

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

AUDIT REPORT

OF

CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM
MANAGEMENT AND OPERATING CONTRACTOR

LAS VEGAS, NEVADA

AUDIT NUMBER YM-ARP-95-16
JULY 24 THROUGH 28, 1995

Prepared by: Stephen R. Maslar Date: 8/13/95

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Approved by: Donald G. Horton Date: 8/17/95

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ENCLOSURE

1.0 EXECUTIVE SUMMARY

As a result of Performance Based Quality Audit YM-ARP-95-16, the audit team determined that the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) is satisfactorily implementing effective controls for the Waste Package Design process that include: Design Input Control, Design Process, Design Analyses, Design Verification, and Design Interface Control. Evaluation of compliance to specified controls for Waste Package Design Analyses activities was found to be marginal. Evaluation of adequacy and compliance to the process for identifying Quality Assurance (QA) Controls for Waste Package Design activities was found to be marginal. The evaluation of the technical adequacy of Work Breakdown Structure (WBS) 1.2.2.1, "Waste Package Coordination and Planning" and WBS 1.2.2.2, "Waste Package Requirements" resulted in satisfactory implementation of Waste Package Design.

The audit team identified four deficiencies during the audit that resulted in the issuance of one Performance Report (PR) and three Deficiency Reports (DRs). PR YMQAD-95-P-005 documents the lack of interface controls for activities performed by Lawrence Livermore National Laboratory (LLNL) on Waste Package Design work for CRWMS M&O. DR YMQAD-95-D-004 documents that scoping design analysis used as input to the Advanced Conceptual Design had no QA controls as approved in the Quality Assurance Procedure (QAP)-2-0, "Evaluation." DR YMQAD-95-D-005 documents that design analyses did not contain a complete presentation of the analysis including all calculations such that any qualified individual could review the analysis without recourse to the originator. DR YMQAD-95-D-006 documents the lack of objective evidence showing the completeness and technical adequacy of checked design analyses. Two other deficiencies were corrected during the audit and are described in Section 5.5.2. Additionally, there were thirteen recommendations resulting from this audit which are detailed in Section 6.0 of this report.

2.0 SCOPE

This performance based audit was conducted to evaluate the effectiveness of the CRWMS M&O controls for performing the Waste Package Design Process and resultant products to determine the degree to which they meet program requirements and management commitments and expectations. The audit also reviewed compliance to selected Waste Package Design controls. The evaluation of WBS 1.2.2.1 and WBS 1.2.2.2, Waste Package Design process effectiveness and product acceptability was based upon the following activities in accordance with the approved audit plan:

ACTIVITIES AUDITED

- Design Input Control
- Design Process
- Design Analyses
- Design Verification
- Design Interface Control
- QA Controls for Waste Package Design Activities

TECHNICAL AREAS

This audit was conducted to evaluate the CRWMS M&O controls for performing WBS 1.2.2.1, "Waste Package Coordination and Planning," and WBS 1.2.2.2, "Waste Package Requirements".

3.0 AUDIT TEAM AND OBSERVERS

The following is a list of audit team members, their assigned areas of responsibility, and observers:

| <u>Name/Title/Organization</u> | <u>Activities</u> |
|---|--|
| Stephen R. Maslar, Audit Team Leader (ATL), Yucca Mountain Quality Assurance Division (YMQAD) | Waste Package Design Process Design Interface Control and Analysis |
| John R. Matras, ATL in training, YMQAD | Indoctrination and Training, and Records |
| Marc J. Meyer, Auditor , Headquarters Quality Assurance Division | Waste Package Design Input Control, Design Process, Design Verification, and Identifying QA Controls for Waste Package Design |
| Paul L. Cloke, Technical Specialist, Science Applications International Corporation | WBS 1.2.2.1 and WBS 1.2.2.2 |
| John G. Spraul, Observer, U.S. Nuclear Regulatory Commission (NRC) | |

Kien Chang, Observer, NRC

Thomas C. Trbovich, Observer, NRC,
Southwest Research

Susan Zimmerman, Observer, State of Nevada

4.0 AUDIT MEETINGS AND PERSONNEL CONTACTED

The pre-audit meeting was held at the CRWMS M&O office in Las Vegas, Nevada, on July 24, 1995. A daily debriefing and coordination meeting was held with CRWMS M&O management and staff, and daily audit team meetings were held to discuss issues and potential deficiencies. The audit was concluded with a post-audit meeting held at the CRWMS M&O office in Las Vegas, Nevada, on July 28, 1995. Personnel contacted during the audit are listed in Attachment 1. The list includes those who attended the pre-audit and postaudit meetings.

5.0 SUMMARY OF AUDIT RESULTS

5.1 Program Effectiveness

The audit team concluded that, in general, the CRWMS M&O process controls are satisfactorily being implemented for Waste Package Design except for the process for identification of QA controls which was determined to be marginal.

5.2 Stop Work or Immediate Corrective Actions Taken

There were no Stop Work Orders, immediate corrective actions or related additional items resulting from this audit.

5.3 QA Program Audit Activities

A summary table of audit results is provided in Attachment 2. The details of the audit evaluation, along with the objective evidence reviewed, are contained within the audit checklists. The checklists are kept and maintained as QA Records.

5.4 Technical Audit Activities

The technical evaluation of WBS 1.2.2.1 and WBS 1.2.2.2 resulted in an overall satisfactory implementation of the Waste Package Design. A summary table of audit results is provided in Attachment 2. The details of the audit evaluation, along with the objective evidence reviewed, are contained within the audit checklists. The checklists are kept and maintained as QA Records.

5.5 Summary of Deficiencies

The audit team identified four deficiencies during the audit for which one PR and three DRs have been issued. Two additional deficiencies were identified and corrected prior to the postaudit meeting.

Synopses of deficiencies documented as PR, DRs, and those corrected during the audit are presented below. The PR has been issued to the CRWMS M&O responsible individual in accordance with AP-16.1Q, Revision 0. The DRs have been transmitted under separate letter, number YMQAD:RBC-4152 dated August 03, 1995.

5.5.1 Performance Reports (PR)

PR YMQAD-95-P-005

Work to be performed by LLNL at the request of CRWMS M&O was reviewed using LLNL procedures not CRWMS M&O procedures. This PR documents the lack of CRWMS M&O interface controls and procedures for reviewing activities performed by LLNL on Waste Package Design for CRWMS M&O.

5.5.2 Deficiency Reports (DRs)

DR YMQAD-95-D-004

QARD, Revision 4, Paragraph 2.2.3.F requires "... quality assurance controls (grading) shall be applied to the degree commensurate with the 1) function or end use of the item...". Scoping design analyses used as an input to the Advanced Conceptual Design had no QA controls identified in the QAP-2-0 evaluation.

DR YMOAD-95-D-005

QAP-3-9, Revision 5, Attachment I, Item 7, requires "Design Analysis - The complete presentation of the analysis, including all calculations, shall be presented such that any qualified individual could review the analysis without recourse to the originator." This was not evident in design analyses: BB 00000000-01717-0200-00005, Revision 00; BB 00000000-01717-2200-00080, Revision 00; and BB 00000000-01717-0200-00079, Revision 00.

DR YMOAD-95-D-006

QAP-3-9, Rev 5 Para 5.2.3A requires "a check of the design analysis for completeness and technical adequacy". The discipline check of four design analyses lacked objective evidence showing that there was a check for completeness and technical adequacy.

5.5.2 Deficiencies Corrected During the Audit

Deficiencies which are considered isolated in nature and only requiring remedial action can be corrected during the audit. The following deficiencies were identified and corrected during the audit:

1. Design Analysis reports B 00000000-01717-2200-00080, Revision 00 and B 00000000-01717-2200-00079, Revision 00 did not address or identify the need for external reviews as required by QAP 3-9, Revision 5, Paragraph 5.4. The design analysis review summary sheets for both documents were revised. Both now state that external reviews are not required based on the interdisciplinary reviews performed. This was verified and accepted prior to the post audit meeting.
2. The record package submittal form submitted for Design Analysis, B0000000-01717-0200-00005, Revision 00, contained incorrect dates for some of the included records. The submittal form was revised to show the correct dates prior to the postaudit meeting. This action was verified and accepted. Records Processing Center Accession Number is MOV-950512-16.

5.5.3 Follow-up of Previously Identified CARs

None

6.0 RECOMMENDATIONS

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

- 6.1 The Product Integrity Group performed a detailed review of the "Report on Preliminary Selection of Waste Package Materials," (BBA0000000-01717-5705-00007). Results were documented in Report Number OPJ-95-033. Several problems were noted that require resolution. PR LVMO-95-P-001 was issued internally to address some of the issues. This review constitutes an external review of an approved document. This review is defined as a non-QA activity that is not required to comply with the applicable QARD requirements. It is recommended that reviews performed by the Product Integrity Group of quality affecting work activities be performed as a quality activity in accordance with the applicable QARD requirements.
- 6.2 Reviews of "Report on Preliminary Selection of Waste Package Materials," (BBA 0000000-5705-00007) missed a number of violations of QAP-3-5 during their review, which was identified in CRWMS M&O PR LVMO-95-P-001. Based on discussions with two of the reviewers, the reason for this may have been a lack of time and confusion on how To Be Verified (TBV) was documented. It is recommended that "TBV" requirements and other factors that may have contributed to the conditions described in CRWMS M&O PR LMVO-95-P-001 be clarified to reviewers. Insure that reviewers have sufficient time to perform their reviews and are provided with appropriate training and the necessary supporting information.
- 6.3 It is difficult to ascertain whether work identified on QAP-2-0 evaluation forms is old work, future work, or current work. It is recommended that the relationship between described work and scheduled activities be identified by citing milestone numbers and if necessary, estimated start and completion dates.
- 6.4 Responsible managers are sharing QAP-2-0 evaluation forms signed by only one responsible manager. Thus, it is not readily apparent that work on the form will be performed by a number of different organizations. It is

recommended that each responsible manager sign the QAP-2-0 evaluation form, complete separate QAP-2-0 evaluation forms, or identify on the QAP-2-0 evaluation form the lead organization and other participating organizations.

- 6.5 Not all activities related to a Q-List item need to be subject to the QARD. However, due to the way Part II of the QAP-2-0 evaluation form is structured, a "yes" response to "Is the activity related to an item in the WASTE/MGDS Q-List?" makes the activity subject to the QARD. It is recommended that Part II of the QAP-2-0 evaluation form be revised.
- 6.6 It is sometimes difficult to understand the applicability of QAPs listed in Part III of the QAP-2-0 evaluation form based on the description of the activity in Part I. For example, Part I may read "Evaluate information furnished by supplier," and Part III may read, "QAPs 3.1, 3.2, 3.5, and 6.1." Thus, it is not certain whether all four QAPs must be implemented or only one of the four. It is recommended that a list of products resulting from the activity in Part I be shown. In Part III identify QAPs and options, if applicable. If relationship between products and QAPs cannot be clearly defined, because of the number of different products involved, break activity into lower-level tasks and define on separate QAP-2-0 evaluation forms.
- 6.7 TBVs 059 and 060-Waste Package Design (WPD) pertain to information and assumptions in Criticality Analyses B 000000-01717-220-079 and 080 respectively. The TBVs cover all information and assumptions needed to calculate the probability of criticality as a function of time. Five categories of information and assumptions are identified. However, much of the information in these categories is contained in References in Section 5 of the analyses that are not considered design input. According to QAP-3-9, only design inputs need to be identified and tracked as TBVs. Thus either this is asking for more than what QAP-3-9 requires, or not all of the inputs have been identified in Section 4 of the two analyses.
- It is recommended that assumptions and inputs that require qualification or verification be identified with an asterisk. Review both analyses to make certain all inputs have been identified. Review QAP-3-9 and other procedures to determine whether the practice of identifying all unqualified inputs in a document with a single TBV is a practice that should only be permitted, if properly controlled, for conceptual design and other early phases of design. Blanket use of TBVs for all design phases of a document is of concern.
- 6.8 LLNL is responsible for long-term testing of waste package materials including

defining test environment. The required test environment is documented in LLNL plans that are not subject to LLNL or CRWMS M&O design controls. It is recommended that this activity and the associated QARD requirements be investigated further, and consider placing the activity under CRWMS M&O design controls during resolution of design interface issues identified in PR YMQAD-95-P-005 prior to the start of the testing program.

- 6.9 More care should be exercised in obtaining definitive published data and in restricting the application of empirical relationships to ranges to which they have been shown to apply. One instance of inadequate care was found for each of these points.

"Analysis of Degradation due to Water and Gases in Mult Purpose Canister (MPC)," Document Identifier BB0000000-01717-0200-00005, Revision 00, involves the vapor pressure of the azeotrope (ca. 68% HNO₃) in the nitric acid-water system. Data for 90% HNO₃ were used to estimate the vapor pressure. Existing literature data should have been obtained. These data show the estimate to be high by a factor of nearly 3.5. This is still conservative, so there is no impact on the conclusions.

The second involves the use of equation 6 in "Initial Waste Package Probabilistic Criticality Analysis: MPC with Disposal Container (TBV-060-WPD)," Document Identifier B00000000-01717-2200-00080, Revision 00, and "Initial Waste Package Probabilistic Criticality Analysis: Uncanistered Fuel (TBV-069-WPD)," Document Identifier B00000000-01717-2200-00079, Revision 00. These documents state: "This equation is representative of experimental data for moderate temperatures (up to about 350°K)." Instead it was used for calculations at 839°K. Thus, it was used well outside the range of applicability. At the higher temperature and presumably relatively low pressure the water will be a low density steam as contrasted to the water at a density close to 1 gm/cm³ of which the equation is representative. No data appears to exist to indicate that the same equation applies for these conditions. However, new calculations conducted during the audit in response to added items showed that the high temperature provide a less conservative result than the sea water case. Recalculation of the latter provides conservatism comparable to that previously attributed to the steam example. The net result is that there is no impact on the conclusions.

- 6.10 "Analysis of Degradation due to Water and Gases in MPC," Document Identifier BB0000000-01717-0200-00005, Revision 00, cites requirements in the MPC Subsystem Design Procurement Specification. One of these, specifies

that the residual water content of the MPC interior be less than 0.25 volume percent. This specification is subject to at least three different interpretations. The recommendation is, if feasible, to rewrite this specification such that only one interpretation remains. Whereas, this has no impact on the present document, because all three interpretations were considered, it could significantly reduce any future effort on the topic of the present document or a related question.

- 6.11 In section 4.3.2 of "Analysis of Degradation due to Water and Gases in MPC," Document Identifier BB0000000-01717-0200-00005, Revision 00, a statement is made to the effect that a fill pressure greater than 152 kPa could lead to excessive internal pressure. However, neither the value of this excessive pressure nor its basis is stated. It is recommended that at some point during the design process, such a pressure be determined and included in a suitable document. This might be as simple as demonstrating that a fill pressure of 1.5 atmosphere will not, on heating to the maximum allowable temperature, exceed the strength of any container material under consideration.
- 6.12 Discussions indicated that the potential for water leakage through pin holes, i.e., failures, in the zircaloy cladding of fuel rods was significantly greater in the past than at present. Possibly this source of water would exceed the permissible limit. It is, therefore, recommended that this possibility be carefully evaluated in respect to criticality, and, if necessary, older fuel rods be segregated from newer ones and be handled in a different manner so as to remove the water before emplacement in a repository.
- 6.13 In view of the usage of a high estimate of the vapor pressure of the azeotrope in the water-nitric acid system noted in recommendation 6.6, it is recommended that the potential impact of nitrogen be reevaluated. This might include consideration of the potential for nitrogen gases to dissolve in thin surface films of water (e.g., mono- or di-molecular layers) as well as corrosion by nitrous acid, which should also be present as a consequence of nitrogen oxides dissolving in water.

7.0 LIST OF ATTACHMENTS

- Attachment 1: Personnel Contacted During the Audit
Attachment 2: Summary Table of Audit Results

ATTACHMENT 1
Personnel Contacted During the Audit

| <u>Name</u> | <u>Organization/Title</u> | <u>Preaudit Meeting</u> | <u>Contacted During Audit</u> | <u>Postaudit Meeting</u> |
|---------------------|--------------------------------|-------------------------|-------------------------------|--------------------------|
| Arth, F. C. | CRWMS M&O/QA | X | X | X |
| Bailey, J. | CRWMS M&O/ DO Mgr., E&I Mgr. | | X | |
| Bailey, S. D. | CRWMS M&O/OPI | | X | |
| Belke, B. | NRC | | | X |
| Benton, H. A. | CRWMS M&O/WPDevelopment Mgr. | X | X | X |
| Berlien, R. B. | CRWMS M&O/QA Surveillance Lead | X | X | X |
| Cogar, J. A. | CRWMS M&O/MGDS Mgr, Engr. | X | | |
| Doering, T. W. | CRWMS M&O/WPD Mgr | X | X | X |
| Gilstrap, O. J. | CRWMS M&O/QA/QE Mgr. | | X | X |
| Gotlieb, P. | CRWMS M&O/WP Risk Mgr | X | X | |
| Greene, H. T. | YMQAD/QATSS/Division Mgr. | | | X |
| Haught, D. C. | DOE/Waste Package Team Lead | | | X |
| Horton, D. G. | DOE/Director, OQA | | | X |
| Howard, R. | CRWMS M&O/OPI QA Engr | | X | X |
| Justice, B. R., Jr. | CRWMS M&O/QA/QE Support Mgr. | X | | |
| Justice, J. B. | CRWMS M&O/TR Mgr. | X | X | X |
| Lotz, T. L. | CRWMS M&O/WPD Engr. | | | X |
| Massari, J. | CRWMS M&O/WPD Engr. | X | X | X |
| McCoy, J. K. | CRWMS M&O/MGDS DPA | X | X | X |
| Ruth, R. P. | CRWMS M&O/QA Mgr. | X | | X |
| Salchak, J. J. | CRWMS M&O/Checking Group Mgr. | | X | |
| Segrest, A. M. | CRWMS M&O/MGDS Mgr. | X | X | X |
| Snell, R. D. | CRWMS M&O/E&I Mgr. | X | | |
| Stahl, D. | CRWMS M&O/WPM Mgr. | X | X | X |
| Thompson, A. O. | CRWMS M&O/WPD/Engr. | X | | |
| Vaslos, G. P. | CRWMS M&O/QA Principal Engr. | X | X | X |
| Wagster, R. E. | CRWMS M&O/MGDS SI | X | X | X |
| Wallin, W. | CRWMS M&O/WPD/Engr. | X | X | X |
| Warren, C. C. | YMQAD/QATSS/Verification Lead | | | X |
| Willis, J. | CRWMS M&O/QA Mgr. | X | | X |

ATTACHMENT 1(continued)
Personnel Contacted During the Audit

Legend:

DO Deputy Operations
DPA Development Performance Analyst
E&I Engineering & Integration
Engr. Engineer
DOE U.S. Department of Energy
Mgr. Manager
MGDS Mined Geologic Disposal System
OPI Office of Product Integrity
OQA Office of Quality Assurance
QATSS Quality Assurance Technical Support Services
QE Quality Engineer
SI Systems Integrator
TR Training Records
WP Waste Package
WPD Waste Package Design
WPM Waste Package Materials

ATTACHMENT 2
SUMMARY TABLE OF AUDIT RESULTS

| QA ELEMENT/ ACTIVITIES | PROCESS STEPS | CHECKLIST DETAILS | PR/ DR | CDA | RECOM- MENDATION | ADE- QUACY | COMP- LIANCE | OVER- ALL |
|------------------------------------|---|-------------------|---------------|-----|-----------------------------|------------|--------------|-----------|
| Waste Package Design Input Control | Development of Technical Documents | Pages 1-3 | YMQ AD-95-P-5 | N | 6.2, 6.7, 6.8 | SAT | SAT | SAT |
| Waste Package Design Process | Indoctrination and Training | Page 40 | N | N | N | SAT | SAT | SAT |
| | Development of Technical Documents | Pages 4-6 | N | N | N | SAT | SAT | |
| Waste Package Design Analysis | Design Analysis MPC Design Analysis | Pages 22-29 | YMQ AD-95-D-6 | 1 | N | SAT | MARG-INAL | SAT |
| Waste Package Design Analysis | Analysis of Degradation due to Water and Gases in MPC | Pages 7-15 | YMQ AD-95-D-5 | N | 6.9, 6.10, 6.11, 6.12, 6.13 | SAT | MARG-INAL | SAT |

ATTACHMENT 2
SUMMARY TABLE OF AUDIT RESULTS

| QA ELEMENT/ ACTIVITIES | PROCESS STEPS | CHECKLIST DETAILS | PR/ DR | CDA | RECOM- MENDATION | ADE- QUACY | COMP- LIANCE | OVER- ALL |
|-------------------------------|--|----------------------|------------------|-----|---------------------|---------------|-----------------|--------------|
| Waste Package Design Analysis | Report on Preliminary Selection of Waste Package Materials | Page 16 | N | N | N | SAT | SAT | SAT |
| Waste Package Design Analysis | Initial Waste Package Probabilistic Criticality Analysis: Uncanistered Fuel | Pages 17-21 | YMQ AD-95-D-5 | N | 6.9 | SAT | MARG- INAL | SAT |
| Waste Package Design Analysis | Initial Waste Package Probabilistic Criticality Analysis: Multi-Purpose Canistered with Disposal Container | Pages 17-21 | YMQ AD-95-D-5 | N | 6.9 | SAT | MARG- INAL | SAT |

ATTACHMENT 2
SUMMARY TABLE OF AUDIT RESULTS

| QA ELEMENT/ACTIVITIES | PROCESS STEPS | CHECKLIST DETAILS | PR/DR | CDA | RECOMMENDATION | ADEQUACY | COMPLIANCE | OVERALL |
|--|---|-------------------|---------------|-----|-------------------------|----------|------------|----------|
| Waste Package Design Verification | Technical Document and Milestone Review | Page 30-33 | N | N | 6.1 | SAT | SAT | SAT |
| Waste Package Design Interface Control | Transmittal of Design input | Pages 34-36 | N | N | N | SAT | SAT | SAT |
| | Record Source Responsibilities for Inclusionary Records | Page 39 | N | 2 | N | SAT | SAT | |
| Identifying QA Controls for Waste Package Design | Control of Activities | Pages 37-39 | YMQ AD-95-D-4 | N | 6.3, 6.4, 6.5, 6.6, 6.7 | MARGINAL | MARGINAL | MARGINAL |
| TOTAL | | 40 | 4 | 2 | 13 | | | |

CDA Corrected During Audit N . . None
 DR . . Deficiency Report PR . Performance Report
 MPC Multi-Purpose Canister SAT Satisfactory