19 SEVERE ACCIDENTS

19 SEVERE ACCIDENTS

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 19, "Severe Accidents," Section 19.1, "Probabilistic Risk Assessment," 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.

19.1 Probabilistic Risk Assessment

19.1.1 Regulatory Criteria

The applicant prepared a probabilistic risk assessment (PRA) to support the original ABWR DC rule, published May 12, 1997. The originally certified ABWR DCD did not contain this PRA but did summarize the PRA and its results. The staff reviewed and evaluated the applicant's process for updating the PRA and corresponding ABWR DCD descriptions, as appropriate, to reflect design changes made in GEH's DC renewal application.

GEH submitted the ABWR DCD, Revision 5, as part of the ABWR DC renewal application in December 2010. In a letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the NRC staff identified 28 suggested changes for GEH's consideration that the staff considered to be regulatory improvements or changes that could meet the criteria in 10 CFR 52.59(b). In Item Nos. 14, 15, and 16 of this letter, the staff suggested that GEH consider improving the full-power and shutdown 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 ABWR DC rule. 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 for the DC renewal.

To renew the DC for the ABWR, the staff must find, among other things, that the design "either as originally certified or as modified during the rulemaking on the renewal" complies with the regulations in effect at initial certification. When initially certified, 10 CFR 52.47(a)(1)(v) required the DC application to contain "[a] design-specific probabilistic risk assessment." A summary of this PRA and its results were included in the original ABWR DCD, Revision 4. To be "design-specific," the PRA and the corresponding ABWR DCD descriptions must appropriately reflect the design as it exists. Therefore, the staff determined that the impact of renewal-related design changes on the ABWR DC PRA should be adequately evaluated to determine whether the PRA requires changes.

GEH determined that the PRA and the associated ABWR DCD descriptions did not need to be changed as a result of the ABWR DC renewal-related changes. Therefore, the staff's review addressed whether a modification to the design was necessary to satisfy 10 CFR 52.47(a)(1)(v) (1997). For this review scope, the staff evaluated the need for a modification under 10 CFR 52.59(a), using the regulations applicable and in effect at initial certification.

As required by 10 CFR 52.47(a)(1)(v) (1997) a DC application must contain a design-specific PRA. For safety-related SSCs, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities" (1997), requires, in part, that design control measures shall be provided for verifying or checking the adequacy of the design, such as by the performance of design reviews.

The staff evaluated the ABWR DC renewal PRA in accordance with NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, "LWR Edition)," (SRP) Section 19.0, "Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors," Revision 3, issued December 2015. The staff used this guidance because guidance on PRA did not exist when GEH completed its PRA for the initial ABWR DC. However, the staff recognizes that GEH is not held specifically to this SRP guidance because GEH must meet the regulations applicable and in effect at initial certification.

19.1.2 Summary of Technical Information

In ABWR DCD, Revision 6, submitted by letter dated February 19, 2016 (ADAMS Accession No. ML16081A268), GEH revised the ABWR DC renewal application to incorporate design changes identified in the July 20, 2012 staff letter, responses to NRC staff requests for additional information and public meetings held with the staff.

In support of the safety conclusions that need to be made regarding ABWR DCD, Revision 7, Chapter 19, "Response to Severe Accident Policy Statement," the staff conducted a PRA audit to ensure that the applicant established and conformed to an acceptable process to evaluate the impacts on the PRA due to design changes associated with its DC renewal.

The staff audited GEH documents related to renewal application design changes (from Revision 4 to Revision 6) and procedures governing engineering change control and PRA model maintenance and updates. The staff's audit report "Regulatory Audit Results Summary Report of the Probabilistic Risk Assessment of Design Changes for the Advanced Boiling-Water Reactor Design Certification Renewal," dated January 16, 2018 (ADAMS Accession No. ML17352A576) identifies the technical documents related to the ABWR PRA reviewed by the staff.

19.1.3 Technical Evaluation

In a letter dated September 25, 2015 (ADAMS Accession No. ML15271A171), GEH stated that the PRA from the original DC remains applicable to the renewal application for Level 1 and 2 full-power risk and for shutdown risk, and that DCD Tier 2, Appendix 19K, contains a comprehensive list of risk-significant SSCs. In addition, GEH stated the following in the letter:

> GEH has established a process that requires evaluation of the design changes that are included in the renewal application. The process specifies evaluation of

the changes for impact on the PRA. If a design change results in a significant impact on PRA, risk evaluation will be performed at an appropriate level.

After further evaluation, in a letter to GEH dated February 2, 2018 (ADAMS Accession No. ML17097A470), the staff determined that the suggested improvements in Item Nos. 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 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 ABWR DC. The staff also decided that further evaluating these improvements through the 10 CFR 52.59(b) process is not warranted.

As described in the audit report, the staff reviewed GEH's technical information to determine if the applicant adequately evaluated and dispositioned the renewal-related design changes with respect to potential impacts on the ABWR DC PRA. Specifically, the staff reviewed the process and guidance the applicant used to assess the impact of design changes on the ABWR PRA and all of the change packages documenting the application of this process. The staff asked the applicant to conduct a table-top exercise on three design changes the staff identified as having the potential to impact the ABWR PRA. As a result of this exercise, the staff agreed with GEH's conclusion that the changes would have no significant impact on the current ABWR PRA model.

The audit allowed the staff to determine the potential impact of design changes on the ABWR design-specific PRA, confirm that the process used by GEH for PRA update meets the intent of SRP Section 19.0, and verify the applicant's compliance with its procedures. Specifically, the staff evaluated the ABWR DCD changes and their impact on the originally approved ABWR design-specific PRA and finds that the design changes have negligible impact on the PRA results including the accident sequences and frequencies that could lead to the release of radioactive fission products to the environment as described in SRP Section 19.0, "Acceptance Criteria."

The audit provided an understanding of the technical basis, assumptions, and methods by which GEH evaluates, screens, and tracks for PRA inputs or design changes. Based on its audit, the staff finds that the process used by GEH to evaluate the risk impact of design changes is acceptable and meets the intent of staff guidance in SRP Section 19.0. The applicant's conclusion that none of the GEH change packages required a change to the PRA is therefore justified. Consequently, the staff also concludes that no changes to the associated descriptions of the PRA and its results in the ABWR DCD are warranted.

19.1.4 Conclusion

Based on the evaluation provided in this FSER supplement and as informed by the staff's audit of the ABWR PRA, the staff concludes that GEH has adequately evaluated and dispositioned the ABWR renewal-related design changes with respect to potential impacts on the ABWR PRA. Therefore, the staff concludes that the design as modified complies with the applicable requirements in 10 CFR 52.47(a)(1)(v) (1997) and 10 CFR Part 50, Appendix B (1997).

References

1. 10 CFR Part 50, Appendix B (1997), “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.”

2. 10 CFR 52.47, “Contents of Applications; Technical Information.”

3. 10 CFR 52.59, “Criteria for Renewal.”

4. 10 CFR Part 52, Appendix A, “Design Certification Rule for the U.S. Advanced Boiling Water Reactor.”

5. NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, “LWR Edition),” Section 19.0, “Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors,” Revision 3, December 2015 (ADAMS Accession No. ML15089A068).

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. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 4, Tier 1 and Tier 2, December 2010 (ADAMS Accession No. ML11126A129).

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

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

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