8 ELECTRICAL POWER SYSTEMS

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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 8, "Electric Power System," Section 8.3.4.4, "Isolation Between Class 1E Buses and Loads Designated as Non-Class 1E," 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.

8.3.4.4 Isolation Between Class 1E Buses and Loads Designated as Non-Class 1E

8.3.4.4.1 Regulatory Criteria

In the GEH ABWR DCD Revision 7, the applicant completed a design change to add non-safety reactor building (RB) external connections for providing electrical power to the safety-related 480-volt (V) alternating current (VAC) RB Class 1E power centers from an external power source. These additional 480-V electrical connections to the safety-related 480-V system would 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" (the 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 their application to renew the ABWR DC. The applicant was requested by the staff in Item No. 26, of the July 20, 2012, staff letter to address ABWR DCD design changes related to aspects of the NRC Fukushima Near Term Task Force Recommendation 4.2 regarding mitigation strategies for beyond-design-basis external events based on the NRC policy, at that time, which was outlined in a staff requirements memorandum (ADAMS Accession No. ML120690347) 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," dated 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]

[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

In a letter dated January 23, 2017 (ADAMS Accession No. ML17025A386), GEH provided supplemental information in response to Item No. 26 of the NRC's suggested ABWR design changes. The applicant narrowed the scope of Item No. 26 to exclude changes directly related to SECY-12-0025, pending final rulemaking for the MBDBE rule. GEH retained the related design change of non-safety RB external connections to provide electrical power to the safety-related 480 VAC RB 1E power centers from an external power source as an operational enhancement to provide additional defense in depth. These ABWR design enhancements could provide a potential COL applicant the means for meeting the MBDBE rule.

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 supplement and will correspondingly be evaluated using the regulations in effect at renewal. In this case, the change made by GEH was not required by the regulations, but for the purposes of evaluating the applicant's DCD design amendments to add RB external connections for providing electrical power to the safety related 480 VAC RB 1E power centers, the staff evaluated the change to ensure consistency with the following regulatory requirement and associated guidance:

- 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants,"

- (GDC) 17, "Electric power systems," requires, in part, that nuclear power plants have onsite and offsite electric power systems to permit the functioning of structures, systems, and components that are important to safety. The onsite system is required to have sufficient independence, redundancy, and testability to perform its safety function, assuming a single failure. The independence of safety-related equipment and circuits, and auxiliary supporting features is established and maintained via physical separation and electrical isolation.

- Regulatory Guide (RG) 1.75, "Physical Independence of Electric Systems," Revision 2, issued September 1978 (ADAMS Accession No. ML003740265), provides guidance addressing independence and specifically, physical separation and electrical isolation.

8.3.4.4.2 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 Fukushima Near-Term Task Force Recommendation 4.2 mitigation strategies for beyond-design-basis external events as outlined in Attachment 2 of the Commission Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A735).

As described in the version of the draft final MBDBE rule that was publicly available in November 2016, no requirements would be applicable to applicants for a standard DC (or a renewal, as in the case of the ABWR application). It was also expected, at that time, that the final rule would be effective before the ABWR DC renewal would be completed.[2] On that basis, in a letter dated December 6, 2016 (ADAMS Accession No. ML16341A812), GEH informed the

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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."

[2] The final MBDBE rule was published in the *Federal Register* on August 9, 2019 (84 FR 39684) with an effective date of September 9, 2019.

NRC of its plans to submit a revised response for addressing Item No. 26 by the end of January 2017. In its January 23, 2017, letter 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 480 VAC RB 1E power centers.

GEH revised DCD Tier 1, Section 2.12.1, and Figure 2.12.1a, and DCD Tier 2, Table 1.9-1, Section 8.3.1.1.2.1, Figure 8.3-1, Sheet 3, and Section 8.3.4. The applicant's changes will add RB external connections to provide electrical power to the 480 VAC RB 1E power centers from an external power source.

During a public teleconference on September 7, 2017 (ADAMS Accession No. ML17311A055), GEH agreed to provide COL Information Items regarding the design enhancements related to off-site non-safety portable power. A portable power supply could be used during a beyond-design-basis event to supply site safety-related 480 VAC 1E power centers for an extended loss of alternating current (ac) power (usually referred to as an extended station blackout (SBO) condition). GEH documented the COL Information Items in a letter dated October 10, 2017, (ADAMS Accession No. ML17283A305).

GEH added two COL Information Items to the ABWR DCD. These COL Information Items would add actions for a future applicant to (1) describe in the FSAR the physical location of external connections for a portable diesel generator and (2) develop procedures for connecting the portable external diesel generators. These design changes were submitted in the applicant's January 23, 2017 letter, Enclosure 2 and in the letter dated October 10, 2017, which were incorporated in ABWR DCD, Revision 7.

8.3.4.4.3 Technical Evaluation

In its submittal dated January 23, 2017, the applicant provided ABWR design enhancements with RB external connections for providing electrical power to the 480 VAC RB 1E power centers. This change enhances the capability to provide electrical power to critical power centers from an external power source. GEH revised DCD Tier 1, Section 2.12.1, and Figure 2.12.1a; and DCD Tier 2, Table 1.9-1, Section 8.3.1.1.2.1, Figure 8.3-1 sheet 3, and Section 8.3.4. DCD Tier 1, Section 2.12.1 identifies the DCD section that discusses the electrical power distribution system. DCD Tier 1, Figure 2.12.1a identifies the Class 1E electrical power distribution system. DCD Tier 2, Table 1.9-1 identifies the summary of ABWR standard plant COL Information Items. DCD Tier 2, Section 8.3.1.1.2.1 identifies the DCD section that discusses the Power Centers. DCD Tier 2, Section 8.3.4 discusses the COL License Information Items.

In the January 23, 2017 letter, Enclosure 2 DCD Tier 2, Section 8.3.1.1.2.1, the applicant added a new paragraph which states that, to cope with an extended loss of ac power (ELAP), external (to the RB) connections to each 1E RB divisional power center for portable external 480 VAC diesel generators are installed, normally isolated from the 480 VAC 1E divisional power centers by open 1E breakers.

The applicant also added two COL Information Items in DCD Tier 2, Section 8.3.4.5, "Physical Locations of Connections for Portable External Diesel Generators," which states that the COL applicant will describe in the FSAR the details and physical locations of the connections for the portable external diesel generators and DCD Tier 2, Section 8.3.4.6, "Develop Procedures for

Connecting Portable External Diesel Generators," which states that the COL applicant will develop procedures for connecting the portable external diesel generators.

The staff reviewed the ABWR design changes to ensure that proper connections and isolation are maintained to minimize the probability of losing electric power from the onsite power supplies. In DCD Tier 2, Table 8.1-1, "Onsite Power System SRP Criteria Applicable Matrix", and DCD Tier 2, Section 8.3.3.1, "Physical Separation and Independence," state that the ABWR design conforms to RG 1.75 Revision 2. GDC 17 requires the independence of safety-related equipment and circuits, and auxiliary supporting features to be established and maintained via physical separation and electrical isolation, RG 1.75 Revision 2, also provides guidance on physical separation and electrical isolation. DCD Tier 2 Section 8.3.1.1.2.1, "Power Centers," the low voltage Class 1E Power Distribution System and states that each 480V Class 1E bus in a division is physically and electrically independent of the other 480V buses in other divisions and non-Class 1E load groups. Since the external connections to each Class 1E RB divisional power center for portable external 480 VAC diesel generators are normally isolated from the 480 VAC 1E divisional power centers by open Class 1E breakers, the staff finds that physical separation and electrical isolation from the Class 1E system is maintained. Hence, the staff finds that the design conforms to the guidance in RG 1.75 Revision 2, as it relates to physical separation and electrical isolation and therefore, continues to be consistent with the requirements of GDC 17. Therefore, the staff finds the changes to be acceptable.

The applicant provided the necessary information in the ABWR DCD, Revision 7, which incorporated the changes described in the applicant's responses to Item No. 26, of the staff's letter dated July 20, 2012. Therefore, Confirmatory Item 8.3.4.4-1 from the staff's advanced safety evaluation with no open items for the ABWR DC renewal is resolved and closed.

8.3.4.4.4 Conclusion

The staff reviewed the GEH ABWR design enhancement adding RB external connections for providing portable electrical power to the 480 VAC RB 1E power centers and the associated COL Information Items. This design continues to conform to the guidance in RG 1.75 Revision 2 and is therefore consistent with the requirements of GDC 17, as discussed above. Therefore, the changes are acceptable.

References

1. 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants.”

2. 10 CFR Part 52, Appendix A, “Design Certification Rule for the U.S. Advanced Boiling Water Reactor.”

3. 10 CFR 52.47, “Contents of applications; technical information.”

4. 10 CFR 52.59, “Criteria for renewal.”

5. NRC, NUREG-1503, “Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design,” July 1994 (ADAMS Accession No. ML080670592).

6. 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).

7. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 5, Tier 1 and Tier 2, December 2010 (ADAMS Accession No. ML110040323).

8. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 6, Tier 1 and Tier 2, February 2016 (ADAMS Accession No. ML16214A015).

9. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 7, Tier 1 and Tier 2, December 2019 (ADAMS Accession No. ML20007E371).

10. 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).

11. EA-12-049, “Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events,” March 12, 2012 (ADAMS Accession No. ML12054A735).