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### **3 DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND 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 3, "Design of Structures, Components, Equipment and Systems," Section 3.7.3, "Seismic Subsystem Analysis," 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.

#### **3.7.3 Seismic Subsystem Analysis**

##### *3.7.3.1 Regulatory Criteria*

The certified ABWR DCD and the ABWR DCD, Revision 5, for the renewal application, did not provide information regarding the design and analysis of the tunnel structures for diesel generator fuel oil transfer systems (DGFOTS). In a letter dated July 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12125A385), the NRC staff identified 28 items for GEH's consideration as part of their application to renew the ABWR DC. In Item No. 23 of the July 20, 2012, letter, the staff requested that GEH provide the tunnel structure analysis. The applicant addressed this omission by providing proposed changes to the ABWR DCD in a letter dated July 17, 2015 (ADAMS Accession No. ML15198A344), to explicitly specify the Seismic Category I tunnel structures to be a reinforced concrete tunnel and be designed and analyzed according to NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP), Section 3.7.3, "Seismic Subsystem Analysis," Revision 2, issued August 1989. In addition, GEH proposed to add a combined license (COL) information item directing COL applicants referencing the ABWR design to provide the design and analysis for the DGFOTS tunnel structures for routing the fuel oil transfer piping and cable system from the fuel oil storage tank to the diesel generator (DG) in the reactor building.

As a result, the applicant stated that it is not changing the ABWR design, but rather specifying the classification and criteria consistent with SRP Section 3.7.3, Revision 2, to be used by COL applicants to design and analyze the tunnel structures. The proposed revisions effectively constitute interface requirements that should have been identified in the initial DCD to satisfy 10 CFR 52.47(a)(1)(vii) (1997 version). GEH also proposed clarifications to ABWR DCD Tier 2, Sections 3.8.4.1.3 and 3.12.3 that are unrelated to the DGFOTS tunnel structures. These clarifications are consistent with the original understanding of the design information in the initial DC. Therefore, the proposed changes are "modifications," in accordance with 10 CFR 52.59(a)

as this term is defined in Chapter 1 of this supplement, therefore the change complies with regulations applicable and in effect at the time the certification was issued.

The following regulatory requirements apply to the evaluation of the proposed GEH ABWR DCD modifications:

- 10 CFR Part 50, Appendix A, “General Design Criteria for Nuclear Power Plants,” (GDC) 2, “Design Bases for Protection Against Natural Phenomena,” (1997) in the relevant parts, that structures, systems, and components (SSCs) important to safety be designed to withstand the effects of natural phenomena such as earthquakes, without loss of capacity to perform their intended safety functions. GDC 2 further requires that the design bases reflect appropriate consideration of the most severe natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which historical data have been accumulated in the past.
- 10 CFR Part 100, “Reactor Site Criteria,” Appendix A, “Seismic and Geologic Siting Criteria for Nuclear Power Plants,” (1997) requires considering two earthquake levels, the safe shutdown earthquake (SSE) and operating basis earthquake, in the design of safety-related SSCs. Appendix A to 10 CFR Part 100 further states that the engineering method used to ensure that the required safety functions are maintained during and after the vibratory ground motion associated with the SSE, shall involve the use of either a suitable dynamic analysis or a suitable qualification test to demonstrate that SSCs can withstand the seismic and other concurrent loads, except where it can be demonstrated that the use of an equivalent static load method provides adequate conservatism.
- 10 CFR 52.47, “Content of Applications,” (1997) the NRC states in 10 CFR 52.47(a)(1)(vii) that the interface requirements must be met by those portions of the plant for which the application does not seek certification. Also, 10 CFR 52.47(a)(1)(viii) requires justification that compliance with the interface requirements of this section is verifiable through inspections, tests, or analyses, and requires the method to be used for verification of interface requirements to be included as part of the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) required by 10 CFR 52.47(a)(1)(vi).

### 3.7.3.2 *Summary of Technical Information*

GEH submitted the proposed changes in a letter dated July 17, 2015 (ADAMS Accession No. ML15198A344), to indicate that the tunnel structures for DGFOTS are Seismic Category I. In addition, GEH proposed a COL Information Item directing COL applicants to provide the design and analysis of the tunnel structures in accordance with SRP Section 3.7.3, Revision 2. GEH also proposed clarifications to ABWR DCD Tier 2, Sections 3.8.4.1.3 and 3.12.3, that are unrelated to the DGFOTS tunnel structures.

### 3.7.3.3 *Technical Evaluation*

The staff reviewed the proposed changes to ABWR DCD Tier 2, Revision 6, Table 1.9-1 and Sections 3.7.3.12, 3.8.4.1.3, 3.12.2.1, and 3.12.3, as well as new Sections 3.8.4.1.6 and 3.8.6.5, in order to determine compliance with GDC 2 and 10 CFR Part 100, Appendix A. The staff used the review guidance in SRP Section 3.7.3, Revision 2, to conduct its review.

In a letter dated July 17, 2015 (ADAMS Accession No. ML15198A344), GEH added the COL information item for Seismic Category I buried piping, conduits and tunnels to the list of COL

information items in ABWR DCD Tier 2, Table 1.9-1. In DCD Tier 2, Section 3.7.3.12, GEH added text to describe the physical characteristics and design/analysis specifications of Seismic Category I underground tunnels as reinforced concrete structures in direct contact with soil and having adequate dynamic clearance to their housing piping/cables to avoid transmission of seismic in-ground accelerations and displacements. GEH also added the statement that the design and analysis of Seismic Category I underground tunnels follow the engineering process specified in SRP Section 3.7.3, Revision 2. In the new DCD Tier 2, Section 3.8.4.1.6, GEH added that the Seismic Category I buried piping, conduits and tunnels, shall be designed and analyzed in accordance with SRP Section 3.7.3, Revision 2. In the new DCD Tier 2, Section 3.8.6.5, GEH stated that the COL applicant shall provide a design and analysis report for Seismic Category I buried piping, conduits and tunnels in accordance with SRP Section 3.7.3, Revision 2, and referred to DCD Tier 2, Section 3.7.3.12. GEH also described in DCD Tier 2, Section 3.12.2.1, that specific seismic requirements are included in Section 3.7.3.12 and specified in SRP Section 3.7.3.

The staff reviewed the proposed changes in DCD Tier 2, Table 1.9-1, Sections 3.7.3.12, 3.8.4.1.6, and 3.8.6.5, and concludes that it is not practical to perform Seismic Category I assessment for the tunnel structures at this stage because site-specific soil information is not available. Therefore, the staff finds it acceptable to defer the design and analysis of Seismic Category I tunnel structures to the COL applicant because (1) the proposed changes provide assurance that the Seismic Category I tunnel structures will not be adversely affected by the adjacent Diesel Oil Storage Tank and Reactor Building structures under design-basis loads, and (2) the design and analysis of the tunnel structures will be performed by the COL applicant per the guidelines provided in SRP Section 3.7.3, Revision 2.

In its letter dated July 17, 2015 (ADAMS Accession No. ML115198A344), GEH also added the text “rebar stress and required rebar” to ABWR DCD Tier 2, Section 3.8.4.1.3, that included rebar information for the radwaste building (RW/B). In addition, GEH added the text “Non-Safety Related” to the title of DCD Tier 2, Section 3.12.3. The staff reviewed the these editorial changes in DCD Tier 2, Sections 3.8.4.1.3 and 3.12.3, and finds that they are not relevant to the Seismic Category I tunnel structures of DGFOTS; however, they are acceptable to the staff because: (1) GEH follows the common engineering principles and practices, which clarify the rebar information for the RW/B; and (2) the change of the title of DCD Tier 2, Section 3.12.3 is consistent with the contents of this section.

#### 3.7.3.4 *Conclusion*

Based on the evaluation provided in this FSER supplement, the staff concludes that the COL Information Item directing COL applicants to provide the design and analysis of the tunnel structures for DGFOTS, will assure that all Seismic Category I utilities (i.e., piping, conduits, or auxiliary system components) that are routed within these tunnels are adequately protected and will perform their intended safety functions. Therefore, the staff concludes that the requirements of GDC 2, 10 CFR Part 100, Appendix A and 10 CFR 52.47 are met.

## References

1. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
2. 10 CFR Part 50, Appendix A, GDC 2 (1997), "Design bases for protection against natural phenomena."
3. 10 CFR Part 52, Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor."
4. 10 CFR Part 100, Appendix A (1997), "Seismic and Geologic Siting Criteria for Nuclear Power Plants."
5. NUREG-0800, Section 3.7.3, "Seismic Subsystem Analysis," Revision 2, August 1989 (ADAMS Accession No. ML052340570).
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 5, Tier 1 and Tier 2, November 2010 (ADAMS Accession No. ML110040323).
9. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 6, Tier 1 and Tier 2, February 2016 (ADAMS Accession No. ML16214A015).
10. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 7, Tier 1 and Tier 2, December 2019 (ADAMS Accession No. ML20007E371).