U.S. NUCLEAR REGULATORY COMMISSION OBSERVATION AUDIT REPORT OAR–05–06, OBSERVATION OF THE U.S. DEPARTMENT OF ENERGY, OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, AUDIT OF BECHTEL SAIC COMPANY, LLC, OCRWMP-OQA-05-11, PROJECT ENGINEERING AND RECORDS MANAGEMENT AND DOCUMENT CONTROL

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1.0 INTRODUCTION

On September 12–22, 2005, 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 Radioactive Waste Management (OCRWM), Office of Quality Assurance (OQA), audit OCRWMP–OQA–05–11 of Bechtel SAIC Company, LLC (BSC). Representatives of OQA conducted the audit of BSC (i) Project Engineering and (ii) Records Management and Document Control activities at the BSC facilities in Las Vegas, Nevada. The objectives of this audit were to (i) evaluate the adequacy, implementation, and effectiveness of applicable requirements; and (ii) design engineering products relating to the Fuel Handling and Canister Handling Facilities. The audit team also evaluated an underground waste canister handling design. The NRC observers (observers) assessed the effectiveness of the audit team and the audit process in achieving the audit objective.

2.0 MANAGEMENT SUMMARY

The audit team conducted an audit of BSC's Project Engineering activities and the Records Management and Document Control functions. In relation to technical performance, the audit team examined design documents to determine the effectiveness of OCRWM design control measures. The audit team determined that BSC was effectively implementing its Quality Assurance (QA) program with the exception of ineffective implementation of technical document input controls relating to design assumptions. In addition, the audit team identified four minor adverse conditions and one opportunity for improvement. The audit team concluded that, overall, design controls were being effectively implemented and design documents were satisfactory.

The observers reviewed the qualifications of the Audit Team Leader, auditors, and Technical Specialists and determined that they were qualified by education, experience, and training and were independent of the areas reviewed. The observers determined that the audit was performed effectively and agreed with the audit team's conclusions and findings. However, the observers determined that the audit could have been performed more efficiently with additional planning.

3.0 PARTICIPANTS

<u>Audit Team</u>

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James Flaherty, Auditor
Mike Floyd, Auditor
Bruce Foster, Auditor
William Petrie, Auditor
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NRC Observers

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Other Observer

Engelbrecht von Tiesenhausen, Clark County

4.0 REVIEW OF THE AUDIT AND AUDITED ORGANIZATION

The DOE audit team conducted the audit in accordance with the DOE Quality Assurance Requirements and Description (QARD), DOE/RW-0333P, as implemented by Line Procedure (LP)–18.3Q–OCRWM, Quality Assurance Internal Audit Program, and Administrative Procedure (AP)–16.1Q, Condition Reporting and Resolution. AP–16.1Q discribes Condition Reports (CRs) as (i) Level A (significant adverse condition), (ii) Level B (adverse condition), (iii) Level C (Minor adverse condition, and (iv) Level D (opportunity for improvement. The NRC observers followed NRC Manual Chapter 2410, Conduct of Observation Audits, while observing the audit.

4.1 Scope of the Audit

The audit team evaluated the adequacy, implementation, and effectiveness of applicable requirements and design documents relating to the Fuel Handling and Canister Handling Facilities. In addition, one underground waste package emplacement design was audited. The audit team evaluated BSC's implementation in relation to DOE/RW–0333P, *Quality Assurance Requirements and Description* (QARD) Revision 16 and current implementing procedures.

The following procedures were included within the scope of the audit:

LP–2.9Q–BSC	Establisment and Verification of Education and Experience of Personnel
LP–2.14Q–BSC	Document ReviewLP–2.18Q–BSC Personnel Training and Qualification
AP–2.22Q	Classification Analyses and Maintenance of the Q List
AP–3.9Q	Interface Management Process
LP–3.11Q–BSC	Technical Reports
LP–3.12Q–BSC	Design Calculations and Analyses
LP–3.13Q–BSC	Design Control
LP–3.15Q–BSC	Managing Technical Product Inputs
LP–3.19Q–BSC	Specifications
LP–3.20Q–BSC	Design Verification
LP–3.24Q–BSC	Drawings
LP–3.25Q–BSC	Design Criteria
LP–3.26Q–BSC	System Description Documents

LP–3.28Q–BSC	Off-Project Design Reviews
LP–ENG-013–BSC	Certification and Stamping of Engineering Documents
LP–ENG-014–BSC	Engineering Studies
AP–6.1Q	Document Control
AP–17.1Q	Records Management
LP–17.1Q–BSC	Records Processing
LP–SI.11Q–BSC	Software Management

4.2 Conduct and Timing of the Audit

In general, the audit team conducted the audit effectively. Prior to the start of the audit, the auditors prepared checklists based on applicable procedure requirements and applied the checklists in their assessments. When appropriate, the auditors went beyond the scope of their checklists to probe and resolve potential issues. The audit team's Technical Specialists prepared for interviews with BSC Project Engineering staff by reviewing upper tier design documents and preparing questions. Because only a limited number of design documents were available to the audit team's Technical Specialists before the start of the audit, the technical audit progressed slowly in its early stages. The audit team's Technical Specialists were also unfamiliar with the Yucca Mountain project organization, document hierarchy and relationships, and design methods, and may have benefitted from additional preparation and orientation. The audit team also evaluated CRs issued during and since the 2004 audit of BSC Project Engineering activities to assess the effectiveness of corrective actions.

The timing of the audit was appropriate in relation to the availability of design documents to review. Although the designs available to audit were not final and design verifications had not been performed, the controls applicable to this phase of development were properly assessed.

4.3 Audit Team Qualifications and Independence

The observers reviewed the qualifications of the Audit Team Leader, auditors, and Technical Specialists and determined that they were qualified by education, experience, and training and independent of the areas reviewed. The auditors of the design-related procedures had engineering education and experience, so they were able to add performance-based components to their evaluations.

4.4 Examination of Elements

4.4.1 Quality Assurance Program

The auditor identified about 25 individuals from the BSC staff who performed, checked, reviewed, and approved calculations to verify their training, education, and experience. Checklist items were based on the two applicable procedures. An individual's training was compared to their work assignment to determine whether the proper training had been assigned and completed. The auditor identified a Level C CR where the current training needs were not reflected in the training database or in training records.

The auditors reviewed the requirements for classifying structures, systems, and components (SSCs) that are safety class (SC). These SSCs are either important to safety or important to waste isolation. The auditor's reviewed the methodology and classification criteria and the PreClosure Safety Analysis (PCSA) flowdown to the Q-List. The Q-List identifies the SSCs that are SC. The auditor discussed the bases for identifying specific SSCs on the Q-List, their safety function, and specific requirements with the PCSA engineer who prepared the latest revision to the Q-List. The Q-List was maintained in accordance with current project baseline authorization.

The observers determined that the audit was effective in this area and agreed with the conclusion of the auditors.

4.4.2 Design Control

The audit team evaluated the adequacy and implementation of 13 procedures associated with design processes. The audits of drawings, calculations, and technical document inputs were conducted simultaneously. The audit team checked

- Drawings for compliance with format, content, and review requirements, and whether supporting calculations were identified.
- Calculations for the required level of documentation and for proper reviews.
- Direct inputs to drawings and calculations for (i) data qualification status and (ii) the To Be Verified (TBV) status.

The auditors identified (i) a Level C CR that had a drawing with data yet to be issued as direct inputs that was incorrectly classified as Qualified and (ii) a Level C CR for check copies of drawings that lacked the required initials, dates, and statements if no comments were generated.

The design documents available to audit were not final, so design verification (LP–3.20Q–BSC) was not yet applicable. The Audit Technical Specialists identified several instances of design assumptions that were not clearly stated or sufficiently justified. The audit team issued a Level B CR to address this condition and concluded that the BSC implementation was ineffective in this specific area. Auditors issued a Level C CR regarding the use of registered Professional Engineers' stamps that are not in accordance with procedure LP–ENG–013–BSC.

The auditors reviewed the control of project technical and management requirements and design criteria flowdown into the design documents. These documents include the facility and system design documents. CRs that were initiated prior to the audit documented that the Project Requirements Document (PRD) had not been maintained in accordance with current project planning and direction. To address this concern, the BSC systems engineering management stated that they were implementing a requirements management system to track all project regulatory, licensing, engineering, and design bases requirements within the BSC scope of work. This system, the Direct Object Oriented Requirement System (DOORS), is intended to relate the requirements, and how they are met, across the organizations, engineering disciplines, and requirements and criteria document hierarchy. The BSC Manager of Systems Engineering stated that, as a result of the investigation of the CRs, BSC has verified that all design products, including Facility and System Design Documents (FDDs/SDDs),

license application documents, and safety analyses, reflect current requirements, even though the high level requirements in the PRD may not have been kept current with other project direction such as baseline change proposals and technical direction letters. The auditors reviewed the flowdown of design requirements from the PRD to lower hierarchy design documents and design products, and did not note any conditions resulting from the CR issues. The observers noted that DOORS was planned to manage the project and technical requirements within the BSC scope of work, but was not currently planned for use by the DOE. The NRC staff also noted that they to follow this issue for potential impact on the DOE documents supporting the potential license application and the Project's processing of the related CRs through the Corrective Action Program.

The audit team, upon suggestion by the observers, recommended that LP–3.12Q–BSC be clarified regarding when to assign TBV status for assumptions when future verification of the assumptions is needed.

The observers determined that the audit was effective in this area and agreed with the conclusion of the auditors.

4.4.3 Document Control

Most of the BSC staff access controlled documents through an electronic system, therefore, very few controlled (paper) copies are distributed. The auditor identified 10 BSC design staff that receive controlled documents and checked for correct maintenance of the documents and for obsolete documents. A few minor discrepancies were noted and corrected during the audit.

Three document control-related CRs from the previous (2004) audit were reviewed and no recurrence was identified.

The observers determined that the audit was effective in this area and agreed with the conclusion of the auditors.

4.4.4 Quality Assurance Records

The auditors interviewed supervisors and staff responsible for records processing, and records receipt, identification, verification, classification, and archive processes were evaluated. The BSC QA records staff visited the records storage subcontractor periodically to confirm proper operations. This activity was in addition to the audits performed by the QA staff. BSC maintained performance metrics for errors related to the records-submitting organization and to errors in records processing. The BSC records group worked closely with Project Engineering document control and implemented a records prescreening process that has significantly reduced errors in recent months.

The observers determined that the audit was effective in this area and agreed with the conclusion of the auditors.

4.4.5 Software Control

The auditor reviewed the list of design-related documents to be audited and identified seven calculation documents that used software. In all cases, GT STRUDL Version 26 had been used. In order to obtain a larger sample of software, the auditor reviewed other design calculations to identify three other software products used over the past year. All software versions used were under appropriate control at the time of use and had been properly installed.

The audit plan identified two software control process-related procedures for potential application if issues were identified with the base procedure; LP–SI.11Q–BSC, *Software Management*. Since no issues were identified with LP–SI.11Q–BSC, compliance with software qualification and verification and validation procedures (audited in August 2005) was not evaluated.

The observers determined that the audit was effective in this area and agreed with the conclusion of the auditors.

4.5 Examination of Technical Elements

4.5.1 Fuel Handling Facility—Primary Confinement Heating, Ventilation, and Air Conditioning (HVAC) System

The audit team's Technical Specialist reviewed the primary HVAC system composite flow diagram. In addition, the Technical Specialist reviewed two calculation documents supporting the drawing.

The audit process included discussions on

- Flow diagram and system functions
- Design requirements for space allocation and sizing of the HVAC system
- Design process
- Air-loss analysis
- Input data verification
- Data flow cited in the reports

The Technical Specialist had no findings related to the technical contents of the document. The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.2 Fuel Handling Facility—Transfer Trolley (Cask) Mechanical Equipment

The audit team's Technical Specialist reviewed the drawing and design calculations for the transfer trolley, which will be used to transfer transportation casks and the waste packages inside the Fuel Handling Facility. The purpose of the calculations was to establish a preliminary bounding envelope for equipment dimensions and weights to support space allocation in the Fuel Handling Facility. The trolley design presented was preliminary (i.e., it will be developed further). The Technical Specialist reviewed the design control process applied to the current drawing and calculations.

The audit approach involved discussions on

- Design process
- Input data and assumptions
- Design codes and standards used
- Calculations and references

The Technical Specialist identified the following to the BSC design staff:

- The basis (rationale) for the input data for the design basis seismic acceleration and structural damping was not clearly stated.
- The structural analysis of a sudden stop at the design basis trolley speed should be checked.

The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.3 Fuel Handling Facility—Cask Cavity Gas Sampling System

The audit team's Technical Specialist reviewed the cask cavity gas sampling system drawing and supporting design calculations. The initial helium atmosphere in the transportation casks will be sampled and analyzed for gaseous fission products and hydrogen. The system will be designed to vent the remaining gas and refill the cask before it is moved for fuel transfer operations. The associated calculation, which will support the potential license application, provides preliminary estimates used for equipment sizing and space allocation. Gas sampling is a non-safety class (not important to safety) item.

The audit approach involved

- Overview of the gas sampling process
- Discussion of the design process
- Discussion of the design method, input data, assumptions, and units
- Review of the calculations and reference citations

The audit team's Technical Specialist identified that the assumption that 13 cubic feet per minute air flow was needed for purging the hot gases was not justified and that no TBV status was assigned to this assumption. This finding contributed to the Level B CR described in Section 4.4.2.

The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.4 Fuel Handling Facility—Shear Wall and Diaphragm Design

The audit team's Technical Specialist reviewed the drawings for the shear wall and diaphragm designs and technical reports associated with these drawings. In addition to providing structural stability of the Fuel Handling Facility, the shear wall and diaphragm provide shielding and confinement where needed.

The audit approach involved discussions on

- Design bases
- Input information (including loads)
- Modeling techniques
- Codes and standards used
- Design control process

The Technical Specialist found that the design process of the shear wall and diaphragm was adequate. The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.5 Fuel Handling Facility—Seismic Analysis

The audit team's Technical Specialist reviewed (i) the dynamic and static analyses of the Fuel Handling Facility and (ii) the resulting seismic forces that will be used in a subsequent calculation to complete the design of its concrete walls, diaphragms, and basemat.

The audit process included review of

- Geotechnical data
- Ground response spectra
- Three-dimensional multiple stick model
- Computer software use (GT STRUDL)
- Design calculation and analysis checklists

The audit team's Technical Specialist found the seismic analysis to be adequate. The Technical Specialist noted that the finalization of the seismic hazards and geotechnical site investigation is critical to the progress of the design because many structural analyses and designs depend on these inputs.

The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.6 Fuel Handling Facility—Foundation

The audit team's Technical Specialist reviewed the basemat reinforcement design and the stability analysis of the Fuel Handling Facility. In addition, the Technical Specialist reviewed structural design drawings for the shear and flexural reinforcement required.

The audit process included discussions on

- Seismic input information
- Numerical modeling techniques
- Dynamic soil pressure calculations
- Basemat reinforcement calculations
- Foundation stability calculations

The Technical Specialist had no findings related to the design of the foundation. The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.7 Canister Handling Facility—Contamination Classifications

The audit team's Technical Specialists reviewed the drawing depicting the areas of contamination and radiation on the floor plans of the Canister Handling and Fuel Handling Facilities. Zones that can potentially cause radiological dose consequences or exposure to the facility workers were classified into five categories ranging from no contamination/radiation to high contamination/radiation. Selection of contamination and radiation zones was based on information from the plant design layout group and was a coordinated effort by multiple disciplines.

The audit approach involved evaluating

- Drawing control and checking processes
- Compliance with the LP–2.14Q–BSC technical document review procedure
- Multi-discipline input to Revision A of the drawing

The Technical Specialist had no findings related to the technical contents of the document. The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.8 Canister Handling Facility—Structural Notes and General Reference Drawings

The audit team's Technical Specialist reviewed structural notes and general reference drawings regarding the facility's constructability and operability.

The audit approach involved reviewing

- Plans in progress for constructing and operating the facility
- Lessons learned from construction of other facilities
- Drawing preparation and controls

The Technical Specialist found that early constructability interface activities followed good practices. The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.9 Canister Handling Facility—Wall Reinforcement

The audit team's Technical Specialist reviewed the wall reinforcement drawing and supporting calculations.

The audit approach included discussions on

- Soil properties
- Tornado design
- Alternate design

- Modular construction
- Beyond-design basis ground motion
- Basis for wall thickness selection

The Technical Specialist found the design process for wall reinforcement to be adequate. The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.10 Canister Handling Facility—Motorized Shield Covers

The audit team's Technical Specialist reviewed the motor-sizing calculations for the motors used to move the pit shield covers to their open and closed positions. The shield covers close the pit openings in the Canister Handling Facility and provide radiation shielding for personnel entering this area. The design of the shield covers will be further developed to support the potential license application.

The audit process included discussions on

- Assumptions used in the calculations
- Sources of input data
- Information flow for document changes
- Use of procedures LP–3.12Q–BSC, LP–3.15Q–BSC, and LP–3.24Q–BSC

The motor-sizing calculations were preliminary, and the associated pit shield cover drawing was in draft form. The Technical Specialist found that the rationale for all assumed input values was not clearly identified. This finding contributed to the Level B CR described in Section 4.4.2.

The audit team determined that LP–3.12Q–BSC did not clearly state how assumed input values used in calculations would be tracked through the preliminary design to the committed and final designs. The audit team, upon the suggestion of the observers, recommended that the procedure be clarified.

The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.11 Canister Handling Facility—Seismic Analysis

The audit team's Technical Specialist's review of the seismic analysis for the structural design included reviews of the

- Calculation of the base springs between the basemat of the Canister Handling Facility building and its supporting soil medium
- Damping values for soils and structures
- Justification for using upper bound (84th Percentile) soil profile
- Concrete shear walls modeling
- Computer software use
- Inputs and analysis assumptions
- Structural response calculations
- Design drawings

The Technical Specialist found the seismic analysis process to be adequate. The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.5.12 Underground Facility—Emplacement Gantry

The audit team's Technical Specialist reviewed the emplacement gantry requirements and incorporated these requirements into associated design calculations. The emplacement gantry will be used to position waste packages in the emplacement drifts. The design calculations for the emplacement gantry were bounding envelope and sizing calculations.

The audit process included discussions on

- General arrangement drawing
- Design calculations
- Input data
- Design revisions
- Codes and standards application
- Information from seismic analyses

The Technical Specialist found that unqualified information from previously generated documents was used in the design calculation assumptions. This finding contributed to the Level B CR described in Section 4.4.2.

The observers determined that the audit was effective in this area and agreed with the conclusions of the Technical Specialist.

4.6 Potential Audit Findings

The audit team identified the following potential CRs:

Level B:

LP–3.12Q–BSC, Section 5.2.12 requires that assumptions be clearly stated and the rationale for the suitability of using the assumptions shall be included or referenced. In several instances (See Sections 4.4.2, 4.5.1.3, 4.5.2.4, and 4.5.3), assumption inputs were not clearly stated and defended.

Level C:

- LP–2.18Q–BSC Section 5.4 requires that training requirements be identified based on the training description and that the line manager provides training needs to the training manager. The latest training needs were not reflected in the training system database or in training records. (Note: This occurred in 2 of 24 records checked.) (See Section 4.4.1)

- LP–3.15Q–BSC, Attachment 3, requires that if the input (to the design) is determined to be Product Output, the Q status is Qualified. However, some design inputs had not been issued yet, but were incorrectly classified as Qualified data. (See Section 4.4.2)

- LP–3.24Q–BSC requires initialing and dating drawing check copies and noting if no comments were generated. These activities were being inconsistently performed for review check copies. (Note: Review comments were being adequately resolved and incorporated.) (See Section 4.4.2)

- LP–ENG–013–BSC defined the process for using Registered Professional Engineer stamps. Two specifications were identified with several inconsistent applications of this procedure. (See Section 4.4.2)

Level D:

- LP–3.12Q–BSC should more clearly identify the process for identifying assumptions (i.e., as TBV) when future verification is needed. (See Section 4.4.2)

The audit team identified four noteworthy practices:

- Using simple models to arrive at design conclusions and later using sophisticated models to refine and optimize designs.
- Using inter-disciplinary reviews to provide early construction input.
- Using the monthly management report of quality metrics derived from check copies that identify trends and opportunities for improvement.
- Applying the QA program to prototype designs that will be classified as SC.

5.0 NRC STAFF FINDINGS

5.1 NRC Observation Summary

The observers determined that the audit team was effective in evaluating the QA program adequacy and the BSC implementation of applicable implementing procedures as applied to the design engineering activities. The observers agreed with the audit team's conclusions, findings, process improvement recommendations, and noteworthy practices. The observers determined that the audit team members were qualified, independent of the areas being audited, and had adequate knowledge and understanding of the requirements.

The observers determined that the audit process could be improved by better planning and preparation of Technical Specialists, particularly when the Technical Specialists are unfamiliar with Yucca Mountain Project systems, design approaches, and practices.

5.2 NRC AUDIT OBSERVER INQUIRY

No audit observer inquiries were submitted.