6.0 ENGINEERED SAFETY FEATURES

6.2.1.6 Suppression Pool Dynamic Loads

6.2.1.6.1 Regulatory Criteria

The applicant added a COL License Information Item 3.8.6.5, "Loads Associated with Post-DBA Suppression Pool Water Level," to the ABWR DCD Tier 2, Revision 6, Section 3.8.6, "COL License Information." The staff considered this as a "modification," as that term is defined in Chapter 1 of this supplement, because the change was made to correct an assumption on suppression pool water level used in hydrodynamic analysis. Therefore, the staff evaluated the change using the regulations applicable and in effect at the initial ABWR certification.

The applicable regulatory requirement for evaluating the proposed DCD change is 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 4 (1997), as it relates to the environmental and missile protection design. As pertinent here, GDC 4 requires that structures, systems, and components important to safety be designed to accommodate the dynamic effects (e.g., effects of missiles, pipe whipping, and discharging fluids) that may result from equipment failures and may occur during normal plant operation or following a loss-of-coolant accident.

The staff used the guidance provided in NUREG–0800, "Standard Review Plan, for Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," Section 6.2.1.1.C, "Pressure-Suppression Type BWR Containments," Revision 6.

6.2.1.6.2 Summary of Technical Information

The applicant added the following to the GEH ABWR DCD Tier 2, Revision 6, Section 3.8.6, "COL License Information":

> 3.8.6.5 Loads Associated with Post-DBA Suppression Pool Water Level: The COL applicants will confirm that the suppression pool water level used in the containment loads evaluation is based on the maximum predicted post-accident suppression pool water level rise that can occur concurrent with each of the defined containment loads (Appendix 3B). This load will then be used to update the associated analyses in Section 3.8, Appendix 3G and Appendix 3H.

6.2.1.6.3 Technical Evaluation

In a letter dated March 31, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14090A068), the applicant provided the NRC a 10 CFR 21.21(a)(2) "60-Day Interim Report Notification: Containment Loads Potentially Exceed Limits with High Suppression Pool Water Level in the ABWR Design". In Attachment 1 to this letter, the applicant states that:

> Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply[:] ABWR hydrodynamic loads have been calculated with the Suppression Pool water level defined at the Technical Specification Suppression Pool High Water

> Level (HWL). The Suppression Pool level during the postulated LOCA vessel blowdown may be greater than the Suppression Pool HWL during the pertinent timeframe for hydrodynamic loads because vessel coolant inventory is transferred into the suppression pool during blowdown. Additionally, certain containment structures previously thought uncovered may be submerged with the higher Suppression Pool water level. Increased hydrodynamic loads may correspondingly increase the totals in the design load combinations for which containment structures are designed to withstand.

In a letter dated August 29, 2014 (ADAMS Accession No. ML14241A306), the applicant informed the NRC that "[t]he GEH assessment has concluded that the predicted increase in the suppression pool water level above the value used for defining the ABWR loads and applied in the structural analysis will not result in the creation of a Substantial Safety Hazard nor will it lead to exceeding a Technical Specification Safety Limit for the US ABWR Certified Design."

To determine the effect of this error on the GEH ABWR DC renewal application, in Request for Additional Information (RAI) 06.02.01-1, the staff requested the applicant to describe the impact of the error on loads on suppression pool wall boundaries, the access tunnel, and structures submerged in the suppression pool in terms of loads from pool swell, condensation oscillation, chugging, and safety relief valve (SRV) discharge.

GEH responded in a letter dated May 29, 2015 (ADAMS Accession No. ML15149A232), that the ABWR DCD, Appendix 3B, only identifies methods to be used in defining loads on submerged structures by citation to references. This includes the methods for loads due to loss-of-coolant accident (LOCA) pool swell, condensation-oscillation, chugging and SRV discharge, but no guidance is provided on choosing a specific water level for the analysis. As such there is no direct impact of the increased suppression pool water level on the ABWR DCD description. According to the applicant:

- The loads affecting structural integrity, that are affected by the predicted increase in suppression pool water level are condensation oscillation and chugging

- Pool swell loads are unaffected as they occur at the beginning of a LOCA before a significant transfer of water to the suppression pool that would raise the water level

- The increase in pool boundary loads from SRV discharge due to the higher suppression pool water level is insignificant because the expected water level rise during SRV discharge is small

- The effect on SRV load is negligible relative to the conservatism in the SRV loads definition.

The staff agrees with the applicant's reasoning and determined that the applicant had identified the containment structural loads impacted by the predicted increase in suppression pool water level.

The staff review confirmed that the predicted increase in suppression pool water level had no direct impact on the certified ABWR DCD description since the specification for the water level is not provided in the DCD.

The applicant evaluated predicted increases for LOCA condensation oscillation and chugging loads acting on the ABWR suppression pool boundaries. The applicant's evaluation conservatively assumed that the suppression pool water level increase will result in increasing condensation oscillation and chugging forces by 50 percent and 20 percent. The resulting stresses in the reinforced concrete containment vessel and reactor pressure vessel pedestal for the governing faulted load combination will increase less than 1 percent. The applicant concluded that potential increases or changes to hydrodynamic loads that were defined for the ABWR containment, which are associated with elevated suppression pool water level, will not result in exceeding ABWR structural design limits.

On October 28, 2015 (ADAMS Accession No. ML15357A292), the staff audited the applicant's analyses supporting this conclusion. The staff confirmed that the increase in resultant forces (less than 1 percent) due to the suppression pool water level change induced by the postulated LOCA event has negligible effect on the containment structure. There were no outstanding issues, and the audit was closed.

On access tunnel structural integrity, the applicant's May 29, 2015, response states the following: "The access tunnel design is only described in the US ABWR DCD; there is no associated stress analysis results included in the US ABWR DCD."

On integrity of submerged primary structure safety related structures, components and equipment (SC&E) the applicant's May 29, 2015, response states the following: "Increases in the [condensation oscillation] and chugging contribution to the emergency and faulted load combinations can result in increases in the primary structure model responses that can impact the design margins for safety-related SC&E. The US ABWR DCD does not include design details for SC&E; there is no associated stress analysis results included in the US ABWR DCD."

Based on the applicant's response that the US ABWR DCD does not contain the design details of the access tunnel and submerged safety-related SC&E, the staff finds that the predicted increase in suppression pool level does not impact the information provided in US ABWR DCD.

In its response to the RAI, the applicant stated that an evaluation for the access tunnel structural integrity was performed, for a Non-domestic ABWR plant-specific design in order to confirm that the predicted increase in the condensation oscillation and chugging loads do not result in exceeding the safety design margins of the access tunnel. The applicant stated that the evaluation determined that sufficient margins exist in the design to accommodate stress limits and buckling limits of the access tunnel.

As stated above in Section 6.2.1.6.2, the applicant added COL License Information Item 3.8.6.5 to ABWR DCD, Revision 6, Tier 2, so that the COL applicant will use the appropriate suppression pool water level for the containment loads evaluation. The staff found this acceptable because it directs the COL applicant to use the appropriate suppression pool water level for the containment load evaluation. However, the staff's acceptance of the ABWR design was not based on this COL License Information item; the existing DCD information is acceptable, and revising the containment load evaluation has negligible impact on the ABWR certified design.

Based on the review of the applicant's May 29, 2015, response and the October 28, 2015 audit, the staff determined that the increased pool level induced by the postulated LOCA event has an insignificant impact on the design capacity of the containment structure and COL License

Information Item 3.8.6.5 will direct COL applicants to use the maximum predicted post-accident suppression pool water level rise that can occur concurrent with each of the defined containment loads in the designs of access tunnel and submerged primary structure safety-related SC&E. The staff concluded that the applicant addressed the staff's concerns raised in RAI 06.02.01-1, and therefore, it is closed.

The staff concluded that the containment structure, access tunnel, and primary structure safety-related SC&E meet 10 CFR Part 50, Appendix A, GDC 4 (1997).

6.2.1.6.4 Conclusion

The staff review finds that the applicant's proposed change to the ABWR DCD is acceptable because it does not alter the safety findings made in NUREG-1503 and meets the applicable regulations in effect at the initial certification, including the requirements of 10 CFR Part 50, Appendix A, GDC 4.