U.S. DEPARTMENT OF ENERGY

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

OFFICE OF QUALITY ASSURANCE

AUDIT REPORT FOR THE AUDIT OF

LAWRENCE LIVERMORE NATIONAL LABORATORY

LIVERMORE, CALIFORNIA

AUDIT NO. YMP-92-21

AUGUST 10 THROUGH 14, 1992

PROGRAM ELEMENTS EVALUATED:

2.0 Quality Assurance Program
3.0 Design Control and Scientific Investigation
4.0 Procurement Document Control
5.0 Instructions, Procedures, Plans, and Drawings
6.0 Document Control
7.0 Control of Purchased Items and Services
8.0 Identification and Control of Materials, Parts and Components
12.0 Control of Measuring and Test Equipment
13.0 Handling, Shipping and Storage
16.0 Corrective Action
17.0 Quality Assurance Records
18.0 Audits
19.0 Software Quality Assurance

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EXECUTIVE SUMMARY

This report contains the results of the U.S. Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM) Audit No. YMP-92-21 of Lawrence Livermore National Laboratory (LLNL) that was conducted in Livermore, California, on August 10 through 14, 1992. This external audit was performed by a team of auditors from the Yucca Mountain Quality Assurance Division (YMQAD) of the Office of Quality Assurance (OQA). The audit team evaluated implementation of 13 Quality Assurance (QA) Program Elements described in the LLNL Quality Assurance Program Plan (QAPP), Revision 1. This was done by verifying implementation and effectiveness of the systems in place, as well as verifying compliance with requirements.

Overall, for the QA Program elements audited, LLNL is satisfactorily implementing an effective QA program in accordance with the LLNL QAPP and implementing procedures except for the area of Software QA. Implementation of Quality Program Elements 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 12.0, 13.0, 16.0, 17.0, and 18.0, were found to be satisfactory. Element 19 was determined as unsatisfactory due to the problems noted in LLNL Corrective Action Requests (CARs).

The audit team identified five deficiencies during the course of the audit that required the issuance of OCRWM CARs. Three addressed documentation and control of Measuring and Test Equipment (M&TE), one addresses legibility of records, and one addresses the contents and submittal of audit records. Eight other deficient conditions were identified and corrected by LLNL during the course of the audit. Details of issued OCRWM CARs and corrected deficient conditions may be found in Sections 6.1 and 6.2 of this report.

There were no pertinent outstanding CARs associated with the program elements examined during the audit.

1.0 INTRODUCTION

This report contains the results of the DOE OCRWM OQA QA Audit No. YMP-92-21 of LLNL. The audit was performed by a team of auditors from the YMQAD during the period of August 10 through 14, 1992, in Livermore, California. This audit was performed in accordance with the approved audit plan (Reference: correspondence dated June 6, 1992).

2.0 AUDIT SCOPE

This audit evaluated effectiveness of the LLNL QA Program in meeting the requirements and commitments imposed by OCRWM. This was done by verifying implementation of QA requirements delineated in the LLNL QAPP and implementing procedures.

LLNL activities associated with the following QA Program elements were audited:

2.0 Quality Assurance Program
3.0 Design Control and Scientific Investigation
4.0 Procurement Document Control
5.0 Instructions, Procedures, Plans, and Drawings
6.0 Document Control
7.0 Control of Purchased Items and Services
8.0 Identification and Control of Materials, Parts and Components
12.0 Control of Measuring and Test Equipment
13.0 Handling, Shipping and Storage
16.0 Corrective Action
17.0 Quality Assurance Records
18.0 Audits
19.0 Software Quality Assurance

The technical activities focused on the methodology and documentation related to:

WBS 1.2.1.4.5, Geochemical Modeling
WBS 1.2.2.3.1.1, Waste Form Testing
WBS 1.2.2.3.2, Metal Barriers

3.0 AUDIT TEAM AND OBSERVERS

A list of audit team members, the program elements or technical activity they evaluated, and audit observers can be found in Enclosure 1.

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

A pre-audit conference was held at LLNL facilities in Livermore, California, on August 10, 1992. Daily coordination meetings were held with LLNL management and staff, and daily audit team/observer meetings were held to discuss issues and potential deficiencies. The audit was concluded with a post-audit conference held at LLNL facilities in Livermore, California on August 14, 1992. A list of auditors, observers, and personnel contacted during the audit is included in Enclosure 2. The list includes an indication of those who attended the pre- and post-audit conferences.

5.0 SUMMARY OF AUDIT RESULTS

5.1 QA Program Effectiveness

Overall, for the QA Program elements examined, implementation of the LLNL QAPP and implementing procedures is effective, except for the area of Software QA. The 13 QA Program Elements audited, 2.0, "Quality Assurance Program," 3.0, "Design Control and Scientific Investigation," 4.0, "Procurement Document Control," 5.0, "Instructions, Procedures, Plans, and Drawings," 6.0, "Document Control," 7.0, "Control of Purchased Items and Services," 8.0, "Identification and Control of, Materials, Parts and Components," 12.0, "Control of Measuring and Test Equipment," 13.0, "Handling, Shipping and Storage," 16.0, "Corrective Action," 7.0, "Quality Assurance Records," 18.0, "Audits," are being satisfactorily implemented. Due to the number of LLNL internal corrective action documents issued, in the area of 19.0, "Software Quality Assurance," this area is determined to be ineffective.

5.2 Programmatic and Technical Audit Activities

Details of the programmatic and technical audit activities are included as Enclosures 3 of this report.

5.3 Summary of Deficiencies

The audit team identified a total of 13 conditions adverse to quality during the course of the audit. The conditions adverse to quality were not considered to have a significant impact on quality. A snynopis of the issued conditions adverse to quality and the conditions adverse to quality corrected during the audit are included in Sections 6.1 and 6.2 of this audit report.

6.0 SYNOPSIS OF DEFICIENCIES

6.1 Corrective Action Requests

The OCRWM CARs listed below were issued as a result of the audit. Information copies of these CARs are provided as Enclosure 5 of this report.

YM-92-064 - M&TE have been entered in the Master Status List without documented evidence of the calibration record. Additionally, M&TE calibration records do not contain required information.

YM-92-065 - M&TE were found to not be calibrated as required by the manufacture's and designer's recommendation.

YM-92-066 - Audit reports are not being sent to the Local Records Center (LRC) within the time limits set forth in the Quality Procedure (QP).

YM-92-067 - QA Records for M&TE equipment that is no longer in use are not being forwarded to the LRC as required.

YM-92-068 - No evidence to indicate that the LRC inspected and accepted a record that was legible. This record was illegible on both film and hard copy at the LRC.

6.2 Deficiencies Corrected During the Audit

1. Procedure 033-YMP-QP 2.1, Revision 3, Section 2.1.4.3.3 requires that a memorandum identifying the comments due date, clarifying information and special instructions, be retained as a QA record. This condition was corrected by the issuance of Revision 4 to 033-YMP-QP 2.1 which requires this memorandum for controlled documents other than QPs, QAPP Requirements, Quality Assurance Grading Reports (QAGRs) and Quality Assurance Requirements (QARs).

2. Procedure 033-YMP-QP 2.8, Revision 2, Section 2.8.5.6 requires sign-off of Exhibits C and D by specific individuals. Generally, the signatures were missing; however, all required signatures were on Exhibit A which is used to initiate a QAGR. Change Notice (CN) 2.8-2-3 was generated and approved to require that all signatures appear only on Exhibit A.

3. Paragraph 3.0.7 of QP 033-YMP-QP 3.0, Revision 2, requires that verifications be accomplished through technical review, QA surveillances, or as a supplemental means, by peer review. Contrary to these requirements, software development and maintenance activities for EQ 3/6 performed under Geochemical Modeling, were not verified in accordance with one of these three methods. Because LLNL performs verification of software under QP 033-YMP-QP-3.2, CN No. 3.0-2-3 to QP 3.0 was approved for issuance during the audit to allow for verification of software in accordance with QP 3.2.

4. 033-YMP-QP 4.0, Revision 3, Paragraph 4.0.5 requires that Purchase Requisitions (PRs) and SANLs for the purchase of quality-affecting items, be processed in accordance with this procedure. Contrary to this requirement, services from Electronic Services Group (ESG) and EMTA are being procured via Letters of Agreement (LOA). To remedy this anomaly, CN 4.0-3-1 to 033-YMP-QP 4.0 was initiated and signed by the Quality Assurance Manager (QAM) and the Yucca Mountain Site Characterization Project (YMP) Leader on 8/14/92. This CN requires LOAs to be subjected to applicable Program Element 4.0 requirements similar to the normal procurement documents. No further actions were warranted due to the fact that these two entities were subsequently removed from the LLNL-YMP Qualified Suppliers List.

5. 033-YMP-QP-12.0, Revision 2, Paragraph 12.0.4 states that the Calibration Coordinator (CC) will enter M&TE on the Master Status List upon receipt of the required calibration records. Upon review of the Master Status List, Mass Standards ID. No. 251 was listed. However, when a copy of the calibration record for 251 was requested, it could not be found. Subsequent to this finding, LLNL personnel provided a copy of the National Institute of Standards and Technology calibration record 822/247805. It was identified that this calibration was for Mass Standards ID No. 251. Also, it was pointed out that the number 251 applies to the physical location where the standards were used. A written clarification, which links Mass Standards ID No. 251 to calibration report 822/247805, was generated and signed by the Technical Project Officer and concurred with by the QAM. This clarification was issued August 12, 1992. The action taken resolves this deficiency.

6. 033-YMP-QP-18.0, Revision 3, Paragraph 18.0.5.6 states that the results of the audit are documented using an audit report, which contains a statement concerning the effectiveness of the implementation of the quality elements that were audited. However, audit YMP-92-03 contains a statement concerning the effectiveness of implementation of the procedure 033-YMP-QP-3.3. In reviewing the checklists for the audit, it was not possible to determine that this

procedure was used in the development of any of the checklists used during the audit. To resolve this issue, the QAM issued an Interoffice Memorandum LLYMP920880 stating that the audit report contained an error in this area.

7. 033-YMP-QP-18.2, Revision 1, Paragraph 18.2.4.2.3 states that the QAM will certify the successful completion of the examination requirement and will document the certification in the individual's certification file. However, a Lead Auditor certification was found to be missing this information. After locating the written examination which was verified by the auditor, the QAM proceeded to correct the certification accordingly.

8. The Software Quality Assurance Plan (SQAP), Section 6.2.1, requires that "Software development is under the life cycle process when the programming effort has not begun or when acquired, existing, or commercial software needs modification or error correction." The Individual Software Plan (ISP) for EQ3/6 ISP-NF-06, did not state any requirements for a software development/change life cycle (i.e., requirements, design, implementation test). ISP-NF-06-0-1 was issued to address this issue.

7.0 RECOMMENDATIONS

During the audit, several areas were identified within the LLNL QA Program where there are opportunities for improvement. The following recommendations are offered for LLNL management consideration:

1. It is recommended that LLNL modify the record "adequate for its intended purpose" statement on Records Package Transmittal Form Table Of Contents (YMP 050(I) Revision 9). If this type of statement is to be utilized, it should be as an exception rather than as a matter of routine that appears to apply to every records package. In modifying this statement, LLNL should consider identifying specifically what is unacceptable with the records package including the page number where unacceptable entries are found.

2. It is difficult, although possible, to trace data cited in publications to original sources in laboratory notebooks. It is recommend that traceability be improved to facilitate rapid retrieval. One possible way to do this would be to include within the records package for any technical document, a listing of the data sources. This might include the number of the laboratory notebook or notebooks and the pages within these books whereon the data may be found. It was easy and fast to relate the document to the record package through the LLNL document numbering system. Likewise once the right notebook and page were found, it was easy to confirm the data. The missing link is from the records package to the notebook and page.

3. In conjunction with planned enhancements of EQ3/6, it is recommended that relevant study plans and scientific investigation plans be revised to include the acquisition of data pertinent to these enhancements. The data might be either from the literature, or from new experiments, or both. These data should be incorporated into one or more data bases to accompany the EQ3/6 software package and should be managed in a manner comparable to that for thermodynamic data through GEMBOCHS. Examples of such data are rate constants, solid solution parameters, and surface chemistry parameters. An example of a literature source that may prove helpful for some such data is "A Compilation of Solubility and Dissolution Kinetics Data on Minerals in Granitic and Gabbroic Systems," by V. N. Fleer and R. M. Johnston, Atomic Energy of Canada, AECL-TR-328-2 (1986). (It is not meant to imply that all of the data therein are worthy of inclusion in a data base for EQ3/6.) Such data bases to accompany EQ3/6 would significantly assist users in much the same way that the thermodynamic data base does even though they would not be read directly by EQ3NR or EQ6.

4. LLNL should develop a method or system to explain how adverse conditions reported to the QAM by personnel other than QA are required to be handled.

5. The use of Technical Specialist for special or technical audits should be implemented.

6. A more defined statement for effectiveness of the areas audited should be developed and implemented accordingly.

8.0 ENCLOSURES

Enclosure 1: Audit Team Members and Observers
Enclosure 2: Personnel Contacted During the Audit
Enclosure 3: Audit Details
Enclosure 4: Objective Evidence Reviewed During the Audit
Enclosure 5: Information Copies of Corrective Action Requests

ENCLOSURE 1

AUDIT TEAM MEMBERS AND OBSERVERS

TEAM MEMBERS:

Name and QA Program/Area Assignment:

Richard L. Maudlin, Audit Team Leader, YMQAD
Mario R. Diaz, Auditor, YMQAD, 12.0, 16.0, 18.0
Thomas J. Higgins, Auditor, YMQAD, 19.0
John R. Matras, Auditor, YMQAD, 19.0
John E. Therien, Auditor, YMQAD, 4.0, 7.0, 8.0
Charles C. Warren, Auditor, YMQAD, 3.0, 17.0
Richard L. Weeks, Auditor, YMQAD, 2.0, 5.0, 6.0
Paul L. Cloke, Technical Specialist, Science Applications International Corporation (SAIC), 3.0

OBSERVERS:

Kenneth Hooks, U.S. Nuclear Regulatory Commission (NRC)
Kenneth Kalman, NRC
Bruce Mabrito, NRC
Jack Sprual, NRC
Susan Zimmerman, State of Nevada
Philip Niedzielski-Eichner, Nye County
Donald Horton, Director, OCRWM QA

ENCLOSURE 2

PERSONNEL CONTACTED DURING THE AUDIT

Name	Organization/Title	Preaudit Meeting	Contacted During Meeting	Post Audit Meeting
Alegre, B.	LLNL/Records		X	
Blink, J.	LLNL/Deputy Project Leader	X	X	X
Bourcier, W.	LLNL/Task Leader			X
Bryan, B.	LLNL/Project Administration	X	X	X
Campbell, E.	LLNL/Technical Administrator	X	X	
Clark, J.	LLNL/Secretary	X	X	
Clarke, W.	LLNL/TPO	X	X	X
Cloke, P.	SAIC/Audit Technical Specialist	X		X
Comstock, P.	LLNL/Resource Manager	X	X	X
Diaz, M.	YMQAD/Auditor	X		X
Glassley, B.	LLNL/Geochemistry Task Leader	X	X	X
Halsey, B.	LLNL/Technical Area Leader (TAL)	X	X	X
Hamati, R.	LLNL/KEL QA Engineer	X	X	X
Higgins, T.	YMQAD/Auditor	X		X
Holmes, T.	LLNL/Training Coordinator/Records	X	X	X
Hooks, K.	NRC/Observer	X		X
Horton, D.	OCRWM/Dir., OQA Observer	X		X
Johnson, J.	LLNL/Task Leader		X	
Kalman, K.	NRC/Observer	X		X
Kishi, T.	LLNL/Software Engineer		X	
Konynenburg, R.	LLNL/YMSCP Engineer	X		
Krantz, P.	LLNL/Doc. Control and Cal Coord.		X	
Leder, H.	LLNL/Chemist/Spent Fuel	X		
Lewis, L.	LLNL/Software Engineer		X	
Lundeen, S.	LLNL/Software Engineer		X	
Mabrito, B.	NRC/Observer	X		X
Matras, J.	YMQAD/Auditor	X		X
Maudlin, R.	YMQAD/ATL	X		X
Phinney, D.	LLNL/Principal Investigator (PI)		X	
Podobnik, J.	LLNL/YMSCP Project Control Mgr.	X	X	

PERSONNEL CONTACTED DURING AUDIT (Continuation)

Name	Organization/Title	Preaudit Meeting	Contacted During Meeting	Post Audit Meeting
Quinn, T.	LLNL/Lead Software Engineer		X	
Rainwater, G.	LLNL/Administrative Specialist		X	
Revelli, M.	LLNL/Task Leader	X		
Ruffner, D.	LLNL/TAL Engineering and Analysis	X		
Schock, R.	LLNL/Energy Program Leader	X		X
Schwartz, R.	LLNL/Assoc. Energy Prog. Leader	X	X	X
Spraul, J.	NRC/Observer	X		X
Steward, S.	LLNL/Task Leader	X	X	X
Stout, R.	LLNL/TAL/WF	X	X	
Therien, J.	YMQAD/Auditor	X		X
Viani, B.	LLNL/Task Leader		X	
Warren, C.	YMQAD/Auditor	X		X
Weed, H.	LLNL/Chemist and Spent Fuel	X	X	X
Weeks, R.	YMQAD/Auditor	X		X
Wolery, T.	LLNL/PI/Physicist	X	X	
Wolfe, D.	LLNL/QAM	X	X	X
Younker, L.	LLNL/Earth Science Dept. Head			X
Zimmerman, S.	State of Nevada/Observer			X

ENCLOSURE 3

AUDIT DETAILS

This enclosure contains a summary of the evaluations performed by the programmatic auditors and technical specialist. A list of the objective evidence examined during the evaluations is provided in Enclosure 4, as well as a complete reference for each of the documents mentioned in this enclosure.

Program Element 2.0, "Quality Assurance Program"

Objective evidence generated as a result of implementation of the following procedures was evaluated to determine compliance to specific requirements which are listed below:

033-YMP-QP 2.1, Revision 3, "Preparation, Approval, and Revision of Procedures, Requirements, Plans, and the Quality Assurance Program Description"

- Minimum required information is included in each QP.
- Independent reviewers are utilized when appropriate.
- QAPP review packages awaiting Yucca Mountain Site Characterization Project Office (YMPO) approval are properly stored.
- Appropriate memorandums are created with comment due date, clarifying information and special instructions.
- Information required on Review Request and Review Close-out forms is provided.
- Documents awaiting YMPO approval but in use, shall be stamped "Approved For Interim Use."
- Procedures that have been completely rewritten shall be stamped "General Rewrite" or "Complete Rewrite."
- CNs shall be approved by authorized personnel prior to issuance.
- A log of controlled document revisions and CNs is maintained.
- Specific QA records shall be retained.

Based on an examination of seven procedure review packages, five CN review packages, and a log of procedure revisions and CN Log, it was determined that the requirements of this procedure are satisfactorily implemented.

033-YMP-QP 2.3, Revision 0, "Management Assessment"

- Management shall assess the following elements annually:
  1. training with respect to QA requirements,
  2. effectiveness of QA program, and
  3. adequacy of resources provided for the QA program.
- The decision as to who will conduct the assessment will be documented and kept as a QA record.
- Management Assessment report shall be uniquely numbered.
- Assessment Worksheets are complete and identify assessment areas.
- The assessment report contains the following information:
  1. identification of management assessment individual,
  2. description of the assessment activities,
  3. scope of the management assessment,
  4. identification of personnel interviewed during the assessment,
  5. Management Assessment worksheets,
  6. summary of the results of the assessment, and
  7. a description of any adverse conditions identified during the management assessment.
- The Management Assessment report shall be signed by appropriate individuals and distributed to specified individuals.

Although the LLNL Yucca Mountain Management Assessment Report met specific procedural requirements, the content of the Management Report, as indicated by the author, stated that QA requirements created an impediment to scientific work. Discussions with the Management Report author indicated that she made no distinction between administrative requirements and QA requirements and all requirements were classified a QA invoked. YMQAD considers the conclusions expressed in the Management Report of concern and will pursue resolution as a separate issue from the audit. This area is being satisfactorily implemented.

033-YMP-QP 2.8, Revision 2, Quality Assurance Grading

- QA grading is documented and required information is recorded.
- Each grading report shall have a unique number assigned to it.
- Grading documentation that is in final form shall be signed by appropriate individuals.

Based on a review of eight grading reports, the requirements of this procedure have been satisfactorily implemented.

033-YMP-QP 2.9, Revision 3, "Indoctrination and Training"

- All individuals assigned to the LLNL-YMP project receive specified minimum training.
- Trainer Preparation sheets are complete and contain required information.
- Training materials are approved by the Training Coordinator prior to use.
- Specified training records are retained as QA records.

Based on a review of training records for six individuals, it was determined that all required documentation was available and complete. This procedure has been satisfactorily implemented.

033-YMP-QP 2.10, Revision 4, "Qualification of Personnel"

- Personnel Qualification Records are prepared, reviewed and approved by TAL for each individual.
- Written position descriptions which include education, experience and skills are prepared and approved for each project position.
- LLNL-YMP management shall verify the relevant education and experience history of all personnel.

- A Management Certificate is completed for each employee.

- All required QA records are retained.

Based on a review of Personal Qualification Records of six new employees, the requirements of this procedure have been satisfactorily implemented.

The implementation of the following activities could not be evaluated due to lack of procedural implementation during the time frame of the audit:

033-YMP-QP 2.2 "Peer Review"
033-YMP-QP 2.4 "Technical Review"
033-YMP-QP 2.5 "Acceptance of Data Not Generated Under the Control of the YMP QAPP"
033-YMP-QP 2.6 "Readiness Reviews"
033-YMP-QP 2.7 "Stop Work Order"
033-YMP-QP 2.11 "Qualification and Certification"

Overall, the LLNL implementation of Program Element 2.0 is satisfactory.

Program Element 3.0, "Design Control and Scientific Investigation"

QA Program

Objective evidence generated as a result of implementation of the following procedures was evaluated to determine compliance to specific requirements which are listed below:

033-YMP-QP 3.0, Revision 2, "Scientific Investigation Control"

- Development, review and approval of work planning documents for scientific investigations.

- Documentation and approval of Technical Implementing Procedures (TIPs).

- Use of Scientific Notebooks to record information.

- Verification of Scientific Investigation activities.

- Performance of reviews and approvals for planning documents and procedure revisions.

- Identification of hold points in activity plans.

- Identification of LLNL technical interfaces.

- Documentation of results of Scientific Investigation Activities.

033-YMP-QP 3.4, Revision 2, "Scientific Notebooks"

- o Identification and control of Scientific Notebooks.
- o Adequacy of Scientific Notebook entries.
- o Technical review of Scientific Notebooks.
- o Qualifications of Technical Reviewers.
- o Submittal of Scientific Notebooks to the LRC.

With exception of one area of procedural noncompliance with scientific investigation control verification activities that was corrected during the audit, compliance to the above quality procedures was verified for Geochemical Modeling and Waste Form Testing. No quality affecting work in the Metal Barriers area had been performed during the time frame for the audit and therefore, could not be evaluated.

In addition, LLNL has not implemented the following procedures in the examined technical areas for the time frame of the audit and compliance to these procedures could not be evaluated:

033-YMP-QP 3.1, "Design Control"
033-YMP-QP 3.3, "Review of Technical Publications and Data"
033-YMP-QP 3.5, "Control of Internal Technical Interfaces"

Technical Evaluation

The technical evaluation covered the work completed in three technical areas. Although budget constraints in the last fiscal year restricted the activities at LLNL, it was deemed prudent not to omit a technical review altogether. The technical checklist focused on the progress reported by LLNL to C. Gertz, Project Manager, YMPO. The results of the review for each of the three areas are reported in the sections that follow.

WBS 1.2.1.4.5 Geochemical Modeling

LLNL has upgraded the structure of the sets of basis and auxiliary basis aqueous species used in the software code EQ3/6. These are actually resident in the database code GEMBOCHS which provides the input data set for EQ3/6 calculations. The upgrade results in the capability to compute separate results for organic compounds distinct from other carbon species with similar capability for reduced and oxidized species of sulfur and nitrogen. The practical result is that radiolysis effects on the near field geochemistry induced by the waste package's radiation field

can be modeled which is another step towards the capability to model waste package's containment performance. The documentation supporting this upgrade was found to be satisfactory.

LLNL plans to improve on EQ3/6, Version 8, through architectural changes in the code(s). At present EQ3 can model redox disequilibrium, a common condition, while EQ6 lacks this capability. The proposed changes will remedy this and also allow redox equilibrium to be achieved when controlled by a rate equation. However, modeling of specification disequilibrium and kinetics when there is no change of oxidation state will still not be possible and additional modification would be required to achieve this capability. As presently conceived, the planned architectural changes to EQ3/6 will permit modeling of any reaction in which redox occurs, e.g. rock dissolution, metal corrosion, and waste form dissolution. It will also be able to accommodate steep thermal gradients. LLNL's approach in this effort is considered satisfactory.

The availability of existing aqueous redox kinetic data relevant to Yucca Mountain that might be qualified for use has not been actively pursued. LLNL plans to collect laboratory data from experiments on dissolution and precipitation on zeolites and clays, including ion exchange and sorption, as well as for redox rates. The plan to acquire these data experimentally is adequate.

LLNL's plans to acquire additional modeling capability were also discussed. These are in the area of surface and solid solution chemistry which, together with all of the forgoing, are important for modeling corrosion and the near-field geochemical environment. Availability of necessary data was also discussed. In each case, LLNL appears to have a workable approach that is considered satisfactory.

In summary, the conduct of this activity, though restricted by budget constraints, has shown progress and is technically satisfactory.

WBS 1.2.2.3.1.1 Waste Form Testing: Spent Fuel Dissolution

The Spent Fuel Dissolution effort is conducted in accordance with Activity Plan D-50-53a, "Flow-through Dissolution Tests on UO2," Revision 2, Appendix B, "Test Plan." The activity has been beset with several experimental difficulties that LLNL believes are now solved.

The most important of the problems was the anomalously high dissolution rates measured for the dissolution of Uranium oxide pellets. During consultations with other elements of the Laboratory a straightforward explanation of these rates was identified; the pellets were disintegrating at an unexpected rate in the experimental environment thereby increasing surface area. As dissolution rate is a function of surface area, the observed dissolution rates only

appeared to be high but were not. The personnel responsible for this activity consulted with other organizations within LLNL but external to the YMP program. This consultation involved certain measurements and tests that were diagnostic in intent and which were intended to explain the cause for the unexplained dissolution rates. These activities were not conducted under the QA program. After consideration of the facts, it was clear to the audit team that there was no violation of the QA program in seeking external aid since the dissolution rate data are taken in accordance with the program and these were unaffected by the external diagnostic measurements.

LLNL expects that the data needed by the project will be supplied by dissolution rate measurements in progress at this time. These measurements are being made on single crystals of UO2. This approach avoids the disintegration problem encountered with pellets.

Based on an examination of notebooks, procedures, and the experimental apparatus, the conduct of this work is in accordance with the Activity Plan and is satisfactory.

WBS 1.2.2.3.2 Metal Barriers

LLNL is completing preparation of reports which summarize the state of Project knowledge on nickel-chromium-molybdenum alloys and titanium alloys. These have progressed through internal LLNL review and will be submitted to the Project Office.

At FOCUS '91, LLNL presented the results of a rating process to rank the various metal barrier candidates according to a merit index.

The resulting top three candidates for the waste package container are titanium-grade 12, alloy C-4, and alloy 825. The audit team examined the draft of the follow-on publication that will report these results (authors: Van Konyenburg, Halsey, McCright, Clarke, & Gdonski) and the supporting internal reports (UCRL-ID-108330 and UCRL-JC-103744) that were the basis for the process. All of these were found to be consistent with one another. In addition, it was verified that the weighting factors used in the ranking process were those recommended by the peer review panel.

Additional results and data, reported at FOCUS '91 and dealing with measurement of pitting corrosion and its stochastic modeling, were successfully traced to internal (UCRL) publications and then, with some difficulty to the lab notebooks. This difficulty is the source of one of the recommendations in Section 7.0 of the audit report (Item 2).

LLNL is presently conducting no laboratory measurements supporting Metal Barriers activity at the Laboratory.

The Metal Barriers activity is judged to be technically satisfactory.

Overall, the LLNL implementation of Program Element 3.0 requirements is satisfactory.

Program Element 4.0, "Procurement Document Control"

The evaluation of these program elements was based on the examination of objective evidence to determine compliance with selected requirements taken from the implementing procedures.

033-YMP-QP-4.0, Revision 3, "Procurement Document Control"

- PRs include the scope of work, technical requirements and QA requirements.
- The Task Leader prepares a Procurement Document Review (PDR) form if the procurement is quality-affecting.
- SANL procurements include the scope of work, technical requirements, and QA requirements. The QAM and the LLNL/YMP Leader reviews and signs the PDR.

033-YMP-QP-4.1, Revision 1, "Preparation of Quality Assurance Requirements Specifications and Approval of Subcontract Quality Assurance Programs"

- The QAM prepares the Generic QA Requirements Specification and the YMP Project Leader approves the document.
- The Subcontract QA Requirements Specifications are approved by the Cognizant Technical Area Leader, the QAM, and the YMP Project Leader.
- The QAM reviews subcontractor's QA Program Manual for inclusion of the requirements specified in the Subcontractor QA Requirements Specification.
- Task Leaders review existing subcontractor QA Requirements Specification each time there is a change to the Generic QA Requirements Specification, a change to the scope, or once each year.

Based on the examination of two procedures, two major SANL procurements, three QA Requirements Specifications, and two pre-qualified QA Surveillances, the implementation of activities associated with the requirements contained within Program Elements 4.0 and 7.0, is generally satisfactory with the exceptions of the anomalies identified in LLNL CAR LLNL-020, dated 7/30/92.

Program Element 5.0, "Instructions, Procedures, Plans, and Drawings"

The evaluation of this program element was based on the examination of objective evidence to determine compliance with selected requirements taken from the implementing procedure 033-YMP-QP 5.0, Revision 2, "Technical Implementing Procedure (TIP)." The selected requirements reviewed are listed below:

The TIP will contain as applicable:

1. The requirements, objectives, methods and characteristics to be tested or observed.

2. A stepwise or detailed description of the procedure sequence.

3. Special training or qualification requirements for personnel performing the process.

5. A list of materials to be used.

6. Prerequisites to TIP implementation, such as calibrated instrumentation, adequate and appropriate equipment and instrumentation, suitable and controlled environmental conditions, and provisions for data collection and storage.

7. Acceptance and rejection criteria and limits including required levels of precision and accuracy.

8. Mandatory verification points (as required).

9. QA Records that will be generated by the TIP and include a description of how data and information will be recorded and identified for record purposes.

   - o Procedural deviations encountered during activities are authorized and documented by change notices.

   - o Procedures (TIP) pertaining to multiple technical areas (TIP-YM) or Quality Assurance (TIP-QA) are approved by the YMP Project Leader and YMP QAM.

   - o The TIP identifies a method of documenting work progress. If a scientific notebook is used, entries are made in sufficient detail that another competent individual could repeat the work.

   - o The retained QA Records are the current and previously issued TIPs and change notices, returned draft review copies with major comments, and the disposition of comments.

Based on the examination of all four procedures issued in the time frame specified in the audit plan, together with the single CN, and the record packages for each of the four procedures, implementation of this program element is satisfactory.

Program Element 6.0, "Document Control"

The evaluation of this program element was based on the evaluation of objective evidence to determine compliance to specific requirements taken from implementing procedure 033-YMP-QP 6.0, Revision 2, "Document Control," The specific requirements are as follows:

- Receipt Acknowledgement Forms shall be used and tracked for distribution of controlled documents.
- LLNL-YMP Project administrator approves Table of Contents.
- Minor changes are approved by appropriate individuals and meet the definition of "minor change."
- The LRC shall maintain a document master list for all controlled document categories.
- Specified QA records are retained by LLNL-YMP.

Based on an examination of 12 procedure review and CN review record packages and the LLNL-YMP document master list, this program element is being satisfactorily implemented.

Program Element 7.0, "Control of Purchased Items and Service"

Requirements evaluated for this section were performed under QA Program element 4.0.

Program Element 8.0, "Identification and Control of Materials, Parts, and Components"

The evaluation of this program element was based on the examination of objective evidence to determine compliance with selected requirements taken from the implementing procedure 033-YMP-QP 8.0, Revision 0, CN 8.0-0-1, "Identification and Control of Items, Samples, and Data." The selected requirements are summarized below:

- Measures for the identification and control of items, samples, and data are provided in the TIPs or in the work planning document as described in 033-YMP-QP 3.0.
- Markings are applied using material and methods that provide clean and legible identification and do not adversely affect the function or service of the item or sample.

- Measures are implemented to maintain sample identification while in storage and these measures are consistent with the planned duration and conditions of storage.

- Identification of data includes a reference to the origin of the data.

Although the quality-affecting attributes related to Program Element 8.0, were very limited, the conduct of the Flow-Through Dissolution Test on UO2 indicate that the requirements associated with Program Element 8.0 are being satisfactorily implemented. This is based on the examination of two procedures, the proper identification of items and samples associated with UO2 leaching and the references related to data indicated in the Preliminary Selection Criteria for the YMP Waste Package Container Material (CURL-ID-104552).

Program Element 12.0, "Control of Measuring and Test Equipment" (M&TE)

The evaluation of this program element was based on the examination of objective evidence to determine compliance with selected requirements taken for the implementing procedure dealing with M&TE.

Detailed descriptions of attributes and selected requirements checked pertaining to M&TE are found in procedure 033-YMP-QP-12.0, Revision 2, CN No. 12.0-2-1, Sections 12.0.4 and 12.0.5.

Selected requirements were:

- The M&TE Master Status List identifies the M&TE authorized for use on the YMP.

- The M&TE Master Status List is issued and updated periodically.

- Required accuracy for M&TE is specified in calibration procedures and is consistent with the accuracy of the manufacturer's or the designer's specifications.

- Calibration frequency of M&TE has been established and is consistent with the manufacturer's or designer's recommendations.

- Calibration certificates contain all the information required by pertinent paragraph.

- The accuracy of a standard(s) used for calibration must be equal to or better than the instrument calibrated.

- The CC issued recall notices prior to the expiration date of the calibration interval of the M&TE.

- M&TE in service do have calibration stickers.

- o If M&TE, used in quality-affecting activities, is found out-of-calibration, a Nonconformance Report (NCR) is prepared by the Task Leader.

- o If calibration is performed by a user, the calibration record includes information required by pertinent paragraph.

- o If a waiver of calibration-interval is used, the applicable requirements are followed.

- o Calibration records are handled as QA records.

Several non-significant deficiencies were detected in this area and documented on CARs YM-92-064, YM-92-065, and YM-92-067.

Overall, the LLNL implementation of Program Element 12.0 requirements is satisfactory.

Program Element 13.0, "Handling, Shipping, and Storage"

The evaluation of this program element was based on the evaluation of objective evidence to determine compliance to specific aspects taken from implementing procedure 033-YMP-QP 13.0, Revision 0, "Handling, Shipping and Storage." The specific requirements are as follows:

- o Written instructions stating how items and equipment are handled, stored and shipped are incorporated into appropriate documents.

- o Handling, shipping and storage records are maintained.

Based on an examination of five Quality Assurance Requirements Specifications (QARSs) and one Scientific Notebook, the requirements of this procedure has been satisfactorily implemented.

Program Element 16.0, "Corrective Action"

The evaluation of this program element was based on the examination of objective evidence to determine compliance with selected requirements taken from the implementing procedures:

033-YMP-QP 16.0, Revision 3, "Corrective Action"

The selected requirements are listed below:

- o Conditions adverse to quality are documented on CARs.

- o Copies of CARs are distributed to pertinent personnel.

- o CARs are categorized as Significant or Not Significant.

- o Weekly Action Item Lists and completed CARs plus supporting documentation are transmitted to the LRC within time limitations.

033-YMP-QP 16.2, Revision 3, "Trend Analysis"

- o Trend Analysis (TA) are issued annually.
- o If trend is identified in the TA, CARs are issued or explanation for not issuing them, is part of the TA.
- o TA reports(s) are submitted to the LRC within time limitation.

Based on the objective evidence reviewed, the implementation of Program Element 16.0 is satisfactory.

Program Element 17.0, "Quality Assurance Records"

Evaluation of this program element was performed by examination of objective evidence at the LLNL LRC and with record sources to determine compliance to the requirements of QP 033-YMP-QP 17.0, Quality Assurance Records. The selected requirements are indicated below:

- o Records source requirements for transmittal and verification.
- o LRC records inspection requirements.
- o Rejection of records by the LRC.
- o Correction of records.
- o Logging records receipt by the LRC.
- o Records revision process.
- o Documentation of lost or damaged records.
- o Transmittal of records to the Central Records Facility.
- o Storage and preservation of records.

With exception of two instances of noncompliance with the record legibility requirements at the LRC and one instance of the records source not meeting time limitations for submittal of records

to the LRC, all other activities performed by the LRC and records sources at LLNL were found to be in compliance with QP 17.0. The above deficiencies are documented on CARs YM-92-068 and YM-92-066 respectively.

Overall, the LLNL implementation of Program Element 17.0 requirements is satisfactory.

Program Element 18.0, "Audits"

The evaluation of this program element was accomplished through the examination of objective evidence to determine compliance with selected requirements taken from the implementing procedures dealing with Audits, Surveillances, and Qualification of Audit Personnel and DOE Surveillance Report YMP-SR-92-010, Section 6.0.

The selected requirements are listed below:

033-YMP-QP 18.0, Revision 3, CN Nos. 18.0-3-1 and 18.0-3-2, "Audits"

- All applicable program elements are audited annually.
- Subcontractors are audited on triennial basis when supplemented by annual evaluations.
- If technical specialists were used in audits, their qualification were accepted by YMP Leader and QAM.
- Audit plans are prepared for audit and do contain all elements required by pertinent paragraph.
- Audit reports are issued no later than 30 days after closing meeting and do contain all information required by pertinent paragraph.
- Audit records containing pertinent documentation are transmitted to LRC within the time limitation.

033-YMP-QP 18.1, Revision 4, "Surveillances"

- Surveillance schedule(s) are issued.
- Checklists are used for surveillances.
- Surveillance reports containing pertinent documentation are transmitted to LRC within 20 days of completion of surveillance.

033-YMP-QP 18.2, Revision 1, CN Nos. 18.2-1-1, 18.2-1-2, 18.2-1-3, and 18.2-1-4, "Qualification of Quality Assurance Audit Personnel"

- Files for each auditor containing training and audit participation are maintained by the QAM.
- Lead Auditors are evaluated by the YMP QAM.
- Supplementary examinations are administered for those individuals previously certified by another organization.
- Lead Auditor certifications reviewed and accepted by the QAM.
- QA records of Lead Auditors certifications are in accordance with requirements of pertinent paragraph.
- Surveillance of records packages to ensure authentication adequacy was performed and the results were satisfactory (DOE Surveillance Report YMP-SR-92-010, Section 6.0).

Based on the objective evidence reviewed, the implementation of this program element is satisfactory.

Program Element 19.0, "Software Quality Assurance"

The evaluation of this program element was accomplished through the examination of objective evidence to evaluate compliance with selected requirements taken from the SQAP for ISPs and requirements taken from implementing procedure TM-YM-11, Revision 0, "Software Configuration Management System."

The selected requirements from the SQAP are listed below;

- The Master Log shall identify the software products under configuration management.
- The Software Engineer shall maintain the ISP.
- A software Category Selection Form shall be processed for quality-affecting software.
- A backup log shall be maintained.
- ISPs shall be approved for all software quality-affecting work.
- Errors and change requests shall be reported and distributed.

- o A Configuration Status Accounting and Reporting System shall be implemented.
- o Configuration Management records shall be maintained by the Software Engineer.

The selected requirements from TIP-YM-11 are listed below:

- o Master File Folders, File Folders and Development Logs shall be maintained for software products.
- o The ISP shall identify the software package release number.
- o Configuration items shall be identified correctly.

The Lawrence Livermore Software Quality Assurance Program is inadequate at this time based on the following reasons:

a. written procedures have not been established to assure that the requirements of the SQAP are implemented in a consistent and systematic manner.

b. procedures are required for:

- discrepancy reporting
- independent verification and validation
- change control and reporting
- software development life cycle
- error tracking and reporting
- media control and physical security
- qualification of software
- use of released software

c. software activities have been graded incorrectly

d. the SQAP is inconsistent and difficult to understand

The Lawrence Livermore Quality Assurance Program has identified these problems in Surveillance Report S92-05 and the resulting LLNL corrective action documents CAR-15, CAR-16, CAR-17, and CAR-19. There are also two other out standing corrective action documents CAR-18, and CAR-21.

EQ3/6 is the only software application under configuration management. The software is classified as a large existing SES code. The documentation is excellent. This software will be going through verification and validation to achieve qualification for release.

Based on the objective evidence reviewed, the implementation of Program Element 19.0 is unsatisfactory.

ENCLOSURE 4

OBJECTIVE EVIDENCE REVIEWED DURING THE AUDIT

1.0 PROGRAM ELEMENT 2.0, QA PROGRAM

Procedure review record packages:

033-YMP-QP 2.1, Revision 3, "Preparation, Approval, and Revision of Procedures, Plans, and the Quality Assurance Program Description"
033-YMP-QP 2.3, Revision 0, "Management Assessments"
033-YMP-QP 2.8, Revision 2, "Quality Assurance Grading"
033-YMP-QP 2.9, Revision 3, "Indoctrination and Training"
033-YMP-QP 2.10, Revision 4, "Qualification of Personnel"
033-YMP-QP 4.0, Revision 3, "Procurement Document Control"
033-YMP-QP 5.0, Revision 2, "Technical Implementing Procedures"
033-YMP-QP 16.0, Revision 3, "Corrective Action"
033-YMP-R 3, Revision 1, "Scientific Investigation and Design Control"
033-YMP-R 17, Revision 1, "Quality Assurance Records"

CN record packages:

J-20-8.1-0-2
TIP-YM-11 CN No. 1
D-20-53B CN No. 2
D-20-53b-0-4
ISP-PA-01

1991/1990 QA Document Review Log for TIPs
1991 QA Document Review Log for TIPs

1992 Management Assessment Report 92-01
Management Assessment Worksheets
Closure Memorandum

Grading Reports:

QAG-L002, Revision 1
QAG-L014, Revision 1
QAG-L015, Revision 0
QAG-L016, Revision 0
QAG-L017, Revision 0

QAG-L025, Revision 0
QAG-L041, Revision 0
QAG-L045, Revision 0

Training Records for the following individuals:

Greg Gdowski
Toni Holmes
Tad Kishi
Petra Krantz
Jeff Roberts
Dean Wolfe

Training materials for one new program: "Refresher Training for Technical People"

2.0 PROGRAM ELEMENT 3.0, DESIGN CONTROL AND SCIENTIFIC INVESTIGATION

LLNL YMP Quality Procedures:

033-YMP-QP 3.0, Revision 2, "Scientific Investigation Control"
(Including CN Nos. 3.0-2-1 and 3.0-2-2)
033-YMP-QP 3.1, Revision 1, "Design Control"
033-YMP-QP 3.3, Revision 2, "Review of Technical Publications and Data"
(Including CN Nos. 3.3-2-1 and 3.3-2-2)
033-YMP-QP 3.4, Revision 2, "Scientific Notebooks"
(Including CN Nos. 3.4-2-1, 3.4-2-2, 3.4-2-3, and 3.4-2-4)
033-YMP-QP 3.5, Revision 0, "Control of Internal Technical Interfaces"
(Including CN Nos. 3.5-0-1 and 3.5-0-2)

LLNL Technical Implementing Procedures:

TIP-YM-10, Revision 0, "Documentation And Coding Standards For Fortran Programs"
TIP-YM-11, Revision 0, "Software Configuration Management System,"
(Including CN TIP-YM-11-0-1)
TIP-YM-12, Revision 0, "Electronic Record Keeping"
TIP-YM-3, Revision 0, "Labeling, Tracking, and Shipping of Samples"

Plans:

LLNL YMP QAPP, Revision 20

Activity Plan D-20-53a LLNL YMP Spent Fuel Waste Form Testing

TIP-YM-6, Revision 0, "Measurement of the PH of Aqueous Solutions with the Glass Electrode," (Including CN TIP-YM-6-0-1)
TIP CM-3, Revision 0, "Operator Calibration of Scanning Electron Microscopes"

Scientific Investigation Plans (SIPs):

SIP-2, "Geochemical Modeling" (EQ 3/6)
SIP-WF-01, "YMP Spent Fuel Waste Form Testing"
SIP-CM-01, "Metal Barrier Selection and Testing"

Quality-Affecting Determination Forms:

L015, "Selection of Container Material"
L016, "Preliminary Metal Barrier Selection Criteria"
L017, "Experimental Technique Development"
L018, "Parametric Studies"
L019, "Parametric Studies"
L020, "Model Development"
L021, "Degradation Mode Survey"
L022, "EQ 3/6 Documentation and Code Release"
L023, "EQ 3/6 Code and Data Base Maintenance"
L024, "EQ 3/6 Data Base Development"

Scientific Notebooks (SNs):

SN 00141, "Flowthrough Dissolution Tests"
SN 00142, "Flowthrough Dissolution Tests"
SN 00143, "AE 200 Balance, B25, R2122"
SN 00144, "Balance Calibration PC 16/PM 16"

3.0 PROGRAM ELEMENT 4.0, PROCUREMENT DOCUMENT CONTROL AND PROGRAM ELEMENT 7.0, CONTROL OF PURCHASED ITEMS AND SERVICES

Procurement documents and supporting documentation:

- SANL 216-003
- SANL 210-001

- o PDR forms associated with SANL 216-003 and 210-001
- o Memorandums initiating SANLs 216-003 and 210-001
- o Procurement Action Forms associated with SANLs 216-003 and 210-001

QA requirements specifications and subcontract QA requirements specifications:

- o QARS-001-0-1, Revision 0
- o QARS-001B, Revision 0
- o QARS-001C, Revision 0
- o QARS-003, Revision 2

Prequalification surveys:

- o S89-08, Argonne National Laboratory
- o S89-13, Pacific Northwest Laboratories

CNs to QAPP:

- o CN R 1-1-2
- o CN R 4-0-2
- o CN R 8-0-2

Correspondence and Miscellaneous:

- o LOA to ESG, Short to Braley, dated 8/22/89.
- o LOA to Engineering Measurements and Analysis (EM&A) section, signed by Root and Jardine, dated 5/29/90.
- o Audits of EM&A, 88-16 and 88-17.
- o Requalification audit of ESG, 3/27-28/91.
- o Qualified Suppliers List, dated 8/10/92.

LLNL Corrective Action Reports (LLNL CARs)

- o CAR-LLNL-020, dated 7/30/92

4.0 PROGRAM ELEMENT 5.0, INSTRUCTIONS, PLANS, PROCEDURES AND DRAWINGS

Technical Implementing Procedures and QA Records:

TIP-PA-01, Revision 0, "Depth Profiling on the Ion Microscope"
TIP-PA-02, Revision 0, "Data Reduction for Depth Profiles"

TIP-YM-09, Revision 0, "Dektak IIA Surface Profiling System"
TIP-YM-12, Revision 0, "Electronic Record Keeping"

Change Notice:

TIP-YM-11-0-1, CN No. 1 to TIP-YM-11, Revision 0, "Software Configuration Management System"

Miscellaneous:

Controlled Document Report prepared by the Custodian dated June 1992
1991 QA Document Review Log (contained all 1992 entries to date)

5.0 PROGRAM ELEMENT 6.0, DOCUMENT CONTROL

Master List (of Controlled Documents), dated 6/25/92

Procedures/CNs:

ISP-PA-02, R0, TIP-YM-11, R0, CN No. 1
ISP-NF-03, R0, D-20-53b, R0, CN No. 2
ISP-NF-04, R0, D-53-b, R0, CN No. 4
ISP-NF-05, R0, ISP-PA-01, R0
ISP-NF-06, R0, TIP-YM-12, R0
J-20-8.1, R0, AP-CN:2, TIP-PA-01, R0

6.0 PROGRAM ELEMENT 8.0, IDENTIFICATION AND CONTROL OF MATERIALS, PARTS, AND COMPONENTS

Procedures:

- o TIP-YM-3, Revision 0, "Labeling, Tracking, and Shipping of Samples"
- o 033-YMP-QP 3.0, Revision 2, "Scientific Investigation Control"

Items:

- o Nine lines and related buffers identified on laboratory equipment used in UO2 Leaching Process.

Samples:

- Two procured samples (not yet used) for metal barrier selection and testing sample Nos. 304L, E-20-18A, and 316L, E-20-182.

- Bottle samples associated with UO2 Leaching:

R9-27	R4-28	R6A-28
5-5	5-5	
8-6-92	8-7-92	8-7-92
SN 155	SN 165	SN 155

Data:

- Data contained in Scientific Notebook No. 155 associated with UO2 Leaching.

- Data provided in Preliminary Selection Criteria for the YMP Waste Package Container Material (UCRL-ID-104552).

7.0 PROGRAM ELEMENT 12.0, MEASURING AND TEST EQUIPMENT

Documentation dealing with the status of the following M&TE:

M&TE	ID No.	Recall Notices Date
Mass Standards	WN 251	N/A
Weight Set	4311	N/A
Stout Test Weights	4935825	1/15/92
Wilder Press Gauge	5015236	N/A
Wilder Press Gauge	5015243	6/12/91
Stout Multimeter	5067303	5/17/91
Stout Power Meter/Head	4913045	3/27/92
Stout Spectrophotometer	920268	10/9/91
Thermocouple	4004538	N/A
Thermocouple	3979325	11/25/90
Thermocouple	3979271	11/25/90
Thermocouple	8261-40-2	3/16/91

Calibrations performed on balance PM 16 N on 3/27/92 and recorded on scientific notebook No. 144 for activity Work Breakdown Structure WBS 1.2.2.3.1. Calibration of scale using standard ID No. 3411 and recorded on scientific notebook No. 155.

Waivers of calibration interval for M&TE ID No. 8261-40-2, dated 2/23/90, 5/4/90, and 12/16/90.

M&TE Master Status Lists, dated 8/6/92, 4/27/92, 3/27/92, 2/27/92, 1/21/92, 11/21/91, and 9/23/91.

QP 033-YMP-QP 12.0, Revision 2, CN No. 12.0-2-1, "Control of Measuring and Test Equipment"

8.0 PROGRAM ELEMENT 13.0, HANDLING, SHIPPING, AND STORAGE

QP 033-YMP-QP 13.0, Revision 0, "Handling, Storage and Shipping"
QARS-001, Revision 0
QARS-001B, Revision 0
QARS-001C, Revision 0
QARS-003, Revision 2
QARS-004, Revision 0

SN No. 155, Pages 13-15, Shipping and Handling Documentation

9.0 PROGRAM ELEMENT 16.0, CORRECTIVE ACTION

CARs LLNL-003, 004, 006, 008, 012, 014, 022, and 023.

QA Action Item lists dated 4/3/92, 5/1/92, 6/5/92, and 7/6/92.

Trend Analysis Report for 1991 issued on 2/27/92.

QPs 033-YMP-QP 16.0, Revision 3, CN No. 16.0-3-1, "Corrective Action" and 033-YMP-QP 16.2, Revision 3, "Trend Analysis"

10.0 PROGRAM ELEMENT 17.0, QUALITY ASSURANCE RECORDS

Plans:

LLNL YMP QAPP, Revision 20
Activity Plan D-20-53a, LLNL YMP Spent Fuel Waste Form Testing

Procedures:

LLNL QP 033-YMP-QP 17.0, Revision 4, "QA Records"

Scientific Notebooks:

SN 00141, Flowthrough Dissolution Tests
SN 00142, Flowthrough Dissolution Tests
SN 00143, AE 200 Balance, B25, R2122
SN 00144, Balance Calibration PC 16/PM 16

Quality-Affecting Determination Forms:

L015, Selection of Container Material
L016, Preliminary Metal Barrier Selection Criteria
L017, Experimental Technique Development
L018, Parametric Studies
L019, Parametric Studies
L20, Model Development

Miscellaneous:

Checklist For Records
Rejected Records Log
Records Packages 9102177 and 9105143 for Completed Training Modules
Addendums to Records Package 9102177 and 9105143
Fire Resistant Records Storage Container No. H 952908 at the LRC
Fire Resistant Records Storage Containers Nos.B 17284 and 07-001498-79295-47 at Records Sources

11.0 PROGRAM ELEMENT 18.0, AUDITS

Audit Reports YMP-92-03, YMP-92-04, and YMP-92-05
Surveillance Reports S92-02, S-92-03, S92-04, S92-05, and S92-06
Lead Auditor files of R. Hamati and D. Wolfe

QPs 033-YMP-QP 18.0, Revision 3, CN Nos. 18.0-3-1 and 18.0-3-2, "Audits"; 033-YMP-QP 18.1, Revision 4, "Surveillances;" and 033-YMP-QP 18.2, Revision 1, CN Nos. 18.2-1-1, 18.2-1-2, 18.2-1-3, and 18.2-1-4, "Qualification of QA Audit Personnel."

12.0 PROGRAM ELEMENT 19.0, SOFTWARE QUALITY ASSURANCE

033-YMP-R Section 3 and Appendix H
Software Master Log Revision 0, August 3, 1992
VTOUGH Configuration Management ID Log
Software Category Selection EQ3/6
Software Development Log List of Controlled Items
Software Development File Folder
LLNL Audit Report 92-04
Surveillance Report S92-05
CAR-LLNL-15
CAR-LLNL-16
CAR-LLNL-18
CAR-LLNL-17
CAR-LLNL-19
CAR-LLNL-21
Surveillance Report YMP-SR-92-018
CAR YM-92-048
CAR YM-92-049
Audit Report YMP-91-01
SQAP
CN SQAP-0-1
CN SQAP-0-2
ISP-NF-07 EQ3/6 MAINTENANCE
ISP-NF-06 EQ3/6 V&V
ISP-NF-06-0-1
ISP-NF-05 D0OUT
ISP-NF-04 CNGBOCHS
ISP-NF-03 DBAPP
ISP-NF-01 VTOUGH
ISP-PA-02 PANDORA
PRESENTATION: The GEMBOCHS Database and Software Library: Overview of Contents, Components, and Applications by James W. Johnson
LLNL-QAG-L020 Metal Barrier
LLNL-QAG-L022 Maintenance EQ3/6
LLNL-QAG-L023 V&V EQ3/6
LLNL-QAG-L042
Progress Report on V&V of EQ3NR/6

13.0 PROGRAM ELEMENT 3.0, TECHNICAL REVIEW OBJECTIVE EVIDENCE

Mission 2001 Technical Database Input, for WBS 1.2.1.3.5, 1.2.1.4.5, and 1.2.2.2.1, dated 8/10/92 (these consist of networks)

Data blocks displayed on computer screen for DATA0.R13 and DATA0.R14

Software Development File Folder, Part B: General Purpose Entry Sheet, File Folder Label: DATA, Title: Audit Report for DATA0.xxx.R14, Dated 8/7/92

Corrosion Considerations of High-Nickel Alloys and Titanium Alloys for High-Level Radioactive Waste Disposal Containers, by G. E. Gdowski and R. D. McCright, UCRL-JC-103744

Denny A. Jones, "Principles and Prevention of Corrosion," (1992), MacMillan, New York

Laboratory notebook, "UO_2 Dissolution Experiments, SN No. 00155"

Activity Plan D-20-53a, Flow-through Dissolution Tests on UO_2, Revision 2, 7/17/92, Appendix B, Test Plan

Examined display on computer terminal that identified the UCRL numbers for the papers in FOCUS '91, cited elsewhere in this list, by McCright and Fleming, and by Henshall

Laboratory notebook 0022, LLNL, Metal Barrier Selection and Testing Task, issued to Greg Henshall, Activity E-20-16

Supplement to SN-00087, Corrosion Program Results No. 3.

Draft user's manual for EQ3

Draft user's manual for EQ6

Draft user's manual for EQPT

Draft user's manual for the EQ3/6 software package

James Johnson and Suzanne Lundeen (LLNL), The GEMBOCHS Database and Software Library: Overview of Contents, Components, and Applications (View graphs)

Thomas Wolery (LLNL), ESTSC Abstract for EQ3/6(Version 7.0) (Revised 8/7/92)

Electronic Mail Messages: Johnson to Lundeen, Final R10 Changes, 4/10/91; Lundeen to Wolery, Data 0R10, 4/15/91; Johnson to Aines, Supcrt92 on Gem, 6/28/91; Lundeen to Wolery, RE: Data Base Blues, 5/28/92; Lundeen to Wolery, Data0, 5/28/92; Lundeen to Wolery, RE: Crank, 6/9/92; Wolery to Lundeen, R14 Data Bugs, 5/20/92; Wolery to Lundeen, Data Base Blues, 5/28/92; Wolery to Lundeen, Progress Marches On, 6/1/92; Wolery to Lundeen, The Borate Species Problem, 6/3/92; Wolery to Lundeen, RE: Crank, 6/8/92; Wolery to Lundeen, RE: Crank, 6/11/92; Wolery to Lundeen, R15 Data Files, 6/25/92; Wolery to Lundeen, R15 Data Files, 6/26/92; Wolery to Lundeen, The B-Dot Fix, 6/26/92; Lundeen to Bruton, Latest Version of Data0, 7/14/92; Lundeen to Wolery, EQPT, 7/20/92

W. G. Halsey (February 1991), Preliminary Selection Criteria for the Yucca Mountain Project Waste Package Container Material, UCRL-ID-104552, LLNL

G. E. Gdowski (March 1991), Survey of Degradation Modes of Four Nickel-Chromium-Molybdenum Alloys, UCRL-ID-108330, LLNL

Interdepartmental letterhead, Wolery to Johnson and Lundeen, Basis Species and Reactions on EQ3/6 Data Files: Rationale and Guidelines, 4/10/92

Interdepartmental letterhead, Wolery to Glassley, EQ3/6 Code Development: Where We Are, What Needs to be Done, 2/3/92

R. A. Van Konynenburg, W. G. Halsy, R. D. McCright, W. L. Clarke, Jr., G. E. Gdowski (KMI, Inc.) (Jun 1992), Selection of Candidate Container Materials for the Conceptual Waste Package Design for a Potential High Level Nuclear Waste Repository at Yucca Mountain, LLNL

Peer Review Report on "Selection Criteria for the Yucca Mountain Project Waste Package Container Material," Prepared by Metal Barrier Selection Criteria Peer Review Panel, December 1988

G. A. Henshall (LLNL), Stochastic Models for Predicting Pitting Corrosion Damage of HLRW Containers, in Proceedings of the Topical Meeting on Nuclear Waste Packaging Focus '91, September 29-October 2, 1991, Las Vegas, Nevada

American Nuclear Society, Inc., La Grange Park, IL

R. D. McCright and D. L. Fleming (LLNL), Electrochemical Polarization Measurements on Pitting Corrosion Susceptibility of Nickel-Rich Alloy 825, in Proceedings of the Topical Meeting on Nuclear Waste Packaging

Focus '91, September 29-October 2, 1991, Las Vegas, Nevada, American Nuclear Society, Inc., La Grange Park, IL

ENCLOSURE 5

CORRECTIVE ACTION REQUESTS ISSUED DURING AUDIT

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
U.S. DEPARTMENT OF ENERGY
WASHINGTON, D.C.

8 CAR NO.: YM-92-064
DATE: 8/21/92
SHEET: 1 OF 1
QA

CORRECTIVE ACTION REQUEST

1 Controlling Document
033-YMP-QP-12.0

2 Related Report No.
Audit 92-21

3 Responsible Organization
LLNL

4 Discussed With
R. Hamati

5 Requirement:

033-YMP-QP 12.0, Rev 2, CN 12.0-2-1 para 12.0.4 states in part "The Calibration Coordinator will enter M&TE on the Master Status Listing upon receipt of the required calibration records. The calibration certificate will provide a record of: as found, as left, unique M&TE identifier. The accuracy of standards used for calibration will be equal to or better than the instrumentation calibrated".

033-YMP-R-12, Rev 0, Para 2.6 states in part "calibration records identify, the calibration procedure (including revision) utilized to perform the calibration".

6 Adverse Condition:

Measuring and Test Equipment (M&TE) have been entered in the Master Status List without documented evidence of the calibration record. Additionally some M&TE calibration records do not contain information detailed in item 5 above.

Examples are:

- Omega/Type J Thermocouple ID# 8261-40-2 in shown as Master Status list dated Sept 23, 1991 as being calibrated on March 16, 1989. however, the pertinent certificate of calibration is missing from the QA Records package.
- Stout Test Weights ID# 4935825, Stout Multimeter ID# 5067303, Stout Power Meter/Head ID# 4913045. Their certificates do not certain information described in item 5 above.

9 Does a significant condition adverse to quality exist? Yes___ No X
If Yes, Circle One: A B C

10 Does a stop work condition exist? Yes___ No X ; If Yes - Attach copy of SWO
If Yes, Circle One: A B C D

11 Response Due Date:
20 working days from issuance

12 Required Actions: [X] Remedial [X] Extent of Deficiency [X] Preclude Recurrence [X] Root Cause Determination

13 Recommended Actions:

1. For the conditions noted in block 6, assure calibration package contains required documentation and that calibration records reflect all required information.
2. Take action to: determine extent of condition, take action to preclude recurrence, and identify root cause.

7 Initiator	Date	14 Issuance Approved by:	Date
M. R. Diaz	8-14-92	QADD	8/25/92
15 Response Accepted		16 Response Accepted	
QAR	Date	QADD	Date
17 Amended Response Accepted		18 Amended Response Accepted	
QAR	Date	QADD	Date
19 Corrective Actions Verified		20 Closure Approved by:	
QAR	Date	QADD	Date

REV. 08/91

ENCLOSURE 5

CORRECTIVE ACTION REQUESTS ISSUED DURING AUDIT
(Continuation)

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8 CAR NO.: YM-92-065
DATE: 8/21/92
SHEET: 1 OF 2
QA

CORRECTIVE ACTION REQUEST

1 Controlling Document	2 Related Report No.
033-YMP-QP-12.0	Audit 92-21

3 Responsible Organization	4 Discussed With
LLNL	R. Hamati

5 Requirement:

033-YMP-QP-12.0, Rev 2, CN 12:0-2-1, Para 12.0.4 states in part "Calibration frequency will be established consistent with the manufacturer's or designer's recommendations".

6 Adverse Condition:

Several M&TE were not calibrated as required by the manufacturer's or designer's recommendations. Examples are:

- Omega/Type J Thermocouple ID# 8261-40-2 was due for calibration on March 16, 1990. However, several waivers were issued extending the due date until March 16, 1991 based on the instrument being used in an ongoing experiment but requiring to be recalibrated at the end of the experiment. The instrument was used until Feb 22, 1991 and no recalibration has been performed yet.

- Thermocouple ID#s 3979271, 3979325 and 4004538 has a due date for calibration of Nov 25, 1990. They were used until Jan 9, 1992 without being recalibrated since the above due date.

9 Does a significant condition adverse to quality exist? Yes___ No X If Yes, Circle One: A B C	10 Does a stop work condition exist? Yes___ No X ; If Yes - Attach copy of SWO If Yes, Circle One: A B C D	11 Response Due Date: 20 working days from issuance

12 Required Actions: [X] Remedial [X] Extent of Deficiency [X] Preclude Recurrence [X] Root Cause Determination

13 Recommended Actions:

1. Perform the necessary calibration on the instruments reference in block 6. If any of the instruments are found out of calibration, note all uses of the instrument since last calibrations and require work to be redone using instruments that are in calibration.

2. Take action to determine: Extent of condition, action to preclude

7 Initiator M. R. Diaz	Date 8-14-92	14 Issuance Approved by: QADD	Date 8/25/92
15 Response Accepted QAR	Date	16 Response Accepted QADD	Date
17 Amended Response Accepted QAR	Date	18 Amended Response Accepted QADD	Date
19 Corrective Actions Verified QAR	Date	20 Closure Approved by: QADD	Date

REV. 08/91

ENCLOSURE 5

CORRECTIVE ACTION REQUESTS ISSUED DURING AUDIT
(Continuation)

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8 CAR NO.: YM-92-065
DATE: 8/21/92
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QA

CORRECTIVE ACTION REQUEST (Continuation Page)

13 Recommended Action(s) (continued)
recurrence and root cause.

REV. 08/91

ENCLOSURE 5

CORRECTIVE ACTION REQUESTS ISSUED DURING AUDIT
(Continuation)

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8 CAR NO.: YM-92-066
DATE: 8-21-92
SHEET: 1 OF 1
QA

CORRECTIVE ACTION REQUEST

1 Controlling Document	2 Related Report No.
033-YMP-QP-18.0/033-YMP-QP-17.0	Audit Report YMP-92-21

3 Responsible Organization	4 Discussed With
LLNL	Dean Wolfe

5 Requirement:

033-YMP-QP-18.0, Revision 3, Para. 18.0.5.4 states in part, "The audit plan includes the QAPP requirements."

033-YMP-QP-17.0, Revision 4, Para. 17.0.5.2 states in part, "The records must be transmitted to the LRC by the record source no later than 10 working days after the records are completed."

6 Adverse Condition:

Audit reports have been issued without following procedural requirements.

Examples are:

Audit Report No. YMP-92-03 was issued on March 18, 1992 but it was transmitted to the LRC on May 11, 1992.

Audit YMP-92-05. The audit plan does not contain any QAPP elements. Additionally, the audit report was issued on June 9, 1992, but was not transmitted to the LRC until June 26, 1992.

9 Does a significant condition adverse to quality exist? Yes___ No X If Yes, Circle One: A B C	10 Does a stop work condition exist? Yes___ No X ; If Yes - Attach copy of SWO If Yes, Circle One: A B C D	11 Response Due Date: 20 working days from issuance

12 Required Actions: ☐ Remedial ☒ Extent of Deficiency ☒ Preclude Recurrence ☒ Root Cause Determination

13 Recommended Actions:

1. Randomly select a sample of completed audit reports and determine if this is a repetitive condition.
2. Identify measures to preclude recurrence.
3. Investigate to determine what caused the problem.

7 Initiator Mario R. Diaz Mario Diaz Date 8-14-92	14 Issuance Approved by: QADD R.C. Lopez Date 8/25/92
15 Response Accepted QAR Date	16 Response Accepted QADD Date
17 Amended Response Accepted QAR Date	18 Amended Response Accepted QADD Date
19 Corrective Actions Verified QAR Date	20 Closure Approved by: QADD Date

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ENCLOSURE 5

CORRECTIVE ACTION REQUESTS ISSUED DURING AUDIT
(Continuation)

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8 CAR NO.: YM-92-067
DATE: 8-21-92
SHEET: 1 OF 1
QA

CORRECTIVE ACTION REQUEST

1 Controlling Document	2 Related Report No.
033-YMP-QP-17.0	Audit Report YMP-92-21

3 Responsible Organization	4 Discussed With
LLNL	D. Wolfe/R. Ramati

5 Requirement:

033-YMP-QP-17.0, Revision 4, Para. 17.0.5.2 states in part, "Record segments, such as calibration information, are not required to be submitted to the LRC until the package is complete, which occurs when the equipment is no longer used."

6 Adverse Condition:

QA Records of several Measuring and Test Equipment (M&TE) have not been transmitted to the LRC after they have been declared no longer in use.

Calibration information of the following M&TE, ID Nos. 999GM07, 3763795, 4778699, 4260941, 5067198, 3642427, 5015199, 4935825, and 5015205, were not found as QA records in the LRC. Some of these equipment have been declared no longer in use as of October 1, 1991.

9 Does a significant condition adverse to quality exist? Yes___ No_X_ If Yes, Circle One: A B C	10 Does a stop work condition exist? Yes___ No_X_; If Yes - Attach copy of SWO If Yes, Circle One: A B C D	11 Response Due Date: 20 working days from issuance

12 Required Actions: [X] Remedial [X] Extent of Deficiency [X] Preclude Recurrence [X] Root Cause Determination

13 Recommended Actions:

1. Take the necessary action to transmit the calibration records noted in Block 6 to the LRC.

2. Take actions to: Determine extent of deficiency, action to preclude recurrence, and determine root cause.

7 Initiator	14 Issuance Approved by:
Mario R. Diaz Date 8-14-92	QADD Date 8/25/92
15 Response Accepted	16 Response Accepted
QAR Date	QADD Date
17 Amended Response Accepted	18 Amended Response Accepted
QAR Date	QADD Date
19 Corrective Actions Verified	20 Closure Approved by:
QAR Date	QADD Date

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ENCLOSURE 5

CORRECTIVE ACTION REQUESTS ISSUED DURING AUDIT
(Continuation)

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8 CAR NO.: YM-92-068
DATE: 8-21-92
SHEET: 1 OF 1
QA

CORRECTIVE ACTION REQUEST

1 Controlling Document
LLNL Quality Procedure 033-YMP-QP 17.0

2 Related Report No.
YMP-92-21

3 Responsible Organization
LLNL

4 Discussed With
D. Wolfe/B. Bryan

5 Requirement:
Paragraph 17.0.5.3 states the following: "Record transmittals received by the LRC are inspected to assure they are legible...."

6 Adverse Condition:
Contrary to this requirement, there was no objective evidence that the LRC inspected and accepted Records Package for Scientific Notebook 00142 as legible (i.e., approximately 30% of the Notebook pages had signature blocks partially or completely cut off on both hardcopy and film at the LRC).

Also, one Certificate of Calibration for multimeter ID 5067303, dated September 6, 1991, was found to contain illegible information.

9 Does a significant condition adverse to quality exist? Yes___ No XX
If Yes, Circle One: A B C

10 Does a stop work condition exist? Yes___ No X ; If Yes - Attach copy of SWO
If Yes, Circle One: A B C D

11 Response Due Date:
20 working days from issuance

12 Required Actions: [X] Remedial [X] Extent of Deficiency [X] Preclude Recurrence [X] Root Cause Determination

13 Recommended Actions:
Correct LRC and CRF (if required) copies of Scientific Notebook 00142. Determine cause of condition. Determine if other inspected/accepted Scientific Notebooks indicate similar problems. Take appropriate action to preclude recurrence.

Verify that Certificates of Calibration for M&TE maintained by the LRC are legible. Take appropriate action to correct any potential deficiency and preclude recurrence.

7 Initiator C. C. Warren for Date 08/14/92	14 Issuance Approved by: QADD Date 8/25/92
15 Response Accepted QAR Date	16 Response Accepted QADD Date
17 Amended Response Accepted QAR Date	18 Amended Response Accepted QADD Date
19 Corrective Actions Verified QAR Date	20 Closure Approved by: QADD Date

REV. 08/91