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## 9 AUXILIARY SYSTEMS

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 9, "Auxiliary Systems," Section 9.1.5, "Overhead Heavy Load Handling Systems," 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.

### 9.1.5 Overhead Heavy Load Handling Systems

#### 9.1.5.1 Regulatory Criteria

In this section the staff reviews and evaluates the applicant's proposed changes to the ABWR DCD, Revision 7, overhead heavy load handling system (OHLHS), which consists of all components and equipment for moving all heavy loads. This includes loads weighing more than one fuel assembly and its handling device - loads greater than 1,000 pounds for the GEH ABWR design. The main emphasis in the ABWR DC renewal review is on critical load handling where inadvertent operations or equipment malfunctions, separately or in combination, could cause a release of radioactivity, a criticality accident, or an inability to cool fuel within the reactor vessel or spent fuel pool; or could prevent the safe shutdown of the reactor.

A combined license (COL) applicant that references the GEH ABWR DC will incorporate the OHLHS requirements specified for the ABWR design and the COL applicant will implement the applicable ABWR procedures to address regulatory requirements for overhead heavy load handling as described in the ABWR DCD.

GEH submitted ABWR DCD, Revision 5, as part of the GEH DC renewal application in 2010. There was no difference between Revision 5 and Revision 4 of DCD Tier 2, Section 9.1.5, approved as part of the original ABWR DC in 1997. In a letter dated July 20, 2012 (Agencywide Documents Access and Management System 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 in Item No. 13, of that letter, to consider adding a commitment to American Society of Mechanical Engineers (ASME) standard NOG-1, "Rules for Construction of Overhead and Gantry Cranes," issued in 2004, as an acceptable approach to meeting the criteria in NUREG-0554, "Single Failure-Proof Cranes for Nuclear Power Plants," issued May 1979, for the design of OHLHS cranes.

The applicant had proposed changes in ABWR DCD, Revision 6, submitted in 2016, to update the DC renewal application and to identify ASME NOG-1 as an acceptable approach for a COL

applicant to design the OHLHS and meet the design requirements already established for the ABWR DC. The applicant also made changes to reflect the elimination of the new fuel storage vault, as discussed in Section 9.1.1 of this FSER supplement. 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 FSER supplement and will correspondingly be evaluated using the regulations in effect at renewal.

The relevant requirements for this area of review and the associated acceptance criteria are given in NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition” (SRP), Section 9.1.5, Revision 1, “Overhead Heavy Load Handling Systems,” issued March 2007, Review criteria are as follows:

- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” (GDC) 1, “Quality Standards and Records,” as it relates to the design, fabrication, and testing of structures, systems, and components (SSCs) important to safety to quality standards commensurate with the importance of the safety functions to be performed.
- GDC 2, “Design Bases for Protection Against Natural Phenomena,” as it relates to the ability of structures, equipment, and mechanisms to withstand the effects of earthquakes.
- GDC 4, “Environmental and Dynamic Effects Design Bases,” as it relates to the protection of safety-related equipment from the effects of internally generated missiles (i.e., dropped loads).

Acceptance criteria adequate to meet the above requirements are:

- Acceptance for meeting the relevant aspects of GDC 1, GDC 2, and GDC 4 for heavy load handling cranes is based on NUREG-0554; and
- ASME NOG-1 is one acceptable approach to meet the requirements of NUREG-0554.

#### 9.1.5.2 *Summary of Technical Information*

In Revision 6 of the ABWR DCD, the applicant proposed the following changes related to the OHLHS:

- DCD Tier 2, Section 9.1.5.1, “Design Bases,” is revised, in part, to state as indicated below (added texts are underlined):

“... Cranes and hoists are also designed to criteria and guidelines of NUREG-0612, Subsection 5.1.1(7), ANSI B30.2 and CMAA-70 specifications for electrical overhead traveling cranes, including ANSI B30.11, ANSI B30.16, and NUREG-0554 as applicable. For design of Type 1 cranes, ASME NOG-1 is an acceptable approach to meeting NUREG-0554 criteria.”

- DCD Tier 2, Section 9.1.5.2.1, “Reactor Building Crane,” is revised, in part, to state as indicated below (added texts are underlined and deleted texts are crossed-out):

“ ... The main hook 1.471 MN will be used to lift the concrete shield blocks, drywell head, reactor pressure vessel (RPV) head insulation, RPV head, dryer, separator strongback, RPV head strongback carousel, new-fuel shipping containers, and spent-fuel shipping cask. The orderly placement and movement paths of these components by the R/B crane precludes transport of these heavy loads over the spent fuel storage pool ~~or over the new-fuel storage vault~~.

... Minimum crane coverage includes R/B refueling floor laydown areas, and R/B equipment storage pit. During normal plant operation, the crane will be used to handle new-fuel shipping containers and the spent-fuel shipping casks. Minimum crane coverage must include ~~the new-fuel vault~~, the R/B equipment hatches, and the spent-fuel cask loading and washdown pits. A description of the refueling procedure can be found in Section 9.1.4.

The R/B crane will be interlocked to prevent movement of heavy loads over the spent-fuel storage portion of the spent-fuel storage pool. Since the crane is used for handling large heavy objects over the open reactor, the crane is of Type I design. The R/B crane shall be designed to meet the single-failure-proof requirements of NUREG-0554. For design of Type 1 cranes, ASME NOG-1 is an acceptable approach to meeting NUREG-0554 criteria.”

- DCD Tier 2, Table 9.1-6, “Reference Codes and Standards,” is revised to add a new entry as indicated below:

“ASME NOG-1 Rules for Construction of Overhead and Gantry Cranes (Top Running Bridges, Multiple Girder)”

- DCD Tier 2, Table 9.1-8, “Heavy Load Operation,” under the column of “**Hardware Handling Tasks**,” is revised, in part, to state as indicated below (added text are underlined and deleted texts are crossed-out):

“ ... Remove inner container and ~~store fuel bundle in new fuel vault rack~~. M~~ove~~ fuel to new fuel inspection stand; ~~inspect and return to storage and~~ perform inspection.

Move new fuel from ~~vault inspection stand~~ to fuel pool, storage of fuel channel fixtures. Channel new fuel and store. Move channeled fuel and load into reactor core ... ”

- DCD Tier 2, Table 1.8-19, “Standard Review Plans and Branch Technical Positions Applicable to ABWR,” is revised to update SRP 9.1.5 from “Revision 0 (issued July 1981)” to “Revision 1 (issued March 2007).”

- DCD Tier 2, Table 1.8-21, “Industrial Codes and Standards\* Applicable to ABWR,” is revised to add a new entry under the heading of “**American Society of Mechanical Engineers (ASME)**” as indicated below:

“NOG-1 2004 Rules for Construction of Overhead and Gantry Cranes”

#### 9.1.5.3 *Technical Evaluation*

The staff reviewed all changes to the OHLHS in the ABWR DCD Revision 6 in accordance with SRP Section 9.1.5.

The ABWR DCD originally referenced NUREG-0554 as the established guidance for the design of the reactor building (R/B) crane. During the staff’s review of Revision 4 of the ABWR DCD, referencing NUREG-0554 alone was sufficient to meet acceptance criteria delineated in Revision 0 (issued July 1981) of SRP Section 5. However, in Revision 1 (issued March 2007) of SRP Section 9.1.5, the staff enhanced the guidelines for the design of single-failure-proof cranes by adding the ASME NOG-1-2004 standard, “Rules for Construction of Overhead and Gantry Cranes,” which provides comprehensive detailed design requirements including information that shows how specific design criteria of NUREG-0554 will be satisfied. In Revision 6 of the ABWR DCD, the applicant added a reference to ASME NOG-1, 2004 as an acceptable approach to meeting NUREG-0554 criteria for the design of the R/B crane. The staff finds the change acceptable.

The staff also noted that the changes to DCD Tier 2, Section 9.1.5.2.1 and Table 9.1-8 include deletion of “the new-fuel storage vault” from various descriptions of load handling activities involving the use of the R/B crane. In the ABWR DCD, Revision 6, the applicant proposes a design change which removes the new fuel storage facility from the scope of the ABWR DC. The new fuel, upon receipt at the site, will be stored instead in the spent fuel pool as described in the applicant’s changes to DCD Sections 9.1.1, “New Fuel Storage.” The staff’s evaluation of this design change is documented in Section 9.1.1 of this FSER supplement. As such, the proposed changes to DCD Tier 2, Section 9.1.5 and Table 9.1-8 are only conforming changes; therefore, the staff finds them acceptable.

#### 9.1.5.4 *Conclusion*

Based on the evaluation provided in this FSER supplement, the staff concludes that the amendment as reflected in ABWR DCD, Revision 7, associated with the addition of ASME NOG-1 as an option for designing the cranes meets the requirements of a GDC 1, GDC 2, and GDC 4 as reviewed by the staff in accordance with the associated SRP Section 9.1.5, Revision 1, acceptance criteria. The staff also concludes that the conforming changes to DCD Tier 2, Section 9.1.5.2.1 and Table 9.1-8, to reflect the elimination of the new fuel storage vault are acceptable.

## References

1. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
2. 10 CFR Part 50, Appendix A, GDC 1, "Quality Standards and Records."
3. 10 CFR Part 50, Appendix A, GDC 2, "Design Bases for Protection Against Natural Phenomena."
4. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases."
5. 10 CFR Part 52, Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor."
6. 10 CFR 52.59, "Criteria for Renewal."
7. NRC, NUREG 0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 9.1.5, Revision 1, "Overhead Heavy Load Handling Systems," March 2007(ADAMS Accession No. ML070380201).
8. NRC, NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design," July 1994 (ADAMS Accession No. ML080670592).
9. 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).
10. NRC, NUREG-0554, "Single Failure-Proof Cranes for Nuclear Power Plants," May 1979 (ADAMS Accession No. ML110450636).
11. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 5, Tier 1 and Tier 2, December 2010 (ADAMS Accession No. ML110040323).
12. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 6, Tier 1 and Tier 2, February 2016 (ADAMS Accession No. ML16214A015).
13. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 7, Tier 1 and Tier 2, December 2019 (ADAMS Accession No. ML20007E371).
14. ASME, NOG-01, "Rules for Construction of Overhead and Gantry Cranes," 2004.