

## 5.0 Reactor Coolant System and Connected Systems

### 5.4.7 Residual Heat Removal System

#### 5.4.7.1 Regulatory Criteria

In the GE-Hitachi Nuclear Energy (GEH), Advanced Boiling-Water Reactor (ABWR) Design Control Document (DCD), Revision 6, GEH (the applicant) proposed a change to add a redundant alternating current (ac) independent water addition (ACIWA) mode to the residual heat removal (RHR) system Loop B. The modification would provide emergency water injection from the fire protection system (FPS) or from an external water source such as a fire truck through a cross connection in the RHR Loop B to the reactor vessel, the containment wetwell or drywell spray sparger, or the spent fuel pool. The proposed additional ACIWA RHR Loop B is configured similarly to the current ABWR ACIWA RHR Loop C components and piping arrangement with equivalent system design parameters.

In a letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the U. S. Nuclear Regulatory Commission (NRC) staff identified 28 items for GEH's consideration as part of their application to renew the ABWR Design Certification (DC). In Item No. 26 of the letter, the applicant was requested 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 outlined in a staff requirements memo 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).

In a letter dated January 23, 2017 (ADAMS Accession No. ML17025A386), GEH provided supplemental information for GEH's response to Item 26 of the NRC suggested ABWR design changes for consideration as part of its application to renew the ABWR DC. The applicant narrowed the scope of Item No. 26 to exclude changes directly related to SECY-12-0025, pending final rulemaking for Title 10 *Code of Federal Regulations* (10 CFR) 50.155, "Mitigation of Beyond-Design Basis Events." As such, GEH retained the addition of the ACIWA RHR Loop B as an operational enhancement to provide additional defense in depth. These proposed ABWR design enhancements could provide a potential COL applicant the means for meeting the MBDBE rule requirements of 10 CFR 50.155.

These proposed 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. The applicable regulatory requirements for evaluating the proposed DCD design amendments to add an ACIWA subsystem to Loop B of the RHR system and related changes as discussed above are as follows:

General Design Criterion (GDC) 34, "Residual Heat Removal," as it relates to the ABWR RHR system, which requires the capability to transfer decay heat and other residual heat from the reactor such that fuel and pressure boundary design limits are not exceeded. Compliance with

GDC 34 enhances plant safety by providing assurance that decay and RHR will be accomplished and the reactor coolant system (RCS) pressure boundary and fuel cladding integrity will be maintained, thereby minimizing the potential for the release of fission products to the environment.

The staff performed the review of this ABWR DC Renewal amendment in accordance with NUREG-0800, Section 5.4.7, "Residual Heat Removal (RHR) System."

#### *5.4.7.2 Summary of Technical Information*

In the ABWR final safety evaluation (FSER), NUREG-1503 (ADAMS Accession No. ML080670560), Section 5.4.7, the staff provided its technical evaluation and regulatory approval of the original ABWR ACIWA subsystem which has the function of providing a beyond design basis emergency water source to the reactor vessel, containment, and spent fuel pool through the ABWR RHR Loop C from the plant FPS supplemental water sources. The staff provided a description of the ACIWA subsystem piping and components arrangement that links the FPS water source or an alternate external water source such as a fire truck to the RHR Loop C pump discharge line downstream of the pump's discharge check valve. The ACIWA safety related isolation valves are normally closed and designed to isolate the non-safety fire protection system from the safety related RHR system. During a beyond design basis event including the loss of onsite and offsite ac (e.g., Extended Station Blackout (SBO) the valves can be manually operated and can be placed into operation locally from the emergency core cooling systems (ECCS) / RHR valve room. This flow path allows an additional water source for injection into the reactor vessel and the drywell during postulated beyond-design-basis conditions including an SBO condition where all ac power and all ECCS pumps are unavailable.

The GEH proposal to add a redundant ACIWA subsystem to the RHR Loop B discharge line, as described in the technical evaluation section below, includes revisions to both Tier 1 and 2 information.

#### *5.4.7.3 Technical Evaluation*

In GEH's license renewal application, the ABWR DCD, Revision 6 included an additional ACIWA subsystem to RHR Loop B as an enhancement to the design features that provide water makeup from the FPS or backup external source to the reactor pressure vessel, containment, and spent fuel pool during degraded beyond design basis plant conditions (such as an extended SBO) when both onsite and offsite ac power sources are unavailable. The staff reviewed the proposed change to RHR Loop B and considers the additional ACIWA comparable to the RHR LOOP C ACIWA. Each ACIWA subsystem will have connections to the FPS adjacent to the ECCS / RHR valve room with a check valve upstream of two normally locked closed safety related manually operated valves in series to isolate and prevent back flow into the FPS. The external source connection is configured the same as the ACIWA connection, with the exception of an additional manual valve located outside of the reactor building. The staff finds the configuration acceptable because it provides isolation from the safety related RHR system during normal operation while preventing reverse flow if the manual valves in series are misaligned during operation of the RHR.

The staff finds that the ACIWA vessel injection, containment injection, or spent fuel pool makeup modes are not adversely affected by this additional design enhancement and adds additional flexibility to the ACIWA system. The staff considers the physical separation of the two ACIWA subsystems is sufficient to ensure that at least one will be available during degraded plant conditions such as an extended SBO. In addition, the staff finds the revision to the DCD complete and confirmed the changes against the GEH markups of the DCD Tier 1 and Tier 2 figures, sections, and tables.

#### *5.4.7.4 Conclusion*

Based on the evaluation provided in this FSER section supplement, the staff concludes that the proposed ABWR DCD amendments do not alter the safety findings made in the FSER for the original ABWR certification. In addition, the changes proposed by the applicant improve the reliability of the ACIWA to deliver water makeup to the reactor vessel, containment, and spent fuel pool during degraded plant conditions. Therefore, the staff finds that the proposed changes are in compliance with GDC 34 and the proposed changes are acceptable because they improve plant operational flexibility and safety by providing additional means of decay and RHR.