



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

February 2, 2018

Mr. Jerald G. Head  
Senior Vice President, Regulatory Affairs  
GE-Hitachi Nuclear Energy  
3901 Castle Hayne Road MC A-18  
Wilmington, NC 28401

SUBJECT: GE-HITACHI NUCLEAR ENERGY—U.S. ADVANCED BOILING-WATER  
REACTOR DESIGN CERTIFICATION RENEWAL APPLICATION, CLOSURE  
OF DESIGN ITEMS 14, 15, 16, 21, 24, AND 25

Dear Mr. Head:

In a letter dated December 7, 2010, you submitted a design certification (DC) renewal application for the U.S. 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." On July 20, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a letter describing certain design changes for consideration by GE-Hitachi Nuclear Energy (GEH) for inclusion in your application (Agencywide Documents Access and Management System Accession No. ML12125A385). This letter contained 28 design items in a table titled, "Advanced Boiling Water Reactor Design Certification Renewal Design Changes for GE-Hitachi Nuclear Energy's Consideration," that the staff considered to be regulatory improvements or changes that could meet the criteria in 10 CFR 52.59(b).

After the July 20, 2012, letter, GEH submitted responses to address the 28 design items identified by the NRC staff. With respect to Design Items 14, 15, 16, 21, 24, and 25, GEH submitted justifications explaining how the original ABWR DC contains sufficient information that alleviates the need for changes to the DC with respect to renewal of the application. 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.

The enclosure to this letter contains the NRC staff's review with respect to the specific design items mentioned above. In summary, the staff determined that the six unaccepted suggested improvements listed 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 design certification. The staff has also decided that further evaluating these improvements through the 10 CFR 52.59(b) process is not warranted.

Should you have any questions or comments concerning this matter, please contact Adrian Muñoz at (301) 415-4093, or via e-mail at [Adrian.Muniz@nrc.gov](mailto:Adrian.Muniz@nrc.gov).

Sincerely,

**/RA/**

Frederick D. Brown  
Acting Director  
Office of New Reactors

Docket No.: 52-045

Enclosure:  
As stated

cc w/encl.: See next page

SUBJECT: GE HITACHI NUCLEAR ENERGY – UNITED STATES ADVANCED  
BOILING-WATER REACTOR DESIGN CERTIFICATION RENEWAL  
APPLICATION – DATED FEBURARY 2, 2018

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### **Probabilistic Risk Assessment—Design Items 14, 15, and 16**

By letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the U.S. Nuclear Regulatory Commission (NRC) provided a compilation of design changes for GE-Hitachi Nuclear Energy (GEH) to consider in the renewal of the design certification (DC) for the U.S. Advanced Boiling-Water Reactor (ABWR). Design Items 14, 15, and 16 suggested that GEH consider improving the full-power and shutdown probabilistic risk assessment (PRA) to ensure that the risk-significant structures, systems, and components (SSCs) and other risk insights are comprehensively identified. The ABWR PRA predates the improvements in PRA methods and operating experience gained since the 1997 design certification rule (DCR). Since the issuance of the final DCR for the ABWR, additional guidance has been developed on PRA technical adequacy and the application of PRA (e.g., PRA standards included in Regulatory Guide 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," issued March 2009). Therefore, the staff requested that the applicant update the ABWR PRA to fully identify the risk insights that should be used to support the identification of design and operational requirements at the DC stage.

By letter dated September 25, 2015 (ADAMS Accession No. ML15271A171), GEH stated its position that the PRA remains applicable to the renewal application for Level 1 and 2 full-power risk and for shutdown risk, and that the Design Control Document (DCD), Tier 2, Appendix 19K, contains a comprehensive list of risk-significant SSCs. Although the ABWR DC PRA could potentially be improved to identify a more comprehensive set of risk insights, the regulatory standard for renewal of a DC is compliance with the regulations applicable and in effect at the time of initial certification. The staff finds that the ABWR DC PRA utilized the accepted approaches for complying with the regulations applicable and in effect at initial certification. Therefore, the staff concludes that sufficient risk insights were identified to support the identification of design and operational requirements at the DC stage and were used as input to the reliability assurance program, technical specifications, and inspections, tests, analyses, and acceptance criteria (ITAAC).

In accordance with 10 CFR 50.71(h)(1), each holder of a combined license (COL) under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," is required to have a plant-specific Level 1 and Level 2 PRA available by fuel load, covering those initiating events and operating modes for which NRC-endorsed consensus standards on PRA exist 1 year before the scheduled date for initial loading of fuel. Therefore, should an ABWR be licensed, constructed, and operated, the plant-specific PRA would be upgraded to the prevailing state of practice and be capable of supporting applicable operational programs. The staff will have the opportunity to audit this PRA if it is used for PRA applications (e.g., 10 CFR 50.65(a)(4), 10 CFR 50.69).

Based on the above, the staff has determined that the suggested improvements in Design Items 14, 15, and 16 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 design certification. The staff has also decided that further evaluating these improvements through the 10 CFR 52.59(b) process is not warranted. Therefore, design Items 14, 15, and 16 are closed. The staff will address the effect of design changes on the ABWR PRA in the safety evaluation report for the design certification renewal application review.

Enclosure

## **Instrumentation and Control Systems—Design Item 21**

In Design Item 21 (ADAMS Accession No. ML12125A385), the staff asked GEH to consider replacing the obsolete data communication technology in its application for renewal of the ABWR DC. In its response dated August 14, 2015 (ADAMS Accession No. ML15226A416), GEH stated that it considers the ABWR DC requirements for data communication technology to be sufficient for NRC approval of the DC renewal application. Therefore, GEH proposed no changes to the application at this time.

GEH's response referenced NUREG-1503, "Final Safety Evaluation Report [FSER] Related to the Certification of the Advanced Boiling Water Reactor Design," issued July 1994, which in Section 7.1.3.3 states the following:

It is premature to complete the final design details for the microprocessor and digital control technology aspects of the I&C [instrumentation and controls] system design of the ABWR before the COL is issued. This is because the technology in this area is rapidly evolving and it is, therefore, important that the certified design description and ITAAC [inspections, tests, analyses, and acceptance criteria] not "lock in" a design which could be obsolete at the time of construction. The approach that will be used is to "lock in" a design process and the specific acceptance criteria which, if met, would result in a design which is acceptable. At the same time, the functional system description, commitment to standards, and commitment to a structured design process in the CDM [certified design material] must be sufficient for the staff to make its final safety determination.

Section 7.1.3.3 also states the following:

GE has not finalized the hardware and software design for the ABWR digital I&C systems. Therefore, the staff used the two-part approach described in SECY-92-053 ["Use of Design Acceptance Criteria During 10 CFR Part 52 Design Certification Reviews," dated February 19, 1992] to reach its safety finding for design certification. In reviewing the I&C systems, the first part of this approach involved a detailed functional review at the block diagram level to ensure the applicant has appropriately implemented the Commission's requirements related to postulated single failures, common mode failures, signal isolation, and other aspects of the staff's review that are typical for any safety-related I&C system, including analog control systems such as those in current operating nuclear plants. This review confirmed that the detailed functional requirements for the I&C systems are established.

The second part of the staff's approach to reach certification safety finding addresses the adequacy of the digital control systems implementation with respect to the system functional requirements. This relies upon a formal design implementation process with a phased ITAAC program for design development within certain predefined constraints and limits.

In its response letter, GEH also stated that it agrees with the assessment of the rapidly evolving nature of I&C technology that the NRC made in its FSER for the ABWR DCR and that GEH fully intends to consider technological improvements in any future detailed design implementation of the ABWR design requirements, as data communication technology is expected to continue to

evolve. According to GEH, the ABWR DC defines the ABWR data communications design as being based on fiber optic communication links and a fiber distributed data interface protocol, a technology that has been successfully implemented in nuclear power plants and continues to be supported by suppliers of the equipment and controls. GEH stated that business continuity practices encourage the use of contemporary, but proven, technologies in applications as long as functional requirements and acceptance criteria are met. The ABWR certified design material (Tier 1) includes: (1) design descriptions that provide functional requirements of the processes and (2) acceptance criteria by which the details of the design of the ABWR I&C system would be developed, designed, and evaluated. ITAAC verify, through inspections, tests, and acceptance criteria, that the as-built system conforms to the design description of the communications protocol, performance criteria, and functions. GEH contends that following these requirements and criteria as part of a future ABWR project will allow consideration of the evolutions in digital I&C communication technology at that time, as the NRC envisioned in the FSER, including for the design described in the ABWR DCR.

The staff finds GEH's position on dealing with evolving digital I&C technology for the ABWR DC renewal using the processes described in the ABWR DCD to be reasonable. This concept of developing a state-of-the-art ABWR digital I&C design that conforms to the ABWR certified design descriptions, performance criteria, functional requirements, and acceptance criteria has been successfully demonstrated in the COL application for South Texas Project (STP) Units 3 and 4. The STP COL applicant incorporated by reference the ABWR DC for all of the I&C design attributes and took departures from the certified design in the areas of evolving technology, such as the use of state-of-the-art proven data communication technology. The STP COL application also provided additional engineering details on the design departures to demonstrate compliance with current regulations and associated guidance documents.

As state-of-the-art digital I&C technology is constantly evolving, the staff agrees that digital I&C technical advances would be best addressed at the COL application stage. The safety finding made in the original ABWR FSER, Chapter 7 of NUREG-1503, on data communications design as defined in the ABWR DC is still valid (including the finding on compliance with the regulations applicable and in effect at the time the certification was issued), provided a plant is built in conformance with the certified ABWR design without any departure from the specified data communications design and technology. The existing process allows for technological advances but does not mandate them. Thus, a COL applicant could use the certified design without departures.

Based on the above, the staff has determined that the suggested improvement in Design Item 21 is not necessary for compliance with the applicable regulations in effect at initial certification and, therefore, is also not necessary for reasonable assurance of adequate protection of the public health and safety. For this reason, incorporation of this suggested improvement is not necessary to support the findings required by 10 CFR 52.59(a) to renew the design certification. The staff has also decided that further evaluating this improvement through the 10 CFR 52.59(b) process is not warranted. Therefore, Design Item 21 is closed.

#### **Inspections, Tests, Analyses, and Acceptance Criteria—Design Item 24**

In Design Item 24 (ADAMS Accession No. ML12125A385), the staff asked GEH to consider applying the guidance from Regulatory Issue Summary (RIS) 2008-05, Revision 1, "Lessons Learned to Improve Inspections, Tests, Analyses, and Acceptance Criteria Submittal," dated September 23, 2010 (ADAMS Accession No. ML102500244), to the existing ABWR Tier 1 ITAAC. The NRC first issued RIS 2008-05, dated February 27, 2008 (ADAMS Accession

No. ML073190162), to address good practices for preparing ITAAC. RIS 2008-05, Revision 1, expands on the original RIS based on lessons learned from prior DC reviews.

For the renewal application, GEH has submitted new or revised ITAAC for the ABWR Design Control Document (DCD) Tier 1 in response to certain NRC Requests for Additional Information. These new or revised ITAAC are listed in Enclosure 1 of the GEH letter dated June 3, 2016 (ADAMS Accession No. ML16155A025). GEH stated that it considered NRC guidance on ITAAC in the development of these new and or revised ITAAC. GEH states that the final safety evaluation report for the initial certification (NUREG-1503) explains how the NRC staff reviewed Tier 1 ITAAC through a very thorough process in accordance with 10 CFR Part 52 requirements and concluded that the ITAAC are acceptable. GEH also stated that subsequent NRC guidance does not change these conclusions.

The staff understands that while it would be desirable to apply the guidance in RIS 2008-05 to all ABWR ITAAC, this does not constitute a basis for overturning the NRC findings made in support of the initial certification. Based on the above, the staff has determined that the suggested improvement in Design Item 24 is not necessary for compliance with the applicable regulations in effect at initial certification and, therefore, is also not necessary for reasonable assurance of adequate protection of the public health and safety. For this reason, incorporation of this suggested improvement is not necessary to support the findings required by 10 CFR 52.59(a) to renew the design certification. The staff has also decided that further evaluating this improvement through the 10 CFR 52.59(b) process is not warranted. Therefore, Design Item 24 is closed.

### **Human Factors Engineering—Design Item 25**

In Design Item 25 (ADAMS Accession No. ML12125A385), the staff asked GEH to consider a control room design that reflects state-of-the-art human factors principles in accordance with 10 CFR 50.34(f)(2)(iii). This regulation states that the application must provide, for Commission review, a control room design that reflects state-of-the-art human factors principles before committing to the fabrication or revision of fabricated control room panels and layouts.

GEH responded in a letter dated September 11, 2015 (ADAMS Accession No. ML15258A666), that no substantive changes were needed to Chapter 18 of the ABWR DCD, on the topic of human factors engineering (HFE), based on the following factors:

- The DCD addresses the design and implementation of HFE principles previously approved.
- The DCD describes the process for the design and implementation of HFE aspects of the plant.
- Delaying detailed design to a time close to construction allows the design to take advantage of technological developments and innovations, as the NRC recognized in the FSER for the original ABWR DC.

Although 10 CFR 50.34(f)(2)(iii) requires that the control room design reflect “state-of-the-art” human factors principles, the standard for renewal of a DC is that it is in compliance with the regulations applicable and in effect at the time the certification was issued. Thus, in the context of DC renewal, “state-of-the-art” must be judged by what was applicable and in effect at the time the certification was issued, in this case 1997. The NRC staff evaluated the scope of the

existing DCD Chapter 18 against current guidance and found that it does not address all the computer technology and HFE design validation acceptance criteria contained in the Commission's current regulatory guidance. However, the existing DCD Chapter 18 design process is consistent with the I&C technology described in DCD Chapter 7 and does contain a basic HFE design validation process that provides reasonable assurance that the design will minimize the potential for human error. Also, the ABWR HFE design does reflect state-of-the-art human factors principles as they existed in 1997.

Based on the above, the staff has determined that the suggested improvement in Design Item 25 is not necessary for compliance with the applicable regulations in effect at initial certification and, therefore, is also not necessary for reasonable assurance of adequate protection of the public health and safety. For this reason, incorporation of this suggested improvement is not necessary to support the findings required by 10 CFR 52.59(a) to renew the design certification. The staff has also decided that further evaluating this improvement through the 10 CFR 52.59(b) process is not warranted. Therefore, Design Item 25 is closed.