

19.0 Severe Accidents

19.1 Probabilistic Risk Assessment

19.1.1 Regulatory Criteria

GE Nuclear Energy prepared a probabilistic risk assessment (PRA) to support the original Advanced Boiling-Water Reactor (ABWR) Design Certification (DC) (Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Appendix A), published May 12, 1997. The originally certified ABWR design control document (DCD) did not contain this PRA but did summarize the PRA and its results. In this section, the staff reviews and evaluates the applicant's process for updating the PRA and corresponding DCD descriptions, as appropriate, to reflect design changes made in General Electric-Hitachi (GEH's) design certification renewal application (DCRA).

Revision 5 of the ABWR was submitted as part of the GEH DCRA in 2010. In a letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the U.S. Nuclear Regulatory Commission (NRC) 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 design certification 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 at the design certification stage.

By 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 the 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 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 also decided that further evaluating these improvements through the 10 CFR 52.59(b) process is not warranted.

However, to renew the ABWR, the NRC 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 DCD. To be “design-specific,” the PRA and the corresponding 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 design certification PRA should be adequately evaluated to determine whether the PRA requires changes.

GEH determined that the PRA and the associated DCD descriptions did not need to be changed as a result of the 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, 10 CFR Part 50, Appendix B (1997), requires, in part, that design control measures shall be provided for verifying or checking the adequacy of design, such as by the performance of design reviews.

In support of the safety conclusions that need to be made regarding ABWR DCD, Revision 6, 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 review reflects consideration of the guidance in Revision 3, NUREG-0800, “Standard Review Plan [SRP] 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,” December 2015. The staff used this guidance because NRC guidance on PRA did not exist when GEH completed its PRA for the initial design certification. 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 Revision 6 of the ABWR DCD submitted by letter dated February 19, 2016 (ADAMS Accession No. ML16081A268), GEH revised the ABWR DCRA to incorporate proposed design changes identified following responses to staff requests for additional information and public meetings with the staff.

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 update. 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” (ADAMS Accession No. ML17352A576) identifies the technical documents reviewed by the staff.

19.1.3 Technical Evaluation

As described in the audit report, 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 design certification PRA. Specifically, the staff

reviewed the process and guidance the applicant used to assess the impact of proposed 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 proposed 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 GEH DCD changes and their impact on the originally approved ABWR design-specific PRA and finds that these proposed 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 DCD descriptions of the PRA and its results are warranted.

19.1.4 Conclusion

Based on the evaluation provided in this SER section supplement and as informed by the staff PRA Audit, the staff concludes that GEH has adequately evaluated and dispositioned the ABWR renewal-related design changes with respect to potential impacts on the 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).