

3.3 Wind and Tornado Loadings

3.3.1 Regulatory Criteria

In accordance with U.S. Nuclear Regulatory Commission (NRC) regulations, nuclear plants must be designed so that they remain in a safe condition under extreme meteorological events, including those that could result in the most extreme wind events (tornadoes and hurricanes) that could reasonably be predicted to occur. The applicant added hurricane wind speed and hurricane missile spectra to the list of site parameter values presented in Tier 1, Section 5.0, and Tier 2, Section 2.0, of the General Electric-Hitachi (GEH) Advanced Boiling-Water Reactor (ABWR) Design Control Document (DCD). A combined license (COL) applicant that references the GEH ABWR DC will assess whether the actual site characteristics fall within the site parameters specified for the ABWR design.

The proposed changes are being made to provide criteria for a COL applicant to determine whether an ABWR located at a particular site is appropriately protected against the effects of hurricane winds and missiles. In interim staff guidance (ISG), DC/COL-ISG-024, "Implementation of Regulatory Guide 1.221 on Design-Basis Hurricane and Hurricane Missiles," issued May 2013, the NRC staff explicitly addressed the ABWR and concluded that hurricane winds and missiles needed to be addressed to provide reasonable assurance of adequate protection of the public health and safety and ensure compliance with General Design Criteria (GDC) 2 and 4. Therefore, in accordance with Title 10 *Code of Federal Regulations* (10 CFR) 52.59(a) the proposed changes in this regard are defined as "modifications," as described in Chapter 1 of this staff safety evaluation report (SER) supplement, and will correspondingly be evaluated using the regulations applicable and in effect at the initial ABWR certification.

As a result of adding hurricane wind and missile site parameters, GEH updated the DCD to account for extreme hurricane wind and missile loading consistent with the methodology applicable at the time of initial certification. This evaluation documents the staff's review of these changes.

The relevant NRC requirements associated with the review of GEH ABWR DCD, Tier 2, Revision 6, Sections 3.3.1, "Severe Wind Loads," and 3.3.2, "Extreme Wind Loads (Hurricanes and Tornadoes)," are given in 10 CFR Part 50, Appendix A, GDC (1997) and summarized below. The associated acceptance criteria are provided in Sections 3.3.1 "Wind Loadings" and 3.3.2 "Tornado Loadings" of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," (Rev. 2) (SRP (1981)).

1. GDC 2 (1997), "Design bases for protection against natural phenomena," requires, in part, that SSCs important to safety be designed to withstand the effects of natural phenomena such as tornadoes and hurricanes without loss of capability to perform their safety function.
2. Regulatory Guide (RG) 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants," Revision 0, October, 2011.

3.3.2 Summary of Technical Information

Revision 5 to the GEH ABWR DCD, which GEH originally submitted in support of their GEH ABWR DC renewal application, contained tornado site parameters related to the maximum tornado wind speed and missile spectra, but did not contain any site parameters related to hurricane wind speed or hurricane missiles.

In DCD, Revision 6, Tier 2, Section 3.3.2.2, "Determination of Forces on Structures," the applicant proposed the inclusion of design-basis hurricane wind and missile loading.

DCD Tier 1: DCD, Revision 6, Tier 1, Table 5.0, "ABWR Site Parameters," included the addition of hurricane wind speed and missile spectra for the potential site.

DCD Tier 2: DCD, Revision 6, Tier 2, Table 2.0-1, "Envelope of ABWR Standard Plant Site Design Parameters," included the addition of hurricane wind speed and missile spectra for the potential site.

In RAI 02-1 response, Supplement 5, dated April 13, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17103A125) was provided after submission of Revision 6 of the ABWR DCD. In this RAI response, the applicant modified Tier 2, Table 2.0-1, to define the design-basis maximum hurricane wind speed of 257 km/h as a fastest-mile wind speed which corresponds to 286.5 km/h 3-second gust wind speed per RG 1.221, Revision 0, measured at 10 meters above ground over open terrain, and to clarify the maximum tornado wind speed of 483 km/h as a fastest 1/4-mile wind speed which corresponds to 483 km/h 3-second gust wind speed.

3.3.3 Technical Evaluation

The staff's evaluation of the missiles generated by extreme winds (hurricane) is provided in Section 3.5.1.4 "Missiles Generated by Natural Phenomena" of this SER supplement and the staff's complete evaluation of meteorological site parameters is evaluated in Section 2.3 of this SER supplement. In this SER section the staff evaluates the resulting hurricane wind and missile loading.

In a letter dated September 25, 2014, the staff issued a request for additional information (RAI) 02-1 (ADAMS Accession No. ML14267A352), requesting that GEH update their DCD during the renewal process to address the possibility that the wind speeds from the design-basis tornado may not be bounding for ABWR structures, systems and components (SSCs) in certain locations along the United States Gulf Coast and the southern Atlantic Coast. In a letter dated November 19, 2014 (ADAMS Accession No. ML14324A084), responding to RAI 02-1, GEH submitted the proposed changes to show that SSCs important to safety are protected from the effects of hurricane winds and missiles. In addition GEH updated its response in the following RAI supplements as follows:

- Supplement 1 by letter dated June 26, 2015 (ADAMS Accession No. ML15177A036)
- Supplement 2 by letter dated November 5, 2015 (ADAMS Accession No. ML15309A158)
- Supplement 3 by letter dated January 12, 2016 (ADAMS Accession No. ML16012A290)

- Supplement 4 by letter dated November 16, 2016 (ADAMS Accession No. ML16321A413)
- Supplement 5 by letter dated April 13, 2017 (ADAMS Accession No. ML17103A124)

In its response to RAI 02-1, the applicant proposed up to date hazards information in its ABWR DCD using current staff guidance with respect to hurricane wind speed and hurricane missiles based on RG 1.221, Revision 0.

The staff reviewed the proposed changes in GEH ABWR DCD Table 5.0 in Tier 1, Revision 6, and Table 2.0-1, and Sections 3.3.1 and 3.3.2 in Tier 2, Revision 6, in order to determine compliance with GDC 2 (1997) in Appendix A to 10 CFR Part 50, using the guidance in Sections 3.3.1, Revision 2 (1981) and 3.3.2, Revision 2 (1981) of the standard review plan.

The staff reviewed DCD Revision 6, Tier 1, Table 5.0 and Tier 2, Table 2.0-1, and compared the design-basis hurricane wind speed and its missile velocities with the design-basis tornado wind speed and its missile velocities. The staff found that the design-basis hurricane wind speed and its missile velocities are bounded by the design-basis tornado wind speed and its missile velocities. The staff also reviewed the RG 1.221, Revision 0, and found that the methodology used in combining the effects of the design-basis hurricane winds and hurricane-generated missiles is the same as the one for the design-basis tornado winds and tornado-generated missiles in the original certification. Therefore, the staff concluded that the design-basis tornado loading governs as described in the original certification.

In addition, the staff reviewed Section 3.3.1 in GEH ABWR DCD Tier 2, Revision 6, and confirmed that the ABWR design-basis code, the American National Standards Institute (ANSI)/American Society of Civil Engineers (ASCE) 7-88, "Minimum Design Loads for Buildings and Other Structures," was not changed. The staff also reviewed Section 3.3.2.2 in GEH ABWR DCD Tier 2, Revision 6, and found that the procedures for transforming the extreme hurricane wind loading into effective loads and distribution across the structures are consistent with that of the ABWR design-basis code, ANSI/ASCE 7-88, which was approved in the original certification, and therefore are acceptable.

In a public teleconference held on March 2, 2017, the staff requested further clarification on the DCD wind parameters in order to be consistent with the guidance for a design-basis hurricane wind speed in RG 1.221 based on the nominal 3-second peak-gust values at a height of 10 meters in flat open terrain, which is consistent with the definition of design wind speeds in the ASCE/SEI design standard.

In GEH RAI Supplement 5, the applicant provided additional DCD changes to indicate the severe wind and extreme hurricane wind speed in terms of 'fastest-mile', consistent with the ASCE 7-88 methodology at the time of certification. The corresponding equivalent '3-second gust' is provided in the site-parameter table to facilitate comparison of design wind speeds consistent with RG 1.221, Revision 0.

Additionally, for tornado wind speed, the DCD is updated to confirm the tornado design wind speed in 'fastest 1/4-mile'. The corresponding equivalent 3-second gust design wind speed is also provided in the site-parameter table for future COL applicant's site-specific tornado wind speed comparison. The proposed DCD changes will be included in the next DCD revision.

All the changes identified in the applicant's response to RAI 02-1, Supplement 5 are being tracked as **Confirmatory item 3.3-1**.

3.3.4 Conclusion

Based on the evaluation provided in this SER section supplement, the staff concludes that the proposed changes to the ABWR DCD are acceptable and do not alter the safety findings made in the ABWR DC NUREG-1503 and meets the applicable regulations in effect at initial certification including the requirements of GDC 2 (1997) and as reviewed by the staff in accordance with the SRP associated acceptance criteria in, Sections 3.3.1 "Wind Loadings," Revision 2 (1981) and 3.3.2 "Tornado Loadings," Revision 2 (1981) of NUREG-0800 (1981). Inclusion of the proposed changes in the DCD is being tracked by the **Confirmatory Item 3.3-1** discussed above.