May 16, 2010

ORGANIZATION: GE-Hitachi Nuclear Energy Americas, LLC

PROJECT: Economic Simplified Boiling Water Reactor (ESBWR) Design Certification

SUBJECT: SUMMARY OF AUDIT FOR REVIEW OF GEH METHODOLOGY FOR DETERMINING THE BOUNDING ANALYSES AND PARAMETERS FOR THE ESBWR DESIGN WITH RESPECT TO ATMOSPHERIC DISPERSION OF RADIOACTIVE EFFLUENTS AND CLOSURE OF RAI 12.2-28

On April 22, 2010, U.S. Nuclear Regulatory Commission (NRC) staff conducted an audit of supporting documents held by GE-Hitachi Nuclear Energy Americas, LLC (GEH) related to Chapters 2 and 12 of the Economic Simplified Boiling Water Reactor (ESBWR) design certification document (DCD), at the Nuclear Energy Institute's offices in Rockville, Maryland.

During this audit, the NRC staff audited documents that describe the applicant's methodology for determining the bounding analyses and parameters for the ESBWR design with respect to atmospheric dispersion of radioactive effluents during normal operations and anticipated operational occurrences. These documents provide supporting design detail, calculations and assumptions for the determination of bounding meteorological parameters contained within Chapters 2 and 12 of the docketed ESBWR DCD. A list of attendees is provided in Enclosure 1, and a summary of the meeting is provided in Enclosure 2.

During continuing review of the ESBWR design certification, staff will be considering information gained during this audit and will communicate any additional issues or requests for information with the applicant on the ESBWR docket.

/RA/

Ilka T. Berrios, Project Manager
ESBWR/ABWR Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket No. 52-010

Enclosures:
As stated

cc w/encls: See next page

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Audit Participation Summary

Name	Organization
Amy Cubbage	NRC
Brad Harvey	NRC
George Cicotte	NRC
Erik Kirstein	GEH
Tim Enfinger	GEH
Wayne Marquino (via telecon)	GEH
James Cascone (via telecon)	GEH

Enclosure 1

Summary of audit for review of GEH methodology for determining the bounding analyses and parameters for the ESBWR design with respect to atmospheric dispersion of radioactive effluents and closure of RAI 12.2-28
April 22, 2010

1.0 SUMMARY

On April 22, 2010, U.S. Nuclear Regulatory Commission (NRC) staff audited supporting documents held by GE Hitachi (GEH) staff, related to Chapters 2 and 12 of the Economic Simplified Boiling Water Reactor (ESBWR) design certification application, at the Nuclear Energy Institute's offices in Rockville, Maryland. The NRC staff audited documents that describe the applicant's methodology for determining the bounding analyses and parameters for the ESBWR design with respect to atmospheric dispersion of radioactive effluents during normal operations and anticipated operational occurrences. These documents provide supporting design detail, calculations and assumptions for the determination of bounding meteorological parameters contained within Chapters 2 and 12 of the docketed ESBWR Final Safety Analysis Report (FSAR). Therefore, the amount of detail included in these documents is higher than what is required in the FSAR. However, auditing such information allows the staff to conduct its review more efficiently. Specifically, the staff gains a better understanding of the basis underlying the formal application and identifies areas where additional information should be submitted to allow a licensing decision on the application.

2.0 REGULATORY BASIS

- 10 CFR 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion ''As Low as is Reasonably Achievable'' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

- Title 10 of the *Code of Federal Regulations* (10 CFR), Section 52.47, "Contents of Applications"

- 10 CFR 50.9, "Completeness and Accuracy of Information."

- Title 10 Code of Federal Regulations (10 CFR) 20, "Standards for Protection Against Radiation."

- Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Section C.I.12.3.2, "Shielding."

- NUREG-0800, "Standard Review Plan," Section 2.0, "Site Characteristics and Site Parameters," Section 2.3.5, "Long-Term Atmospheric Dispersion Estimates for Routine Release," and Sections 12.3-12.4, "Radiation Protection Design Features."

- Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable."

Enclosure 2

- Regulatory Guide 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors.”

As a result of the audit, the staff will await receipt of additional clarifying information on Docket 52-010 for review in determining whether the information is acceptable and the open item related to RAI 12.2-28 may be closed.

3.0 RESULTS OF AUDIT (Summary of Findings)

Activities were specified in the audit plan (ML101090156), consistent in scope and detail with discussions between NRC staff and GEH prior to the audit.

3.1 Documents Audited

GEH made the following documents available at the NEI offices for audit by the NRC staff, both in hard copy and via internal electronic transmission to their media:

- Calculation Notes for XOQDOQ and input parameters
- Construction Engineering Notes
- Shielding Analysis Engineering Notes

3.2 Interaction with GEH Staff

During the period covered by this summary, brief entrance and exit summaries, as well as substantive technical discussions, were held with GEH staff at the Rockville, Maryland, offices of NEI. Technical staff identifying themselves as cognizant GEH staff and confirmed by GEH staff present in Rockville were also available via telephone to confirm and discuss the available documents.

3.3 Issue Resolution

3.3.1 X/Q and D/Q site parameter values for DCD Tier 2 Table 2.0-1

In its response to RAI 12.2-28 dated January 19, 2010, the applicant proposed a new set of long term dispersion estimate (X/Q and D/Q) site parameter values for DCD Tier 2 Table 2.0-1. The new set of X/Q and D/Q values were, on average, approximately 1/2 the value (e.g., less conservative) as compared to the previous set of values. The applicant also proposed a change to DCD Tier 2 Section 12.2.2.1 stating that the new set of X/Q and D/Q values were determined by performing an analysis of available meteorological information for 27 locations using the XOQDOQ computer code (NUREG/CR-2919) assuming an 800 meter exclusion area boundary (site boundary). The applicant stated that a significant majority of the maximum generated X/Q and D/Q parameters were bounded by (e.g., were less than) the new set of site parameter values.

The staff's independent evaluation using meteorological data submitted in support of the first four early site permit applications (i.e., North Anna, Clinton, Grand Gulf, and Vogtle) showed otherwise. Therefore, the intent of the audit was to review the applicant's XOQDOQ computer runs for its 27 locations to determine why the staff's conclusions differed from the applicant's conclusions.

The staff reviewed a subset of the applicant's 27 XOQDQO computer code runs and concluded that a couple of inputs to the applicant's model runs resulted in under prediction of the X/Q and D/Q values for the two mixed-mode (part-time elevated/part-time ground level) release pathways (the RB/FB vent stack and the TB vent stack). In particular,

a. Regulatory Guide 1.111 states that for mixed-mode releases, the plume should be considered as an elevated release whenever the plume vertical exit velocity is at least 5 times the horizontal wind speed at the height of the release (e.g., vent height). This is accomplished within XOQDOQ by setting the input variable SLEV in Card Type 16 to the height of the vent stack (i.e., 52.8 m for RB/FB vent releases and 71.3 m for TB vent releases). Because the wind speed provided as input to the code was measured at 10 m, the code uses this variable to correct the wind speed to the vent height. GEH set its SLEV variable input to 10 m, so no correction was made. Correcting the wind speed to the vent height increases the wind speed values used to compare against the plume vertical exit velocity, thereby increasing the percent of time the plume is assumed to be a ground-level release; this generally results in higher (more conservative) X/Q and D/Q values.

b. For the elevated portion of mixed-mode releases, the maximum terrain height between the release point and the point for which the calculation is made should be subtracted from the effective release height; this will result in higher X/Q and D/Q values. GEH did not provide terrain heights as input, thereby assuming each site was a flat terrain site (a slightly non-conservative assumption).

To address NRC staff concern over the apparent inconsistencies noted above, the applicant proposed the following:

a. A “pointer” will be created from DCD Tier 2 Table 2.0-1 to the Chapter 12, Subsection 12.2.2.1 discussion regarding the basis for the long term dispersion estimate X/Q and D/Q site parameter values.

b. Footnote #12 to DCD Tier 2 Table 2.0-1 will be revised because the COL applicant is required to perform the routine release dose analyses, regardless of whether a selected site has X/Q and D/Q values that exceed the ESBWR site parameter values.

c. The row in DCD Tier 2 Table 12.2-15 referring to the meteorology boundary distance of 800 meters will be deleted. The applicant will also confirm that no text in the DCD refers to this information.

d. The wording in DCD Section 12.2.2.1 will be revised to remove the discussion regarding the use of meteorological data from 27 available sites to generate the X/Q and D/Q site parameter values. The discussion will be replaced by an explanation of how the applicant (1) back-calculated the X/Q and D/Q site parameter values to ensure 10 CFR 50 Appendix I dose criteria were met and (2) performed airborne dose calculations for three actual sites that are, or were being, considered for an ESBWR plant and how those results compared to 10 CFR 50 Appendix I dose limits. These site-specific airborne dose calculations will be performed addressing the staff’s XOQDOQ input comments provided above.

The applicant is not expected to revise the X/Q and D/Q site parameter values or make any changes in the dose assessment results presented in Revision 7 of DCD Tier 2 Chapter 12.

3.3.2 Shielding Analysis Values for In-Plant – changes in Revision 7.

The GEH staff responsible for preparation of the responses to RAI 12.2-28 were requested to clarify specifically the meaning of the term “latest calculations” referred to by the applicant in Revision 7 to the DCD, which the applicant had stated were made in response to RAI 12.2-28, as this related to shield wall details that were revised. The applicant stated that the term referred to the docketed information (ML093451078) received previously by NRC in response to the inspection conducted on September 14-18, 2009 (ML093090440) which was prompted by additional questions related to the applicant’s earlier submission (ML092450484).

3.3.3 Clarification of Change to Table 12.2-23a.

The GEH staff responsible for preparation of the responses to RAI 12.2-28 were requested to clarify the nature of the calculation of Radwaste Building exhaust air flow, as it relates to the rate of air exchange within the building, for controlling surface contamination that contributes to worker exposures. GEH staff clarified that the change was editorial and provided access to the engineering details upon which the calculations were based.

4.0 CONCLUSIONS

During the visit, the scheduled audit activities were completed successfully. The status of actions to resolve the open item related to RAI 12.2-28 was reviewed.

GEH addressed the open item as noted in the summary of findings. The open item is expected to be resolved through the changes to the DCD verbally proposed by GEH (item 1 of findings). Review of the changes and the effect on confirmatory analyses by NRC staff (RSAC and CHPB) will be used to determine whether the proposed methodology is acceptable and whether RAI 12.2-28 may be closed.

The information on shielding analysis (Item 2 of findings) and ventilation exhaust flow rate (Item 3 of findings) values provided sufficient clarification to close that portion of RAI 12.2-28.

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