

## 9.0 Auxiliary Systems

### 9.1.2.1 *New and Spent Fuel Storage*

#### 9.1.2.1.1 *Regulatory Criteria*

The originally certified U.S. Advanced Boiling-Water Reactor (ABWR) Design Control Document (DCD) describes the fuel racks in the spent fuel pool (SFP) as a seismic Category I structure, and states that the combined license (COL) applicant will perform the necessary confirmatory criticality and load drop analysis, including consideration of the free fall of a fuel assembly and its associated handling tool. The U.S. Nuclear Regulatory Commission (NRC) staff final safety evaluation report (FSER) approved the fuel storage racks in the SFP as described in the DCD. This is documented in Section 9.1.2, "Spent Fuel Storage," of NUREG-1503, "Final Safety Evaluation Report Related to Certification of the Advanced Boiling Water Reactor Design."

In a letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the NRC staff identified 28 items for consideration by GE-Hitachi Nuclear Energy (GEH) as part of its application to renew the ABWR Design Certification (DC). In Item Nos. 19 and 20 of the letter, the applicant was requested to provide thermal-hydraulic analysis and criticality analyses of new and spent fuel racks.

In response to the staff July 20, 2012, letter dated August 11, 2015 (ADAMS Accession No. ML15223B138), the applicant stated that the fuel racks are highly dependent on the specific rack design; therefore, these analyses are more appropriately addressed as a COL item, so GEH submitted proposed changes to the COL license information regarding SFP thermal-hydraulic and criticality analysis. In this letter, the applicant also proposed to remove the New Fuel Storage Vault from the ABWR design and instead use the racks in the SFP for storage of new fuel prior to loading into the reactor; this change is evaluated in Section 9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage and Handling," of this supplement.

The GEH ABWR DCD, Revision 6 reflects the changes described above. Specifically, the applicant proposed changes to a thermal-hydraulic analysis COL information item in DCD Tier 2, Section 9.1.6.8, "Spent Fuel Racks Thermal-Hydraulic Analysis," and additional criticality analysis information to the COL information item in DCD Tier 2, Section 9.1.6.3, "Spent Fuel Storage Racks Criticality Analysis."

Because the applicant proposed to update the certified design in accordance with Title 10 *Code of Federal Regulations* (10 CFR) 52.57(a) to provide clarifications consistent with the original understanding of the design information regarding SFP thermal-hydraulic and criticality analysis in the original ABWR DC, it is a "modification," as this term is defined in Chapter 1 of this supplement. Thus, this modification must comply with the Atomic Energy Act of 1954, as amended, and the Commission's regulations applicable and in effect at the time the certification was originally issued. Therefore, the proposed change is evaluated using the regulations in effect at the time the certification was originally issued.

The relevant requirements for this area of review and the associated acceptance criteria are given in Revision 2, Section 9.1.1 and Revision 3 of Section 9.1.2 of NUREG-0800, "Standard

Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” LWR Edition Standard Review Plan (SRP). These are summarized below.

- 10 CFR Part 50, “Domestic Licensing Of Production And Utilization Facilities,” Appendix A, General Design Criterion (GDC) 61 as it relates to the facility design for fuel storage, specifically item (4), requiring the system to be designed “with a residual heat removal capability having reliability and testability that reflects the importance to safety of decay heat and other residual heat removal”;
- 10 CFR Part 50, Appendix A, GDC 62 as it relates to the prevention of inadvertent criticality in the fuel storage system by physical systems or processes, preferably by use of geometrically safe configurations.

#### *9.1.2.1.2 Summary of Technical Information*

The changes proposed by GEH in the letter dated August 11, 2015, to address Item Nos. 19 and 20 of the staff’s July 20, 2012, letter include both Tier 1 and Tier 2 changes to the DCD. A DCD markup based on Revision 5 of the ABWR DCD was provided in Enclosure 2 of the August 11, 2015, letter (ADAMS Accession No. ML15223B141). The proposed changes augment a COL information item for the combined new and spent fuel storage racks in the SFP.

In Item 19 the staff requested that a thermal-hydraulic analysis be provided to evaluate the rate of naturally circulated flow and the maximum rack water exit temperatures. GEH stated that, because the thermal-hydraulic analysis of the fuel racks is highly dependent on the specific rack design, this item is more appropriately addressed as a COL item. DCD, Revision 5, Section 9.1.6.8 already included a COL information item to provide a confirmatory thermal-hydraulic analysis to the NRC for the spent fuel racks that evaluates the rate of naturally circulated flow and the maximum rack water exit temperature. The proposed DCD markup from the August 11, 2015, letter adds a reference to existing Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) 2.5.6.4 and provides specific acceptance criteria, including that the analysis will use maximum decay heat generation rates for the worst-case power history. Also, the natural circulation flow through the rack arrangement should prevent water temperatures from exceeding 100°C under normal, abnormal, and accident conditions.

In Item 20 the staff requested that a criticality analysis be provided. The certified ABWR DCD already contained a separate COL Information Item 9.1.6.3 for the spent fuel storage rack criticality analysis. The proposed DCD markup from the August 11, 2015, letter revises the COL information item in Section 9.1.6.3 to add a specific reference to existing ITAAC 2.5.6.1, 2.5.6.2, and 2.5.6.3 and specific acceptance criteria and analysis assumptions.

The proposed changes described above were subsequently incorporated in DCD Revision 6.

#### *9.1.2.1.3 Technical Evaluation*

The staff reviewed the proposed changes to the GEH ABWR DCD to address Item Nos. 19 and 20 of the NRC staff’s July 20, 2012, letter to determine compliance with the applicable regulations in Appendix A to 10 CFR Part 50 related to stored fuel cooling and criticality accident requirements. Guidance originally used for the ABWR DC, including SRP, Revision 2

Section 9.1.1 and SRP, Revision 3, Section 9.1.2, was used for the review. The review considered the placement of new fuel in the SFP due to the removal of the New Fuel Storage Vault and new fuel storage racks from the ABWR design and how this change affects the staff's original ABWR FSER for the certified design.

The staff reviewed the design criteria, design bases, and safety classification for the fuel storage racks and the provisions necessary to maintain a subcritical array and adequate natural circulation cooling. The staff concluded that the design changes and related commitments conform to the Commission's regulations applicable and in effect at the time of the original certification and do not alter the original staff FSER conclusions, as described in NUREG-1503, and which are summarized below.

GDC 61 requires that the fuel storage system be designed for adequate safety under normal and postulated accident conditions. As relevant here, the design must be capable of adequately cooling the stored fuel under normal and postulated accident conditions. Since the detailed rack design is not specified in the DCD, and will be determined by the supplier, COL Information Item 9.1.6.8 is used to specify acceptance criteria for thermal-hydraulic analysis. The GEH proposed 100°C limit for natural circulation flow through the racks under normal, abnormal, and accident conditions will ensure that boiling is prevented, and that adequate cooling can be maintained. A confirmatory analysis will be performed by the COL applicant which considers the number of racks in the storage pool and the limiting decay heat loading under normal, abnormal, and accident conditions.

GDC 62 requires the prevention of criticality in the fuel storage system through the use of physical systems or processes, with preference given to the application of geometrically safe configurations. As revised by GEH, COL Information Item 9.1.6.3 is used to specify acceptance criteria for the criticality analysis. A confirmatory analysis will be performed by the COL applicant which considers the number of racks in the storage pool, fuel capacity, rack material, neutron poison content, and fuel center-to-center distance. The analysis must demonstrate that the storage racks can be maintained subcritical (i.e.,  $k_{eff} \leq 0.95$ ) when fully loaded.

The staff evaluated the applicant-proposed changes to COL Information Item 9.1.6.3 and 9.1.6.8 and determined that these changes do not alter the scope, or the staff safety conclusion reached on NUREG-1503. GEH provided sufficient additional details related to the COL information items for the fuel racks related to thermal-hydraulic and criticality analyses to ensure that the detailed rack design will meet the applicable regulations. Therefore, the staff finds the proposed changes to COL Information Items 9.1.6.3 and 9.1.6.8 acceptable.

The draft DCD Revision 5 markups provided in the GEH August 11, 2015, letter were subsequently incorporated in DCD Revision 6. This revision was submitted on February 19, 2016, by letter dated February 19, 2016 (ADAMS Accession No. ML16081A268). The staff confirmed that the proposed changes were appropriately incorporated.

#### 9.1.2.1.4 *Conclusions*

In NUREG-1503 and Supplement 1 thereto, the staff documented its conclusions that the ABWR design and DCD (up to and including Revision 4 of the DCD) were acceptable and that the application for the DC met the requirements of Subpart B to 10 CFR Part 52, "Licenses,

Certifications, and Approvals for Nuclear Power Plants,” that were applicable and technically relevant to the ABWR standard plant design.

The staff reviewed the applicant’s proposed changes to the ABWR DCD as described above. Based on this evaluation, the staff concludes that the proposed revisions to the COL information items meet all applicable regulatory requirements at the time of original certification, specifically GDCs 61 and 62, and therefore these proposed COL information item clarifications are acceptable.