

1.0 INTRODUCTION AND GENERAL DISCUSSION

1.1. Introduction

In a letter dated December 7, 2010 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML110040176), GE-Hitachi Nuclear Energy (GEH or the applicant) submitted a Design Certification (DC) Renewal application for the United States Advanced Boiling-Water Reactor (ABWR) pursuant to the requirements of Subpart B, "Standard Design Certifications," of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

This report supplements the final safety evaluation report (FSER) for the ABWR standard plant design. The U.S. Nuclear Regulatory Commission (NRC) staff issued the FSER as NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design," in July 1994 and NUREG-1503, Supplement 1 in May 1997, to document the NRC staff's review of the ABWR. This report, Supplement 2 to NUREG-1503, documents the NRC staff's review of GEH's application to renew the ABWR DC. Except as modified by this supplement to the FSER, the findings made in NUREG-1503 and its Supplement 1 remain in full effect. Each section of Supplement 2 is numbered and titled the same as the section of the FSER that is being updated, where applicable. The discussions and staff findings in this supplement are supplementary to, but not in lieu of, the discussions in the original FSER, unless otherwise noted.

GEH submitted the ABWR DC renewal application under Subpart B, "Standard Design Certifications," of 10 CFR Part 52. GEH's renewal application includes the ABWR design control document (DCD) and an environmental report.

Review Criteria

The following Commission regulations specify requirements for DC renewals:

1. 10 CFR 52.57(a) states, in part, that an application for renewal must contain all information necessary to bring up to date the information and data contained in the previous application.
2. 10 CFR 52.59(a) states that the Commission shall issue a rule granting the renewal if the design, either as originally certified or as modified during the rulemaking on the renewal, complies with the Atomic Energy Act and the Commission's regulations applicable and in effect at the time the certification was issued, provided, however, that the first time the Commission issues a rule granting the renewal for a standard DC in effect on July 13, 2009, the Commission shall, in addition, find that the renewed design complies with the applicable requirements of 10 CFR 50.150, "Aircraft impact assessment".

3. 10 CFR 52.59(b) states that the Commission may impose other requirements if it determines that:
 - a. They are necessary for adequate protection to public health and safety or common defense and security;
 - b. They are necessary for compliance with the Commission's regulations and orders applicable and in effect at the time the certification was issued; or
 - c. There is a substantial increase in overall protection of the public health and safety or the common defense and security to be derived from the new requirements, and the direct and indirect costs of implementing those requirements are justified in view of this increased protection.
4. 10 CFR 52.59(c) states that the applicant for renewal may request an amendment to the DC. Section 52.59(c) also states that the Commission shall grant the amendment request if it determines that the amendment will comply with the Atomic Energy Act and the Commission's regulations in effect at the time of renewal.

In addition, while 10 CFR 52.63(a) imposes more restrictive limits on the types of changes that may be made while a design certification rule (DCR) is in effect, 10 CFR 52.59(c) allows the ABWR DC renewal applicant greater flexibility in seeking changes to the ABWR DC. Thus, ABWR DC renewal applications that include amendments to the certified ABWR design are not required to address the criteria in 10 CFR 52.63. For example, the renewal applicant does not need to identify specific criteria in 10 CFR 52.63(a)(1) as the basis for proposing an amendment to the certified design. Also, because 10 CFR 52.63(a)(3) does not apply to DC renewal, changes made to the design during renewal are not imposed on combined license's applicants and holders referencing the initial certification. However, in accordance with 10 CFR 52.59(c), if the amendment request entails such an extensive change to the DC that an essentially new standard design is being proposed, an application for a DC must be filed in accordance with Subpart B of 10 CFR Part 52.

The design basis for the ABWR DC and DC renewal, with the exception of those design amendments proposed by the applicant in accordance with 10 CFR 52.59(c), is based on the regulations in effect at the time of certification. While some of these regulations were specific to DCs under 10 CFR Part 52 (e.g., 10 CFR 52.47(1)(1)(iii)-(ix) (1997)), most fell under 10 CFR 52.47(a)(1)(i) (1997), which required that the DC application contain "[t]he technical information which is required of applicants for construction permits and operating licenses by 10 CFR Part 20, "Standards for Protection Against Radiation," and Part 50, "Domestic Licensing of Production and Utilization Facilities," and its appendices, and Parts 73, "Physical and Protection of Plants and Materials," and 100, "Reactor Site Criteria," and which is technically relevant to the design and not site-specific." Similarly, 10 CFR 52.47(a)(1)(ii) (1997) required the DC application to demonstrate "compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f)." The requirements referenced by 10 CFR 52.47(a)(1)(i)-(ii) that are relevant to the ABWR are discussed in the FSER for the original certification and, as applicable, in this supplement.

Review Approach

Based on the regulations cited in the Review Criteria above, the NRC staff's safety review focused on ensuring that the design, as modified, is consistent with 10 CFR 52.59(a) and that any amendments comply with 10 CFR 52.59(c). The NRC staff review also focused on ensuring that the entire ABWR DCD (i.e., the version of the ABWR DCD last approved for incorporation by reference) was updated under 10 CFR 52.57(a). Updates include clarifications consistent with the original understanding of the design information, and corrections of errors, typos, and defects (as defined in 10 CFR Part 21, "Reporting of Defects and Noncompliance"). In addition, the ABWR DCD was updated to include the information necessary to demonstrate the technical qualification of the applicant because GEH is not the original applicant for the ABWR DC. General Electric Nuclear Energy (GENE) was the original applicant for the ABWR DC that became effective on June 11, 1997. In 2007, General Electric Company and Hitachi formed an alliance, and GEH became the entity to retain the ABWR design information of predecessor to GENE. GEH has been involved in the design and development of commercial nuclear power plants, reactor plant designs and nuclear fuel for boiling-water reactors. Therefore, based on the above, GEH is technically qualified to supply the design.

To support the initial certification of the ABWR, the NRC determined that the design was safe and complied with NRC requirements. Therefore, consistent with the Commission's direction in the May 12, 1997, final rule for the original certification of the ABWR (62 FR 25800, 25804-05), the NRC staff did not perform a *de novo* review of GEH's renewal application. Instead, the staff's review conformed to the Commission's expectation that "the review focus would be on changes to the design that are proposed by the applicant and insights from relevant operating experience with the certified design or other designs, or other material new information arising after the NRC staff's review of the DC."

For those sections of the ABWR DCD that the applicant did not propose to change, the NRC staff evaluated whether the staff's findings in NUREG-1503 and NUREG-1503, Supplement 1 are still valid. This evaluation was based on the consideration of the following types of information:

- i. errors (including typographical errors) and defects (as defined in 10 CFR Part 21) that should result in corrections to the DCD;
- ii. material new information with respect to technical resolutions to high and medium priority unresolved safety issues (USIs) and generic safety issues (GSIs) addressed in the original ABWR DCR;
- iii. new USIs and GSIs created or identified since the ABWR design was certified;
- iv. new generic letters and bulletins issued after the ABWR design was certified;
- v. any relevant domestic and international operating experience that has been documented since the ABWR design was certified; and
- vi. any other new, material information of which the staff is aware that invalidates the staff's findings in NUREG-1503 and NUREG-1503, Supplement 1.

The applicant provided information to support the staff's consideration described above in letters dated August 31, 2016 (ADAMS Accession No. ML16244A122), November 17, 2016 (ADAMS Accession No. ML16323A003), and December 13, 2016 (ML16348A096). In determining whether the staff's findings in support of the original certification are still valid, the staff sought additional information from the applicant on some issues. In some cases, the applicant proposed design changes to address the staff's questions, and in other cases the staff determined that no change was necessary. For those sections that have not changed in the ABWR DCD, the staff did not identify any new information of the type described above that would invalidate the findings in NUREG-1503 and NUREG-1503, Supplement 1. Therefore, the staff concludes that the unchanged sections of the DCD continue to comply with the Atomic Energy Act and the Commission's regulations applicable and in effect at the time the certification was issued per 10 CFR 52.59(a). For those sections that have changed in the ABWR DCD as a result of the consideration described above, the staff's SE includes a discussion of the specific matter associated with the design change.

The staff considers design changes to fall in three categories. These categories are: modifications, renewal backfits, and amendments. Therefore, the staff evaluated design changes as follows:

1. *Modifications* to the certified design are those changes made pursuant to the requirement to update the application in accordance with § 52.57(a) (e.g., clarifications consistent with the original understanding of the design information, changes to correct known errors, typos, or defects as defined in 10 CFR Part 21) or that are necessary to meet § 52.59(a).¹ Modifications must comply with the Atomic Energy Act of 1954, as amended (AEA), and the Commission's regulations applicable and in effect at the time the certification was originally issued with the exception of those changes proposed by the DC renewal applicant to comply with 10 CFR 50.150, as required by § 52.59(a).
2. *Renewal backfits* to the certified design are those changes that are necessary to comply with additional requirements imposed by the NRC through application of the criteria in § 52.59(b). The NRC staff is responsible for justifying renewal backfits under this provision.
3. *Amendments* to the certified design are those changes proposed by the DC renewal applicant in accordance with § 52.59(c). Amendments must comply with the AEA and the Commission's regulations applicable and in effect at the time of renewal. If the amendment request entails such an extensive change to the certified design that an essentially new standard design is being proposed, a new DC application must be submitted.

Renewal backfits are changes imposed by the NRC, while modifications and amendments are changes proposed by the applicant. If a design change is made to satisfy the updating requirement in 10 CFR 52.57(a) or to meet the standards in 10 CFR 52.59(a), then the change is a modification and must comply with the regulations applicable and in effect at the time the certification was issued. Otherwise the change is an amendment and must satisfy the regulations in effect at the time of renewal.

¹ The term "modification" derives from 10 CFR 52.59(a), which refers to the "design, either as originally certified or as *modified* during the rulemaking on the renewal" (emphasis added).

This supplement is issued by the Division of Licensing, Siting, and Environmental Analysis in the Office of New Reactors, NRC. The NRC's project manager for the review of GEH's ABWR DC renewal application is James Shea. He may be reached by calling 301-415-1388, or by writing to him at the Office of New Reactors, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. The ABWR design documentation and all revisions are available for public inspection at the NRC's Public Document Room and the NRC's public electronic documents access to ADAMS.² Through the NRC public website (<https://www.nrc.gov/>), the public can gain electronic access to ADAMS, which provides text and image files of NRC's public documents. The ABWR FSER (NUREG-1503 and NUREG-1503, Supplement 1) as well as this supplement are also available for public inspection at the NRC's public electronic documents access to ADAMS and the ABWR DC Renewal public web-site (<https://www.nrc.gov/reactors/new-reactors/design-cert/renewal-abwr-ge-hitachi.html#safety>).

1.5 Summary of Principal Review Matters

By letter dated December 7, 2010 (ADAMS Accession No. ML110040176) GEH submitted an application to renew the ABWR DC. The NRC staff reviewed the application and, in a letter dated July 20, 2012 (ADAMS Accession No. ML12125A385), identified proposed changes that were considered to be regulatory improvements or changes that could meet the criteria in 10 CFR 52.59(b). These suggested changes by the staff for GEH consideration included recommendations contained in SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," dated February 17, 2012 (ADAMS Accession No. ML12039A111), addressing Recommendations 4.2, 7.1 and 9.3 from the Fukushima Near-Term Task Force Report, and SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 (ADAMS Accession No. ML11186A950).

Subsequent to the staff's 2012 letter to GEH, the NRC staff issued several requests for additional information (RAIs) to identify additional items or clarify the items communicated in the 2012 letter. By letter dated February 19, 2016 (ADAMS Accession No. ML16081A268), the applicant submitted the first revision of its application to incorporate changes to the ABWR DCD that were previously communicated to the NRC via letters responding to the 2012 staff letter and to the staff's RAIs. In addition, this revision (DCD Revision 6) transmitted corrections of typographical mistakes that were uncovered during document development and other required formatting changes. These corrections represent non-substantive changes that are editorial in nature. The NRC staff reviewed these typographical changes and determined that they do not affect the staff's findings in the FSER for initial certification and are acceptable.

For the staff-suggested changes in Items 14, 15, 16, 21, 24, and 25 in the 2012 staff letter, the applicant informed the NRC staff that changes will not be made to the ABWR DCD through the

² ADAMS is the NRC's information system that provides access to all image and text documents that the NRC has made public since November 1, 1999, as well as bibliographic records (some with abstracts and full text) that the NRC made public before November 1999.

Documents available to the public may be accessed via the Internet at <https://www.nrc.gov/reading-rm/adams.html>. Documents may also be viewed by visiting the NRC's Public Document Room at One White Flint North, 11555 Rockville Pike, Rockville, Maryland. Telephone assistance for using web-based ADAMS is available at (800) 397-4209 between 8:30 a.m. and 4:15 p.m. eastern time, Monday through Friday, except Federal holidays.

renewal application. In letters dated September 25, 2015, August 14, 2015, June 03, 2016, and September 11, 2015 (ADAMS Accession Nos. ML15271A171, ML15226A416, ML16155A025, and ML15258A666), GEH submitted justifications explaining that the original ABWR DC contains sufficient information with respect to these items. These items relate to (1) probabilistic risk assessment, (2) instrumentation and controls system design, (3) inspections, tests, analyses, and acceptance criteria, and (4) human factors engineering.

In a letter dated February 2, 2018 (ADAMS Accession No. ML17097A470), the NRC staff provided its review with respect to these items. In summary, the staff determined that Items 14, 15, 16, 21, 24, and 25 are not necessary for compliance with the applicable regulations in effect at initial certification and, therefore, are also not necessary for reasonable assurance of adequate protection of the public health and safety. For this reason, incorporation of these suggested improvements is not necessary to support the findings required by 10 CFR 52.59(a) to renew the DC. The staff has also decided that further evaluating these improvements through the 10 CFR 52.59(b) process is not warranted.

The remaining items identified in the 2012 staff letter, as well as the RAIs issued by the NRC staff, resulted in the applicant proposing changes to the ABWR DCD to address the staff's concerns. Therefore, the NRC staff did not need to impose any renewal backfits during the renewal review.

The table below identifies the safety evaluation report sections with the staff's evaluations of the ABWR DC changes contained in the renewal application and identifies whether the changes are modifications or amendments. The amendments are limited in nature, and do not entail such an extensive change to the certified design that an essentially new standard design is being proposed.

SER Section	Amendment/Modification
Section 2.3, Meteorology	Modification
Section 2.5, Geological, Seismological and Geotechnical Engineering	Modification
Section 2.6.2, Water Level (Flood) Design Site Parameters	Modification
Section 2.6.8, ABWR Site Acceptability	Modification
Sections 3.2.3, Safety Classifications	Amendment
Section 3.3, Wind and Tornado Loadings	Modification

SER Section	Amendment/Modification
Section 3.5.1.4, Missiles Generated by Natural Phenomena	Modification
Section 3.7.3, Seismic Subsystem Analysis	Modification
Section 4.2, Fuel System Design	Modification
Section 5.2.5, Reactor Coolant Pressure Boundary Leakage Detection	Amendment
Section 5.4.7, Residual Heat Removal System	Amendment
Section 5.4.7.1.1.10, ACIWA	Amendment
Section 5.4.8, Reactor Water Cleanup System	Amendment
Section 6.2.1.3, Short-Term Pressure Response	Amendment
Section 6.2.1.6, Suppression Pool Dynamic Loads	Modification
Section 6.2.1.9, Containment Debris Protection for ECCS Strainers	Amendment
Section 7.4.1.4.4, Shutdown Panel	Amendment
Section 7.5.2.1, Post Accident Monitoring System	Amendment
Section 7.7.1.2.1, Control Rod Ganged Withdrawal Sequence Restrictions	Modification
Section 8.2.5, NRC Bulletin 2012-01: Design Vulnerability In Electric Power System	Modification
Section 8.3.4.4, Isolation Between Class 1E Buses and Loads Designated as Non-Class 1E	Amendment

SER Section	Amendment/Modification
Section 9.1.1, New Fuel Storage	Amendment
Section 9.1.2.1, New and Spent Fuel Storage	Modification
Section 9.1.2.2, Fuel Racks	Amendment
Section 9.1.3, Fuel Pool Cooling and Cleanup System	Amendment
Section 9.1.4, Light Load Handling System (Related to Refueling)	Amendment
Section 9.1.5, Overhead Heavy Load Handling Systems	Amendment
Section 9.5.1, Fire Protection	Modification
Section 11.4, Solid Waste Management System	Modification
Section 12.2, Radiation Sources	Modification
Section 12.3, Radiation Protection Design Features	Amendment
Section 13.3, Emergency Planning	Modification
Section 13.5, Plant Procedures	Amendment
Section 14.3.2.3.6, Structural Task Group Review	Modification
Section 16, Technical Specifications	Amendment
Section 19.2.3.3.4, ABWR Containment Vent Design	Modification

SER Section	Amendment/Modification
Section 19.5, Aircraft Impact Assessment	Amendment
Section 22.0, Requirements Resulting from Fukushima Near Term Task Force Recommendations	Amendment