

7 INSTRUMENTATION AND CONTROL SYSTEMS

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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 7, "Instrumentation and Control Systems," Section 7.7.1.2.1, "Control Rod Ganged Withdrawal Sequence Restrictions," 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.

7.7.1.2.1 Control Rod Ganged Withdrawal Sequence Restrictions

7.7.1.2.1.1 Regulatory Criteria

In the GEH, ABWR DCD, Revision 7, the applicant corrected an error in the originally certified DCD that stated the incorrect sequence for ganged control rod withdrawal for the reactor startup evolution. This supplemental FSER evaluation documents the staff's review of the correction to the control rod ganged withdrawal sequence restrictions in DCD Tier 2, Section 7.7.1.2.1(5)(b)(iii).

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 its application to renew the ABWR DC. In Item No. 22 of that letter, the staff asked GEH to address an apparent error in the wording of the ABWR DCD related to the ganged control rod withdrawal sequence.

Because the applicant's change is a correction to an error in the DC, it is a "modification," as this term is defined in Chapter 1 of this supplement and must comply with regulations applicable and in effect at the time the certification was originally issued. The following regulatory requirements provide the acceptance criteria for the staff's review:

- 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," (GDC) 28, "Reactivity Limits," states "The reactivity control systems shall be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in damage to the reactor coolant pressure boundary greater than limited local yielding, nor (2) sufficiently disturb the core, its support structures or other reactor pressure vessel internals to impair significantly the capability to cool the core. These postulated reactivity accidents shall include consideration of rod ejection (unless

prevented by positive means), rod dropout, steam line rupture, changes in reactor coolant temperature and pressure, and cold-water addition.”

7.7.1.2.1.2 Summary of Technical Information

The originally certified DCD Tier 2, Section 7.7.1.2.1(5)(b)(iii), Revision 4, states, “Groups 1-4 may only be withdrawn before groups 5 –10 are in the full-in position.”

The NRC staff discovered that this statement was in error during the review of the combined license (COL) application for South Texas Project (STP) Units 3 and 4. The GEH ABWR DCD Revision 5 submitted for design certification renewal contained the same erroneous statement. The staff issued a request for additional information (RAI) dated April 20, 2015 (ADAMS Accession No. ML15110A122), and in question 07-01 noted that if the ganged withdrawal sequence is performed as described in the DCD Tier 2, Section 7.7.1.2.1(5)(b)(iii) as cited above, the ganged control rod sequence steps could create a potentially unsafe operating condition through inappropriate limits on the amount and rate of reactivity increase. The staff concluded that the ganged withdrawal sequence, as described does not appear to comply with GDC 28 and is contrary to generally accepted BWR operating practices. The staff asked the applicant to correct the ganged withdrawal sequence description or provide a technical basis and further explanation as to why this section, as currently written, is correct and accurate. In response to the staff RAI, the applicant in a letter dated May 19, 2015 (ADAMS Accession No. ML15139A210), provided its response in Enclosure 1 and submitted DCD markups to ABWR DCD Revision 5, in Enclosure 2. GEH had subsequently incorporated this change in ABWR DCD, Revision 7. The revised language states, “Groups 1-4 must be fully withdrawn before groups 5-10 can be withdrawn from the full-in position.”

7.7.1.2.1.3 Technical Evaluation

In RAI question 07-01 the staff noted a wording error related to the control rod ganged withdrawal sequence in ABWR DCD Tier 2, Section 7.7.1.2.1(5)(b)(iii). In response to the staff RAI, GEH revised the wording as follows:

Groups 1-4 must be fully withdrawn before groups 5-10 can be withdrawn from the full-in position.

The staff finds that with this correction to the wording in the ABWR DCD, the ganged control rod withdrawals will be performed in the correct sequence and the design of the rod control and information system is in compliance with GDC 28. The staff also finds that this correction to the wording in the DCD does not otherwise affect the staff’s original ABWR DC FSER documented in Section 7.7.2, “Specific Findings and Evaluations,” of NUREG-1503.

The staff verified that the ABWR DCD, Revision 7, incorporates the correction as described above. Therefore, this issue is resolved.

7.7.1.2.1.4 Conclusion

The applicant has corrected the ganged withdrawal sequence wording in the DCD, Tier 2, Section 7.7.1.2.1(5)(b)(iii) as stated above, which the staff evaluated and finds acceptable. With this wording correction the staff finds that design of the ABWR rod control and information system is in compliance with GDC 28.

References

1. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
2. 10 CFR Part 50, Appendix A, GDC 28, "Reactivity limits."
3. 10 CFR Part 52, Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor."
4. NRC, NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor Design," July 1994 (ADAMS Accession No. ML080670592).
5. 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).
6. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 5, Tier 1 and Tier 2, December 2010 (ADAMS Accession No. ML110040323).
7. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 6, Tier 1 and Tier 2, February 2016 (ADAMS Accession No. ML16214A015).
8. GEH, ABWR Standard Plant Design Certification Renewal Application Design Control Document, Revision 7, Tier 1 and Tier 2, December 2019 (ADAMS Accession No. ML20007E371).
9. South Texas Project, Unit 3 Combined License No. NPF-097, February 12, 2016 (ADAMS Accession No. ML16033A020).
10. South Texas Project, Unit 4 Combined License No. NPF-098, February 12, 2016 (ADAMS Accession No. ML16033A047).