

7 INSTRUMENTATION AND CONTROL SYSTEMS

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7 INSTRUMENTATION AND CONTROL SYSTEMS

Appendix A, “Design Certification Rule for the U.S. Advanced Boiling Water Reactor,” to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” constitutes the standard design certification (DC) for the U.S. Advanced Boiling Water Reactor (ABWR) design. To document the U.S. Nuclear Regulatory Commission (NRC) staff’s review supporting initial certification of the ABWR, the staff issued a final safety evaluation report (FSER) in 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.

The staff is documenting its review of the GE-Hitachi Nuclear Energy (GEH or the applicant) application for renewal of the ABWR DC in Supplement 2 to NUREG-1503. Chapter 1 of this supplemental FSER describes the staff’s review process for the ABWR DC renewal. This supplemental FSER section documents the NRC staff’s review specifically related to Chapter 7, “Instrumentation and Control Systems,” Section 7.4.1.4.4, “Shutdown Panel,” of the GEH Design Control Document (DCD), Revision 7. Except as modified by this supplement to the FSER, the findings made in NUREG-1503 and its Supplement 1 remain in full effect.

7.4.1.4.4 Shutdown Panel

7.4.1.4.4.1 Regulatory Criteria

In the GEH ABWR DCD, Revision 7, the applicant incorporated a design change to include additional controls and indications for the ABWR remote shutdown panel. These additional controls and indications improve the diversity and defense in depth during beyond-design-basis events and could provide a potential combined license (COL) applicant the means for meeting the requirements of 10 CFR 50.155, “Mitigation of Beyond-Design Basis Events,” (MBDBE) rule.

In a letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the NRC staff identified 28 items for GEH’s consideration as part of its application to renew the ABWR DC. In item No. 26 of the letter, the NRC staff requested that the applicant address ABWR DCD design changes related to aspects of the NRC Fukushima Near Term Task Force (NTTF) Recommendation 4.2, regarding mitigation strategies for beyond-design-basis external events based on the NRC policy at that time, as outlined in the staff requirements memorandum for 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,” issued February 17, 2012 (ADAMS Accession No. ML12039A111). Subsequently, during the MBDBE rulemaking that created 10 CFR 50.155, the Commission decided not to impose mitigation strategies requirements on DCs.¹

The final rule was published in the *Federal Register* on August 9, 2019 (84-FR-39684) with an effective date of September 9, 2019. In a letter dated January 23, 2017 (ADAMS Accession No. ML17025A386), GEH provided supplemental information for its response to the NRC staff’s July

¹ In the MBDBE proposed rule regulatory analysis (ADAMS Accession No. ML15266A133), the Commission proposed to not make the MBDBE proposed rule applicable to existing DCs, which included the ABWR, because “[t]he issues that may be resolved in a DC and accorded issue finality may not include operational matters, such as the elements of the [MBDBE] proposed rule.”

20, 2012 letter. After the Commission decision to exclude DCs from elements of the MBDBE rule, the applicant narrowed the scope of Item No. 26 to exclude changes directly related to SECY-12-0025. GEH retained the related design change of additional controls and indications for the ABWR remote shutdown panel as an operational enhancement to provide additional defense-in-depth. These ABWR renewal design enhancements could provide a potential COL applicant the means for meeting the MBDBE rule requirements.

These changes do not fall within the definition of a “modification.” Therefore, in accordance with 10 CFR 52.59(c), these design changes are “amendments,” as this term is defined in Chapter 1 of this supplemental FSER, and will correspondingly be evaluated by the staff using the regulations in effect at renewal. The applicable regulatory requirements for evaluating the ABWR DCD design amendments to add additional controls and indications to the remote shutdown panel are as follows:

- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants.” (GDC) 19, “Control Room,” requires, in part, that equipment at appropriate locations outside the control room shall be provided with (1) a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures.

7.4.1.4.4.2 Summary of Technical Information

Item No. 26 from the staff letter dated July 20, 2012, requested that the applicant address the design related aspects of NTF Recommendation 4.2 regarding mitigation strategies for beyond-design-basis external events as outlined in Attachment 2 of the Commission Order EA-12-049, “Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” dated March 12, 2012 (ADAMS Accession No. ML12054A735).

The staff discussed NRC actions involving a pending final rulemaking for the MBDBE rule during a public teleconference held on December 1, 2016. The staff noted during that call that, according to the latest public information regarding the pending final rule, no requirements would be applicable to applicants for a standard DC (or a renewal, as in the case of the ABWR application). The staff expected the final rule to be effective before the completion of the ABWR DC renewal. On that basis, in a letter dated December 6, 2016 (ADAMS Accession No. ML16341A812), GEH informed the NRC of its plans to submit a revised response for addressing Item No. 26 by the end of January 2017. By letter dated January 23, 2017 (ADAMS Accession No. ML17025A386), the applicant provided the updated GEH response for Item No. 26, maintaining some enhanced design features related to mitigating strategies that may be used by a potential COL applicant to satisfy the MBDBE rule requirements including enhancements to the ABWR remote shutdown panel.

7.4.1.4.4.3 Technical Evaluation

In the letter dated January 23, 2017, the applicant stated the ABWR design enhancements provide additional features, rather than addressing specific regulatory requirements, that, for example, provide redundancy or offer operational conveniences that have been proposed by the industry. The features may be used as part of an overall approach for mitigating strategies when COL applicants or licensees implement the final MBDBE rule for the development of

procedures, or programs. For these reasons, GEH elected to retain most of these design features in the ABWR DCD but did not characterize them as “mitigating strategies.”

The design enhancements the applicant provided for the ABWR remote shutdown system include:

- Replacement of control for safety relief valves (SRVs) “G”, “J”, “K” and “P” with control for automatic depressurization system (ADS) SRVs “C”, “H”, “L” and “R”, which can be operated by the replenishable supply of nitrogen gas (N₂). This change affects DCD Tier 1, Figure 2.1.2a, and DCD Tier 2, Figure 7.3-2, Sheets 2, 3, 4, 6, 7, 9, 10 and 18, Figure 7.4-2, and Figure 7.4.3, Sheets 2 and 9.
- Addition of wide-range reactor pressure vessel water level indication (Divisions I and II) (cold calibration) to provide capability to monitor this parameter from a centralized location during extended loss of alternating current (ac) power events. This change affects DCD Tier 1, Figure 2.1.2e, and DCD Tier 2, Sections 7.4.1.4.4, 16.3.3.6.2, and 16.B.3.3.6.2, Figure 5.1-3, sheets 5 and 6, and Figure 7.4-2.
- Addition of N₂ supply header pressure indication (Divisions I and II) to provide capability to monitor this parameter from a centralized location during extended loss of ac power events. This change affects DCD Tier 1, Sections 2.2.6, 2.11.13, and Figure 2.2.6, and DCD Tier 2, Sections 7.4.1.4.4, 16.3.3.6.2, 16.B.3.3.6.2, Figure 6.7-1, and Figure 7.4-2.
- Addition of condensate storage tank water level indication (Division I, which will be in addition to the existing Division II) to provide capability to monitor this parameter from a centralized location during extended loss of ac power events. This change affects DCD Tier 1, Figure 2.11.2, and Figure 2.2.6, and DCD Tier 2, Sections 7.4.1.4.4, 16.3.3.6.2, 16.B.3.3.6.2, Figure 6.7-1, Figure 7.4-2, and Figure 9.2-4.
- Addition of containment wide-range pressure indication (Divisions I and II) to provide capability to monitor this parameter from a centralized location during extended loss of ac power events. This change affects DCD Tier 1, Figure 2.2.6, and DCD Tier 2, Sections 7.4.1.4.4, 16.3.3.6.2, 16.B.3.3.6.2, Figure 6.2-39, Sheet 3, and Figure 7.4-2.
- Addition of wide-range suppression pool water level indication (Divisions I and II) to provide capability to monitor this parameter from a centralized location during extended loss of ac power events. This change affects DCD Tier 2, Sections 7.4.1.4.4, 16.3.3.6.2, 16.B.3.3.6.2, Figure 6.2-39, Sheet 2, and Figure 7.4-2.

The applicant stated that these shutdown panel design changes will provide enhancements and additional capability for plant operation during control room evacuation as well as beyond-design-basis event conditions. The capability to operate SRVs assigned to ADS valves, that include a replenishable supply of N₂ for motive force would enable operation of the ADS and SRVs from the remote shutdown panels during extended loss of ac power events such as a beyond-design-basis station blackout event.

The staff finds that these design changes are enhancements to the ABWR as stated by the applicant and do not affect the staff’s evaluation findings documented in NUREG–1503,

Section 7.4.3 of the staff FSER for the initial ABWR DC. Specifically, the staff finding remains valid for the stated DCD amendments:

“Equipment at appropriate locations outside the control room have been provided (1) with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) with a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures”

Therefore, the staff concludes that the systems controlled from the ABWR remote shutdown panel, required for safe shutdown, satisfy the requirements of GDC 19 for capability of a prompt hot shutdown and potential capability for subsequent cold shutdown.

The applicant provided the necessary information in the ABWR DCD, Revision 7 which incorporated the changes described in the applicant’s January 23, 2017 letter, Enclosure 2. Therefore, Confirmatory Item 7.4.1.4.4-1 from the staff’s advanced safety evaluation report with no Open Items for the ABWR DC renewal is resolved and closed.

7.4.1.4.4.4 Conclusion

The staff reviewed the GEH design enhancements as updated in the ABWR DCD, Revision 7, and determined them to be acceptable, because the changes allow for enhanced plant shutdown capabilities from the remote shutdown panels in a beyond-design-basis event such as during an extended loss of ac power. These enhanced remote shutdown system design features do not affect the staff’s evaluation findings documented in NUREG-1503, Section 7.4.3 the FSER for the original ABWR DC. Therefore, the staff concludes that the systems required for safe shutdown satisfy the requirements of GDC 19 and are therefore, acceptable.

References

1. 10 CFR 50.155, "Mitigation of Beyond-Design -Basis Events."
2. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
3. 10 CFR Part 50, Appendix A, GDC 19, "Control Room."
4. 10 CFR Part 52, Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor."
5. 10 CFR 52.59, "Criteria for Renewal."
6. NRC, NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design," July 1994 (ADAMS Accession No. ML080670592).
7. NRC, NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design," Supplement 1, May 1997 (ADAMS Accession No. ML080710134).
8. NRC, 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," February 17, 2012 (ADAMS Accession No. ML12039A111).
9. NRC, EA 12-049, "Issuance of Order to Modify Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (ADAMS Accession No. ML12054A735).
10. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 5, Tier 1 and Tier 2, December 2010 (ADAMS Accession No. ML110040323).
11. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 6, Tier 1 and Tier 2, February 2016 (ADAMS Accession No. ML16214A015).
12. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 7, Tier 1 and Tier 2, December 2019 (ADAMS Accession No. ML20007E371).