4.0 Reactor

4.2 Fuel System Design

4.2.1 Regulatory Criteria

In the GE-Hitachi Nuclear Energy (GEH), U.S. Advanced Boiling Water Reactor (ABWR) Design Control Document (DCD), Revision 6, GEH (the applicant) proposed to include additional clarity in the ABWR DCD concerning a combined license (COL) applicant's responsibility to perform an analysis of the combined loading on the reactor core from a seismic event and loss-of-coolant-accident (LOCA) to demonstrate conformance to the structural acceptance requirements for the reactor core.

In a letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the U. S. Nuclear Regulatory Commission (NRC) staff identified 28 items for GEH's consideration as part of its application to renew the ABWR Design Certification (DC). In Item No. 18a of the letter, the applicant was requested to provide analysis of the combined seismic and LOCA loading on the reactor core to demonstrate conformance to the structural acceptance requirements described in Appendix A of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," LWR Edition Standard Review Plan (SRP) Section 4.2. In a letter dated September 24, 2015 (ADAMS Accession No. ML15271A169), the applicant stated that the DCD need not be revised because the requirements of SRP Section 4.2, Appendix A, are directly satisfied by a requirement in ABWR DCD Tier 2, Chapter 4, Section 4.2.3.1.2(1). However, to provide further clarity for potential COL applicants in the future, GEH added COL Item 4.2.5.2 to Section 4.2.5, "COL License Information," in Revision 6 of the ABWR DCD.

Because the applicant's proposed change clarifies information in the original ABWR design certification, it is a "modification," as this term is defined in Chapter 1 of this supplement. Therefore, this modification must comply with the Atomic Energy Act of 1954, as amended, and the Commission's regulations applicable and in effect at the time the certification was originally issued. Therefore, the proposed change is evaluated using the regulations in effect at the time the certification was originally issued.

The relevant requirements for this area of review and the associated acceptance criteria are described in SRP Section 4.2, Revision 2, July 1981, Appendix A. The relevant requirement is Title 10 *Code of Federal Regulations* Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," as it relates to the structural protection for fuel assemblies and control blades during accidents involving earthquakes. GDC 2 requires the design bases of structures, systems, and components, which include fuel assemblies and control blades, to reflect appropriate consideration of natural phenomena, which includes consideration of combined loading due to natural phenomena and limiting hydrodynamic loads.

4.2.2 Summary of Technical Information

In its letter dated September 24, 2015, GEH proposed a resolution to Item 18a of the staff letter dated July 20, 2012. GEH submitted the proposed ABWR DCD, Revision 5 markups in Enclosure 2 of the September 24, 2015 letter to address the staff request. In Enclosure 1 of this letter, GEH described the proposed changes that would be made to the ABWR DCD, Tier 2, Subsection 4.2.5 and Table 1.9-1 to include the new COL information item clarifying the responsibility of future COL applicants regarding analysis of the combined seismic and LOCA loading on the reactor fuel.

4.2.3 Technical Evaluation

The ABWR DCD reference fuel is GE P8x8R as described in GE Topical Report NEDE-31152P, "General Electric Fuel Bundle Designs Evaluated with GESTAR-Mechanical Analysis Bases (proprietary)," dated December 1988 (ADAMS Accession No. ML003725063 (Non-public)), which used the fuel bundle design methodologies described in GE Topical Report NEDE-24011-P (GESTAR II), Amendment 7. GESTAR II, Amendment 7 fuel bundle design methodologies were approved by the staff in a NRC safety evaluation letter from C. O. Thomas to J. S. Charnley (GE), "Acceptance for Referencing of Licensing Topical Report NEDE-24011-P Amendment 7 to Revision 6, General Electric Standard Application for Reactor Fuel," March 1, 1985 (ADAMS Accession No. ML090760583 (Non-public)).

These approved, referenced fuel design methodologies are described in the ABWR DCD Tier 2, Section 4.2.3.1.1. Additionally, ABWR DCD Tier 2, Appendix 4B lists the fuel licensing acceptance criteria and Appendix 4D demonstrates that the reference fuel meets the acceptance criteria. The GESTAR II, Amendment 7, references the seismic-and-LOCA loading evaluation in GE Topical Report NEDE-21175-3-P, “BWR Fuel Assembly Evaluation of Combined Safe Shutdown Earthquake (SSE) and Loss-of-Coolant Accident (LOCA) loadings,” Amendment 3, July 1982. In the NRC safety evaluation for GESTAR II, Amendment 7, the NRC stated the following:

> *The entire seismic-and-LOCA loads evaluation (including design limits) has been described by GE in the approved topical report NEDE-21175-3 to which GESTAR II makes reference. We conclude that the criteria for fuel assembly structural damage from external forces in NEDE-21175-3 are acceptable for GESTAR II.*

In ABWR DCD Tier 2, Section 4.2, GEH stated that each COL applicant may have different fuel and core designs which will be provided by the COL applicant to the NRC for review and approval. In Section 4.2 of NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design, Main Report," the final safety evaluation report (FSER) for the original certification of the ABWR design, the NRC approved the ABWR fuel design with the following condition in DCD Tier 2, Section 4.2.3.1.2:

> *The license/applicant must provide a plant-specific analysis of combined seismic and LOCA loading using NRC-approved methodology or another acceptable method to demonstrate conformance to the structural acceptance requirements described in Appendix A of Standard Review Plan Section 4.2*

This condition is Tier 2* information and therefore cannot be changed without prior NRC approval. The staff notes that because this seismic and LOCA analysis is site-specific, deferring to the COL applicant to perform this analysis is also acceptable under current guidance in accordance with Regulatory Guide 1.206, October 2018, Section C.1.11.b, "Supplemental Information." In the September 24, 2015 letter responding to Item 18a, GEH proposed the following COL information item in DCD Tier 2, Section 4.2.5, "COL License Information" to ensure clarity concerning the COL applicant's responsibility to perform an analysis of reactor core combined seismic and LOCA loading:

> *4.2.5.1 - Reactor Core Seismic and LOCA Structural Acceptance*
> *The COL applicant shall provide the NRC a confirmatory plant-specific analysis of the reactor core combined seismic and LOCA loading using NRC-approved methodology or another acceptable method to demonstrate conformance to the structural acceptance requirements described in Appendix A of Standard Review Plan, Section 4.2, for the fuel referenced in the COL application. This analysis will use as input the site-specific ground motion and the fuel characteristics of the plant's initial core load.*

The staff concluded that the ABWR reference fuel and design methodologies were previously approved by the NRC, and the proposed COL information item will add clarity to the ABWR DCD concerning the COL applicant's responsibility to perform an analysis of the combined seismic and LOCA loading on the reactor core that will meet the structural acceptance criteria in Appendix A of SRP Section 4.2. Therefore, GEH's response to Item 18a of the staff July 20, 2012, letter is acceptable. In addition, the staff confirmed incorporation of the COL information item into Revision 6 of the DCD (Section 4.2.5.2).

4.2.4 Conclusions

The staff reviewed the applicant's proposed changes to the ABWR DCD as described above. Based on this evaluation, the staff concludes that the change is acceptable because the ABWR reference fuel and methodologies continue to meet all applicable regulatory requirements at the time of original certification, including GDC 2 as referenced in Appendix A to SRP Section 4.2, Revision 2, July 1981, and the change does not alter the safety conclusions made previously in the staff FSER as documented in NUREG-1503.