however, they have not been submitted to the RPC, and the investigators are no longer working on the Yucca Mountain Site Characterization Project (YMP).

DR YM-96-D-106: There was no objective evidence that an independent review of some data associated with LANL scientific notebooks was performed.

DR YM-96-D-107: The 1996 VSR, Preface identifies all of the data cited in Chapters 3, 4, and 6, and the revised sections of Chapter 2 as "Q" data, however, unqualified data sources were used in some of the chapters. The resultant data should have been identified as unqualified.

DR YM-96-D-108: The LANL technical review was completed for the 1996 VSR and forwarded for Project Office acceptance without identifying and correcting data problems.

The audit team identified one deficiency during the audit which will be resolved through open OCRWM DR YM-96-D-073, identified during OCRWM audit YM-ARC-96-16. This deficiency concerned the lack of a documented QA Program for analytical services.

There was one deficiency identified by the audit team and corrected prior to the postaudit meeting. This condition is described in Section 5.5.4 of this report. Additionally, there were five recommendations resulting from the audit, which are detailed in Section 6.0 of this report.

2.0 SCOPE

The audit was conducted to evaluate adequacy and effectiveness of LANL's processes and activities associated with volcanism studies and the adequacy of end-products produced as a result of these studies. Also, for activities associated with volcanism studies, the audit evaluated compliance to the LANL QA Program, as described in the QARD and LANL implementing procedures.

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 the 1995 "Status of Volcanism Studies for the Yucca Mountain Site Characterization Project" (1995 VSR), LA-12908-MS, and the 1996 "Volcanism Synthesis Report" (1996 VSR), Milestone 3781, were selected for evaluation from WBS elements 1.2.3.2.5.1.1, "Probability of Volcanic Eruption," 1.2.3.2.5.1.2, "Effects of a Volcanic Eruption Penetrating the Repository," and 1.2.3.2.5.5.1, "Characterization of Volcanic Features."

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 LANL activities for WBS 1.2.3.2.5.1.1 and 1.2.3.2.5.5.1, and their associated end-products, were evaluated for the critical process steps listed below. The activities for WBS 1.2.3.2.5.1.2 were evaluated for critical process steps 1 and 2.

1. Sample Control (Supplement II)
2. Data Control (Supplement III)
3. Analytical Method (Supplement III)
4. Software Control (Supplement I)
5. Model Output (Supplement III)
6. Data Update and Changes (Supplement III)

In addition, a sample of applicable QA Program requirements and controls, as they applied to Volcanism studies and the 1996 VSR, were examined to evaluate the degree of compliance. These elements were evaluated for applicability and compliance:

- 2.0 QA Program (Qualification and Training of Personnel)
- 5.0 Implementing Documents
- 6.0 Document Control
- 7.0 Control of Purchased Items and Services
- 12.0 Control of Measuring and Test Equipment
- 17.0 QA Records

TECHNICAL AREAS

The audit included a technical evaluation of the development process and adequacy of the 1995 VSR and the 1996 VSR. 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>
Stephen R. Dana, Audit Team Leader, Yucca Mountain Quality Assurance (YMQA)	2.0, 5.0, 6.0, 7.0, 12.0, 17.0, Supplements I & III

Mary G. McDaniel, Auditor,
YMQA

Supplements II & III
WBS 1.2.3.2.5.1.1
WBS 1.2.3.2.5.1.2
WBS 1.2.3.2.5.5.1
1995 VSR & 1996 VSR

John M. Savino, Technical Specialist,
M&O/Science Applications International
Corporation

WBS 1.2.3.2.5.1.1
WBS 1.2.3.2.5.1.2
WBS 1.2.3.2.5.5.1
1995 VSR & 1996 VSR

Jack Spraul, Observer,
U.S. Nuclear Regulatory Commission (NRC)

John Trapp, Observer, NRC

Bill Belke, Observer, NRC

Susan Zimmerman, Observer,
State of Nevada

Carl Johnson, 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 September 16, 1996. A 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 Las Vegas, Nevada, on September 23, 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, in general, LANL process controls are effectively being implemented for areas identified in the scope of this audit. Areas judged by the audit team to be marginally effective include technical review of the 1996 VSR, identification of data qualification status in the 1996 VSR, independent review of technical data associated with scientific notebooks, and turnover of scientific notebooks to the RPC.

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 performed at the LANL office in Los Alamos, New Mexico, and Las Vegas, Nevada. The audit focused on those processes and activities associated with the development of the 1995 "Status of Volcanism Studies for the Yucca Mountain Site Characterization Project," LA-12908-MS, and the draft version of the 1996 "Volcanism Synthesis Report," Milestone 3781. The 1996 VSR presents results from concluding volcanism studies and, in its present form, adds new information obtained since completion of the 1995 VSR. These two reports cover the complete history of the LANL volcanism program conducted for the YMP from 1979 through mid-1996.

The objective of the overall volcanism program has been to evaluate the possible recurrence of volcanic activity during the post-closure period of a potential repository that may be sited at Yucca Mountain. As described in Section 2 of this report activities associated with three WBS elements that address this objective were selected for evaluation during the audit. A technical checklist that addressed the three WBS element areas of investigation was prepared to examine specific data or interpretation issues

included in the 1995 and 1996 VSR's. Sources of information used for the preparation of the checklist included current revisions of Study Plans 8.3.1.8.5.1, 8.3.1.8.1.2, and 8.3.1.8.1.1, interim milestone reports (level 3 and 4 deliverables), the 1995 and 1996 VSR's, participant project reports, papers from the open literature cited by the LANL investigators, and LANL procedures covering field and laboratory investigations. The order of the audit evaluation corresponds to the previously listed order of study plans and was chosen to maximize efficiency of LANL personnel availability and travel considerations.

Characterization of Volcanic Features (1.2.3.2.5.5.1) - The objective of this part of the volcanism program is to acquire the geochronology, field, and geochemistry data that are needed to decipher the history of Cenozoic (with emphasis on the late Miocene/Quaternary) volcanic activity in the Yucca Mountain area. These data feed into studies that are included under the other two study plans mentioned above.

The audit began with an evaluation of the analytical techniques used for acquiring the geochronology data. The dating techniques addressed were $^{40}\text{Ar}/^{39}\text{Ar}$, ^3He , U-Th disequilibrium, and thermoluminescence (TL). It should be noted that while deficiencies were identified with certain aspects of this program area (see Section 5.5.2 of this report), the conclusion of the audit team, after examination of samples and documentation of field and laboratory data, is that the scientific techniques used by LANL involved in the age determinations are state-of-the-art. The problems identified during the audit do not impact the conclusions drawn in the 1996 VSR.

A major accomplishment in the geochronology of the Yucca Mountain volcanic centers reported in the 1996 VSR is the convergence of results from the different techniques, in contrast to the general discordant results that prevailed at the time of the writing of the 1995 VSR. In particular, new $^{40}\text{Ar}/^{39}\text{Ar}$ age determinations made for LANL by the New Mexico Bureau of Mines during FY96 for the Lathrop Wells volcanic center proved to be highly reproducible and generally concordant with existing ^3He and ^{36}Cl cosmogenic exposure ages and with new TL ages. Together these techniques indicate that the Lathrop Wells center formed between 65 and 85 ka. The only defensible evidence contrary to this conclusion is a U-Th disequilibrium isochron age of 50 ± 15 ka from the stratigraphically youngest flow at Lathrop Wells, which leaves open the possibility that some eruptive activity took place 10-20 ka after the majority of the volcanic center had formed.

Issues that have been identified for consideration as a result of the audit have to do with the continuing development of the geochronology techniques. These issues involve data succession, reporting accuracy, and qualification. Regarding succession, in Chapter 2 of the 1996 VSR certain data sets are clearly identified as superseding all previous related

data (e.g., the FY96 revisions presented on page 2-61 for the $^{40}\text{Ar}/^{39}\text{Ar}$ age determinations for eruptive units at Lathrop Wells). In another case, however, data presented in a Milestone 4049 report (submitted after issuance of the 1995 VSR but before the submittal of the 1996 VSR) on TL age determinations were not incorporated in the 1996 VSR. Data reporting accuracy and qualification issues are addressed in deficiency reports YM-96-D-106 through YM-96-D-108 and recommendations discussed in Sections 5.5.2 and 6.0 of this report, respectively.

An extensive body of geochemical data has been acquired for the volcanic centers in the Yucca Mountain region. The audit team reviewed field, sample, and scientific notebooks documenting the major and trace-element chemistry, Nd, Sr, and Pb isotopes, and mineral chemistry data acquired for the Lathrop Wells volcanic center, in particular. These data were obtained from four techniques: x-ray fluorescence, instrumental neutron activation analysis (INAA performed at Washington University in Saint Louis), isotope dilution (performed at the University of Colorado), and electron microprobe. The PI described to the audit team the complete process involved in analyzing any given sample (a sample from the Qs4a volcanic unit at Lathrop Wells was picked by the audit team) starting with sample selection in the field and concluding with complete documentation of results. The team compared INAA results for the Qs4a sample documented the PI's scientific notebook to results presented in a LANL publication by Frank V. Perry and Kelly T. Straub (1996 - LA-13113-MS). All notebooks were found to be in compliance with Project requirements and data adequately documented in terms of traceability and consistency.

Alternative petrogenetic models that best account for the geochemical variations observed at Lathrop Wells were addressed. The possible models tested are 1) fractional crystallization, 2) crustal contamination/mantle mixing, and 3) mantle melting (partially tested). Models 1 and 2, which successfully account for the geochemical variations observed at other small volume volcanic centers, cannot account for the data at Lathrop Wells. Thus, the study of understanding the physical processes that produced the geochemical variations remains incomplete.

An issue for the Project Office is the final disposition of samples collected for the geochronology, geochemistry, and related studies from the volcanic centers in the Yucca Mountain region. Many of the samples are located at the offices of LANL personnel and at the offices of several of the subcontractors to LANL.

Effects of a Volcanic Eruption Penetrating the Repository (1.2.3.2.5.1.2) - The scope of the audit with respect to this activity was limited to questions concerning field and laboratory activities relative to analysis of eruptive and subsurface effects-at analog

volcanic sites. The activities include sample selection and collection, lithic fragment field measurements, observations of the distribution and geometry of dikes, and the determination of geochemical and mineralogical effects of basaltic intrusions.

The audit team reviewed the PI's field notebook and sample logbook for data on xenoliths erupted from small-volume basaltic volcanoes of the Lucero volcanic field in New Mexico and the San Francisco volcanic field in Arizona. While the data collection activities were noted by the audit team to be well documented, there was no evidence of an independent verification of calculations based on the field data. The results of this study are presented in detail in Chapter 5 of the 1996 VSR and have been published in a peer-reviewed journal (i.e., Greg A. Valentine and Kristelle R. Groves, *Journal of Geology*, 1996, Volume 104, p.71-90; "Entrainment of Country Rock during Basaltic Eruptions of the Lucero Volcanic Field, New Mexico"). The QA status of the data supporting this investigation is described in the Preface to the 1996 VSR.

A question asked of the PI regarding this work has to do with the acquisition of xenolith data in the field. As described to the audit team, field measurements were made by a team, one person (the PI) making the measurements and calling them out to a second person who records them in a field notebook. While field measurements were not repeated at a volcanic exposure, given the magnitude of errors introduced by other sources (see page 5-10 of the 1996 VSR) and the large number of measurements at an exposure, the fact that measurements were not independently repeated is not thought to significantly impact the results.

Field analog studies were conducted at Paiute Ridge in southern Nevada and Grants Ridge in New Mexico. The objective of these studies was to determine the factors that control shallow basaltic intrusion geometry and the geochemical and mineralogical effects of basaltic intrusions on silicic pyroclastic host rocks. The field notebooks that document the supporting data for these studies were reviewed in part by the audit team and found to be sufficiently well detailed and properly reviewed. The results of these analog studies are described on pages 5-15 to 5-41 of the 1996 VSR, with supporting geochemical and mineralogical data documented in Tables 5-3 through 5-9.

The information that will be available from the studies of the eruptive and subsurface effects of magmatism for performance assessment calculations is 1) xenolith volume fraction estimates from the Lucero Volcanic and the San Francisco Volcanic fields, 2) lithic fragment entrainment rates from the Lucero field, and 3) estimates of the alteration extent of basaltic intrusions from the analog studies at Paiute Ridge and Grants Ridge. The QA status of the supporting data is described in the Preface to the 1996 VSR.

Regarding the final disposition of samples collected for these studies, the PI noted that he would be shipping all samples in his possession to the Sample Management Facility in the near future.

Probability of Magmatic Disruption of the Repository (1.2.3.2.5.1.1) - The objective of this activity was to evaluate the probability of magmatic disruption of a potential repository located at Yucca Mountain by future basaltic volcanic activity. The primary data sources for this evaluation are from 1) investigations performed under Characterization of Volcanic Features, and 2) the geology and geophysics programs being conducted in the Yucca Mountain region. The audit team focused on the results of the probability evaluation, as described in the 1995 VSR and the 1996 VSR.

Questions for the PI responsible for this work addressed how results from the Probabilistic Volcanic Hazard Assessment (PVHA) conducted by an expert judgment panel and the project-wide synthesis effort in geology and geophysics were incorporated into final probability evaluations. The first point that the PI made was that the final estimate of the probability of disruption of a potential repository at Yucca Mountain is provided by the PVHA study described in the report by Geomatrix (1996-Probabilistic Volcanic Hazard Analysis for Yucca Mountain, Nevada, BA0000000-01717-2200-0082, Revision 0). The PI's most recent work in this area, presented in Chapter 6 of the 1996 VSR, is an examination of the sensitivity of variables in PVHA. Sensitivity studies of PVHA were evaluated for the disruption probability and the recurrence rate incorporating event counts and equally weighted spatial distribution models proposed by the expert judgment panel.

The geophysical information that was available to the expert judgment panel includes results from gravity and magnetic surveys, the seismic reflection survey conducted in late 1994 by the USGS across portions of the Amargosa Valley, Crater Flat, and Yucca Mountain, and the teleseismic tomography study being performed at the University of Nevada at Reno. The PI noted that the geophysical data were consistent with a pull-apart half-graben origin of the Crater Flat basin involving combined extension and strike-slip faulting. The data and interpretations are described in Chapters 3 and 6 of the 1996 VSR.

The audit also addressed the potential impact on PVHA of:

1. undetected or hidden volcanic events in the Yucca Mountain area
2. undrilled aeromagnetic anomalies in the Amargosa Valley
3. the sensitivity of the location and possible changes in the location of the eastern edge of volcanic source zones adjacent to the potential repository

The PI explained that, as documented in detail in Chapter 6 of the 1996 VSR, and in Laboratory Notebook EES-13-LV-08-94-07, sensitivity studies, including bounding calculations for item 1. and a worst case scenario for item 2. (i.e., all undrilled anomalies assumed to be ≤ 1.6 Ma), indicate that the probability of magmatic disruption was not significantly impacted by any of the above three topics.

Finally, the audit team reviewed portions of the PI's Laboratory Notebook EES-13-LV-08-94-07 and compared data tables in the notebook to corresponding tables in the 1996 VSR. While the data tables were noted to be in total agreement, the issue of qualified versus unqualified data came up. In the Preface to the 1996 VSR it's stated, in part, that all of the data cited in Chapters 3 and 6 are "Q" data. The audit team, however, noted several cases of the citing and use of unqualified data in Chapters 3 and 6: volume estimates in Table 1 of Chapter 3; mean $^{40}\text{Ar}/^{39}\text{Ar}$ ages computed using qualified and unqualified data in Chapter 6; and as noted by the PI the incorporation of unqualified data in the sensitivity calculations in Chapter 6. These issues are further addressed in Sections 5.5.2 and 6.0 of this report.

Conclusions - LANL has completed an extensive and long-term investigation of volcanic processes in the Yucca Mountain region. The scientific work presented in the reports and documented in the notebooks that were reviewed during the course of preparing for or conducting the audit were judged to be of outstanding technical quality. While issues were identified during the audit that require action, these issues do not impact the scientific conclusions drawn in the final report (the 1996 VSR) prepared for this project.

5.5 Summary of Deficiencies

The audit team identified six deficiencies during the audit for which four DRs have been issued. One deficiency was identified and corrected prior to the postaudit meeting and one deficiency will be resolved by an open OCRWM DR.

Synopses of deficiencies documented as DRs and those corrected during the audit, are presented below. The DRs have been transmitted under a separate letter, YMQA:MRD-0019, dated October 4, 1996.

5.5.1 Corrective Action Requests (CAR)

None

5.5.2 Deficiency Reports (DR)

YM-96-D-105

Yucca Mountain Site Characterization Project Administrative Procedure (YAP)-17.1Q, "Records Management Requirements and Responsibilities," Paragraph 5.3.1.b, requires that any YMP records contained in working files are submitted to the RPC when an individual is leaving the YMP. Also, LANL procedure LANL-YMP-QP-17.6, "Records Management," Paragraph 6.7.8, requires that records be forwarded to the RPC within 20 working days after authentication. Contrary to these requirements, LANL scientific notebooks for Volcanism were not submitted to the RPC when the Investigator left the YMP and last entry date in the notebooks by the Investigator would indicate they are complete.

YM-96-D-106

QARD, Section III.2.4 requires that a documented independent review of acquired and developed data shall be performed to confirm technical adequacy. Contrary to this requirement, there was no objective evidence that an independent review of some data in LANL scientific notebooks TWS-ESS-5-6-93-01 and TWS-INC-03-93-06 was performed.

YM-96-D-107

QARD, Section III.2.5.A allows unqualified data to be used without qualification in scientific investigation and design activities provided traceability to its status as unqualified data is maintained. Contrary to this requirement, the 1996 VSR, milestone 3781, Preface identifies all of the data cited in Chapters 3, 4, and 6, and the revised sections of Chapter 2 as "Q" data, as defined by the Los Alamos Quality Assurance Program, however, some unqualified data sources were used for sensitivity calculations in Chapter 6.

YM-96-D-108

LANL procedure LANL-QP-03.23, "Documenting Scientific Investigations," Attachment 4, provides the following as reviewer instructions: 1) Review the document for applicability, correctness, technical adequacy, and completeness; 2) For Technical Information

Products, data presented are suitable for the intended use as presented in the report. Contrary to these requirements, the LANL technical review was completed for the 1996 VSR and forwarded to the Project Office without identifying and correcting discrepancies in the 1996 VSR.

5.5.3 Performance Reports (PR)

None

5.5.4 Deficiencies Corrected During the Audit

Deficiencies which are 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.

- QARD, Supplement I.2.1.C requires, "Software including macros, that can be verified by visual inspection and/or hand calculations shall have limited requirements applied as follows: Listing of the baseline version and any subsequent changes to the software." LANL procedure's LANL-YMP-QP-3.5, "Documenting Scientific Investigations," Revision 6, and LANL-YMP-QP-3.21, "Software Life Cycle," Revision 6, did not require a listing of the version for commercial software packages. This was corrected by issuance and approval of a "QP Action Request," which requires the listing of software name and version for commercial or government-off-the-shelf software packages.

5.5.5 Follow-up of Previously Identified Deficiency Documents

Follow up action on DR YM-96-D-73, identified during audit YM-ARC-96-16, to determine if additional analytical services have been used by LANL for studies associated with Volcanism. It was identified during the audit that LANL was using the following suppliers of analytical services without the suppliers having an approved documented QA program.

- New Mexico Bureau of Mines
- Lehigh University
- Washington University at St. Louis
- University of Colorado

The YMQA Quality Assurance Representative (QAR) responsible for DR YM-96-D-073 corrective action verification was notified of the additional suppliers by the audit team.

6.0 RECOMMENDATIONS

The following recommendations resulted from the audit and are presented for consideration by Project Office/CRWMS M&O/LANL management.

1. The RPC should accept and take the necessary actions to maintain original photographs that PIs deem necessary or beneficial to a records package. LANL personnel indicated during the audit that original photographs had been rejected by Records Management with instruction to submit only photocopies (Xerox-type). This adversely effects the legibility and it appears that the photocopy provides little benefit.
2. The Project Office should support the development of a cross-reference between the scientific notebooks and field logbooks and the 1996 VSR similar to Appendices 1 and 2 of the 1995 VSR.
3. A surveillance should be performed in 1997 of the LANL activities for identification and submission of volcanism data to the technical data base. Limited work has been accomplished in this area and, therefore, it could not be thoroughly evaluated during the audit. These 1997 activities, which are currently scheduled to complete the volcanism activities, are important to data identification and traceability.
4. The Project Office should take the necessary actions to ensure that samples associated with the volcanism studies currently maintained by LANL or suppliers of volcanism analytical services, for example, New Mexico Bureau of Mines, are forwarded to the Sample Management Facility for storage
5. The Project Office should be aware of the need to support closeout activities, such as, completion of documentation and final reviews of scientific notebooks, records turnover, and sample disposition if work has to be curtailed, as was the case in 1995. Also, appropriate consideration to these efforts should be given when planning the close-out of scientific investigations.

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>
Andrew Burningham	LANL/QAL		X	X
Mike Clevenger	LANL/QAPL	X	X	
John Friend	LANL/Verification Coord.	X	X	X
Andrew Gallegos	LANL/Deputy QAPL		X	
Brad Gundlich	LANL/SCM		X	
Sandy Martinez	LANL/Training Coordinator		X	
Mike Murrell	LANL/AI Volcanism		X	
Frank Perry	LANL/PI-Volcanism	X	X	X
Greg Valentine	LANL/PI-Volcanism	X	X	
Karen West	LANL/Project Leader	X	X	
Jim Young	LANL/QAL	X	X	

Acronyms

AI	Associate Investigator
PI	Principal Investigator
QAL	Quality Assurance Liaison
QAPL	Quality Assurance Project Leader
SCM	Software Configuration Manager

ATTACHMENT 2
Summary Table of Audit Results
Process/Product Evaluations

ACTIVITY	PROCESS STEPS	DETAILS Checklist Page(s)	DEFICIENCIES	RECOMMENDATIONS	PROCESS EFFECTIVENESS	PRODUCT ADEQUACY	OVERALL
Volcanism WBS: 1.2.3.2.5.1.1 1.2.3.2.5.5.1	Sample Control	2,3,14,16,17,35,36,54	N	Rec #4	SAT	SAT	SAT
	Data Control	2,3,10,11,13,15,16,20,23,26,28,29,31,49,50,55	YM-96-D-106 YM-96-D-107 YM-96-D-108	Rec #s 3 & 5	MARGINAL	MARGINAL	
	Analytical Method	2,15,17-22,24,25,27,30,32,33,36,38,39,48,51,53,56-63	N	N	SAT	SAT	
	Software Control	2,8,34,37,52	N	N	SAT	SAT	
	Model Output	9	N	N	SAT	SAT	
	Data Update & Changes	12	N	Rec #2	SAT	SAT	

ACTIVITY	PROCESS STEPS	DETAILS (Checklist)	DEFICIENCIES	RECOMMENDATIONS	PROCESS EFFECTIVENESS	PRODUCT ADEQUACY	OVERALL
Volcanism WBS: 1.2.3.2.5.1.2	Sample Control	2,3,14,40,45	N	Rec #4	SAT	SAT	SAT
	Data Control	2,3,10,11,41,42-44,46,47	YM-96-D-106 YM-96-D-107 YM-96-D-108	Rec #s 3 & 5	MARGINAL	MARGINAL	

ATTACHMENT 2
Summary Table of Audit Results
Procedural Compliance Evaluations

ELEMENT	DOCUMENTS REVIEWED	DETAILS (Checklist)	DEFICIENCIES	RECOMMENDATIONS	PROGRAM ADEQUACY	PROCEDURE COMPLIANCE	OVERALL
2	QP-02.7, R4	pgs. 1-2	N	N	SAT	SAT	SAT
5	QP-03.5, R6	pg. 3	N	N	SAT	SAT	SAT
	QP-03.21, R6	pg. 3	CDA #1	N	SAT	SAT	
6	QP-06.1, R8	pg. 4	N	N	SAT	SAT	SAT
7	QP-04.06, R4	pg. 5	*YM-96-D-073	N	SAT	SAT	SAT
12	QP-12.3, R3	pg. 6	N	N	SAT	SAT	SAT
17	AP-17.1Q, R0	pg. 7	N	N	SAT	MARGINAL	MARGINAL
	QP-17.6, R5	pg. 7	YM-96-D-105	Rec #1	SAT	MARGINAL	
TOTAL	Pages - 63		6	5	SATISFACTORY		

ADEQUACY...Meets Requirements or Expectations

DRs.....Deficiency Reports

EFF.....Effectiveness - Satisfies Measurement Criteria

REC.....Recommendation

OVERALL.....Summary of Element or Process

CDA.....Corrected During Audit

N.....None

* Similar deficiency identified during audit that will be resolved via this deficiency, identified during OCRWM Audit YM-ARC-96-16