

1.0 INTRODUCTION

Staff from the U.S. Nuclear Regulatory Commission (NRC) Division of High-Level Waste Repository Safety and the Center for Nuclear Waste Regulatory Analyses (CNWRA) observed the U.S. Department of Energy (DOE), Office of Quality Assurance (OQA), audit OCRWMP–OQA–05–20 of Bechtel SAIC Company, LLC (BSC). DOE conducted the audit on January 24–28, 2005, at the BSC facility in Las Vegas, Nevada. The purpose of this audit was to assess portions of the Preclosure Safety Analysis (PCSA) development associated with the Yucca Mountain Project License Application (LA) and BSC implementation of the Office of Civilian Radioactive Waste Management “Quality Assurance Requirements and Description” (QARD), DOE/RW–0333P, Revision 16. The objective of the audit was to evaluate the critical processes used in the development of the PCSA.

2.0 MANAGEMENT SUMMARY

DOE conducted both a performance-based and compliance-based audit of six calculations, analyses, and reports used to support the PCSA that would be included in the potential LA. DOE had originally intended to conduct a vertical slice evaluation of the PCSA from the safety analysis report to its supporting calculations and other design products. However, several final documents had not yet been completed; therefore, the audit team elected to review earlier versions of the same documents, but not to perform a vertical slice review of the criticality, electrical systems, and ventilation systems.

DOE’s auditors evaluated the PCSA technical documents for effectiveness and implementation of applicable quality procedures. The audit team identified 4 conditions adverse to quality (CAQ) and 13 technical improvement recommendations. However, the audit team concluded that procedures to develop the documents were satisfactory and their implementation was adequate.

The observers determined that the audit was performed effectively in those areas audited and the auditors demonstrated sound knowledge of the applicable implementing procedures and QARD requirements. The auditors conducted thorough interviews, challenged and questioned responses when appropriate, and effectively employed their checklists. The observers agreed with the audit team conclusions, findings, and process improvement recommendations.

However, the observers noted the late change in scope of the audit appeared to be the result of the planning, communication, and coordination between DOE and BSC. The change adversely affected the ability of the technical reviewers to perform a thorough review of the documents. The observers concluded that since the documents reviewed during the audit were undergoing revision and were to be reissued in the near future, the work products selected for the audit were not appropriate. This observation was based on several statements from BSC and DOE staff during the audit that the document revisions were addressing many of the audit findings.

3.0 AUDIT PARTICIPANTS

DOE Audit Team Members

Christian Palay, Navarro Quality Services (NQS), Audit Team Leader
Donald Harris, NQS, Audit Team Member—Quality Assurance (QA) Specialist
William Petrie, NQS, Audit Team Member—QA Specialist
James Ziemba, NQS, Audit Team Leader in training
Roy Capshaw, DOE, Audit Team Member—QA Specialist
Gary Sequiera, Management Technical Support Services (MTS), Audit Team Member— Technical Specialist
Robert Fish, MTS, Audit Team Member—Technical Specialist
Robert Bradbury, MTS, Audit Team Member—Technical Specialist

Observation Team

Timothy Kobetz, NRC, Team Leader
Christopher Ryder, NRC, Technical Specialist
Dennis Galvin, NRC, Technical Specialist
Thomas Trbovich, CNWRA, QA Specialist
Douglas Gute, CNWRA, Technical Specialist

4.0 REVIEW OF THE AUDIT AND AUDITED ORGANIZATION

DOE conducted the audit in accordance with Line Procedure (LP)–18.3Q–OCRWM, *Quality Assurance Internal Audit Program*, and Administrative Procedure (AP)–16.1Q, *Condition Reporting and Resolution*. The audit team used the QARD; NUREG–1804, *Yucca Mountain Review Plan*; the *Preclosure Safety Analysis Guide, Revision 1, July 2003*; and applicable APs and LPs to generate the audit checklist. The observers followed NRC Manual Chapter 2410, *Conduct of Observation Audits*, July 12, 2000.

4.1 Scope of the Audit

DOE conducted both a performance-based and compliance-based audit of six calculations, analyses, and reports used to support the PCSA that would be included in the potential LA. DOE had originally intended to conduct a vertical slice evaluation of the PCSA from the safety analysis report to its supporting calculations and other design products. However, several final documents had not yet been completed; therefore, the audit team elected to review earlier revisions of the same documents but not to perform a vertical slice review of the spent fuel criticality, electrical systems, and ventilation systems.

The audit evaluated implementation of the following procedures:

1. AP–2.1Q, *Personnel Training and Qualification*;
2. LP–2.14Q–BSC, *Document Review*;
3. AP–2.22Q, *Classification Analyses and Maintenance of the Q List*;
4. AP–3.12Q, *Design Calculations and Analyses*;

5. AP-3.13Q, *Design Control*;
6. AP-3.15Q, *Managing Technical Product Inputs*;
7. AP-3.24Q, *Drawings*;
8. AP-17Q, *Records Management*;
9. LP-3.11Q-BSC, *Technical Reports*;
10. LP-3.25Q-BSC, *Design Criteria*;
11. LP-3.26Q-BSC, *System Description Documents*; and
12. LP-SI.11Q-BSC, *Software Management*.

4.2 Conduct and Timing of the Audit

The observers determined the audit was performed effectively in the areas audited and that the audit team demonstrated sound knowledge of the applicable implementing procedures and QARD requirements. The audit team members conducted thorough interviews, challenged and questioned responses when appropriate, and effectively employed their checklists. The audit team and observers held a caucus at the end of each day to discuss the audit status and any new or developing issues. With observers present, the audit team met with BSC management each morning to discuss the current audit status and potential issues.

BSC informed the auditors that the revisions to the documents that were to be audited had not been completed and were not ready for review by the audit team. Therefore, the scope of the audit was changed from a vertical slice approach to a document review, and the audit focused on previous revisions of the documents.

The audit team did not receive relevant technical documents in advance of the audit and the team spent considerable time reviewing the documents during the audit before the interviews. Many of the documents audited were being changed based on internal reviews and previous NRC comments. Since the documents reviewed during the audit were undergoing revision and were to be reissued in the near future, the work products selected for the audit were not appropriate.

4.3 Audit Team Qualifications and Independence

The observers reviewed the qualifications of the audit team leader and the auditors and determined they were qualified and independent of the areas reviewed.

4.4 Examination of Quality Assurance Elements

The audit team QA specialists audited the activities identified in this section. Other QA elements were audited jointly by a technical specialist and a QA specialist during the examination of the technical elements.

4.4.1 Personnel Training and Qualification

The auditors selected personnel who had developed or checked the PCSA documents, analyses, or calculations and verified they had the proper education and training listed in the training matrix. The auditors identified that a reviewer of a reliability analysis had not received the required design control process overview training. This discrepancy was identified as a potential CAQ.

The observers determined the audit was effective and agreed with the conclusion of the auditors.

4.4.2 Document Review

The auditors verified appropriate criteria had been used in the documented reviews of the various PCSA documents and that the comments by reviewers had been properly documented and resolved. No discrepancies were noted.

The observers determined the audit was effective and agreed with the conclusion of the auditors.

4.5 Examination of Technical Activities

The audit team technical specialists reviewed the following documents supporting the PCSA and, along with the audit QA specialists, interviewed document authors, checkers, and reviewers as described in this section.

4.5.1 Preclosure Consequence Analysis for License Application, Dated 01/05

The auditors questioned the author about inconsistencies in and the technical basis for assumptions and statements in the document. The following items were noted:

- No basis was provided for using the mean \bar{X}/Q and average spent fuel assembly (SFA) for Category 1 event sequences.
- No basis or reference was provided for the assumption that a dropped SFA will only damage one other SFA.
- One assumption referenced unqualified data used to justify distance measurements.

These discrepancies were identified as a potential CAQ in violation of AP-3.12Q, *Design Calculations and Analysis*.

The observers determined the audit was effective and agreed with the conclusion of the auditors.

4.5.2 Internal Events Hazards Analysis for License Application, Dated 06/04

The auditors noted a lack of documentation and basis for the assumptions made in the subject document. Potential hazards were identified in a generic manner and quantitative aspects of hazards identification or descriptions were not provided. For example:

- The analysis of the repository functional areas were loosely defined, in part, due to a lack of operational information on the facility.
- Human errors were not explicitly listed in the hazards analysis and events were assumed to have potential for occurrence regardless of cause.
- Rationales were not documented for many of the individual assumptions.

These discrepancies were combined into one potential CAQ with similar findings from other reviewed documents.

The observers determined the audit was effective and agreed with the conclusion of the auditors.

4.5.3 Commercial Spent Nuclear Fuel (SNF) Accident Release Fractions, Dated 11/04

The auditors performed a thorough review of the subject document and identified several instances where the assumptions or other technical statements were not transparent, traceable, or correct. For example:

- There was inadequate justification for the assumption that guillotine break and longitudinal split types of SNF failures will not occur.
- The analysis/calculation did not describe or bound the range of SNF burn-up values for the airborne release fraction and respirable fraction values provided in the results.
- One of the assumptions did not clearly describe the aerosol particles to which the assumed density refers.

Seven similar discrepancies were noted in the document and incorporated with similar findings from other reviewed documents into one potential CAQ.

The observers determined the audit was effective and agreed with the conclusion of the auditors.

4.5.4 Categorization of Event Sequences for License Application, Dated 07/04

Section 6.3.1.1 of the subject document stated that two lifts are required for a transportation cask without impact limiters installed. This statement is in conflict with the Internal Hazards Analysis for License Application document which identifies three lifts. This discrepancy was identified as a potential CAQ. In addition, the audit team discussed the many assumptions in the document and recognized that some assumptions will require additional justification and more will require verification by analyses. The author responded that AP3.13Q requirements allow a large number of assumptions to be made in a preliminary design.

The observers determined the audit was effective and agreed with the conclusion of the auditors.

4.5.5 Reliability Analysis of the Electrical Power Distribution System to Selected Portion of the Nuclear HVAC System, Dated 12/04

The subject document contains several figures (Figures A-1, A-2, and A-4) defining the electrical design that were found to be inconsistent or in error. The fault tree analysis appears to have been based on an assumed Figure A-2 that was not consistent with the System Description Document Figure A-4. These discrepancies were identified as a potential CAQ.

The observers determined the audit was effective and agreed with the conclusion of the auditors.

4.5.6 Nuclear Safety Design Bases Analysis

The audit team reviewed two documents in this area: *Nuclear Safety Design for License Application* and *Safety Classification of Structures, Systems, and Components (SSCs) and Barriers*. Transparency and traceability issues with documentation were noted during the discussions on the *Safety Classification of SSCs and Barriers* in violation of AP-3.11Q requirements. The discrepancies were identified as a potential CAQ.

The observers agreed that the audit was effective and agreed with the conclusion of the auditors.

4.6 Potential Audit Findings

The audit team combined the above findings into four potential CAQs at the closing meeting:

- A. The rationales for the assumptions were not sufficiently documented to ensure transparency for the following PCSA documents:
- *Preclosure Consequence Analysis for License Application;*
 - *Internal Hazards Analysis for License Application;*
 - *Commercial Spent Nuclear Fuel (SNF) Accident Release Fractions;* and
 - The documentation in Section 6.2.2 of the *Commercial Spent Nuclear Fuel (SNF) Accident Release Fractions* document was not transparent.
- B. The following PCSA documents had errors that affected correctness of the analyses:
- *Preclosure Consequence Analysis for License Application;*
 - *Categorization of Event Sequences for License Application;*
 - *Commercial Spent Nuclear Fuel (SNF) Accident Release Fractions;* and
 - *Reliability Analysis of the Electrical Power Distribution System to Selected Portions of the Nuclear HVAC System*
- C. One employee did not have the required training before reviewing the *Reliability Analysis of the Electrical Power Distribution System to Selected Portions of the Nuclear HVAC System* document.
- D. The documentation was not transparent in Sections 5.1.1, 5.1.2, 5.1.3, 6.1, and 6.3.6, and Appendix A of the *Nuclear Safety Design Basis for License Application* document.

The audit team made 13 recommendations for technical improvements regarding the clarity and justification for assumptions and event sequences in the *Categorization of Event Sequences for License Application* document and the *Preclosure Consequence Analysis for License Application* document.

5.0 NRC STAFF FINDINGS

5.1 NRC Observation Summary

The observers determined that DOE performed the audit effectively and the auditors demonstrated sound knowledge of the applicable implementing procedures and QARD requirements. The auditors conducted thorough interviews, challenged and questioned responses when appropriate, and effectively employed their checklists. The observers agreed with the audit team's conclusions, findings, and process improvement recommendations.

However, the observers noted the late change in scope of the audit appeared to be the result of the planning, communication, and coordination between DOE and BSC. The change adversely affected the ability of the technical reviewers to perform a thorough review of the documents. The observers concluded that since the documents reviewed during the audit were undergoing revision and were to be reissued in the near future, the work products selected for the audit were not appropriate. This observation was based on several statements from BSC and DOE staff during the audit that the document revisions were addressing many of the audit findings.

5.2 NRC Audit Observer Inquiry

Two new Audit Observer Inquiries were initiated:

1. Procedure AP-3.12Q, Revision 2, ICN 2, March 10, 2004, Sections 5.1 and 5.3 discuss preliminary and final calculations or analysis. However, it is not clear from the procedure or from the interviews (and other discussions with DOE staff) when a calculation or analysis should be made final. In addition, it is not clear whether a calculation or analysis must be declared final to support conclusions stated in a potential LA.
2. Procedure AP-3.13Q, Design Control, Steps 5.1.5 and 5.1.6 discuss the preliminary design as the basis for a "license application for construction authorization" and the final design as the basis for a "license to receive and possess." It is not clear whether the procedure provides sufficient guidance to ensure that the license application is as complete as possible in light of the information that is reasonably available at the time docketing.