

QA: QA

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

AUDIT REPORT M&O-ARP-01-02

OF THE

**CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM
MANAGEMENT AND OPERATING CONTRACTOR**

AND

THE U. S. GEOLOGICAL SURVEY

IN

LAS VEGAS, NEVADA

FEBRUARY 5-9, 2001

Prepared by: _____

**Robert F. Hartstern
Audit Team Leader
Office of Quality Assurance/
Quality Assurance Technical
Support Services**

Date: _____

Approved by: _____

**Robert W. Clark
Director
Office of Quality Assurance**

Date: _____

1.0 EXECUTIVE SUMMARY

This performance-based quality assurance (QA) audit was conducted on the processes and activities related to the Unsaturated Zone Flow and Transport Model (UZ) Process Model Report (PMR). The audit was performed at the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) offices in Las Vegas, Nevada, February 5-9, 2001. The purpose of the audit was to evaluate the effectiveness of the UZ PMR and Analysis and Model Report (AMR) process, through the evaluation of the UZ PMR and four AMRs that support the UZ PMR.

The audit team determined that the CRWMS M&O, which includes Lawrence Berkeley National Laboratory (LBNL), and Los Alamos National Laboratory (LANL), and the U.S. Geological Survey (USGS) has effectively implemented the critical process steps relative to the PMR and AMRs evaluated. One condition adverse to quality was identified resulting in Deficiency Report (DR) LVMO-00-D-044 for failure to close Input Transmittals in accordance with Administrative Procedure (AP) 3.14Q, *Input Transmittals*. In addition, two deficiencies, which were determined to be isolated, were identified and corrected during the audit (CDA); one was for an AMR missing a required statement on software range, and the second for another AMR missing a required statement on the control of electronic information. These three deficiencies are detailed in Section 5.5 of this report. The audit resulted in the issuance of six recommendations, which are documented in the Condition/Issue Identification and Reporting /Resolution System (CIRS) Nos. 1434-1439. CIRS will be used for the response and tracking of the recommendations.

During the audit, both the responses to recommendations made during previous PMR audits, and the corrective actions relative to the conditions identified in previous DRs that could impact the UZ PMR and AMR processes were evaluated. The activities for the UZ PMR and four supporting AMRs reviewed during the audit were determined to be satisfactory relative to these recommendations and DRs.

Based on the review of the UZ PMR and AMRs, interviews of personnel, and examinations of the processes and documentation, the audit team determined that overall, the UZ activities being conducted, at the time of the audit, meet the Office of Civilian Radioactive Waste Management (OCRWM) QA program requirements, with the exception of the three deficiencies identified above. Several positive improvements in activities evaluated, as compared to previous audits, were also identified. A summary of the audit results, including the Technical Specialists' evaluations for the UZ PMR and AMRs can be reviewed in Section 5.4 of this report.

2.0 SCOPE

The audit was conducted to evaluate the effectiveness of the PMR and AMR processes used in development of the UZ PMR. The audit team evaluated the documented activities that constitute scientific and performance assessment (PA) analyses and models pertaining to the UZ. The identified UZ PMR and AMRs, including supporting documents, were examined to determine the effectiveness of the analysis in providing evidence to support the UZ study.

The UZ PMR supports the Total System Performance Assessment (TSPA) and also serves as an important reference to the License Application. The following processes and products were examined as part of this audit:

2.1 **Technical Products:**

One of the primary purposes of the audit was to evaluate the incorporation of CRWMS M&O responses to recommendations and DR corrective actions resulting from previous PMR Audits. To meet the intent of this audit, the audit team selected the following products, for the reasons presented, to be evaluated:

- TDR-NBS-HS-000002, Revision 0, ICN 2, “Unsaturated Zone Flow and Transport Model Process Model Report.” Revision 0 of the PMR was not sufficiently complete to be audited in the previous UZ PMR Audit M&O-ARP-00-04. Both the Revision 0 and the two ICNs were selected for this audit to evaluate the critical process steps.
- AMR U0010, “Simulation of Net Infiltration for Modern and Potential Future Climates,” ANL-NBS-HS-00032, Revision 0, ICN 1. Draft Revision 00A of this AMR was audited in the previous UZ PMR Audit, which resulted in one recommendation, DR LVMO-00-D-034, and several software issues identified in DRs LVMO-00-D-038 and 039. ICN 1 of this AMR was selected for this audit to evaluate the incorporation of the recommendation and effectiveness of corrective actions for DRs identified from the previous UZ PMR audit.
- AMR U0085, “Analysis of Geochemistry Data,” ANL-NBS-HS-000017, Revision 0, ICN 1. Revision 0 of this AMR was not sufficiently complete to be considered in the previous UZ PMR Audit. Both the Revision 0 and the ICN 1 were selected for this audit to evaluate the critical process steps.
- U0110/N0120, “Drift Scale Coupled Processes (DST and THC Seepage) Models,” MDL-NBS-HS-000001, Revision 1. Revision 0 of this AMR was audited in the previous NFE PMR Audit M&O-ARP-00-08, which resulted in ten recommendations, and a software issue identified in DR LVMO-00-D-132. Revision 1 of this AMR was selected for this audit to evaluate the incorporation of the recommendations and effectiveness of corrective actions for the DR identified from the previous NFE PMR audit.
- U0175, “Future Climate Analysis - 10,000 to 1,000,000 Million Years After Present,” ANL-NBS-GS-000011, Revision 0. This new AMR identified after the previous audit was evaluated for critical process steps, including effective implementation of corrective actions from the previous UZ PMR Audit deficiency reports.

2.2 **Planning Documents:**

- WPP-NBS-HS-000002, Revision 00, “Work Package Planning Summary for the Unsaturated Zone Flow and Transport Model Process Model Report.”
- TDP-NBS-HS-000091, Revision 01, Technical Development Plan, “Unsaturated Zone Flow and Transport Model PMR”
- TDP-NBS-HS-000016, Revision 01, Technical Development Plan, “Simulation of Net Infiltration for Modern and Potential Future Climates.”
- TDP-NBS-HS-000040, Revision 00, Technical Development Plan, “Analysis of Geochemistry Data.”
- TWP-NBS-HS-000001, Revision 00, ICN 2, Technical Work Plan, “Unsaturated Zone (UZ) Flow and Transport Process Model Report.”

2.3 **Critical Process Steps:**

The performance-based evaluation of process effectiveness was based upon the following:

- Satisfactory completion of the critical process steps
- Documentation that substantiates quality of data
- Implementation of applicable QA program elements
- Effectiveness of corrective actions
- Implementation of responses to previous PMR Audits.

The following critical process steps were considered during the evaluation of the AMR and calculation process:

- Resources:
 1. Planning - Work Package Planning Summaries (WPPS), Technical Development Plans (TDP) and Technical Work Packages (TWP)
 2. Software and Electronic Information Controls
- Methodology:
 1. Inputs to Analysis/Models and Calculations
 2. Data Acquisition and Rollup
 3. Assumptions, Analysis, and Calculations
 4. Analyses/Models and Calculation Development
 5. Model Validation
- Data Management
 1. Qualification of Data
 2. To Be Verified (TBV)/To Be Determined (TBD)
 3. Submittal of Data to Technical Data Management System (TDMS)

- Adequacy & Accuracy:
 1. Reviews (Checking/Technical)
 2. Approval
 3. Revision and Changes

- Deliverables:
 1. Analyses/Reports/Models
 2. Record Submittals

2.4 Technical Evaluation

The audit included a technical evaluation of the adequacy and effectiveness of the UZ PMR and AMRs development process. Details of the technical evaluation are documented in Section 5.4 of this report.

The principle AP governing the preparation of the UZ PMR was AP-3.11Q, Revision 1, Interim Change Notice (ICN) 1, *Technical Reports*. The principle AP governing the preparation of the AMRs was AP-3.10Q, Revision 2, ICN 3, *Analyses and Models* or applicable earlier revisions. The audit team examined the UZ PMR and AMRs, and used the information, along with the checklist, to structure the interviews of personnel.

The audit team conducted personnel interviews and examined documentation in accordance with the approved audit plan to evaluate the adequacy and effectiveness of the critical process steps for the development of the UZ PMR and AMRs.

3.0 AUDIT TEAM MEMBERS/OBSERVERS

The audit team consisted of personnel from the OCRWM Office of Quality Assurance (OQA)/Quality Assurance Technical Support Services (QATSS) and Management Technical Services (MTS) as follows:

Robert F. Hartstern, OQA/QATSS, Las Vegas, NV, Audit Team Leader
Samuel E. Archuleta, OQA/QATSS, Las Vegas, NV, Auditor
Thomas W. Doe, MTS, Las Vegas, NV, Technical Specialist
Robert P. Hasson, OQA/QATSS, Las Vegas, NV, Auditor
Keith M. Kersch, SAIC, Las Vegas, NV, Technical Specialist
Levy Kroitoru, MTS, Las Vegas, NV, Technical Specialist
Richard E. Powe, OQA/QATSS, Las Vegas, NV, Auditor
Richard L. Weeks, OQA/QATSS, Las Vegas, NV, Auditor

The following four observers were present during the audit:

Hans Arlt, U.S. Nuclear Regulatory Commission (NRC), Headquarters, Rockville,
Maryland
Robert Latta, NRC, Las Vegas, Nevada
James Winterle, Center for Nuclear Waste Regulatory Analyses (CNWRA),
San Antonio, Texas
Susan Zimmerman, State of Nevada, Nuclear Waste Project Office, Carson City, NV

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

A pre-audit meeting was conducted at the CRWMS M&O offices, Las Vegas, Nevada, on February 5, 2001. Daily debriefings were held to apprise the CRWMS M&O and the USGS management and staff of the progress of the audit and of any potential conditions adverse to quality. A post-audit meeting was conducted at the CRWMS M&O offices, Las Vegas, Nevada, on February 9, 2001.

Personnel contacted during the audit, including those that attended the pre-audit and post-audit meetings, are listed in Attachment 1, "Personnel Contacted During the Audit."

5.0 SUMMARY OF AUDIT RESULTS

5.1 Program Effectiveness

The audit team concluded that critical process steps applicable to the PMR and AMR processes were effectively implemented. However, there were three conditions adverse to quality with two resulting in CDAs, and one resulting in DR LVMO-00-D-044, all of which relate to procedure implementation. Details of the conditions adverse to quality are presented in Section 5.5.2 of this report for the DR and in Section 5.5.3 for the CDAs. In addition, six recommendations are provided for Bechtel SAIC Company, LLC (BSC) management (new M&O since the audit) consideration and are detailed in CIRS Nos. 1434-1439.

5.2 Stop Work or Immediate Corrective Actions Taken

There were no Stop Work Orders or immediate corrective actions required as a result of the audit.

5.3 QA Program Activities

Attachment 2, "Summary Table of Audit Results," provides results for each critical process step evaluated. Details of the audit, including the objective evidence reviewed, are documented in the audit checklist. The checklist is maintained as a QA record.

5.4 Technical Audit Activities

Resources:

Planning:

The Activity Evaluations (AE), WPPSs, TDPs and TWPs for the UZ PMR and four AMRs were reviewed and found to be satisfactory. Both the PMR and AMR U0085 were developed under the earlier WPPS/TDP process, while the remaining three AMRs were planned and developed in accordance with the TWP process.

Software Controls and Control of Electronic Information

All four AMRs evaluated reflected a marked improvement in the implementation of established software controls. Software routines were properly documented within the AMRs, and all Software Routine Reports were complete and accurate for the AMRs. Controls for the electronic management of information were also found to be adequate and effective. There were no repeat discrepancies such as those noted during the previous UZ PMR audit.

The following commendable finding deserves special mention: Throughout the audit, the numerous, short-notice requests for support from Software Configuration Management (SCM) were met with immediate and complete results. All documentation requested was promptly produced without exception, attesting to a well-established, fully functioning archiving system. Very noteworthy was the system for packaging related software documentation into a single, easy-to-use binder.

AMR U0010 software documentation and compliance with controls were properly executed. One minor observation was noted. In a revision to the Software Activity Plan (SAP), the description of comparison methodology was not documented. This was viewed as an administrative oversight since the methodology was included in the original SAP, and was also included in a later SAP for Control Point 1 documentation. This oversight was corrected during the audit with the issuance of a revised SAP and is documented as CDA #1 in Section 5.5.3 of this report. It was also noted that ARCINFO 6.1.2 was listed in Table 3.1 as “software.” This software is used solely for “visual display or graphical presentation,” and considered exempt from AP-SI.1Q, *Software Management*, controls. The audit team suggested that this software code be removed from the table, and that its exemption should be stated in Section 3 of the AMR. This change meets the criteria for an “editorial change,” and was handled accordingly. Supplement V requirements were found to be fully and correctly documented.

AMR U0085 used only exempt software as provided for by AP-SI.1Q. Supplement V controls for the electronic management of information was satisfactorily implemented with one minor deviation. The AMR did not identify the use of the LANL procedure for control of the management of electronic data information. This was an apparent oversight and was viewed as minor and isolated, since the TWP had fully documented the use of a line procedure to control electronic information, which was followed in developing the AMR. To correct this error, the audit team recommends that the statement be added and that the implementing procedure (LANL-YMP-QP-5S.O) be listed in Section 8.2 of the AMR. (see CIRS #1434).

AMR U0175 did not employ software, however it did employ the use of electronic media during development of the AMR. Supplement V controls for the management of electronic information was fully and correctly documented.

AMR U0110/N0120 software documentation and compliance with controls were properly executed. The AMR does not identify that software was used only within the range of validation. The audit team recommends that this statement be added (see CIRS # 1435). Supplement V controls for the management of electronic information was correctly documented in this AMR.

Software control was a significant issue in the previous UZ PMR Audit resulting in four DRs. The effectiveness of implementation of corrective actions for applicable DRs were evaluated and determined to be effective. As previously stated, implementation of established software controls was very evident in all four AMRs. There were no deficiencies noted in the baselining of software, or instances where software was not properly obtained from the SCM prior to use. All software used had been qualified or was being used under the provisions of Section 5.11 of AP-SI.1Q, with proper documentation on file. Only minor deviations of documentation requirements were noted as discussed in previous portions of this report. Configuration items are well developed and properly archived in SCM. Software was, in all cases, properly listed on the Baseline Report or the Completed 5.11 Process Report. In general, there was no evidence that corrective actions taken to address previous DRs have been less than effective. To the contrary, the obvious improvement noted during this audit indicates that process controls implemented by the audited organizations have had the desired effect.

Methodology

The technical evaluation results of the UZ PMR and four AMRs, which are comprised of the five critical process steps in methodology, are as follows.

PMR, “Unsaturated Zone Flow and Transport Model”

The audit of the PMR pursued three major technical concerns: the tracking of the data inputs to models to assure currency; adequacy of scientific notebooks (SN) for tracking simulation inputs and results; and the disposition of technical comments.

The tracking of data inputs is of key concern, especially in complicated modeling tasks where several organizations are involved and where co-dependent work may be taking place at the same time. The major conclusions were as follows:

- The timing of data development and its implementation in models was not a major issue for the technical areas checked (mainly geochemical databases).
- The data and model result transfers were taking place through the TDMS and therefore were traceable.
- Data changes were found to be in accordance with AP-3.14Q for notifying data users of data changes, and AP-3.17Q, *Impact Reviews*, for the reviews of

the impacts of these changes on the applications that use the data. This system appears to be performing adequately and effectively.

The second area pertaining to the tracking of simulation runs is vital for assuring that the results of simulations are truly representing the cases they claim to be. This issue is essential for reproducibility and defensibility. The technical evaluation reviewed examples of SNs and the tracking system for simulation inputs and results. The SN system and the tracking system appear to be performing in an exemplary manner.

The third main area of review was the disposition of technical review comments. In reviewing the UZ PMR comments it appeared that in general, comments were being addressed appropriately, adequately resolved, and properly documented. Only one exception was noted, which was PA's comment, concerned with the listing of where alternative models were addressed in the PMR. In following up on this comment, the audit team checked on the matrix diffusion model and its alternative (which is to have no matrix diffusion). It was noted that the criteria for selecting the matrix diffusion model (which should be in one of several places such as 3.11.2.4, 3.11.2.5, and 3.11.9.1) was not discussed. The alternative "no diffusion" model is a conservative choice when compared with the preferred matrix diffusion model. The "no matrix diffusion" case does appear in the PMR, which presents model runs using this alternative. However, nowhere in the PMR is there any justification for choosing matrix diffusion as the preferred case. The justification of models over their alternatives is not required to be in the PMR; however, if it is not discussed in the PMR, it should be covered in the appropriate AMRs. A review of the relevant AMRs did not uncover any discussion of the choice of matrix diffusion models, although there are data in the PMR and AMRs that could be used to support the use of the matrix diffusion alternative. The audit team recommends that the PMR's choice of one process model over an alternative be justified (see CIRS # 1436).

AMR U0010, "Simulation of Net Infiltration for Modern and Potential Future Climates"

The audit team examined the approved Revision 0, ICN 1 of this AMR in preparation for this audit. When the audit began, the audit team was provided with Revision 0, ICN 1 containing editorial corrections recently incorporated. These corrections clarified most of the confusion that appeared in the AMR initially reviewed. The product is greatly improved over the version that was examined in the previous UZ PMR Audit. It was apparent that the corrective actions implemented as a result of the DR have improved the AMR development process.

The CRWMS M&O's response to the Recommendation No. 2 in the previous audit appears to be adequately incorporated. The product is effective and does a good job of following the procedural requirements.

AMR U0085, “Analysis of Geochemistry Data”

The purpose of this AMR is to discuss geochemical data and models that are important for site characterization purposes and for evaluations of site performance. An extensive database of geochemical and isotopic characteristics has been established for pore waters and gases from the unsaturated zone, perched water, and saturated-zone waters in the Yucca Mountain area. The analytical work has been driven by the diverse needs of the YMP site characterization, process modeling and PA communities. Water and gas chemistries influence the sorption behavior of radionuclides and the solubilities of the radionuclide compounds that form. The chemistry of waters that may infiltrate the potential repository will be determined in part by that of water present in the UZ above the potential repository horizon, while pore-water compositions beneath the potential repository horizon will influence the sorption behavior of the radionuclides transported towards the water table. However, more relevant to the discussion in this report, development and testing of conceptual flow and transport models for the Yucca Mountain hydrologic system are strengthened through the incorporation of natural environmental tracer data into the process. Chemical and isotopic data are used to establish bounds on key hydrologic parameters and to provide corroborative evidence for model assumptions and predictions.

This AMR adequately presents the various databases along with the associated conceptual models. However, several areas were identified in which the audit team recommends additional work in order to better:

- Discuss the purpose of this AMR and its input to other AMR's
- Clarify and expand the text on various locations to resolve transparency and traceability issues
- Identify alternative methods/models for C-14 age correction and the calculation of background tritium values
- Develop an approach regarding the treatment of the Assumptions TBVs.

The authors and support staff were very helpful and responsive to discussions conducted during the audit, and agreed that the areas identified will significantly improve the quality of the AMR. A detailed documented description of the areas identified above was provided to the AMR author during the audit and details are provided in the CIRS (see CIRS # 1439).

AMR U0110/N0120, “Drift-Scale Coupled Processes (DST and THC Seepage) Models”

The purpose of this AMR is to document the NFE and UZ models used to evaluate the potential effects of coupled thermal-hydrologic-chemical (THC) processes on UZ flow and transport. These models include the Drift Scale Test (DST) THC Model and several THC seepage models. These models provide the framework to evaluate THC coupled processes at the drift scale, predict flow and

transport behavior for specified thermal loading conditions, and predict the chemistry of waters and gases entering potential waste-emplacement drifts

The focus of the technical evaluation during this audit was to evaluate the AMR against CRWMS M&O responses to the 10 recommendations identified in Audit M&O-ARP-00-08. Written responses to the recommendation were provided by the CRWMS M&O on November 27, 2000 (LV.ART.AO.11/00-039).

The technical quality of Revision 1 was found to be much superior relative to the previously audited revision. All of the Recommendations were adequately addressed with the exception of one. As a result, all but one is considered closed. Further comments were provided for Recommendation No. 8, which will remain open. The references that have been added were not considered adequate and a new reference was proposed (i.e. Ventilation Model AMR ANL-EBS-MD-000030) to be added by the audit team. In general the authors and support staff were very helpful and responsive to discussions conducted during the audit.

AMR U0175, “Future Climate Analysis - 10,000 to 1,000,000 Years After Present”

This AMR is in draft form and has gone through the initial check process. The audit team examined the draft AMR and check comments. The audit team noted a few minor defects in the report; however, the checker had already identified all of these. It was apparent that the staff support for developing this AMR by the USGS has greatly improved. While the report is still in draft form, it appears that the process is effective and will result in a good final product.

Data Management

The evaluation of data management controls implemented to support activities related to the development of the examined AMRs and PMR were found to be adequate and in some cases very good. The examination included a comparison of information provided on locked-out Document Input Reference System (DIRS) with information located in the Automated Technical Data Tracking (ATDT) database. Comparisons were made on both hard copies and by viewing input screens of various ATDT personnel.

The effectiveness of implementation of corrective actions for applicable DRs were evaluated and determined to be effective. Submittal and incorporation of data to the TDMS is considered effective. Initially, a potential deficient condition was identified regarding the submittal of the TDMS database access list. AP-SIII.3Q, Revision 0, ICN 3, *Submittal and Incorporation of Data to the Technical Data Management System*, Section 5.4, c) requires the Technical Data Manager to submit the TDMS database access list to the RPC in accordance with Section 6.0. It does not identify the timing or format of this submittal. Discussions conducted after the audit with the TDMS Manager disclosed that the access list(s) would be submitted at the conclusion of the License Application Phase of the CRWMS program in accordance with Section 6.1 of AP-SIII.3Q. As a result of the

confusion, the audit team recommends the TDMS Manager revise AP-SIII.3Q to clarify the statement currently in Section 6.1 that states, “The TDMS database access list is submitted as an individual QA record.” It is recommended that this sentence be revised to indicate when this list is submitted and in what format (electronic or paper). In addition, it is recommended that the TDMS Manager submit a hard copy of the TDMS database access list to the RPC when personnel are deleted (denied access) and new personnel are added to the list. This action would ensure documentation of the TDMS database access list is captured on an ongoing basis in addition to the electronic record that is submitted at the conclusion of the license application phase of the CRWMS program (see CIRS #1437).

Technical product inputs were verified to be requested from a controlled source such as the TDMS. The audit team verified that Input Transmittal Request forms were issued for inputs not obtained from a controlled source. However, during the review of the Input Transmittal Requests, the audit team revealed that the requests were not being properly processed. This is identified as DR LVMO-01-D-044 (see Section 5.5.2).

The qualification status of the AMR inputs as identified in the TDMS were consistent with the AMR DIRS.

The audit team verified that Unqualified Data was being properly processed in accordance with procedure AP-SIII-2Q, Revision 0, ICN 3, *Qualification of Unqualified Data and Documentation of Rationale for Accepted Data*. A sampling of unqualified data sets were evaluated along with the data qualification plans and reports. The methods used to qualify the data were provided along with the rationale/basis. The qualification reports reviewed reflected proper implementation of the qualification plans. The process for changing the status of the data was evaluated and found to be acceptable.

Adequacy and Accuracy:

The UZ PMR and four AMRs were verified to be processed in accordance with the applicable portions of AP-3.10Q, and AP-3.11Q. The AMR record packages for U0010 and U0085 reflected a determination by the Responsible Manager to initiate a technical review in accordance AP-2.14Q, Revision 1, *Review of Technical Products and Data*. The review was verified to be accomplished and documented by the designated organization/discipline using the Review Records. Review criteria was provided to each Affected Organization as an attachment to the Review Record. Checker comments were verified to be documented on comment sheets with the resolution provided by the originator. Personal interviews with the responsible author and checkers, and review of the completed technical product record packages revealed that both the PMR and AMR packages were checked and approved by individuals having the authority to perform those duties. There was one deficiency and one recommendation identified. The deficiency was corrected during the audit and was associated with editorial changes to AMR U0010 and is documented as CDA #2 in Section 5.5.3

of this report. The audit team is concerned with draft control of documents being reviewed and recommends the use of both an alpha number indicator and a corresponding date so that it is clear which draft version of the document is being reviewed (see CIRS #1438).

The qualifications of the checkers were verified through review of records packages that included their qualifications and basis of selection as reviewers and found to be satisfactory.

Deliverables:

The record packages that reflected the development of the UZ PMR and the four AMRs were reviewed during the audit to evaluate compliance with the OCRWM QA Program. The UZ PMR and AMRs structure, format, controls associated with inputs, documentation of assumptions, and identification of references were included in the evaluation. Overall, the UZ PMR and AMRs development was found to be in accordance with the OCRWM QA Program requirements.

Summary of Conditions Adverse to Quality

5.5.1 Corrective Action Request

No CARs were issued.

5.5.2 Deficiency Reports

The audit team identified one deficiency during the audit that resulted in the issuance of one DR, as follows:

DR LVMO-01-D-044

The CRWMS M&O has failed to properly process Input Transmittals through closure that were referenced in the UZ PMR, Revision 0, ICN 2. Two examples were identified and corrected during the audit, however, during further evaluation of this area, additional examples were found.

5.5.3 Corrected During the Audit

The audit team identified two deficiencies during the audit that resulted in CDAs, as follows:

1. AP-SI.1Q, Section 5.11 c) requires, in making provision for the use of unqualified software, that a SAP be prepared to include discussion of comparison confirmation methodologies to be used to determine impacts that may be applicable once the software is qualified. A review of AMR U0010 revealed that the discussion of comparison confirmation methodologies had not been included. USGS took the

action to revise the SAP during the course of the audit. This was judged to be a minor oversight with no notable impact.

2. AP-3.10Q, Revision 2, ICN 3 requires in Section 5.8, “Editorial Corrections,” that if the Originator makes editorial corrections to the analysis or model documentation after approval, but before it has been distributed by Las Vegas Document Control, that the in-process master must be changed by: 1) Mark the change(s) by drawing a single line through the change(s) (i.e., pen/ink or electronic changes) and inserting the new or correct information, 2) Initial and date the change(s).

Contrary to this, the editorial changes made to AMR U0010, Revision 00, ICN 1 had not been completed as required. The changes were made as if they were a revision with revision bars in the margins; however you could not tell what the changes were without comparing to the unchanged version of Revision 00, ICN 1. Additional editorial changes were also needed as a result of the audit. The editorial changes were corrected to be in accordance with AP- 3.10Q during the audit.

5.5.4 Deficiency Identification and Referral

None.

5.5.5 Follow-up of Previously Identified Deficiencies

During the audit, corrective actions were evaluated relative to conditions adverse to quality identified in previous and existing DRs that could impact the UZ PMR and AMRs.

The PMR and all four AMRs were evaluated for effectiveness of corrective actions taken in response to the following Deficiency Reports:

- a) LVMO-00-D-034 (AMR U0010 deficiency)
- b) LVMO-00-D-036 (Software)
- c) LVMO-00-D-037 (Software)
- d) LVMO-00-D-038 (Software)
- e) LVMO-00-D-044 (Software)
- f) LVMO-00-D-071 (Data Management)
- g) LVMO-00-D-097 (Data Management)
- h) LVMO-00-D-129 (Data Management)
- i) LVMO-00-D-132 (Software)
- j) LVMO-00-D-134 (Software)
- k) LVMO-00-D-136 (Software)
- l) LVMO-00-D-148 (Data Management)

6.0 RECOMMENDATIONS

The audit resulted in the issuance of six recommendations, which are documented in the Condition/Issue Identification and Reporting /Resolution System (CIRS) Nos. 1434-1439. CIRS will be used for the response and tracking of the recommendations.

7.0 LIST OF ATTACHMENTS

Attachment I, "Personnel Contacted"

Attachment II, "Summary Table of Audit Results"

ATTACHMENT 1

PERSONNEL CONTACTED DURING THE AUDIT

| Name | Organization | Pre-Audit Meeting | Contacted During Audit | Post-Audit Meeting |
|--------------------------|--|-------------------|------------------------|--------------------|
| Aden-Gleason, Nancy | UZ/LBNL, EA Manager | X | | X |
| Andrews, Robert | M&O/PA Dept. Manager | | | X |
| Bailey, Jack N. | M&O, Director, Licensing | X | | |
| Beckman, Donald | M&O, Manager, Licensing | X | | |
| Belanger, Ruth | M&O, Manager of Reference Control | | X | |
| Berg, Vance | NSNF, Observer | X | | |
| Blaylock, James | DOE, Engineer | X | | X |
| Bigger, Norma | M&O, Product Checking | | X | |
| Bodvarsson, Gudmundur S. | LBNL, PMR Lead | X | X | X |
| Burningham, Andrew G. | M&O, ART | X | | X |
| Chaney, Thomas H. | USGS | | X | |
| Clark, John | M&O, Staff Engineer | | | X |
| Craig, Robert W. | USGS, TPO | X | | X |
| Cuzner, Marlene | LBNL | X | | X |
| Dana, Stephen R. | OQA/QATSS, Lead QAE | X | | X |
| Dodson, Bill | M&O, Manager TDMS | | X | |
| Dove, F. Harvey | OQA/QATSS | | | X |
| Eshleman, Michael J. | MTS-IT, Consultant, Observer | X | | X |
| Fissekidou, Vivi | LBNL | X | X | X |
| Gallagher, Kimberly | LBNL | | | X |
| Grant, Terry | M&O/DSQD, Products Coordination Lead | | X | |
| Hanson, Glen T. | M&O | | | X |
| Harris, Steve | OQA/QATSS | X | | X |
| Hedegaard, Randall | LBNL, Software Coordinator | X | X | |
| Hobbs, Samuel H. | M&O, Licensing | X | | X |
| Houseworth, James E. | AR&T/LBNL, Deputy Manager | X | X | X |
| Hoxie, Dwight T. | USGS, Hydrologist | X | X | X |
| Hudson, Amy | PWT/USGS, QAIS | X | X | |
| Jackson, June | LBNL | | | X |
| Jaeger, Mike | M&O/DSQD, Data Verification Lead | | X | |
| Jenkins, Dan | M&O, Data Quality Section | | X | |
| Keith, Dale | M&O/TDMS, ATDT DBA | | X | |
| Knop, Matthew | M&O/TDMS, Deputy Manager | | X | |
| Larsen, Kathryn | PWT/USGS, Data Implementation Speclst. | X | X | |
| Liu, Hui-Hai | LBNL | X | | |
| Linden, Ron | MTS, Sr. Hydrogeologist | | | X |
| Mangold, Donald | LBNL | X | | X |
| Martinez, Leo R. | BSC QA Department | X | | |
| Mason, Jeffrey | M&O, Software Secretarial | | X | |
| Mattes, Vincena R. | M&O, SEP DBA | | X | |
| Meijer, Arend | LANL/GCX | | X | |
| McClung, Ivelina | LBNL | | | X |

| Name | Organization | Pre-Audit Meeting | Contacted During Audit | Post-Audit Meeting |
|---------------------------|-------------------------------------|-------------------|------------------------|--------------------|
| Miller-Corbett, Cynthia | USGS, Reg. & Quality Support Team | | X | |
| Mustard, Martha | USGS | | X | |
| Nakashima, Alan | M&O | | | X |
| Nieder-Westermann, Gerald | UZ/LBNL, Program Coordinator | X | X | X |
| Nodora, Donald N. | LBNL | | | X |
| Paces, James | USGS | | X | |
| Palay, Christian M. | M&O, ART | X | X | X |
| Persoff, Peter | UZ/LBNL, Checker | X | X | X |
| Roback, Robert | LANL | | X | |
| Seamans, David L. | EDC, Engineering Tech. II | | X | |
| Scott, William | USGS, Deputy, TPO | X | | |
| Safley, Leslie E. | TDMS, Model Warehouse DBA | | X | |
| Sanchez, Paul | M&O, Data Qualification Team | | X | |
| Sharpe, Saxon | DRI/USGS, AMR Technical Specialist | X | X | |
| Sheaffer, Patricia | PWT/USGS, QAIS Supervisor | X | X | |
| Sonnenthal, Eric | UZ/LBNL, Geological Scientist | X | X | X |
| Splawn, Steven | M&O, Software Configuration Manager | | X | |
| Spycher, Nicolas | LBNL, Scientist | | X | |
| Steinborn, Terry | M&O-DSQD | | X | |
| Terberg, Robert | LBNL, Technical Data Coordinator | | X | X |
| Valladao, Carol | LBNL | X | | X |
| Villavert, Maryann | LBNL | | | X |
| Vosicky, Daynett D. | M&O/EDC, Engineering Tech. II | | X | |
| Washington, Toni | M&O, Engineering Document Control | | X | |
| Weaver, Jeff | M&O/R&L | | | X |
| Wemheuer, Robert | M&O/DSQD, FSS Dept. Manager | | | X |
| Westerman, Gerald | LBNL | | X | |
| Williams, Nancy | BSC, Manager of Projects | | | X |
| Woods, Mary | M&O, Engineering Document Control | | X | |
| Wright, Samatha | M&O/TBX Administrator | | X | |
| Yunker, Jean L. | M&O, Director ART | X | | X |

LEGEND:

- BSC – Bechtel SAIC Company, LLC (New Management and Operating Contractor)
- M&O – Civilian Radioactive Waste Management System Management and Operating Contractor
- LANL – Los Alamos National Laboratory
- LBNL – Lawrence Berkeley National Laboratory
- MTS – Management Technical Support
- NSNF – National Spent Nuclear Fuel
- NRC – Nuclear Regulatory Commission
- QATSS – Quality Assurance Technical Support Services
- USGS – U.S. Geological Survey

**ATTACHMENT 2
SUMMARY OF TABLE OF AUDIT RESULTS**

| Critical Process Steps | Implementing Documents | Detail Checklists | Deficiencies | Recommendations | Process Effectiveness | Product Adequacy | Overall |
|---------------------------------|--|--|---------------------|------------------------|------------------------------|-------------------------|----------------|
| Planning | AP-2.13Q, AP-2.15Q, AP-2.21Q, & QAP-2-0 | Pg. 2 – pg. 5 | N/A | N/A | SAT | SAT | SAT |
| Software Controls | AP-SI.1Q | Pg. 6 – pg. 13 | 1 CDA | CIRS # 1434 | SAT | SAT | SAT |
| Electronic Information Controls | AP-SV.1Q | Pg. 14 – pg. 15 | N/A | N/A | SAT | SAT | SAT |
| Methodology | AP-3.10Q AP-3.12Q AP-3.14Q AP-3.15Q AP-3.17Q AP-SIII.1Q | Pg. 16 – pg. 52 | | | | | |
| UZ PMR | | Pg. 16 – pg. 22 | N/A | CIRS # 1436 | | | |
| AMR U0010 | | Pg. 23 – pg. 25 | 1 CDA | N/A | SAT | SAT | SAT |
| AMR U0085 | | Pg. 26 – pg. 37 | N/A | CIRS # 1439 | SAT | SAT | SAT |
| AMR U0110/N0120 | | Pg. 38 – pg. 46 | N/A | CIRS # 1435 | SAT | SAT | SAT |
| AMR U0175 | | Pg. 47 – pg. 52 | N/A | N/A | SAT | SAT | SAT |
| Data Management | | AP-3.14Q, AP-3.15Q AP-3.17Q, AP-SIII.2Q AP-SIII.3Q | Pg. 53 – pg. 65 | DR LVMO-01-D-44 | CIRS # 1437 | SAT | SAT |
| Adequacy & Accuracy | AP-2.14Q, AP-3.10Q, AP-3.12Q, AP-3.17Q | Pg. 66 - pg. 72 | N/A | CIRS # 1438 | SAT | SAT | SAT |
| Deliverables | AP-3.4Q, AP-3.10Q, AP-3.12Q, AP-3.15Q, AP-17.1Q | Pg. 73 - pg. 74 | N/A | N/A | SAT | SAT | SAT |
| Totals | | 74 Pages | 1 DR & 2CDAs | 6 Recommendations | Satisfactory | | |

Legend:
SAT – Satisfactory
UNSAT – Unsatisfactory
N/A – Not Applicable