Date of Document November 9, 2009

AUDIT REPORT

CALVERT CLIFFS NUCLEAR POWER PLANT UNIT 3

FSAR SECTIONS 3.7.1, 3.7.2, & 3.7.3

DATES OF AUDIT: March 17th through March 19th, 2009

AUDIT LOCATION: Bechtel Offices in Frederick, MD

NRC REVIEW TEAM:

Michael Miernicki, NRC Project Manager

Manas Chakravorty, NRC Technical Monitor (alternate)

Samir Chakrabarti, NRC Technical Monitor

David Foster, Numark Consultant

Tom Houston, Numark Consultant

AUDIT PURPOSE AND OBJECTIVE:

The objective of the audit was to accomplish the following:

- Gain a better understanding of the technical methods and input used for the seismic reconciliation of U.S. EPR Seismic Category I Structures at the Calvert Cliffs Nuclear Power Plant Unit 3 (CCNPP3) Site and for the seismic analysis of site specific structures;
- Review the technical documents and calculations that support the licensing commitments in the FSAR;
- Determine if, as a result of the audit, additional RAIs were required.

AUDIT SUMMARY:

As part of its review of the CCNPP3, members of the NRC staff and its consultants performed an audit covering the technical material that supports the information provided in FSAR Sections 3.7.1, 3.7.2, and 3.7.3. At the time of the audit, RAI responses had not yet been received from UniStar. However, the first set of responses was scheduled to be sent to the NRC during the week of the audit.

A copy of the agenda and audit plan are provided as Attachments 1 and 2, respectively to this audit report. List of representatives from UniStar, AREVA, and Bechtel present full-time or part-time during the audit are provided on Attachment 3. To support the audit, AREVA and Bechtel made available several calculations that document the technical analysis and seismic design of Category I structures. These are identified in Attachment 4.

For each of the audit items identified on Attachment 2, a background presentation was provided which described the technical methods, models, and assumptions used to reconcile the seismic response of the EPR Seismic Category I structures for the CCNPP3 site and to develop the seismic response of site specific seismic Category I structures described in the CCNPP3 FSAR. After the background presentations, breakout sessions were conducted with Bechtel and AREVA staff to discuss the presentation and review samples of backup documentation provided in Attachment 4.

During the course of the audit it was identified that the Ultimate Heat Sink Makeup Water Intake Structure (UHS MWIS) and the Ultimate Heat Sink Electrical Building (UHS EB) will be moved away from their current location adjacent to the Chesapeake Bay and connected to this water supply by means of underground pipes. This is being done to prevent an impact on existing structures during construction. As a result the building design of the UHS MWIS will be modified from its current configuration. The details of this change will be identified in a future revision to the FSAR.

As a result of the presentations and review of the calculations, six issues were identified that relate to four existing open RAIs and it was agreed they would be answered as part of the RAI response. These items are:

- Provide the wave height within the UHS MWIS vaults induced by a seismic event and identify whether the height of the wave could cause an impact on the slab above the vaults. (Include in RAI No. 58, Question 3.7.2-11)
- Justify the use of low strain soil values instead of strain compatible values in the seismic reconciliation of the NI Common Basemat Structures. (Include in RAI No. 58, Question 3.7.1-1)
- Identify the value of structural damping used in the seismic analysis of the UHS MWIS for both structural design and for the generation of ISRS. (Include in RAI No. 58, Question 3.7.1-8)
- Address how the structure-soil-structure interaction effect of the NI Common Basemat Structures on the EPGB and ESWB is considered in the seismic reconciliation of these two structures. (Include in RAI No. 58, Question 3.7.1-3)
- Address why in two different load combinations containing lateral earth pressure loads (H), the total load is significantly less when SSE loads are added to the load combination. Also, the load combination containing the load H without seismic loads produces a moment that exceeds the moment capacity of the un-cracked concrete wall. This also needs to be discussed in the response. (Include in RAI No. 65, Question 3.7.2-8)
- Address cracking of concrete in the two foot thick walls of the UHS MWIS. (Include in RAI No. 65, Question 3.7.2-8)

During the course of the audit, two new items were identified which will require new RAIs to be submitted by the NRC staff. The topics identified as requiring additional RAIs were as follows:

- It was not clear during the audit how locations are selected within a floor for the development of ISRS which are required for the qualification of equipment, components, and piping. It is not usually sufficient to select a single location that corresponds to each floor elevation. The staff would like additional information on this issue.

- It is not clear in reading the FSAR that there is a consistent approach to determine the seismic input for qualification of seismic Category I structures at the CCNPP3 site. It is difficult to understand how the seismic input of one structure relates to the seismic input of another and how these relate to the definition of the SSE for the CCNPP3 site. The site reconciliation of the EPGB and ESWB also require additional information.

The review of all items in Attachment 2 was completed prior to the exit meeting. The audit provided additional technical information that will assist the staff in assessing the responses to RAIs. On Thursday, March 19th at the audit exit meeting the staff presented a summary of the three days of activities including a discussion of the new RAIs that will be forwarded formally to UniStar.

Attachment 1
Agenda for Calvert Cliffs Audit
FSAR Sections 3.7.1, 3.7.2, and 3.7.3
Task Order 28

March 17th

Entrance Meeting (8:00-9:00)

- Introductions
- Purpose and Objectives of Audit
- Review of Audit Plan and Schedule
- Contacts for Calvert Cliffs and NRC

Overview of Site Specific Seismic Analysis Process (Bechtel) (9:00-10:30)

- NI Common Basemat Structures
- EPGB and ESWB
- UHS MWIS

Review of Audit Items 3.7.1-1, 3.7.1-2, 3.7.2-1 (10:30-4:00)

Summary of the Day and Action Items (4:15-5:00)

March 18th

Discussion of Open RAI Items (8:00-9:30)

Review of Audit Items 3.7.2-2, 3.7.2-3, 3.7.2-4 and 3.7.2-5 (9:30-4:00)

Summary of the Day and Action Items (4:15-5:00)

March 19th

Review of Audit Items 3.7.2-6 and 3.7.3-1 (8:00-11:00)

Exit Meeting (11:30-12:00)

- Summary of Audit
- Open Items
- Action Items

Attachment 2
Audit Plan for Calvert Cliffs
Task Order 28

Audit Item (Applicable RAI)	Audit Activity	Objective	Reviewer
3.7.1-1 (RAIs 3.7.1-1, -2, -4)	Review of the seismic model, analysis assumptions, basis for FIRS, and the supporting calculations for the site specific SSI of the NI common basemat structure	Determine the basis and validity of the site-specific SSI results used to compare the site specific design basis with the design basis of the DCD.	Tom Houston
3.7.1-2 (RAIs 3.7.1-5, -7)	Review of the method and calculations used to develop the FIRS for the EPGB and ESWB.	Verify that the FIRS were appropriately determined and the analysis correctly considers the effect of subgrade conditions under dynamic load.	Tom Houston
3.7.2-1 (RAIs 3.7.2-1,-2,-3,-4)	Review of the seismic analysis of the UHS EB including the method and supporting calculations that determine the design loads for the building's walls and slabs.	Determine if assumptions stated in the CC FSAR are valid for determining the response and design loads for this structure.	David Foster
3.7.2-2 (RAI 3.7.2-9)	Review of the FEM model used for the analysis of the UHS MWIS and the basis for assuming the walls are uncracked.	Determine how the FEM model was developed from design drawings and to what extent the model meets SRP 3.7.2 acceptance criteria.	David Foster
3.7.2-3 (RAIs 3.7.1-6, -8, 3.7.2-6, -7, -8, -11, -12, -17)	Review of the SSI analysis for the UHS MWIS including the calculations for the spring constants, basis for the assumed soil properties, effect of groundwater, and the time history method of analysis that was used to determine the building response.	Verify that the assumptions and SSI model for this structure are valid and the analysis has properly accounted for the SSI effects of embedment, subgrade stiffness, ground water and strain dependent soil properties.	Tom Houston
3.7.2-4 (RAI 3.7.2-16)	Review of the calculations that apply building accelerations of the UHS MWIS static model to obtain forces and moments for structural design.	Determine how forces and moments are calculated for the structure and how these results compare with forces and moments determined directly using time history methods.	David Foster
3.7.2-5 (RAI 3.7.2-18)	Review of the calculations the seismically qualify the fire protection tanks.	Determine the basis for seismic qualification of the tanks and to what extent this meets the acceptance criteria of SRP 3.7.3.	David Foster

Attachment 2
Audit Plan for Calvert Cliffs
Task Order 28

3.7.2-6 (RAI 3.7.2-24)	Review of the calculations and results that compare the composite modal damping methodology using non-proportional and proportional damping formulations.	Verify the validity of the damping calculation methods used in the SSI analysis of the UHS MWIS.	Tom Houston
3.7.3-1 (RAI 3.7.3-1)	Review of calculations that qualify buried seismic Category I piping including computer codes, basis for the assumed soil properties, determination of anchor motions, and the basis for determining the maximum friction force per unit length of pipe.	Determine the basis for qualification of buried piping and to what extent this meets the acceptance criteria considerations of SRP 3.7.3.	David Foster

ATTACHMENT 3

Audit CCNPP3 FSAR Sections 3.7.1, 3.7.2, and 3.7.3

3/17 – 3/19/09, Bechtel Offices, Frederick, MD

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Audit CCNPP3 FSAR Sections 3.7.1, 3.7.2, and 3.7.3

3/17 – 3/19/09, Bechtel Offices, Frederick, MD

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ATTACHMENT 4
LIST OF CALCULATIONS FOR CCNPP UNIT 3 AUDIT

AREVA Calculations
US EPR Standard Plant Nuclear Island Soil Structural Interaction Analysis
US EPR Standard Plant Structural Loads - Seismic Loads
Structural Stick Model Development for US EPR Design Certification
Component Stick Models for the USEPR

Bechtel Calculations
Finite Element Model of UHS Intake Structure
Determine Loads on UHS Intake Structure
Tornado Missile Evaluation of UHS Intake Structure
Evaluation of UHS Intake Structure
Time History Analysis - UHS Intake Structure
Ice Effects on UHS Makeup Intake Structure
Study of Differential Settlement
Foundation Parameters for Calvert Cliffs Unit 3 Category I Structures