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22 ENHANCEMENTS RESULTING FROM FUKUSHIMA NEAR TERM TASK FORCE RECOMMENDATIONS

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 or points to the specific sections of the GEH Design Control Document (DCD), Revision 7, where ABWR design enhancements resulting from the Fukushima Near-Term Task Force (NTTF) are made. Except as modified by this supplement to the FSER, the findings made in NUREG-1503 and its Supplement 1 remain in full effect.

This supplemental FSER Chapter, "Enhancements Resulting from Fukushima Near Term Task Force Recommendations," documents the NRC staff's evaluation or cites the specific staff supplemental FSER sections where the staff evaluated the GEH ABWR design enhancements in response to recommendations from the NTTF that the staff asked the applicant to address for renewal of the ABWR DC. The staff determined that the ABWR DC renewal applicant is not required to address the mitigation of beyond-design-basis events (MBDBE) rule (10 CFR 50.155, "Mitigation of beyond-design-basis events") that was published in the *Federal Register* on August 9, 2019 (84 FR 39684) and became effective September 9, 2019.¹ Prior to the implementation of the MBDBE rule, the staff had determined that the ABWR DC renewal applicant should address the following three NTTF topics: (1) mitigation strategies for beyond-design-basis external events (related to NTTF Recommendation 4.2), (2) spent fuel pool (SFP) instrumentation (related to NTTF Recommendation 7.1), and (3) emergency preparedness (EP) staffing and communications (related to NTTF Recommendation 9.3).

Background:

On March 11, 2011, a magnitude 9.0 earthquake struck off the coast of the Japanese island of Honshu. The earthquake resulted in a large tsunami that is estimated to have exceeded 14 meters (45 feet) in height, which inundated the Fukushima Dai-ichi Nuclear Power Plant site. The tsunami caused extensive damage to site facilities and resulted in a complete loss of all alternating current (ac) electrical power at 5 of the 6 units on the site.

In response to the events at the Fukushima Dai-ichi nuclear power plant resulting from the earthquake and tsunami in Japan, the NRC established the NTTF to conduct a systematic and methodical review of NRC processes and regulations to determine whether the agency should

¹ The MBDBE final rule *Federal Register* notice also announced the public availability of the final regulatory guidance, Regulatory Guide (RG) 1.226, "Flexible Mitigation Strategies for Beyond-Design-Basis Events," Revision 0, and RG 1.227, "Wide-Range Spent Fuel Pool Level Instrumentation," Revision 0, both issued in June 2019. Neither RG is applicable to the ABWR DC renewal.

make improvements to its regulatory system, and to make recommendations to the Commission for policy directions. In July 2011, the NTF identified 12 recommendations in a report, SECY-11-0093, "Near Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11186A950). In SECY-11-0124, "Recommended Actions to be Taken Without Delay from the NTF Report," dated September 9, 2011 (ADAMS Accession No. ML11245A127), the staff submitted to the Commission for its consideration NTF recommendations that could be and, in the staff's judgment, should be, partially or entirely initiated without delay. In SECY-11-0124, the staff concluded that specific actions to address a subset of the NTF recommendations would provide the greatest potential for improving safety in the near term. The staff also proposed three tiers of prioritization from the NTF recommendations to the Commission in SECY-11-0137, "Prioritization of Recommended Actions to Be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011 (ADAMS Accession No. ML11269A204). The first tier consisted of those NTF recommendations that the staff determined should be started without unnecessary delay and for which sufficient resource flexibility, including the availability of critical skill sets, existed. The second tier consisted of those NTF recommendations that could not be initiated in the near term due to factors that included the need for further technical assessment and alignment, dependence on Tier 1 issues, and the availability of critical skill sets. The third tier consisted of NTF recommendations that depended on the completion of near-term actions or needed additional study to support a regulatory action.

In SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," dated February 17, 2012 (ADAMS Accession No. ML12039A111), the staff recommended that the Commission issue orders and requests for information under 10 CFR 50.54(f) to power reactor licensees and stated that the staff would ask all combined license (COL) applicants to provide the requisite Tier 1 information addressed in the Commission's orders and the 10 CFR 50.54(f) requests for information through the review process. The staff had determined that the following three Tier 1 NTF recommendations should be addressed by the COL applicants at the time and the staff determined that the ABWR DC renewal applicant should consider design changes to address three Tier 1 NTF recommendation topics for potential future ABWR DC COL applicants:

- (1) Recommendation 4.2: Equipment covered under 10 CFR 50.54(hh)(2) - Order licensees to provide reasonable protection for equipment currently provided pursuant to 10 CFR 50.54(hh)(2) from the effects of design-basis external events, and to add equipment as needed to address multiunit events while other requirements are being revised and implemented.
- (2) Recommendation 7.1: Spent fuel pool instrumentation - Order licensees to provide sufficient safety-related instrumentation, able to withstand design-basis natural phenomena, and to monitor SFP parameters (i.e., water level, temperature, and area radiation levels) from the control room.
- (3) Recommendation 9.3: Emergency preparedness regulatory actions (staffing and communications).

In a letter dated July 20, 2012 (ADAMS 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 by the staff in Item Nos. 26, 27 and 28 of that letter to identify design changes that would allow a COL applicant to address the Tier 1 Fukushima Recommendations 4.2, 7.1, and 9.3, respectively. The staff addresses these requested changes below.

22.1 Mitigation Strategies for Beyond-Design-Basis External Events (NTTF Recommendation 4.2)

During the initial review of the application for ABWR DC renewal, the staff requested that GEH provide proposed changes to the ABWR design to address NTTF Recommendation 4.2 regarding mitigation strategies for beyond-design-basis external events. SECY-12-0025 states that the staff would request all COL applicants to provide the information addressed in the orders (i.e., EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," dated March 12, 2012 (ADAMS Accession No. ML12054A735) (Mitigating Strategies Order), EA-12-050, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents," dated March 12, 2012 (ADAMS Accession No. ML12054A694), and EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," dated March 12, 2012 (ADAMS Accession No. ML12056A044)) through the review process.

For mitigation strategies for beyond-design-basis external events, SECY-12-0025 outlines a three-phase approach. The initial phase involves the use of installed equipment and resources to maintain or restore core cooling, containment, and SFP cooling without both alternating current (AC) power and normal access to the ultimate heat sink. The transition phase involves providing sufficient, portable, onsite equipment and consumables to maintain or restore these functions until they can be accomplished with resources brought from offsite. The final phase involves obtaining sufficient offsite resources to sustain those functions indefinitely.

In the staff's letter dated July 20, 2012, the staff requested that GEH address a compilation of design changes that the agency considered to be regulatory improvements or changes that could meet the criteria in 10 CFR 52.59(b). In this letter the staff requested that GEH identify the design changes that would be incorporated into the DC renewal design control document (DCD) related to aspects of NTTF Recommendation 4.2, regarding mitigation strategies for beyond-design-basis external events, Item No. 26 of the letter. GEH responded to the staff in the letters described below addressing its proposed design changes to allow a potential COL applicant to meet requirements related to NTTF Recommendation 4.2.

On September 17, 2012 (ADAMS Accession No. ML12261A311), GEH responded to the staff's design suggestions by agreeing in the ABWR DCD, Revision 6, to incorporate the staff suggested design change items including Item No. 26 on mitigating strategies. In a letter dated September 9, 2015 (ADAMS Accession No. ML15254A042), GEH provided a detailed specific response with DCD markups to address Item No. 26 on mitigation strategies which was a follow-up from a public meeting on the issue held on May 7, 2015 (ADAMS Accession No. ML15162A613). The applicant provided details to address Attachment 2 of the Commission's Mitigating Strategies Order as requested by the staff.

In a public teleconference on March 17, 2016 (ADAMS Accession No. ML16124A049), the NRC staff requested that GEH clarify the ABWR response to a beyond-design-basis event with specific information items to be provided by the COL applicant that would also address the MBDBE proposed rule that was issued on November 13, 2015 (80 FR 70609). Therefore, in a letter dated April 29, 2016 (ADAMS Accession No. ML16120A032), GEH submitted its proposed

resolution and supplemental information as requested by the staff during the March 17, 2016 public teleconference, including the ABWR DCD, Revision 6, markups and a proposed new Appendix 1D to the ABWR DCD that addresses the ABWR response to a beyond-design-basis event.. In a supplemental letter dated August 24, 2016 (ADAMS Accession No. ML16237A121), GEH provided additional updates to the previously submitted Appendix 1D and Enclosure 2 to the letter including the DCD markups associated with its supplemental response. GEH described how a licensee of an ABWR would use certain design features that are onsite, and what features are available when the plant transitions to using the equipment that could be brought in from offsite to maintain the plant in a safe condition.

As the NRC finalized the draft MBDBE final rule, it became clear that the staff would not require existing DCs including the ABWR, to address operational matters, such as those elements of the then draft proposed MBDBE rule. Therefore, the final rule would be consistent with the issue finality provision for the ABWR in 10 CFR 52.63, "Finality of Standard Design Certifications." The staff describes this clarification for DCs in more detail in the regulatory analysis of the then proposed rule (ADAMS Accession No. ML15266A133).

Therefore, in a letter dated December 6, 2016 (ADAMS Accession No. ML16341A812), regarding the latest public information related to the draft MBDBE final rule and considering that no MBDBE rule requirements would be relevant to applicants for a standard DC (or a DC renewal, as in the case of the ABWR application), GEH stated that it planned to submit a revised response addressing Item No. 26 by the end of January 2017. The revised response would provide a complete description of the changes to the ABWR DCD that would remove references to NTF Recommendation 4.2 mitigating strategies (e.g., Appendix 1D). In its followup response dated January 23, 2017 (ADAMS Accession No. ML17025A386), GEH submitted its final proposal to remove references to NTF Recommendation 4.2 mitigating strategies, and therefore remove any reference or applicability related to the MBDBE rule for the ABWR DC renewal (e.g., Appendix 1D of the ABWR DCD). In addition, to the extent that certain design features were proposed in response to Item No. 26, GEH identified in its revised response which of those would be retained for NRC review as voluntary design changes in the renewal application (e.g., external connections for power and water; enhanced systems capability for residual heat removal (RHR) and reactor core isolation cooling (RCIC)). Therefore, the staff reviewed these design enhancements as separate design elements not required or related to the MBDBE rule, in separate staff SERs as follows:

- DCD Tier 1 and 2, Chapter 5, "Reactor Coolant System and Connected Systems."

Supplemental SER Section 5.4.7.1.1.10, "ACIWA," provides the staff's evaluation of the DCD design amendment proposed by GEH for the addition of a redundant alternating current independent water addition (ACIWA) capability to the RHR Loop B and to provide clarity on the wetwell spray and SFP makeup capabilities of the ACIWA system.

- DCD Tier 2, Chapter 5, "Reactor Coolant System and Connected Systems."

Supplemental SER Section 5.4.7, "Residual Heat Removal System," provides the staff's evaluation of the DCD design amendment proposed by GEH for a redundant ACIWA mode to the RHR Loop B.

- DCD Tier 2, Chapter 7, "Instrumentation and Control Systems."

Supplemental SER Section 7.4.1.4.4, "Shutdown Panel," provides the staff's evaluation of the DCD design amendment proposed by GEH for additional controls and indications on the ABWR Remote Shutdown Panel.

- DCD Tier 2, Chapter 8, "Electric Power."

Supplemental SER Section 8.3.4.4, "Isolation Between Class 1E Buses and Loads Designated as Non-Class 1E," provides the staff's evaluation of the DCD design amendment proposed by GEH for a capability to provide electrical power to safety-related loads from an external non-safety power source.

- DCD Tier 2, Chapter 16, "Technical Specifications."

Supplemental SER Section 16, "Technical Specifications," provides the staff's evaluation of the DCD design amendment proposed by GEH for addition of ACIWA mode to RHR Loop B (currently available for RHR Loop C), affecting TS 3.5.1, "ECCS-Operating," and TS 3.6.2.4, "RHR Containment Spray;" and, additional controls and indications on the ABWR Remote Shutdown Panel.

The ABWR design enhancements GEH provided in the ABWR DCD, Revision 7, may provide a potential COL applicant the means for meeting the MBDBE rule requirements for mitigating strategies.

22.2 Reliable Spent Fuel Pool Instrumentation (NTTF Recommendation 7.1)

In this ABWR supplemental FSER section, the staff evaluates the design changes proposed by GEH to address Fukushima NTTF Recommendation 7.1 regarding SFP reliable level instrumentation. These proposed design changes affect the following ABWR DCD Sections:

- DCD Tier 2, Chapter 3, "Design of Structures, Components, Equipment and Systems."

Supplemental FSER Section 3.2.3, "Safety Classifications," provides a pointer to this Supplemental FSER Section for the staff evaluation of the design changes made by GEH for the SFP level instrumentation to address the NTTF recommendation for reliable SFP instrumentation.

- DCD Tier 2, Chapter 7, "Instrumentation and Control Systems."

Supplemental FSER Section 7.5.2.1, "Post Accident Monitoring System," provides a pointer to this Supplemental FSER Section for the staff evaluation of the design changes made by GEH for the SFP level instrumentation to address the NTTF recommendation for reliable SFP instrumentation.

- DCD Tier 2, Chapter 9, "Auxiliary Systems."

Supplemental SER Section 9.1.3, "Fuel Pool Cooling and Cleanup System," provides a pointer to this Supplemental FSER Section for the staff evaluation of the design changes

made by GEH for the SFP level instrumentation to address the NTTF recommendation for reliable SFP instrumentation.

In responding to and managing the damage caused by the event at Fukushima, those plant operators lacked, among other things, reliable instrumentation to determine the water level in the SFPs on the site. This lack, combined with the operators' inability to visually observe the SFPs because of the conditions in the plant, raised concerns that at least one pool may have boiled dry—resulting in fuel damage—and highlighted the need for reliable SFP instrumentation.

Although the likelihood of a catastrophic event affecting nuclear power plants and the associated SFPs in the United States remains very low, beyond-design-basis external events could challenge the ability of existing SFP instrumentation to provide emergency responders with reliable information on the condition of SFPs. A reliable and available indicator is essential to ensure that plant personnel can effectively prioritize emergency actions.

In SECY-12-0025, the NRC staff states that for DCs and COL applications submitted under 10 CFR Part 52 that are currently under active staff review, the staff plans to ensure that the Fukushima NTTF recommendations approved by the Commission are addressed before certification or licensing.

The Japan Lessons-Learned Project Directorate (JLD)-Interim Staff Guidance (ISG)-2012-03 Revision 0, "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation" (ADAMS Accession No. ML12221A339), endorses with exceptions and clarifications the methodologies described in the Nuclear Energy Institute (NEI) industry guidance document NEI 12-02, "Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation,'" Revision 1, (ADAMS Accession No. ML122400399), and provides an acceptable approach for satisfying the applicable requirements.

22.2.1 Regulatory Criteria

The applicant proposed safety-related SFP level instrument design changes to the GEH ABWR DCD to provide reliable SFP level indication from the normal range to a level down to one meter below the top of active fuel. In addition, the instrument can be powered from an independent power source and power interruption will not impact the design accuracy. Therefore, in accordance with 10 CFR 52.59(c), this design change is an "amendment," as this term is defined in Chapter 1 of this SER supplement and will correspondingly be evaluated using the regulations in effect at renewal.

The applicant included a COL Information Item under DCD Section 7.5.3, describing the maintenance, implementation and training for these safety-related SFP level instruments. The applicant also added a DCD Section 7.5.4, listing the pertinent references used to implement the Commission Order regarding reliable SFP instrumentation.

The relevant requirements for reliable SFP instrumentation are established or described in the following:

- SRM-SECY-12-0025, "Staff Requirements – SECY-12-0025 – Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," dated March 9, 2012, approves the issuance of

orders for reliable SFP instrumentation under an administrative exemption to the Backfit Rule and the issue finality requirements in 10 CFR 52.63 and 10 CFR Part 52 Appendix A, Paragraph VIII (ADAMS Accession No. ML120690347).

- Atomic Energy Act of 1954 as amended (the Act), Section 161, authorizes the Commission to regulate the utilization of special nuclear material in a manner that is protective of public health and in accordance with common defense and security.

The relevant guidance for reliable SFP instrumentation is set forth as follows:

- The Japan Lesson-Learned Project Directorate-Interim Staff Guidance (JLD-ISG)-2012-03, Revision 0 (ADAMS Accession No. ML12221A339), "Compliance with Order EA-12-051, Reliable Spent Fuel Pool Instrumentation," which endorsed, with exceptions and clarifications, the methodologies described in the Nuclear Energy Institute (NEI) industry guidance document NEI 12-02 (ADAMS Accession No. ML12240A307) Revision 1, "Industry Guidance for Compliance with NRC Order EA-12-051, 'To Modify Licenses with Regard to Reliable Spent Fuel Pool Instrumentation.'"

22.2.2 *Summary of Technical Information*

By letter dated September 25, 2014 (ADAMS Accession No. ML14267A352), the NRC staff in a request for additional information (RAI) Question 01.05-1 requested that GEH address the design-related aspects of Fukushima NTTF Recommendation 7.1 regarding enhanced spent fuel instrumentation as outlined in Attachment 2 of Order EA-12-051.

The applicant responded to the staff's RAI in letters dated November 6, 2014 (ADAMS Accession No. ML14310A567), June 18, 2014 (ADAMS Accession No. ML15170A044), and August 25, 2015 (ADAMS Accession No. ML15237A192). As part of the RAI response, the applicant added SFP level instruments that comply with applicable guidance. This change resulted in changes as reflected in the ABWR DCD, Revision 7, to the following Sections:

- DCD Tier 1, Section 2.6.2, Figure 2.6.2 and Table 2.6.2
- DCD Tier 2, Chapter 1, Tables 1.8-21 and 1.8-22
- DCD Tier 2, Chapter 3, Table 3.2-1
- DCD Tier 2, Chapter 7, Sections 7.5.2.1, 7.5.3 and 7.5.4
- DCD Tier 2, Chapter 9, Sections 9.1.3.2 and 9.1.7
- DCD Tier 2, Chapter 21, Figure 9.1-1

22.2.3 *Technical Evaluation*

Commission Order EA-12-051 requires a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel. NEI 12-02 refers to these monitoring levels as Level 1, Level 2 and Level 3, respectively:

- (1) level that is adequate to support operation of the normal fuel pool cooling system,
- (2) level that is adequate to provide substantial radiation shielding for a person standing on the SFP operating deck, and
- (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

In the applicant's response to RAI 01.05-1, GEH stated that the ABWR design departs from the guidance of NEI 12-02 in the choice of water level nomenclature. In accordance with human factors engineering principles, the ABWR SFP and RPV water level nomenclature have been made as consistent as possible. Thus, the ABWR DCD designates SFP Level 3 as slightly below normal water level (EA-12-051 item (1) or NEI 12-02 Level 1), and Level 1 as above the top of active fuel (EA-12-051 item (3) or NEI 12-02 Level 3).

The staff evaluated the applicant's response and found that the proposed departure from the guidance was acceptable. Changing the nomenclature of the levels has no adverse impact on safety, as long as all three levels are monitored and alarmed. During a public meeting with the applicant on August 13, 2015 (ADAMS Accession No. ML15230A204), the staff identified that the applicant had introduced an additional departure from the guidance, without providing adequate justification for how the alternative meets the SFP instrumentation requirements. The markups of DCD Tier 2, Section 9.1.3.2, (that were part of the RAI response) showed that the alarm setpoint for GEH Level 1 (lowest level) would be at the top of the active fuel. This setpoint is not consistent with NEI 12-02, Level 3 (lowest level) which corresponds to the highest point of any fuel rack seated in the SFP.

On August 20, 2015, the applicant submitted a revised response to RAI 01.05-1 based on feedback provided during the August 13, 2015 public meeting. In the revised response, GEH updated the lowest level alarm to be the top of the fuel assembly bail handle in ABWR DCD Tier 2, Subsection 9.1.3.2.

The staff finds the DCD changes meet the guidance in NEI 12-02 and therefore are acceptable. The staff has confirmed that ABWR DCD, Revision 7 incorporated the markups provided in RAI 01.05-1. Order EA-12-051 also requires the SFP instrumentation to include several design features. The discussion below describes the design features (the key words are underlined). All other aspects of RAI 01.05-1 have also been resolved by the applicant.

Instrument:

Commission Order EA-12-051, Attachment 2, Section 1.1 states that the SFP level instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor the SFP water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or high heat and humidity from a boiling pool.

The applicant's response to RAI 01.05-1 states that the instrumentation will consist of two safety related, permanent and fixed instrument channels. DCD Revision 6, Tier 2, Section 7.5.2.1

states that the instruments are designed to remain reliable considering normal operational, event and post-event conditions.

The staff evaluated the applicant's changes to the DCD description and determined that crediting two safety-related permanently installed instruments as primary and backup channels conforms with the design features identified in staff guidance (i.e., JLD-ISG-2012-03). Because the applicant conforms to staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of RAI 01.05-01 is resolved. The staff has confirmed that Revision 7 of the DCD includes the markups provided in the response to RAI 01.05-1.

Arrangement:

Commission Order EA-12-051, Attachment 2, Section 1.2, states that the SFP level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the SFP.

This protection may be provided by locating the primary instrument channel and fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the SFP area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the SFP structure.

In the applicant's response to RAI 01.05-1, GEH proposed markups to DCD Tier 2, Section 9.1.3.2 states that the SFP level instrument channels will be arranged in a manner that provides reasonable protection of the level indication function against external missiles. This protection will be provided by maintaining instrument channel separation within the SFP area and will utilize inherent shielding from missiles provided by the existing SFP structure. The channel separation guidance in NEI 12-02, Revision 1, Section 3.2, will be considered in determining sensor locations.

The staff evaluated the applicant's instrument location description provided in the ABWR DCD and determined that the applicant's changes conform to staff guidance (i.e., JLD-ISG-2012-03). Because the applicant conforms to staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of the RAI 01.05-01 is resolved. The staff has confirmed that Revision 7 of the DCD includes the DCD markups provided in response to RAI 01.05-1.

Mounting:

Commission Order EA-12-051, Attachment 2, Section 1.3 states that the installed instrument channel equipment within the SFP shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the SFP structure.

DCD Tier 2, Table 3.2-1, "Classification Summary," identifies that the SFP wide range level instrumentation is classified as a Seismic Category I component. The staff evaluated the applicant's ABWR DCD description and the equipment description included in the response to RAI 01.05-1 and determined that the applicant's changes conforms to staff guidance (i.e., JLD-ISG-2012-03). Because the applicant conforms to staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of the RAI 01.05-1 is resolved.

Qualification:

Commission Order EA-12-051, Attachment 2, Section 1.4 states, in part, that the primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the SFP water at saturation conditions for an extended period.

The applicant's response to RAI 01.05-1 states that the instrument channels depart from the guidance of NEI 12-02 (Revision 1) in that the instrument reliability does not need to consider post-accident conditions of borated water. Boiling-water reactor (BWR) SFPs do not use borated water. DCD Tier 2, Section 7.5.2.1 states that the augmented quality assurance process will ensure that the level instrumentation will be operational at conditions (temperature, humidity and radiation levels) in the vicinity of the SFP and the area of use considering normal operational, event and post-event conditions for no fewer than seven days post-event or until off-site resources can be deployed by the mitigating strategies.

The staff evaluated the applicant's departure from the approved guidance and found it acceptable. Because borated water is not used in the BWR SFP, the instruments are not expected to be exposed to post-accident borated water conditions. The staff reviewed the applicant's response and the information in the DCD and determined that the instruments will be designed to remain operational during all other post-accident anticipated conditions of temperature, humidity and radiation levels and these capabilities will be demonstrated in accordance with the guidance in JLD-ISG-2012-03. Because the applicant conforms to staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of the RAI 01.05-01 is resolved. The staff has confirmed that Revision 7 of the DCD includes the DCD markups provided in the response to RAI 01.05-1.

Independence:

Commission Order EA-12-051, Attachment 2, Section 1.5 states that the primary instrument channel shall be independent of the backup instrument channel.

DCD Tier 2, Section 7.5.2.1 states that the instrument channels are powered from two independent Class 1E batteries. DCD Tier 2, Section 9.1.3.2 identifies the level transmitters as safety-related independent instruments.

The staff reviewed the applicant's response to RAI 01.05-01 along with the ABWR DCD changes. The staff verified that the physical separation of the channels will be sufficient to establish physical and electrical independence. Accordingly, the staff finds that this feature conforms to the guidance in JLD-ISG-2012-03. Because the applicant conforms to staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of the RAI 01.05-01 is resolved. The staff has confirmed that Revision 7 of the DCD includes the DCD markups provided in the response to RAI 01.05-1.

Power Sources:

Commission Order EA-12-051, Attachment 2, Section 1.6 states, in part, that permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power

connections from sources independent of the plant alternating current (ac) and direct current (dc) power distribution systems, such as portable generators or replaceable batteries.

In the applicant's response to RAI 01.05-01, GEH proposed changes to DCD Tier 2, Section 7.5.2.1 to indicate that the level instrument channels will be powered by Class 1E batteries. In addition, the instruments will have the capability of being powered from an independent power source.

The staff identified that the level instrument channels are powered by separate Class 1E DC batteries capable of powering the instruments. The applicant designed the system with the capability of using an alternate power source to power the level instrumentation. Based on the evaluation of the system description provided in the DCD, the staff concludes that these design features conform to the guidance in JLD-ISG-2012-03. Because the applicant conforms to staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of the RAI 01.05-01 is resolved. The staff has confirmed that Revision 7 of the DCD includes the DCD markups provided in the response to RAI 01.05-1.

Accuracy:

Commission Order EA-12-051, Attachment 3, Section 1.4 states that the instrument shall maintain its designed accuracy following a power interruption or change in power source without recalibration.

In the applicant's response to RAI 01.05-01, GEH proposed changes to DCD Tier 2, Section 7.5.2.1 to clarify that an interruption of power to the instruments will not impact the design accuracy of the instruments or require recalibration of the equipment.

The staff evaluated the applicant's response to RAI 01.05-01 and its proposed changes to the DCD instrument description and determined that the applicant conforms to staff guidance (i.e., JLD-ISG-2012-03). Because the applicant conforms to the staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of the RAI 01.05-01 is resolved. The staff has confirmed that ABWR DCD, Revision 7, includes the DCD markups provided in the response to RAI 01.05-1.

Testing:

Commission Order EA-12-051, Attachment 2, Section 1.8 states that the instrument channel design shall provide for routine testing and calibration.

The DCD described the level channels as permanently installed safety-related instrumentation.

The COL information item in DCD Section 7.5.3.1, states that the COL applicant will provide information to ensure that SFP instrumentation shall be maintained to be available in accordance with the requirements of Commission Order EA-12-051, Attachment 2 and that the permanently installed instrument channels are normally used to monitor the SFP level and will be subject to routine testing and calibration in accordance with plant procedures. Therefore, this part of the RAI 01.05-1 is resolved.

Display:

Commission Order EA-12-051, Attachment 2, Section 1.9 states that trained personnel shall be able to monitor the SFP water level from the control room, the alternate shutdown panel, or another appropriate and accessible location. The display shall provide on-demand or continuous indication of SFP water level.

In the applicant's response to RAI 01.05-01, GEH proposed changes to DCD Tier 2, Section 9.1.3.2 to indicate that SFP water level can be monitored from the control room, the Remote Shutdown Panels, or other appropriate location accessible post-accident. Tier 1, Section 2.6.2, was revised to include ITAAC 2.6.2 Item 7 which requires verification that the safety-related level instruments provide level indication in the main control room and an alternate location.

The staff reviewed the applicant's changes to the system description in DCD Tier 1 and 2. The location of the level indication display, as installed, will be verified through testing, which will be confirmed through ITAAC 2.6.2-7, as discussed above. The staff finds that the applicant conforms to staff guidance (i.e., JLD-ISG-2012-03). Because the applicant conforms to staff guidance, the staff finds the applicant complies with Commission Order EA-12-051. Therefore, this part of the RAI 01.05-01 is resolved. The staff has confirmed that Revision 7 of the DCD includes the DCD markups provided in RAI 01.05-1.

Programs:

Commission Order EA-12-051, Attachment 2, Section 2 states that the SFP instrumentation shall be maintained available and reliable through appropriate development and implementation of a training program, procedures, and a testing and calibration program. Personnel shall be trained in the use of the primary and backup instrument channels, provision of alternate power to each channel and testing and calibration of each channel. Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent SFP instrument channels. Processes shall be established and maintained for scheduling and implementing testing and calibration of the primary and backup SFP level instrument channels sufficient to maintain them at the design accuracy.

In DCD Tier 2, Section 7.5.3, "COL License Information," the applicant in COL Information Item 7.5.3.1, "Spent Fuel Pool Level Instruments," states:

In Commission Order EA-12-051, Attachment 2, Section 2 (Reference 7.5-3) states that the SFP instrumentation shall be maintained to be available and reliable through the appropriate development and implementation of a training program. Personnel shall be trained in the use and maintenance (including test and calibration), and in the procedures for providing alternate power to the level instrument channels.

The staff finds that the COL Information Item 7.5.3.1, conforms to the guidance in JLD-ISG-2012-03, which addresses the development of procedures for testing and calibration of the primary and backup SFP level instrument channel, and therefore complies with Commission Order EA-12-051. The staff has also determined that the existing commitments in Final Safety Analysis Report Section 13.5, "Plant Procedures," already cover the procedures for the use of the safety-related permanently installed SFP level instrumentation. Therefore, no new

commitment is needed for the development of these procedures. Accordingly, this part of the RAI 01.05-01 is resolved.

Based on the discussion presented above, the staff finds that all parts of the staff's concerns identified in the response to RAI 0.05-01 have been addressed and found acceptable, therefore RAI 01.05-01 is considered resolved and closed in its entirety.

ITAAC:

DCD Revision 6, Tier 1, Section 2.6.2 discusses a new ITAAC in Table 2.6.2 (as shown below), to ensure that the SFP level instrumentation will be designed and installed as described in Tier 1, Section 2.6.2.

Tier 1 Table 2.6.2 Fuel Pool Cooling and Cleanup System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The safety-related displays provided for the FPC System spent fuel pool wide range water level are as described in Section 2.6.2.	7. Inspections will be performed of the safety-related FPC system displays in both the main control room and at an alternate location.	7. Displays exist or can be retrieved in both the main control room and an alternate location.

As discussed above (in Display supplemental Section), the staff finds that the new Fuel Pool Cooling and Clean-up System ITAAC acceptance criteria will confirm that the installed level instrumentation meets the design functions specified in Tier 1, Section 2.6.2. Therefore, the staff finds that the new ITAAC is acceptable because it meets the requirements of 10 CFR 52.47(b)(1) with respect to the fuel pool cooling and cleanup system.

COL Information Item:

ABWR DCD, Revision 7, includes a COL Information Item in DCD Section 7.5.3.1, which instructs the COL applicants to develop and implement a training program for the use and maintenance of the SFP level instrumentation. As discussed above (in the *Testing and Programs* Section of this SER), the staff finds that the COL Information Item conforms to the guidance in JLD-ISG-2012-03.

22.2.4 Conclusion

Order EA-12-051 required a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the pool water level conditions by trained personnel. In addition, the Order required that SFP level instrumentation include several design features (e.g., redundant instruments, separation and environment qualification). Based on the evaluation discussed above, the staff concludes that the applicant's design conforms with the guidance in JLD-ISG-2012-03, where appropriate, and therefore, is acceptable. As a result, the staff finds these instruments to be reliable, able to withstand design-basis natural phenomena, and capable of monitoring key SFP level conditions that address NTTF Recommendation 7.1 and meet the relevant requirements of the March 12, 2012, Order EA-12-051. The regulation in 10 CFR 50.155(e), "Spent fuel pool monitoring," makes the requirements of NRC Order EA-12-

051 generically applicable for operating plants under 10 CFR Part 50 and COL license holders under 10 CFR Part 52 for which the Commission has made the finding under 10 CFR 52.103(g). The MBDBE rule is not applicable or required for DC applicants, however the design change enhancements provided by GEH to address NTTF Recommendation 7.1 regarding SFP reliable level instrumentation for the ABWR DC renewal, provided in the ABWR DCD, Revision 7, may provide a potential COL applicant the means for meeting 10 CFR 50.155(e).

22.3 Emergency Preparedness (NTTF Recommendation 9.3)

The objective of EP is to ensure that the capability exists for a licensee (or will exist for a COL applicant) to implement measures that mitigate the consequences of a radiological emergency and to provide for protective actions of the public. The accident at Fukushima highlighted the need to determine the staffing needed to respond to a multi-unit event. Additionally, there is a need to ensure that the communication equipment relied on has adequate power to coordinate the response to an event during an extended loss of ac power. Requiring these staffing and communication capabilities were part of NTTF Recommendation 9.3.

In ABWR DCD, Revision 7, which incorporated DCD markups included in responses to RAIs, GEH made changes to the ABWR design to address various aspects of EP, in support of its ABWR DC application. In finalizing the MBDBE rule the enhanced EP capability related to Fukushima NTTF Recommendation 9.3 was removed as a requirement in the rule prior to the final rule affirmation by the Commission. Staffing and communications were removed from the draft final MBDBE rule by the Commission in its January 24, 2019 SRM-M190124A (ADAMS ML19023A038)The applicant was informed of this subsequently and prior to the completion of this supplemental FSER in Phase B of the review and GEH declined the option to revise its ABWR DCD to remove the EP enhancements related to NTTF Recommendation 9.3 that would be applicable to a potential COL applicant.

The staff reviewed these ABWR DCD design enhancements in a separate staff supplemental FSER Section as follows:

- DCD Tier 2, Chapter 13, “Conduct of Operations.”

Supplemental SER Section 13.3, “Emergency Planning,” provides the staff evaluation of the ABWR DCD design modifications to (1) ensure that site-specific radiological protection for the technical support center (TSC) will be verified at the combined license (COL) application stage, consistent with the applicable TSC habitability guidance, and (2) provide for an assessment of staffing and communications capabilities to respond to a beyond-design-basis-event, pursuant to certain NRC actions arising out of the Fukushima NTTF Recommendation 9.3.

References (Standard)

1. 10 CFR 50.155, "Mitigation of beyond-design-basis events."
2. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
3. 10 CFR Part 52, Appendix A, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor."
4. 10 CFR 52.47, "Contents of applications; technical information."
5. 10 CFR 52.59, "Criteria for renewal."
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, December 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).
11. SECY-11-0093, "Near Term Report and Recommendations for Agency Actions Following the Events in Japan," July 12, 2011 (ADAMS Accession No. ML11186A950).
12. SECY-11-0124, "Recommended Actions to Be Taken Without Delay from the NTF Report," September 9, 2011 (ADAMS Accession No. ML11245A127).
13. SECY-11-0137, "Prioritization of Recommended Actions to Be Taken in Response to Fukushima Lessons Learned," October 3, 2011 (ADAMS Accession No. ML11269A204)
14. SECY-12-0025, "Proposed Orders and Requests for Information in Response to Lessons Learned from Japan's March 11, 2011, Great Tohoku Earthquake and Tsunami," February 22, 2012 (ADAMS Accession No. ML12039A111).
15. NRC, EA 12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (ADAMS Accession No. ML12054A735).
16. NRC, EA-12-050, "Order Modifying Licenses with Regard to Reliable Hardened Containment Vents," March 12, 2012 (ADAMS Accession No. ML12054A694).

17. NRC, EA-12-051, "Order Modifying Licenses with Regard to Reliable Spent Fuel Pool Instrumentation," March 12, 2012 (ADAMS Accession No. ML12056A044).
18. NRC, RG 1.226, "Flexible Mitigation Strategies for Beyond-Design-Basis Events," Revision 0, June 2019.
19. NRC, RG 1.227, "Wide-Range Spent Fuel Pool Level Instrumentation," Revision 0, June 2019.