

## 19.0 RESPONSE TO SEVERE ACCIDENT POLICY STATEMENT

This chapter describes the South Texas Project (STP) Units 3 and 4 plant-specific probabilistic risk assessment (PRA) and severe accident evaluations and corresponding regulatory requirements. In accordance with Title 10 *Code of Federal Regulations* (10 CFR) 52.79(a)(46), a combined license (COL) application is required to contain a description of the plant-specific PRA and its results. In addition, 10 CFR 52.79(d)(1) specifies that if the COL application references a design certification (DC), then the plant-specific PRA information must use the PRA information for the DC and be updated to account for site-specific design information and any design changes or departures.

### 19.1 **Purpose and Summary (Related to RG 1.206, Part I, C.I.19, Appendix A, Section 19.0, “Probabilistic Risk Assessment and Severe Accident Evaluation,” and Section 19.1, “Probabilistic Risk Assessment”)**

#### 19.1.1 Introduction

Section 19.1 of the Final Safety Analysis Report (FSAR) describes the text changes in Section 19.1 of the U. S. Advanced Boiling-Water Reactor (ABWR) design control documents (DCD) due to the departures in the STP Units 3 and 4 design from that described in the ABWR DCD. The applicant stated that the consequence of these changes does not change the conclusion of the PRA in the ABWR DCD.

#### 19.1.2 Summary of Application

Section 19.1 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.1 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Appendix A, “Design Certification Rule for the U.S. Advanced Boiling Water Reactor.” Section 19.1 also incorporates by reference Section 19.1 of the STP Nuclear Operating Company application to amend the design certification rule for the U.S. ABWR, “ABWR STP Aircraft Impact Assessment (AIA) Amendment,” Revision 3, dated September 2010, (the AIA Amendment). In addition, in COL FSAR Section 19.1, the applicant provided the following:

##### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and unnecessary inadvertent actuation prevention logic and equipment in the safety-related instrumentation and control (I&C) architecture. The departure also changes the implementation, architecture, testing, and surveillance descriptions of the Safety System Logic and Control (SSLC).

##### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 10.4-5 Condensate and Feedwater System

This departure stated that the condensate booster pumps are part of the modified condensate and feedwater (FW) system.

### 19.1.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503, “Final Safety Evaluation Report Related to the Certification of the Advance Boiling Water Reactor Design,” (July 1994), (Final Safety Evaluation Report [FSER] related to the ABWR DCD). The regulatory basis of the AIA Amendment information incorporated by reference is in NUREG-1948, “Final Safety Evaluation Report Related to the Aircraft Impact Amendment to the U.S. Advanced Boiling Water Reactor (ABWR) Design Certification,” dated June 2011, (the SER related to the AIA Amendment).

In addition, in accordance with Section VIII, “Process for Changes and Departures,” of “Appendix A to Part 52- Design Certification Rule for the U.S. Advanced Boiling Water Reactor,” the applicant identifies Tier 1, Tier 2\*, and Tier 2 departures. Tier 1 departures require prior U.S. Nuclear Regulatory Commission (NRC) approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2\* departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.6. Tier 2 departures affecting technical specifications (TS) require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.C.4. Tier 2 departures that do not require prior NRC approval are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59.

The regulatory basis for accepting the supplementary information relating to site-specific and plant-specific details and design features is established as follows:

- 10 CFR 52.79(a)(46), a description of the plant-specific PRA and its results.
- 10 CFR 52.79(d)(1), which requires a COL applicant referencing a certified design to include in the FSAR sufficient information demonstrating that the site characteristics fall within the site parameters specified in the DC. In addition, the plant-specific PRA information must use the PRA information for the DC and must be updated to account for site-specific design information and any design changes or departures.
- NUREG–0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition),” the Standard Review Plan, (SRP), Section 19.0, “Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors,” Revision 2.
- Regulatory Guide (RG) 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition),” Regulatory Position C.I.19, also provided guidance for COL applicants, and Regulatory Position C.III.19 provided guidance for a COL applicant referencing a certified design.

In addition, 10 CFR 52.79(a)(17) stated that a COL application must contain an FSAR that provided the information with respect to compliance with technically relevant positions of the Three Mile Island (TMI) requirements in 10 CFR 50.34(f) of this chapter, with the exception of 10 CFR 50.34(f)(1)(xii), 10 CFR 50.34(f)(2)(ix), and 10 CFR 50.34(f)(3)(v).

10 CFR 52.79(a)(38) stated that a COL application for a light-water reactor (LWR) design must contain an FSAR that includes a description and analysis of design features for the prevention and mitigation of severe accidents. For example, challenges to containment integrity caused by

a core-concrete interaction, steam explosion, high-pressure core melt ejection, hydrogen combustion, or a containment bypass.

The Staff Requirements Memorandum (SRM) dated July 21, 1993, on SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light Water Reactor (ALWR) Designs," provided direction about severe accidents and the treatment of external events in PRAs to support DC and COL applications.

Interim Staff Guidance (ISG) DC/COL-ISG-03, "Interim Staff Guidance, Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications," dated June 11, 2008 (ML081430087), supplements the guidance provided to the staff in SRP Section 19.0 concerning the review of PRA information and severe accident assessments submitted to support DC and COL applications.

The regulatory requirement and guidance described in this section will be applicable to all subsequent sections in this chapter of the safety evaluation report (SER).

#### **19.1.4 Technical Evaluation**

As documented in NUREG-1503 and NUREG-1948, staff reviewed and approved Section 19.1 of the certified ABWR DCD and AIA Amendment. The staff reviewed Section 19.1 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD and AIA Amendment to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD and AIA Amendment represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Purpose and Summary."

The staff reviewed the following information in the COL FSAR:

##### Tier 1 Departures

The Tier 1 departures identified by the applicant in this chapter require prior NRC approval in the form of an exemption, and the full scope of their technical impact may be evaluated in other sections (or chapters) of this SER. Part 7, Section 5.0 of the COL application provided a listing of all FSAR sections affected by the Tier 1 departures. In addition, compliance with 10 CFR Part 52, Appendix A, Section VIII.A.4, for Tier 1 departures will be addressed by the staff in an exemption evaluation in Chapter 1 of this SER.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and unnecessary inadvertent actuation prevention logic and equipment. The departure also changes the implementation, architecture, testing, and surveillance descriptions of the SSLC. This departure stated that a delta-PRA assessment was performed to determine the effect of the updates on the I&C fault trees (Appendix 19D) and on the common cause failures (CCFs) (Appendix 19N) of the essential communication function (ECF), as presented in Appendix 19D. However, these changes are not included in STP Units 3 and 4 FSAR Appendices 19D and 19N. The staff

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

issued Request for Additional Information (RAI) 19.01-15 requesting the applicant to describe these changes and explain their impact on the PRA results.

The applicant's response to RAI 19.01-15 dated August 5, 2009 (ML092220163), stated that the changes described in Departure STD DEP T1 3.4-1 were evaluated using the plant-specific PRA model, and no quantitative impact was determined given the model described in the DCD and the design described in Departure STD DEP T1 3.4-1. The applicant also stated that Table 19.2-2 of the STP COL FSAR will be revised to address the COL application changes noted in the RAI response. The staff determined this response to RAI 19.01-15 sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. Therefore, the response is acceptable and this RAI is resolved. The staff confirmed that the applicant has incorporated the proposed revision into Chapter 19 of FSAR Revision 4. Therefore, the staff considers RAI 19.01-15 to be resolved and closed.

### Tier 2 Departures Requiring Prior NRC Approval

The Tier 2 departures requiring prior NRC approval identified by the applicant in this chapter may be evaluated in other sections of this SER. Part 7, Section 5.0 of the COL application provided a listing of all FSAR sections affected by the Tier 2 departures. In addition, the applicant's process for evaluating departures from the DCD is subject to NRC inspections. Finally, because 10 CFR 52.79(d)(1) requires the applicant to update the design certification PRA information to account for departures from the ABWR DCD, this chapter of the SER also addressed how the plant-specific PRA has been updated to account for departures from the DCD, including departures requiring prior NRC approval.

- STD DEP 10.4-5 Condensate and Feedwater System

The STP Units 3 and 4 design modification has four variable speed (adjustable speed drive [ASD]) reactor FW pumps and four condensate booster pumps. The original ABWR DCD design has three motor-driven (MD) reactor FW pumps operating at full power. This departure increases the number of reactor FW pumps from three to four in the condensate and in the FW system design. This departure also adds four condensate booster pumps to the system.

The staff issued RAI 19.01-20 requesting the applicant to discuss the impact of these changes on the PRA results. The applicant's response to this RAI dated August 5, 2009 (ML092220163), stated that the value cited for the FW unavailability (5E-02) is determined by assuming that 50 percent of the time, FW pumps will trip on a high-water level and the failure to manually recover at least one pump train is estimated at 0.1. The applicant stated that the number of FW pumps (three) in the standard ABWR design does not affect the derivation of unavailability failure likelihood. Increasing the number of FW pumps to four in the STP Units 3 and 4 design does not affect the derivation of unavailability. The staff determined this approach to be acceptable and therefore, the staff considers RAI 19.01-20 to be resolved and closed.

The staff also evaluated the impact of this departure on the PRA results. In addition, the staff reviewed other departures in later sections and appendices of Chapter 19 of this SER. The staff verified that the impact of these departures on the PRA results is incorporated into the FSAR.

### **19.1.5 Post Combined License Activities**

There are no post COL activities related to this section.

### **19.1.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG–1503 and NUREG–1948. The staff reviewed the application and checked the referenced DCD and AIA Amendment. The staff's review confirmed that the applicant has addressed the required information relating to "Purpose and Summary," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Purpose and Summary" that were incorporated by reference have been resolved.

In addition, based on the above discussion on "Purpose and Summary," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

### **19.1S Additional Information to Support the COL Application**

#### **19.1S.1 Introduction**

The applicant provided a cross-referenced table between the items in RG 1.206, Regulatory Position C.I.19, Appendix A, and the contents in the STP Units 3 and 4 FSAR.

#### **19.1S.2 Summary of Application**

Section 19.1S of the STP Units 3 and 4 COL FSAR Revision 12 provided supplemental information concerning the application in order to assist reviewers.

#### **Supplemental Information**

Table 19.1S-1 cross-references RG 1.206, Regulatory Position C.I.19, Appendix A items, and the FSAR format. Furthermore, the applicant assessed the risk significance of the PRA changes. The applicant stated that the conclusions of the PRA are unaffected by any design change or site-specific analysis performed to support the COL application for the STP Units 3 and 4.

#### **19.1S.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

#### **19.1S.4 Technical Evaluation**

The staff reviewed Section 19.1S of the STP Units 3 and 4 COL FSAR. The staff reviewed the results of the STP Units 3 and 4 PRA and determined them to be acceptable. The staff verified that the impact of departures on the PRA results is incorporated into the FSAR.

#### **19.1S.5 Post Combined License Activities**

There are no post COL activities related to this section.

## 19.1S.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Additional Information to Support the COL Application." No outstanding information is expected to be addressed in the COL FSAR related to this section.

In addition, based on the above discussion on "Additional Information to Support the COL Application," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## 19.2 Introduction (Related to RG 1.206, Part I, C.I.19, Appendix A, Section 19.1, "Probabilistic Risk Assessment"; Subsection 19.1.2.2, "PRA Level of Detail;" Subsection 19.1.4.1.1, "Description of the Level 1 PRA for Operation at Power;" Subsection 19.1.4.1.2, "Results from the Level 1 PRA for Operations at Power"; and Section 19.2.1, "Introduction")

### 19.2.1 Introduction

Section 19.2 of the FSAR describes the text changes and supplemental information in Section 19.2 of the ABWR DCD due to the site-specific evaluations of the STP Units 3 and 4. The applicant stated that the consequence of these changes does not change the conclusion of the PRA in the ABWR DCD.

### 19.2.2 Summary of Application

Section 19.2 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.2 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 19.2, the applicant provided the following:

#### Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP Admin

This departure corrects the referencing of key PRA assumptions regarding the reactor service water (RSW) system in Table 19.2-1 from FSAR Section 19.9.21 to Section 19.9.26.

#### Supplemental Information

##### *Section 19.2.2 "Objective and Scope"*

Table 19.2-2 in this section summarizes the effects of all listed departures in the COL FSAR on the PRA analysis and results.

##### *Subsection 19.2.3.1 "Key Assumptions and Ground Rules"*

The applicant updated the assumptions using supplemental site-specific information.

##### *Subsection 19.2.4.4 "External Consequence Analysis"*

The applicant updated the evaluation of external consequences with site-specific information using the MACCS computer code.

#### *Subsection 19.2.4.5 “Consequence Analysis Results”*

Using site-specific information, the applicant conducts evaluations and assesses them against the original results in Appendix 19E.3.

### **19.2.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19.2.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Section 19.2 of the certified ABWR DCD. The staff reviewed Section 19.2 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to the “Introduction.”

The staff reviewed the following information in the COL FSAR:

#### *Tier 2 Departure Not Requiring Prior NRC Approval*

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (e.g., misspellings, incorrect references, table headings). The applicant identifies that this departure corrects the referencing of key PRA assumptions regarding RSW in Table 19.2-1 from FSAR Section 19.9.21 to Section 19.9.26. The departure is only an administrative change and is therefore acceptable.

The applicant’s evaluation, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. Within the review scope of this section, the staff determined it to be reasonable that this departure does not require prior NRC approval.

#### *Supplemental Information*

##### *Section 19.2.2 “Objective and Scope”*

Table 19.2-2 lists changes identified as DCD changes or revised structure, system, and component (SSC) design definitions. The table identifies those designs that can potentially impact the PRA and the extent of the impact. The staff asked the applicant to provide additional information on the rationale for determining the impact of the departures on the PRA results.

The staff issued RAI 19.01-17 requesting the applicant to discuss the impact of added components on the results of the interfacing systems loss-of-coolant accident (ISLOCA)

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

analysis. In response to this RAI dated August 5, 2009 (ML092220163), the applicant stated that in the ABWR DCD design all piping systems, major system components (pumps and valves), and subsystems connected to the reactor coolant pressure boundary (RCPB) that extends outside the primary containment boundary are designed, to the extent practicable, to an ultimate rupture strength (URS) at least equal to full RCPB pressure. Accordingly, the ABWR DCD PRA does not include the ISLOCA as an initiating event. Therefore, upgrading the list of ISLOCA components does not change the assumption of an ISLOCA event in the PRA model. The staff determined this response to be acceptable, and therefore, the staff considers RAI 19.01-17 to be resolved and closed.

The staff issued RAI 19.01-13 requesting the applicant to discuss the impact of tripping condensate pumps in the event of an FW line break on the results of the PRA analysis. This RAI was tracked as Open Item 19-1 in the SER with open items. In the response to this RAI dated March 16, 2010 (ML100770391), the applicant stated that the containment response to an FW line break inside the containment—without taking the credit for the automated condensate pump trip—is within the acceptable range. Therefore, taking this credit will have no negative impact on the PRA results. The staff agreed with this assessment, and therefore, the staff considers RAI 19.01-13, (Open Item 19-1) to be resolved and closed.

The staff issued RAI 19-7 requesting the applicant to explain whether the manual switchover from one unit to the other unit for the fire protection system is modeled. If so, the RAI asked the applicant to describe the impact on the core damage frequency (CDF) from a fire event, as well as the impact of this single-fire protection system for the two units on the PRA results from an initiating event that can simultaneously affect both units (e.g., a loss of offsite power [LOOP] event).

The applicant's response to RAI 19-7 dated December 3, 2009 (ML093421266), stated that Table 19.2-2 of FSAR will be revised to indicate that there is no significant effect on CDF, no change to the PRA, and only editorial changes to the fire protection system. The staff determined that the applicant's response was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. The staff confirmed that the applicant has incorporated the proposed revision into Chapter 19 of FSAR Revision 4. Therefore, the staff considers RAI 19-7 to be resolved and closed.

The staff issued RAI 19-8 requesting the applicant to clarify the heat removal rate of the residual heat removal (RHR) system and to explain whether the PRA results are impacted by this change in the heat removal capacity of the RHR heat exchanger.

The applicant's response to RAI 19-8 dated July 13, 2009 (ML092740559), stated that Table 19.2-2 of FSAR will be revised to indicate that the residual heat removal system (RHR) heat removal rate increases to 0.427 megawatts (MW) per degrees Celsius (centigrade) ( $^{\circ}\text{C}$ ) ( $\text{MW}/^{\circ}\text{C}$ ). The staff determined the response to RAI 19-8 was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. The staff confirmed that the applicant has incorporated the proposed revision into Chapter 19 of FSAR Revision 4, and therefore, the staff considers RAI 19-8 to be resolved and closed.

The staff issued RAI 19-9 requesting the applicant to explain whether key lock switches that are replaced with normal manual push-button switches are modeled in the PRA. If so, the RAI asked the applicant to describe the impact on the PRA results and the potential beneficial effect for a plant-specific PRA.

The applicant's response to RAI 19-9 dated July 13, 2009 (ML092740559), stated that the PRA was developed to support the DCD and is not extended to the level of detail to distinguish between key lock switches and push-button switches. Also, generic operator probabilities were used in the PRA, and the applicant stated that operator response time to implement procedures is improved by the rotate and depress push-button action, instead of the slower response resulting from the administrative controls necessary when using key lock switches. The staff determined the applicant's response to RAI 19-9 was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19, and therefore, the staff considers RAI 19-9 to be resolved and closed.

The staff issued RAI 19-10 requesting the applicant to specify whether the described changes to the engineered safety features (ESF) Logic and Control System (ELCS) Mode are a clarification to the text or a design change and if the change is a design change, to explain to the staff how the PRA results are affected.

The applicant's response to RAI 19-10 dated July 13, 2009 (ML092740559), stated that because there is a significant amount of time available for the operator to actuate the RHR system in the suppression pool cooling (SPC) after the core cooling function is successful, the operator action is modeled with a very low human error probability value of  $6.5E-5/\text{demand}$ . The manual switch itself was not modeled. The switch design in the departure requires a certain "permissive" function be performed before the operator can initiate the RHR in the SPC mode, and the applicant characterizes this change as having the beneficial effect of reducing operator error. The applicant also stated that the changes to the ELCS logic assure that the high-pressure core flooder (HPCF) "C" diverse hard-wired manual initiation function has priority over the normal automatic initiation logic for the HPCF "C." This level of detail is not modeled in the PRA developed to support the DCD but is consistent with the intent of the PRA model. So the change does not have any impact on the PRA results. The staff determined that this response to RAI 19-10 was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. Therefore, the staff considers RAI 19-10 to be resolved and closed.

The staff issued RAI 19-11 requesting the applicant to specify whether the described changes to the Containment Spray Logic Change are a clarification to the text or a design change. RAI 19-11 also requested the applicant to explain to the staff how the PRA results are affected if the change is a design change.

The applicant's response to RAI 19-11 dated December 3, 2009 (ML093421266), stated that the departure clarifies the STP Units 3 and 4 containment spray logic design by (1) emphasizing that the low-pressure flooder (LPFL) mode has precedence over the containment spray below reactor vessel water Level 1; (2) clarifying the initiation of drywell and wetwell sprays; (3) clarifying the interlocks associated with the RHR operation; and (4) clarifying that logic changes for the wetwell spray valves and suppression pool return valves do not change the DCD-required functional or safety requirements. The applicant also stated that (a) the containment spray function is modeled in the internal events PRA prepared to support the DCD; (b) credit was taken for the containment spray function in evaluating the radioactive release consequences (categories and their frequencies); and (c) in this evaluation, the spray function is modeled with an operator action, but the control and logic associated with the spray function are not modeled. Therefore, this departure will not change the PRA results. The staff determined this response to RAI 19-11 was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. Therefore, the staff considers RAI 19-11 to be resolved and closed.

The staff issued RAI 19-12 requesting the applicant to specify whether the described changes to the RHR SPC modification are a clarification of the text or a design change. In addition, the RAI requested the applicant to explain to the staff how the PRA results are affected.

The applicant's response to RAI 19-12 dated July 13, 2009 (ML092740559), stated that the departure clarifies the STP Units 3 and 4 RHR SPC logic design to provide (1) a more complete description of the SPC mode automatic and manual operations; and (2) more details regarding the mode switch and its operation and to indicate that there are no changes in the DCD-required functional or safety requirements. The applicant also stated that in the PRA that was prepared to support the DCD, the SPC mode is modeled as being initiated by an operator action. Also, the PRA does not model the details of the switch or the logic associated with the SPC mode of operation; the switch and the logic have a negligible impact on the PRA results compared to the operator action associated with the SPC mode of operation. Therefore, this departure has no impact on the results of the PRA. The staff determined this response to RAI 19-12 was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. Therefore, the staff considers RAI 19-12 to be resolved and closed.

The staff issued RAI 19-13 requesting the applicant to explain whether the safety/relief solenoid valves are modeled in the PRA. If so, the RAI asked the applicant to describe the impacts of these changes on the PRA results, as well as the potentially beneficial effects on the plant-specific PRA.

The applicant's response to RAI 19-13 dated December 3, 2009 (ML093421266), stated that the safety/relief solenoid valves are included in the PRA described by the DCD. However, the testing of the safety/relief valves (SRVs) described in Subsection 7.3.1.1.2(g) and modified by Departure STD DEP 7.3-16 is not included in the PRA described by the DCD. Because the DCD testing restriction stated that the pilot solenoid valves can only be tested when the reactor is not pressurized (i.e., shutdown), there is no change to the PRA described in the ABWR DCD. The applicant also stated that this departure removes the reactor pressure restriction, which allows testing to be performed at any pressure. The improved testing capabilities enhance the ability to schedule and perform planned and preventative maintenance, which leads to improved equipment reliability and reduces online unavailability. This improved equipment reliability is the potential benefit for the plant-specific PRA required to support plant operations in accordance with 10 CFR 50.71(h), which is identified in Table 19.2-2. The staff determined this RAI response was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. Therefore, the staff considers RAI 19-13 to be resolved and closed.

The staff issued RAI 19-14 requesting the applicant to specify whether the described changes to the reactor building cooling water system are a clarification of the text or a design change. RAI 19-11 also requested the applicant to explain to the staff how the PRA results are affected if the change is a design change.

The applicant's response to RAI 19-14 dated July 13, 2009 (ML092740559), stated that Table 19.2-2 of the FSAR will be revised to remove the statement "clarification to text" and no "direct" effect on the PRA. This engineering change supports an increased heat removal capacity and corrects inconsistencies in Subsection 9.2.11.2. The staff determined this response to RAI 19-14 was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. The staff verified that the applicant has incorporated the proposed revision in Revision 4 of the FSAR. In a supplemental response to RAI 19-14 dated January 20, 2010 (ML100250138), the applicant explains the screening process for developing the plant-specific PRA model in

accordance with the guidance described in RG 1.206, Regulatory Position C.III.I.19. Based on this process, eleven changes or departures remained after the preliminary screening. In addition, the site-specific ultimate heat sink (UHS) design is included in the final evaluation process. The staff determined this process to be acceptable for identifying the impact of the departures on the PRA model changes. Therefore, based on the above discussion, the staff considers RAI 19-14 to be resolved and closed.

#### *Subsection 19.2.3.1 “Key Assumptions and Ground Rules”*

In FSAR Subsection 19.2.3.1 Revision 2, the applicant did not provide the supplemental information relating to the key assumptions. The staff issued RAI 19.01-22 requesting the applicant to provide this information. The applicant’s response to RAI 19.01-22 dated August 5, 2009 (ML092220163), is discussed in detail in Section 19.3.4 of this SER. Based on this response, the assumptions in the STP Units 3 and 4 PRA model have been supplemented with updates from site-specific information. Based on the staff’s review of Section 19.3.4, the staff considers RAI 19.01-22 to be resolved and closed.

#### *Subsection 19.2.4.4 “External Consequence Analysis”*

The applicant updated the evaluation of external consequences with site-specific information using the MACCS2 computer code. The evaluation and review are in Section 19E.4 of this SER.

#### *Subsection 19.2.4.5 “Consequence Analysis Results”*

The evaluations and reviews of the results are in Section 19E.4 of this SER.

### **19.2.5 Post Combined License Activities**

There are no post COL activities related to this section.

### **19.2.6 Conclusion**

The staff’s finding related to information incorporated by reference is in NUREG–1503. The staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information relating to the “Introduction,” and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Introduction” that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion in the “Introduction,” the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

**19.3 Internal Event Analysis (Related to RG 1.206, Part I, C.I.19, Appendix A, Subsections 19.1.4.1.1, "Description of the Level 1 PRA for Operation at Power"; 19.1.4.1.2, "Results from the Level 1 PRA for Operations at Power"; 19.1.4.2.1, "Description of the Level 2 PRA for Operations at Power"; 19.1.4.3.1, "Description of the Level 3 PRA for Operations at Power"; and Section 19.2, "Severe Accident Evaluation")**

**19.3.1 Introduction**

Section 19.3 of the FSAR describes the text changes and supplemental information in Section 19.3 of the ABWR DCD due to the site-specific changes in STP Units 3 and 4. The applicant stated that the PRA results and insights are still in compliance with the conclusion of the PRA in the ABWR DCD.

**19.3.2 Summary of Application**

Section 19.3 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.3 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 19.3, the applicant provided the following:

Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump

This departure addressed the issue that the reactor core isolation cooling (RCIC) pump and turbine are contained in the same casing on a monoblock. The design eliminates many supporting components.

- STP DEP T1 5.0-1 Site Parameters

This departure addressed information pertaining to STP Units 3 and 4 site parameters. The information that is not bounded by the ABWR DCD is described in the FSAR.

Tier 2 Departures Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This design change utilizes two medium-voltage electrical systems (MVES) (13.8 kilovolt [kV] and 4.16 kV) instead of the one 6.9 kV electrical system described in the ABWR DCD.

- STD DEP 10.4-5 Condensate and Feedwater System

This departure increases the number of reactor feed pumps from three to four and adds four condensate booster pumps to the system.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 2.2-5 CRAC2 and MACCS2 Code

This departure replaces the CRAC2 code with the MACCS2 computer code; the CRAC2 code was used in the DCD.

- STP DEP 9.2-5 Reactor Service Water (RSW) System

This departure increases the RSW flow rate required for the increased heat load from the STP Units 3 and 4 designs.

- STD DEP 19.3-1 Evaluation of Common Cause Failures

This departure addressed CCF factors identified in the ABWR DCD review process and added to the STP Units 3 and 4 PRA model.

- STD DEP Admin

This departure addressed corrections in the cross-references of various sections in the ABWR DCD.

### Supplemental Information

#### *Section 19.3.1 "Frequency of Core Damage"*

The applicant reviews the impact of these departures on the site-specific PRA results.

##### *Subsection 19.3.1.1 "Accident Initiators"*

The applicant describes the evaluation to verify that the overall risk impact of grid events at STP Units 3 and 4 is bounded by the original Standard Safety Analysis Report (SSAR), Appendix 19D analysis.

##### *Subsection 19.3.1.3 "Accident Sequence Analysis"*

The applicant uses the modified condensate and FW system as a frontline system in the PRA analysis.

##### *Subsection 19.3.1.4 "Frequency of Core Damage"*

The applicant evaluates the impact of the above departures on the frequency of core damage.

##### *Subsection 19.3.1.5 "Results in Perspective"*

The applicant discusses the qualitative results of a Level 1 internal event at power in the context of the above departures.

#### *Section 19.3.3 "Magnitude and Timing of Radioactive Release"*

The applicant changes the location of the results; these are administrative changes.

##### *Subsection 19.3.4 "Consequence of Radioactive Release"*

The applicant stated that the MACCS2 computer code was used to calculate the consequences of potential radioactive releases.

### 19.3.3 Regulatory Basis

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### 19.3.4 Technical Evaluation

As documented in NUREG–1503, staff reviewed and approved Section 19.3 of the certified ABWR DCD. The staff reviewed Section 19.3 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Internal Event Analysis."

The staff reviewed the following information in the COL FSAR:

#### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump

The pump and turbine are contained in the same casing on a monoblock. This design eliminates many supporting components. The staff issued RAI 19.01-14 asking the applicant to describe how the new design is modeled in the STP Units 3 and 4 plant-specific PRA model. The applicant's response to RAI 19.01-14 dated August 5, 2009 (ML092220163), stated that the lubrication system basic event and other supporting component basic events including the condensate pump, the barometric condenser, and the vacuum pump, were removed from the PRA model because these components were eliminated from the new design. The results show that the impact on the CDF is minimal. The staff performed an audit (ML093560778) on the RCIC model changes and confirmed that the impact of the RCIC change on CDF is minimal. Therefore, the staff considers RAI 19.01-14 to be resolved and closed.

- STP DEP T1 5.0-1 Site Parameters

STP Units 3 and 4 site parameters are not bounded by the site parameter descriptions in the ABWR DCD. Appendix 19R of this SER describes and evaluates the effect of this departure on the external flooding analysis.

#### Tier 2 Departures Requiring Prior NRC Approval

The following Tier 2 departures identified by the applicant in this section require prior NRC approval, and the full scope of its technical impact is evaluated in the other sections of this SER accordingly. Part 07, Section 5.0 of the COL application provided a listing of all FSAR sections affected by the Tier 2 departures.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This departure modifies the plant MVES design and stated that dual MVES consisting of 13.8 kV and 4.16 kV will replace the single 6.9 kV MVES in the ABWR DCD. The staff issued RAI 19.01-18 requesting the applicant to provide a list of PRA components that are supported by the 13.8 kV and 4.16 kV systems. The applicant's response to this RAI dated August 5, 2009 (ML092220163), stated that there were no change in divisional Class 1E bus loads and only minor shifts in the non-Class 1E bus loads, between the 6.9 kV and the new 13.8/4.16 kV buses. However, the applicant did not provide the basis for how the new basic event failure rates were calculated. RAI 19.01-18 was tracked as Open Item 19-3 in the SER with open items. In a supplemental response dated December 3, 2009 (ML093421266), the applicant provided the basis for the new basic events. The staff's review indicated that there were no reported differences in failure data between different distribution voltage designs. Therefore, the staff determined it to be acceptable to use the data supporting the ABWR PRA for the revised 13.8 kV/4.16 kV distribution system for STP Units 3 and 4. Therefore, based on this discussion, the staff considers RAI 19.01-18 (Open Item 19-3) to be resolved and closed.

- STD DEP 10.4-5 Condensate and Feedwater System

This departure increases the number of reactor feed pumps from three to four in the condensate and FW system design. The evaluation of this departure is in Section 19.1.4 of this SER.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 2.2-5 CRAC2 and MACCS2 Code

This departure replaces the CRAC2 computer code with the MACCS2 computer code. The evaluation of this departure is in Section 19E.4 of this SER.

- STP DEP 9.2-5 Reactor Service Water (RSW) System

This departure modifies the RSW and the UHS system designs to meet the increased heat removal requirements of the reactor cooling water (RCW) system for STP Units 3 and 4.

The applicant's evaluation of this departure in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. The staff reviewed the Departures Report regarding this departure and could not determine whether it was reasonable for this departure not to require prior NRC approval. Therefore, the staff issued RAI 19.01-19 requesting the applicant to describe the changes in the STP Units 3 and 4 plant-specific PRA model and explain the impact the changes have on the PRA results. In the response to this RAI dated August 5, 2009 (ML092220163), the applicant stated that the addition of the UHS cooling fans resulted in an approximate 10 percent increase in division failure frequency. A normally open motor-operated valve (MOV) was added to the RSW pump discharge with no significant effect on PRA results due to the low failure rate for a normally open valve. The overall CDF increase due to the RSW-UHS design is small. The staff performed an audit (ML093560778) and confirmed that the effect on CDF is small. Therefore, the staff considers RAI 19.01-19 to be resolved and closed.

- STD DEP 19.3-1

## Evaluation of Common Cause Failures

Based on Section 19D.8.6 of the ABWR SSAR, the following SSCs are considered in the CCF sensitivity analysis for the HPCF, RHR, RCW, and RSW systems: pumps, pump auxiliary equipment, manual valves, MOVs, check valves, room air conditioners, spargers, strainers, circuit breakers, flow transmitters, heat exchangers, and temperature elements. CCF factors identified in the ABWR SSAR were added in the STP Units 3 and 4 PRA model. In the response to RAI 19.01-22 dated August 5, 2009 (ML092220163) and the audit of the STP Units 3 and 4 PRA that was conducted at the Nuclear Energy Institute (NEI) office in Rockville, Maryland, during September 22 and 23, 2009 (ML093560778), the staff noted that CCFs were modeled for the pumps of the RSW and RCW systems. However, it was not clear whether CCFs were being considered for other systems and components (e.g., HPCF and RHR). The applicant subsequently revised the PRA model to include the HPCF and RHR systems. Therefore, the staff considers RAI 19.01-22 to be resolved and closed.

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (e.g., misspellings, incorrect references, table headings). The applicant identifies corrections to the appropriate reference in Section 19.3.3, "Magnitude and Timing of Radioactive Release," of the ABWR DCD. This change corrects the cross-referencing in the DCD and has no impact on the results presented in the DCD or the COL FSAR. The staff determined this change to be acceptable.

The applicant's evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5 determined that the departures do not require prior NRC approval. The above Tier 2 departures were evaluated in other chapters of this SER. Within the review scope of this section, the staff determined it to be reasonable that the departures do not require prior NRC approval.

The staff also evaluated the impact of the above departures on the PRA results. The results of the evaluation are summarized below.

### Supplemental Information

#### *Section 19.3.1 "Frequency of Core Damage"*

The applicant reviewed the impact of the departures on the site-specific PRA results. The evaluation includes the departures described above, except for Departure STD DEP 2.2-5, which is evaluated in Appendix 19E.

#### *Subsection 19.3.1.1 "Accident Initiators"*

The applicant describes the evaluation verifying that the overall risk impact of grid events at STP Units 3 and 4 is bounded by the analysis in Appendix 19D of the referenced DCD. The staff issued RAI 19.01-1 requesting the applicant to describe the quantitative information used to determine that the risk impact of the LOOP events at STP Units 3 and 4 is bounded by the analysis in Appendix 19D of the referenced DCD.

The applicant's response to RAI 19.01-1 dated July 23, 2009 (ML092080083), stated that a sensitivity analysis comparing the ABWR LOOP results (including initiating event frequency and recovery data) to similar area specific data in NUREG/CR-6890, "Reevaluation of Station

Blackout Risk at Nuclear Power Plants,” was performed for the STP Units 3 and 4 plant-specific PRA model and re-performed using the reconstituted PRA model of the ABWR. Using the data from NUREG/CR-6890 for the Energy Reliability Council of Texas (ERCOT), there is a decrease in CDF from the LOOP-initiating events. This finding confirms that the frequency estimates for the LOOP events used in SSAR Subsection 19D.3.1.2.4, including specific causes such as a severe storm, are bounding for the STP Units 3 and 4 site. The STP FSAR will be revised to clarify the use of the NUREG/CR-6890 LOOP data and the results of the sensitivity analysis.

During the staff's audit of the STP Units 3 and 4 PRA in September 2009 (ML093560778), the staff reviewed the applicant's detailed quantitative calculation used to determine that the risk impact of LOOP events at STP Units 3 and 4 is bounded by the analysis in Appendix 19D of the SSAR. This evaluation also addressed COL License Information Item 19.6 (see Section 19.9 of this SER for additional details). This detailed calculation included a sensitivity analysis comparing the LOOP PRA results of the SSAR, including LOOP frequency and recovery data, to similar area-specific data using the ERCOT regional information in Table 3-6 of NUREG/CR-6890. The power recovery distribution for STP Units 3 and 4 is consistent with that used in the SSAR. The detailed calculation showed a decrease in CDF from LOOP-initiating events for STP Units 3 and 4, which confirms that the frequency estimates for the LOOP events used in SSAR Subsection 19D.3.1.2.4 are bounding for STP Units 3 and 4. However, the staff determined that the applicant did not actually use the ERCOT regional LOOP frequency (i.e., 0.0262/reactor-critical-year). Instead, the applicant used the plant-level, industry average LOOP frequency in Table 3-1 of NUREG/CR-6890 (i.e., 0.0359/reactor-critical-year). This discrepancy, however, does not change the conclusion that the frequency estimates for the LOOP events used in SSAR Subsection 19D.3.1.2.4 are bounding for STP Units 3 and 4. Based on the above observation, the applicant agreed to revise the detailed calculation using the ERCOT data and to resubmit the response to RAI 19.01-1.

The applicant's revised response to RAI 19.01-1 dated December 3, 2009 (ML093421266), appropriately uses the ERCOT regional LOOP frequency. Based on the above discussion, the staff determined that the applicant's response to RAI 19.01-1 sufficiently addressed the concerns associated with this RAI. The staff confirmed that the applicant has incorporated the proposed revisions into Chapter 19 of FSAR Revision 4. Therefore, the staff considers RAI 19.01-1 to be resolved and closed.

#### *Subsection 19.3.1.3 “Accident Sequence Analysis”*

The PRA analysis used the modified condensate and FW system as a front-line system. See the discussion under Departure STD DEP 10.4-5 in this section.

The staff conducted an audit of the STP Units 3 and 4 PRA on September 22 and 23, 2009 (ML093560778). Before the audit, the staff reviewed the accident sequence analysis in the ABWR SSAR, including selected event trees in Section 19D of this report. The staff also reviewed Subsection 19.3.1.3 of the STP Units 3 and 4 FSAR, Revision 2, for departures. Based on this review, the staff chose the following two at-power internal event trees in the SSAR for comparison against the reconstituted STP CAFTA model (REC model) during the audit:

- Large break, loss-of-coolant accident (LOCA)
- Inadvertent opening of a relief valve

The REC model event trees were determined to be functionally identical to those in the SSAR. No top events in the Level 1 event trees were identified for the control rod drive (CRD) flow, the containment overpressure protection system (COPS), and the firewater addition system in either the SSAR or the REC models. The staff further verified that the CRD flow and firewater addition system are not explicitly modeled in the pertinent STP fault trees.

#### *Subsection 19.3.1.3.1 "Success Criteria"*

As stated previously, staff conducted an audit of the STP Units 3 and 4 PRA (ML093560778). Before the audit, the staff reviewed the success criteria described in Subsection 19.3.1.3.1 of the SSAR and tabulated in Table 19.3-2 of the SSAR. The staff also reviewed the changes to the success criteria described in Table 19.3-2 of the STP Units 3 and 4 FSAR. The only departure in the STP success criteria table requires the addition of a condensate booster pump wherever a condensate pump appears in the corresponding SSAR table.

The staff requested verification that the discharge pressure of the condensate booster pump would be sufficient to overcome reactor pressure vessel backpressure for the events of interest. The staff confirmed that the discharge pressure of the condensate booster pump is equivalent to that of the original condensate pump described in the SSAR and is adequate to provide injection, as specified in the success criteria of Table 19.3-2 of the STP Units 3 and 4 FSAR.

The staff issued RAI 19.01-30 requesting the applicant to confirm that no credit is taken for the firewater addition to the reactor vessel in the calculation of the baseline CDF. In response to RAI 19.01-30 dated November 3, 2009 (ML093140253), the applicant stated that the firewater addition system pump can prevent initial core damage, but this capability is conservatively ignored in the PRA.

The applicant substantially reconstituted the Level 1 internal events PRA from the SSAR and made sequence-by-sequence comparisons between the REC model and the SSAR PRA. A number of significant discrepancies arose when no credit was taken for the CRD flow and the COPS (as well as RHR recovery actions before containment failure and core damage) in the Level 1 REC model. These differences can be substantially reconciled when credit for the CRD and COPS, and RHR recovery is taken via post-processing of the relevant accident sequence frequencies. Specifically, without credit for the CRD flow (or credit for the recovery of some other high-pressure injection system) in the REC model, a number of sequences can be as much as an estimated order of magnitude higher in frequency than the corresponding SSAR PRA results. When integrating overall sequences, credit for the CRD flow reduces CDF by about 3 percent. Likewise, credit for the COPS and RHR recovery reduces the estimated internal CDF events by about a factor of 3 to 4. Although the CRD flow is not explicitly described as part of the success criteria in Table 19.3-2, the CRD flow (or recovery of some other high pressure injection system) may be credited for several events in the reconstituted PRA model. Therefore, the staff issued RAI 19.01-30 requesting the applicant to clarify the following statement in Subsection 19.3.1.3 of the STP Units 3 and 4 FSAR:

The Control Rod Drive (CRD) pumps which have limited capacity have not been included in the success criteria.

The staff's review of the SSAR also identified that although credit for the COPS is not explicitly modeled in the Level 1 PRA event trees, credit can be identified in the containment event trees. For example, Figure 19D.5-10 of the SSAR (Amendment 33) shows the containment event

trees for the Class II plant damage state and corresponding sequences. The COPS rupture disk opening for the branch path with no RHR recovery leads to successful core cooling and no core damage. Thus, the staff issued RAI 19.01-30 requesting clarification regarding the extent to which credit is taken for the COPS for relevant events.

The applicant's response to RAI 19.01-30 dated November 3, 2009 (ML093140253), clarifies the success criteria and the extent to which a number of systems are credited in the Level 1 PRA for STP Units 3 and 4. These systems include the CRD flow, COPS, RHR recovery, and alternating current (ac)-independent water addition (ACIWA). The staff found that the applicant's response to RAI 19.01-30 (parts 1 through 3) clarifies how these systems are or are not credited in the PRA (1) by identifying the appropriate sections and text in the DCD and SSAR, and (2) by the fact that these sections are "incorporated by reference" in the STP Units 3 and 4 FSAR. The staff considered the applicant's response to RAI 19.01-30 acceptable, and therefore considers RAI 19.01-30 to be resolved and closed.

#### *Subsection 19.3.1.4 "Frequency of Core Damage"*

The applicant evaluated the impact of the departures on the CDF. The staff issued RAI 19.01-22 asking the applicant to provide the quantitative results and the discussions of those results. This RAI was tracked as Open Item 19-2 in the SER with open items. The applicant's response to this RAI dated August 5, 2009 (ML092220163), stated that the cumulative impact of the STP plant-specific CDF is less than a 10 percent change in CDF relative to the design certification PRA. Therefore, there is no need to provide the quantitative results according to the staff guidance in DC/COL-ISG-03. The staff performed another audit on March 31, 2010 (ML110260193), and examined the results of the STP plant-specific PRA. The staff determined the results to be acceptable, and RAI 19.01-22 (Open Item 19-2) is therefore resolved and closed.

#### *Subsection 19.3.1.5 "Results in Perspective"*

The applicant provided the qualitative results of a Level 1 internal event at power in the context of the above departures. The staff issued RAI 19.01-22 asking the applicant to provide the quantitative results and the discussions of those results. This RAI was tracked as Open Item 19-2 in the SER with open items. Based on the conclusion of the above discussion in Subsection 19.3.1.4, the staff considers RAI 19.01-22 to be resolved and closed.

#### *Section 19.3.3 "Magnitude and Timing of Radioactive Release"*

The applicant makes administrative changes to the location of the results. This discussion is in Section 19E.4 of this SER.

#### *Section 19.3.4 "Consequence of Radioactive Release"*

The applicant stated that the MACCS2 computer code was used to calculate the potential radioactive release. This discussion is described in Section 19E.4 of this SER.

### **19.3.5 Post Combined License Activities**

The applicant identifies Commitment (COM 19.9-2) to address COL License Information Item 19.2, as discussed in Section 19.9.4 of this SER.

### 19.3.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Internal Event Analysis," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Internal Event Analysis" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "Internal Event Analysis," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

### 19.4 External Event Analysis and Shutdown Risk Analysis (Related to RG 1.206, Part I, C.I.19, Appendix A, Section 19.1.5, "Safety Insights from the External Events PRA for Operations at Power," and Subsection 19.1.6.1, "Safety Insights from the PRA for Other Modes of Operation")

#### 19.4.1 Introduction

Section 19.4 of the FSAR describes the text changes and supplemental information in Section 19.4 of the ABWR DCD due to the site-specific changes in STP Units 3 and 4. The applicant stated that the PRA results are bounded by the conclusion of the ABWR DCD, with the exception of the shutdown risk analysis due to hurricanes and the probabilistic flooding analysis. These site-specific analyses were performed, and the results are discussed in Appendices 19L and 19R, respectively.

#### 19.4.2 Summary of Application

Section 19.4 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.4 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 19.4, the applicant provided the following:

##### Tier 1 Departure

- STD DEP T1 2.15-1 Re-classification of Radwaste Building Substructure from Seismic Category I to Non-Seismic

This departure addressed the determination that the radwaste building (RWB) is not classified as a seismic Category I structure.

##### Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP Admin

This departure addressed the proposed administrative departure from the ABWR DCD that entails minor corrections in the referenced ABWR DCD (e.g., misspellings).

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure addressed the internal flooding of the control building due to the elimination of vacuum breaker valves on the supply and return piping connecting to the RCW heat exchangers. Elimination of the vacuum breaker valves is due to the RSW system design changes that include the use of horizontal type pumps instead of vertical wet-pit type pumps, in addition to piping configuration changes between the UHS basin and the control building. This departure affects FSAR Section 19.4.5 by eliminating the need for considering the anti-siphon capability and pipe length limit in the RSW design.

#### Supplemental Information

##### *Subsection 19.4.3.2.1 “Structure Fragility”*

Because of the reclassification of the RWB from seismic Category 1 to non-seismic in the Departure STD DEP T1 2.15-1, no seismic fragility for this building is evaluated.

##### *Subsection 19.4.3.4 “Results of the Analysis”*

The applicant stated that the STP Units 3 and 4 site-specific geology is bounded by the ABWR DCD seismic design.

##### *Section 19.4.4 “Fire Protection Probabilistic Risk Assessment”*

The applicant reviews the impact of proposed plant departures on the results of the ABWR DCD Fire-Induced Vulnerability Evaluation (FIVE) analysis. The applicant concludes that the existing ABWR FIVE results bound the STP Units 3 and 4 fire analysis.

##### *Section 19.4.5 “ABWR Probabilistic Flooding Analysis”*

The applicant provided site-specific supplemental information that addressed the probabilistic flood analysis of the relocated RSW pump house and external flooding.

##### *Section 19.4.6 “ABWR Shutdown Risk”*

The applicant provided site-specific supplemental information that addressed the shutdown risk due to hurricanes at STP Units 3 and 4.

### **19.4.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19.4.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Section 19.4 of the certified ABWR DCD. The staff reviewed Section 19.4 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of

information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "External Event Analysis and Shutdown Risk Analysis."

The staff reviewed the following information in the COL FSAR:

Tier 1 Departure

- STD DEP T1 2.15-1 Re-classification of Radwaste Building Substructure from Seismic Category I to Non-Seismic

The referenced ABWR DCD Section 2.15.13 stated that the exterior walls of the RWB below grade and the basemat are classified as a seismic Category I structure. This departure revises the seismic category of the RWB substructure from seismic Category I to non-seismic. The RWB does not house any safety-related systems or components. RG 1.29, Revision 3, "Seismic Design Classification," provided a list of SSCs that have to be classified as seismic Category I. Regulatory Position C.1.p of RG 1.29 stated, "systems, other than radioactive waste management systems, not covered by ..." shall be seismic Category I. The phrase "other than radioactive waste management systems" excludes these systems from the list of seismic Category I SSCs. For the radioactive waste management system, RG 1.29 refers to RG 1.143, Revision 2, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants."

Based on this departure, the COL FSAR was revised to delete the description and results of the RWB analysis and design from those sections of the ABWR DCD, which included the description because the RWB substructure was classified as a seismic Category I structure. Examples of these deleted sections include Sections 2.5S.4, 3.7, 3.8, and 3H.3. Also, revisions throughout the COL application have appropriately changed the seismic classification of the RWB. In this departure, the applicant commits to follow the guidance of RG 1.143, Revision 2.

The staff's evaluation determined that there was a need for additional information before accepting Departure STD DEP T1 2.15-1. Specifically, the staff issued RAI 19-24 requesting the applicant to confirm that a failure of the RWB under seismic and tornado loadings will not impact the adjacent seismic Category I buildings and equipment. The staff requested the applicant to state the physical separation of the RWB from seismic Category I buildings.

In the response to RAI 19-24 dated August 26, 2009 (ML092430135), the applicant confirms that the RWB will be designed against collapse when exposed to seismic or tornado loadings. In accordance with the acceptance criteria in SRP Sections 3.3.1, 3.3.2, and 3.7.2, which allow for a design against the collapse of non-seismic Category I buildings onto seismic Category I SSCs, the staff issued RAI 19-33 requesting the applicant to provide generic design procedures for SSCs with interaction potential to resist site-specific external events (e.g., wind, tornado, and seismic events). The staff needed this information to conclude with reasonable assurance that the applicant will adequately analyze and design the RWB against collapse when exposed to seismic or tornado loadings, in compliance with 10 CFR Part 50, "Domestic Licensing Of Production And Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criteria (GDC) 2, "Design bases for protection against natural phenomena," and relevant SRP acceptance criteria. This RAI was tracked as Open Item 19-14.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.



DC and the section adequately incorporates by reference Section 19.4.3 of the ABWR DCD, Revision 4.

#### *Section 19.4.4 "Fire Protection Probabilistic Risk Assessment"*

The applicant reviews the impact of proposed plant departures on the results of the ABWR DCD FIVE analysis. The applicant concludes that the existing ABWR FIVE results bound the STP Units 3 and 4 fire analysis. See Section 19M.4 of this SER for a discussion of the fire protection PRA.

#### *Section 19.4.5 "ABWR Probabilistic Flooding Analysis"*

This section summarizes the important aspects of the probabilistic flood analysis of the relocated RSW pump house developed in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR. The staff determined that this section sufficiently summarizes the important aspects of this probabilistic flood analysis developed in Appendix 19R. Based on this finding and on the staff's safety evaluation of Appendix 19R associated with this probabilistic flood analysis, the staff concluded that the supplemental information in Section 19.4.5 associated with the probabilistic flood analysis of the relocated RSW pump house is acceptable.

Section 19.4.5 of COL FSAR, Revision 3, summarized the probabilistic flooding analysis for external flooding that was developed under Appendix 19R of the STP Units 3 and 4 COL FSAR, Revision 3. However, as a result of the open item identified under Appendix 19R that was associated with this probabilistic flooding analysis, the staff was unable to finalize the conclusions relating to the supplemental information in Section 19.4.5 associated with the probabilistic flooding analysis for external flooding. This issue was tracked as Open Item 19-12 (RAI 19-30) in the SER with open items. The applicant's response to Open Item 19-12 (RAI 19-30) dated July 28, 2010 (ML102110184), stated that FSAR Section 19.4.5 will be revised by deleting the discussion related to external flooding. Based on (1) the change in the watertight door status to be normally closed, and (2) the proposed revisions to the affected COL FSAR sections, the staff concluded that the issues associated with Open Item 19-12 (RAI 19-30) have been resolved. The staff confirmed that the applicant incorporated the proposed revisions in Revision 4 of the FSAR. Therefore, the staff determined the applicant's modeling of external floods to be acceptable.

The staff also noted that Departure STD DEP 12.3-3, "Steam Tunnel Blowout Panel," could impact the results of the PRA flooding analysis. The staff issued RAI 19.01-21 requesting the applicant to provide this information. The applicant's response to this RAI dated August 5, 2009 (ML092220163), stated that the steam tunnel is designed to handle the consequences of a high-energy pipe break. The steam tunnel is vented to the turbine building. Therefore, any flooding originating in the steam tunnel will end up in the turbine building. The design-basis flood analysis of the turbine building evaluated the consequence for floods originating in the circulating water system (CWS) and the turbine building service water system (TSW). Because the amount of the water caused by the steam tunnel blowout panel is much less than the amount originating from the CWS and TWS floods, the consequence of the flood from the steam tunnel is much smaller. The staff determined this approach to be acceptable. Based on the above discussion, the staff considers RAI 19.01-21 to be resolved and closed.

#### *Section 19.4.6 “ABWR Shutdown Risk”*

In the responses to RAI 19.01-31 dated February 16, 2011 (ML110490542) and November 10, 2011 (ML11318A314), the applicant augments the STP Units 3 and 4 FSAR Section 19.4.6 Revision 7, to document the specific bulleted requirements that will be included in the abnormal operating procedures to address hurricane preparations. Commitment (COM 19.4-1) also stated that the specific bulleted requirements documented in FSAR Section 19.4.6 will be included in the abnormal operating procedures to address hurricane preparations. In the response to RAI 19.01-31 dated February 16, 2011, the applicant also discusses a quantitative assessment of hurricanes that was performed independent of the PRA to satisfy the requirements of 10 CFR 52.79(d)(1). Changes to the specific bulleted requirements documented in FSAR Section 19.4.6 require an assessment of the quantitative risk of hurricanes at the beyond design-basis wind speeds and a comparison with the full-scope assessment (all modes, internal and external events model), to assure that the Commission goals stated in the STP FSAR, Revision 6, Section 19.4.6 would continue to be met and that changes to the licensing basis would meet the key principles contained in RG 1.174 Revision 2 “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis.” The applicant will also develop the hurricane abnormal operating procedure for STP Units 3 and 4 consistent with Nuclear Management Resources Council (NUMARC) 87–00, Revision 1, “Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors,” Initiative 2, “Procedures,” and Section 2.11, “Hurricane Preparations.” The staff determined the applicant’s commitment to be acceptable. Refer to SER Section 19L.4 and 19Q for further discussion on the technical evaluation of this issue.

#### **19.4.5 Post Combined License Activities**

The applicant identifies the following commitment as part of the response to RAI 19.01-31:

Commitment (COM 19.4-1, CR 10-15528, Action 2) – Develop an STP Units 3 and 4 abnormal operating procedure for severe weather that is consistent with NUMARC 87-00 Revision 1, “Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors,” Initiative 2, “Procedures,” and Section 2.11, “Hurricane Preparation,” with the following specific requirements:

- Action shall be initiated to place the units in Mode 3 (Hot Shutdown) at least two hours prior to wind speeds in excess of 73 mph (or 96 mph as determined by discussions with the Transmission Distribution Service Provider [TDSP]). The applicability of this requirement is for units in Modes 1 and 2. Units in Modes 3, 4, or 5 will be maintained in Modes 3, 4, or 5.
- One emergency diesel generator (EDG) in each unit is started and loaded onto its safety bus, and the bus is disconnected from offsite power at least 2 hours prior to the arrival onsite of winds in excess of 73 mph.
- If an unstable electrical grid develops or is predicted by the TDSP, the remaining diesel generators are started and loaded on their safety buses and the buses are disconnected from offsite power.

- If applicable to the current unit mode, the RCIC will be verified to be available to provide core cooling in the event of a station blackout.
- The portable diesel-driven fire pump will be staged in an onsite seismic Category I structure prior to the arrival onsite of winds in excess of 73 mph.
- If the containment is inerted at the time of the hurricane warning, it will remain inerted during a forced shutdown due to a hurricane, in anticipation of restoring the units to operation after the hurricane has passed.

#### **19.4.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "External Event Analysis and Shutdown Risk Analysis," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "External Event Analysis and Shutdown Risk Analysis" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "External Event Analysis and Shutdown Risk Analysis," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

#### **19.4S PRA Maintenance**

##### **19.4S.1 Introduction**

The applicant describes the STP Units 3 and 4 PRA maintenance and upgrade programs during the COL review, construction, and operational phases.

##### **19.4S.2 Summary of Application**

In Section 19.4S, the applicant proposed the following commitments:

Develop procedures, prior to starting construction, that control the development and maintenance of the as-designed, as-to-be-built, plant-specific PRA. These procedures will be used during the construction phase of STP Units 3 and 4. (COM 19.4S-1).

Develop and implement procedures, prior to starting construction, to control the plant walkdown process and identify spatial interactions for the purpose of developing the plant's fire PRA, the internal flooding PRA, and the seismic PRA. (COM 19.4S-2).

Develop and implement procedures, prior to starting construction, similar to those used to control the STP Units 1 and 2 PRA (maintenance and update) to control

the incorporation of changes to the as-designed, as-to-be-built plant PRA. (COM 19.4S-3).

Perform an industry peer review of the as-constructed, plant-specific PRA at least 6 months before fuel loading to ensure that the PRA contains the appropriate scope, level of detail, and technical adequacy consistent with the prevailing PRA standards, guidance, and good industry practices. (COM 19.4S-4).

In addition, the applicant stated that an existing plant procedure for STP Units 1 and 2 on the PRA Model Maintenance and Update will be used to maintain the plant-specific PRA developed to support the operation of STP Units 3 and 4.

### **19.4S.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER. In particular, this supplemental section of STP Chapter 19 addressed the PRA quality guidance as described in RG 1.200, Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," and PRA maintenance and upgrade guidance described in RG 1.206, Regulatory Position C.I.19.7.

Also, 10 CFR 50.71(h)(1) stated that no later than the scheduled date for initial loading of fuel, each holder of a COL shall develop a Level 1 and Level 2 PRA. In addition, 10 CFR 50.71(h)(2) stated that each holder of a COL shall maintain and upgrade the PRA required by 10 CFR 50.71(h)(1). The upgraded PRA must cover initiating events and modes of operation contained in NRC-endorsed consensus standards on PRA in effect 1 year prior to each required upgrade. The PRA must be upgraded every 4 years until the permanent cessation of operations.

### **19.4S.4 Technical Evaluation**

The applicant commits (COM 19.4S-1) to develop procedures before starting construction that control the development and maintenance of the as-designed, as-to-be-built, plant-specific PRA. These procedures will be used during the construction phase of STP Units 3 and 4.

The applicant also commits (COM 19.4S-2) to develop and implement procedures before starting construction that control the plant's walkdown process and identify spatial interactions for the purpose of developing the plant's fire PRA, the internal flooding PRA, and the seismic PRA. In addition, the applicant commits (COM 19.4S-3) to develop and implement procedures before starting construction, similar to those used to control the STP Units 1 and 2 PRA to control the incorporation of changes to the as-designed, as-to-be-built plant PRA. The staff issued RAI 19.01-26 requesting the applicant to clarify whether the procedures the applicant will develop will be used in the operational phase.

The applicant's response to RAI 19.01-26 dated August 5, 2009 (ML092220163), stated that STP Units 3 and 4 will develop and implement procedures, before the start of construction, similar to those used to control the STP Units 1 and 2 PRA maintenance and update during the operations phase to control the incorporation of changes to the as-designed, as-to-be-built plant PRA. The staff determined this response to be acceptable, and this RAI is resolved. The staff

confirmed that the applicant has incorporated the proposed revision into Chapter 19 of FSAR Revision 4. Therefore, the staff considers RAI 19.01-26 to be resolved and closed.

The applicant commits (COM 19.4S-4) to perform an industry peer review of the as-constructed, plant-specific PRA at least 6 months before fuel loading to ensure that the PRA contains the appropriate scope, level of detail, and technical adequacy consistent with the prevailing PRA standards, guidance, and good industry practices.

The staff reviewed Section 19.4S of the STP Units 3 and 4 COL FSAR and checked the referenced DCD. The staff concluded that this new section satisfies the PRA maintenance and upgrade guidance described in RG 1.206, Regulatory Position C.I.19.7.

#### **19.4S.5 Post Combined License Activities**

The applicant identifies the following commitments:

- Commitment (COM 19.4S-1) – Develop procedures, prior to starting construction, that control the development and maintenance of the as-designed, as-to-be-built, plant-specific PRA.
- Commitment (COM 19.4S-2) – Develop and implement procedures, prior to starting construction, to control the plant walkdown process to identify spatial interactions for the purpose of developing the plant fire PRA, the internal flooding PRA, and the seismic PRA.
- Commitment (COM 19.4S-3) – Develop and implement procedures, prior to starting construction, to control the incorporation of changes to the as-designed, as-to-be-built plant PRA.
- Commitment (COM 19.4S-4) – Perform an industry peer review of the as-constructed plant-specific PRA at least 6 months before fuel loading to ensure that the PRA contains the appropriate scope, level of detail, and technical adequacy consistent with the prevailing PRA standards, guidance, and good industry practices.

#### **19.4S.6 Conclusion**

The staff reviewed the application and checked the reference DCD. This section is a supplement to the original DCD. The staff's review confirmed that no outstanding information is expected to be addressed in the COL FSAR related to this section. Based on the above discussion on "PRA Maintenance," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

#### **19.5 Source Term Sensitivity Studies (Related to RG 1.206, Part I, C.I.19, Appendix A, Subsection 19.1.4.1.1, "Description of the Level 1 PRA for Operation at Power")**

Section 19.5 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.5, "Source Term Sensitivity Studies," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to

this section remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding information outside of the DCD related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Source Term Sensitivity Studies" have been resolved.

**19.6 Measurement Against Goals (Related to RG 1.206, Part I, C.I.19, Appendix A, Section 19.0, "Probabilistic Risk Assessment and Severe Accident Evaluation"; Section 19.1.3, "Special Design/Operational Features"; and Subsection 19.1.4.1.1, "Description of the Level 1 PRA for Operation at Power")**

**19.6.1 Introduction**

Section 19.6 of the FSAR describes the text changes and supplemental information in Section 19.6 of the ABWR DCD due to a minor reference change of STP Units 3 and 4.

**19.6.2 Summary of Application**

Section 19.6 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.6 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, the applicant provided the following in FSAR Section 19.6:

*Tier 2 Departure Not Requiring Prior NRC Approval*

- STD DEP ADMIN

This departure corrects a cross-reference between sections of the ABWR DCD and the SSAR.

**19.6.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

**19.6.4 Technical Evaluation**

As documented in NUREG-1503, staff reviewed and approved Section 19.6 of the certified ABWR DCD. The staff reviewed Section 19.6 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>2</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Measurement Against Goals."

The staff reviewed the following information in the COL FSAR:

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

<sup>2</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (e.g., misspellings, incorrect references, table headings). The applicant points to DCD Subsection 19.D.5.2, Item (2) *Class II*, to note that there is substantial time available (about 24 hours) to repair any heat removal systems that initially fail.

The applicant's evaluation of this departure in accordance with 10 CFR Part 52, Appendix A, Section V.III.B.5, determined that this departure does not require prior NRC approval. The staff reviewed this departure, and could not determine whether it is reasonable for this departure not to require prior NRC approval. Therefore, the staff issued RAI 19.01-27, Question 1, requesting the applicant to clarify that Subsection 19.D.5.2 refers to the ABWR SSAR. In the RAI response dated August 5, 2009 (ML092220163), the applicant confirmed that the information is in the ABWR SSAR. Therefore, RAI 19.01-27, Question 1 is resolved. Within the review scope of this section, the staff determined it to be reasonable that this departure does not require prior NRC approval.

#### **19.6.5 Post Combined License Activities**

There are no COL license information items in this section.

#### **19.6.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Measurement Against Goals" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "Measurements Against Goals," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

#### **19.7 PRA as a Design Tool (Related to RG 1.206, Part I, C.I.19, Appendix A, Subsections 19.1.1.1, "Uses and Applications of the PRA"; 19.1.2.1, "PRA Scope"; 19.1.7.1, "PRA Input to Design Programs and Processes"; Section 19.1.3, "Special Design/Operational Features"; and Section 19.2, "Severe Accident Evaluation")**

##### **19.7.1 Introduction**

Section 19.7 of the FSAR describes the text changes and supplemental information in Section 19.7 of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

## 19.7.2 Summary of Application

Section 19.7 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.7 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, the applicant provided the following in FSAR Section 19.7:

### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and unnecessary inadvertent actuation prevention logic and equipment. The departure also changes the implementation, architecture, testing, and surveillance descriptions of the SSLC.

### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This departure addressed using two MVES (13.8 kV and 4.16 kV) instead of the one 6.9 kV MVES described in the ABWR DCD. This departure affects FSAR Section 19.7.3, "PRA Studies During the Certification Effort," by changing the output voltage design of the combustion turbine generator (CTG) and the electrical loads supported by this generator.

### Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 19.7-1 Control Rod Drive Improvements

This departure addressed the fine motion control rod drive (FMCRD) brake design testing. The ABWR DCD stated that the FMCRD brake design had to be fully testable on an annual basis to meet the goals for rod ejection frequency. The annual test frequency assumes that the plant is operating under an annual cycle and the inspection is conducted during an outage. For plants operating on an 18-month cycle, testing the brakes during power operation is not practical. FSAR Section 19.7.2, "Early PRA Studies," clarifies the consistency relating to outages on the 18-month cycle basis for the plant. The applicant stated that the FMCRD brake design has to be fully testable on a refueling cycle basis, and the words "refueling cycle" replace the words "an annual."

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure addressed the internal flooding of the control building due to the elimination of vacuum breaker valves on the supply and return piping connecting to the RCW heat exchangers. Elimination of the vacuum breaker valves is due to the RSW system design changes that include the use of horizontal type pumps instead of vertical wet-pit type pumps, in addition to piping configuration changes between the UHS basin and the control building. This departure affects FSAR Section 19.7.3 by eliminating the need for considering the anti-siphon capability and pipe length limit in the RSW design.

## Supplemental Information

### *Subsection 19.7.2 “Early PRA Studies”*

The text changes are the results of Departures STD DEP T1 3.4-1 and STD DEP 19.7-1.

### *Subsection 19.7.3 “PRA Studies During the Certification Effort”*

The text changes reflect Departures STD DEP 8.3-1 and STP DEP 19R-1.

### **19.7.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19.7.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Section 19.7 of the certified ABWR DCD. The staff reviewed Section 19.7 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the ABWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to the “PRA as a Design Tool.”

The staff reviewed the following information in the COL FSAR:

#### Tier 1 Departure

The following Tier 1 departure identified by the applicant in this section requires prior NRC approval, and the full scope of the technical impact may be evaluated in other sections of this SER. Part 07, Section 5.0 of the COL application provided a listing of all FSAR sections affected by the Tier 1 departures.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

The evaluation is described in Section 19.1.4 of this SER.

#### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

The evaluation is described in Section 19.3.4 of this SER.

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 19.7-1 Control Rod Drive Improvements

The technical evaluation of this departure is in Section 4.6 of this SER. The change in testing frequency in Section 19.7.2, Item 4, of the referenced ABWR DCD is proposed to reflect that the plant's refueling outage will be every 18 months, during which time the FMCRD brakes can be tested. This departure does not affect the brake design or function. The testing is to assure that the brake performance to prevent rod ejection is not affected, as considered in the ABWR PRA studies. The change in the brake testing frequency description does not impact the brake design or function and therefore, the likelihood or consequence of a severe accident is not affected. Therefore, the staff determined the supplemental information to be acceptable.

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

The technical evaluation of this departure is in Section 9.2.15 of this SER. The text deletions in FSAR Section 19.7.3 Item 4, paragraph 5 (third bullet) appropriately reflect the RSW design changes under this departure. These changes include the use of horizontal-type pumps instead of vertical, wet-pit type pumps and piping configuration changes between the UHS basin and the control building. The impact of these RSW design changes on plant risk is evaluated in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR. The staff determined these changes to be acceptable.

### Supplemental Information

#### *Section 19.7.2 "Early PRA Studies"*

The text changes in "Instrumentation Studies" are the results of Departure STD DEP T1 3.4-1. The text changes for the CRD brake inspection from the "annual basis" to the "refueling cycle" basis is as a result of Departure STD DEP 19.7-1. The changes are editorial in nature. Therefore, the supplemental information in this section is acceptable.

#### *Section 19.7.3 "PRA Studies During the Certification Effort"*

The text changes in "Combustion Turbine Generator" reflect the change in the medium-voltage system from 6.9 kV in the ABWR DCD to 4.16 kV in site-specific design (Departure STD DEP 8.3-1). The text deletions related to the discussion of the RSW in this section of the FSAR are the result of Departure STP DEP 19R-1. The changes are editorial in nature. Therefore, the supplemental information is acceptable.

#### **19.7.5 Post Combined License Activities**

The applicant identifies Commitment (COM 19.9-14) to address COL License Information Item 19.15, as discussed in SER Section 19.9.4.

#### **19.7.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "PRA as a Design Tool,"

and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “PRA as a Design Tool” that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on “PRA as a Design Tool,” the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

**19.8 Important Features Identified by the ABWR PRA (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.3, “Special Design/Operational Features”; 19.1.4.2, “Level 2, Internal Events PRA for Operations at Power”; 19.1.6.2, “Results from the Low-Power and Shutdown Operations PRA”; 19.1.7, “PRA-Related Input to Other Programs and Processes”; 19.1.8, “Conclusions and Findings”; and 19.2, “Severe Accident Evaluation”)**

**19.8.1 Introduction**

Section 19.8 of the FSAR describes the text changes and supplemental information in Section 19.8 of the ABWR DCD due to the departures in the STP Units 3 and 4 design from the design described in the ABWR DCD.

**19.8.2 Summary of Application**

Section 19.8 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.8 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Section 19.8, the applicant provided the following:

Tier 1 Departures

- STP DEP T1 5.0-1 Site Parameters  
(Table 19.8-5)

This departure addressed the external flooding analysis in Subsection 19.8.5.3.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and unnecessary inadvertent actuation prevention logic and equipment. The departure also changes the implementation, architecture, testing, and surveillance descriptions of the SSLC.

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure addressed internal flooding of the control building due to the elimination of vacuum breaker valves on the supply and return piping connected to the RCW heat exchangers. Elimination of the vacuum breaker valves is due to the RSW system design

changes that include the use of horizontal-type pumps instead of vertical wet-pit type pumps, in addition to piping configuration changes between the UHS basin and the control building.

### Supplemental Information

#### *Subsections 19.8.5.1 “Summary of Analysis Results” and 19.8.5.3 “Features Selected”*

Subsections 19.8.5.1 and 19.8.5.3 of the STP Units 3 and 4 COL FSAR discussed important features identified in the probabilistic flooding analysis of the relocated RSW pump house.

Site-specific supplemental information in Subsection 19.8.5.3 also discusses important features identified in the probabilistic flood analysis of external flooding, which addressed Departure STP DEP T1 5.0-1.

### **19.8.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19.8.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Section 19.8 of the certified ABWR DCD. The staff reviewed Section 19.8 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the ABWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to the “Important Features Identified by the ABWR PRA.”

The staff reviewed the following information in the COL FSAR:

#### Tier 1 Departures

- STP DEP T1 5.0-1 Site Parameters (Table 19.8-5)

The impact of this departure on the external flooding analysis is addressed in FSAR Subsection 19.8.5.3 and FSAR Table 19.8-5. The applicant stated that all external entrances to safety-related buildings located below the maximum flood level have watertight doors or barriers. These measures ensure that no water enters safety-related buildings, thereby allowing a safe shutdown at the plant. The evaluation of this departure on the PRA results is addressed in the supplemental information below.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

In this departure, the applicant renames the essential multiplexing system to the essential communication function in Subsection 19.8.1.3 and FSAR Table 19.8-1. This change has no impact on the important features identified by the ABWR PRA. The evaluation of this departure is in Section 19.1.4 of this SER.

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

The staff reviewed Departure STP DEP 19R-1 included under Section 19.8.5 of the STP Units 3 and 4 COL FSAR. The text that was deleted in Subsection 19.8.5.3 related to the “Anti-siphon Capability”; the “RSW System”; and the “Ultimate Heat Sink.” The deletion appropriately reflects the RSW design changes under Departure STP DEP 19R-1. These changes include the use of horizontal-type pumps instead of vertical wet-pit type pumps and piping configuration changes between the UHS basin and control building. The technical impact of these RSW design changes on plant risk is evaluated in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR.

Supplemental Information

*Subsections 19.8.5.1 “Summary of Analysis Results” and 19.8.5.3 “Features Selected”*

The staff reviewed the supplemental information related to important features identified in the probabilistic flooding analysis of the relocated RSW pump house, which is included under Section 19.8.5 of the STP Units 3 and 4 COL FSAR.

Section 19.8.5 summarizes the important features identified in the probabilistic flooding analysis of the relocated RSW pump house developed in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR. The staff determined that Section 19.8.5 sufficiently summarizes the important features identified in this probabilistic flooding analysis developed in Appendix 19R. Based on this finding and the staff’s safety evaluation of Appendix 19R associated with this probabilistic flooding analysis, the staff concluded that the supplemental information in Section 19.8.5 associated with the important features identified in the probabilistic flooding analysis of the relocated RSW pump house is acceptable.

The staff reviewed the supplemental information related to important features identified in the probabilistic flood analysis for external flooding, which is included in Section 19.8.5 of the STP Units 3 and 4 COL FSAR. However, as a result of the open item identified under Appendix 19R that was associated with this probabilistic flooding analysis, the staff was unable to finalize the conclusions relating to the supplemental information in Section 19.8.5 associated with the probabilistic flood analysis for external flooding. This issue was tracked as Open Item 19-12 (RAI 19-30) in the SER with open items.

In response to Open Item 19-12 (see RAI 19-30 in Appendix 19R) dated July 28, 2010 (ML1021101840), the applicant stated that FSAR Section 2.4 and Subsection 19.8.5.3 will be revised to state that the flooding analysis assumes that all watertight doors are closed and dogged to prevent the flood from propagating to another area or from the outside to the inside. The watertight doors are alarmed to alert security personnel that a watertight door is open. However, with the exception of the watertight doors in the RSW pump house, the watertight doors will not alarm to indicate that a door is not dogged. To guard against doors being left undogged, operators should check the doors at every shift to assure that they are closed and dogged (Commitment 19.9-3).

Based on (1) the change in watertight door status to be normally closed, and (2) the proposed revisions to the affected COL FSAR sections, the staff concluded that the issues associated

with Open Item 19-12 (RAI 19-30) have been resolved. The staff confirmed that the applicant has incorporated the proposed revisions into Revision 4 of the FSAR. Therefore, the staff determined the applicant's modeling of external floods to be acceptable.

#### **19.8.5 Post Combined License Activities**

Section 19.8 of the STP Units 3 and 4 COL FSAR describes numerous activities to be completed by the applicant. These activities are identified as COL license information items in Section 19.9 of the FSAR. The staff's review of these COL license information items is discussed in Section 19.9.4 of this SER.

#### **19.8.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Important Features Identified by the ABWR PRA", and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Important Features Identified by the ABWR PRA" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "Important Features Identified by the ABWR PRA," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

### **19.9 COL License Information (Related to RG 1.206, Part I, C.I.19, Appendix A, Sections 19.3.1, "Resolution of Open Items"; 19.3.2, "Resolution of Confirmatory Items"; and 19.3.3, "Resolution of COL Items")**

#### **19.9.1 Introduction**

Section 19.9 of the FSAR provided resolutions and commitments to address the COL license information items identified in the ABWR DCD.

#### **19.9.2 Summary of Application**

Section 19.9 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.9 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 19.9, the applicant provided the following:

##### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump

This departure addressed the RCIC pump and turbine monoblock design (the pump and turbine are contained in the same casing), which simplifies the design and removes multiple components.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure addressed the elimination of obsolete data communication technology and unnecessary inadvertent actuation of prevention logic and equipment. There is a clarification of digital controls nomenclature and systems and a change in implementation architecture and SSLC testing and surveillance.

- STP DEP T1 5.0-1 Site Parameters

This departure addressed the site's design-basis flood level, the maximum design precipitation rate for rainfall, and the humidity (wet-bulb temperature). Also, the shear wave velocity at the STP Units 3 and 4 site will not be bounded by the ABWR DCD.

Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 10.4-5 Condensate and Feedwater System

This departure increases the number of reactor feed pumps from three to four and adds four condensate booster pumps to the system.

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 9.2-5 Reactor Service Water (RSW) System

This departure addressed the increased RSW flow rate required for the increased heat load in the STP Units 3 and 4 design.

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure addressed internal flooding of the control building as a result of the elimination of RSW vacuum breaker valves on the supply and return piping that connects to the RCW heat exchangers.

COL License Information Items:

- COL License Information Item 19.1 Post Accident Recovery Procedure for Unisolated CUW Line Break

This COL license information item specifies that the applicant develop and implement (before fuel loading) an operating procedure for post-accident recovery from a reactor water cleanup system (CUW) line break. (COM 19.9-1).

- COL License Information Item 19.2 Confirmation of CUW Operation Beyond Design Basis

This COL license information item specifies that the applicant evaluate the CUW operation in the heat removal mode, update the PRA, and develop and implement the emergency operating procedure for operating the CUW in the heat exchanger bypass mode. (COM 19.9-2). The applicant will complete the evaluation of the CUW operation in the heat removal mode before fuel loading. (COM 19.9-28).

- COL License Information Item 19.3 Event Specific Procedures for Severe External Flooding

This COL license information item specifies that the applicant provide site-specific supplemental information in Section 19.9.3 of the STP Units 3 and 4 COL FSAR, for developing and implementing an operating procedure for external flooding before fuel loading. There are also guidelines for this procedure. (COM 19.9-3).

- COL License Information Item 19.4 Confirmation of Seismic Capacities Beyond the Plant Design Basis

This COL license information item specifies that the applicant complete the seismic capacity analysis before fuel loading. (COM 19.9-4).

- COL License Information Item 19.5 Plant Walkdowns

This COL license information item specifies that the applicant develop before fuel loading procedures for plant walkdowns to identify seismic, fire, and internal flooding vulnerabilities. (COM 19.9-5).

- COL License Information Item 19.6 Confirmation of Loss of AC Power Event

This COL license information item specifies that the applicant provide an assessment addressing site-specific parameters, such as specific causes of the loss of power and their impact on a timely recovery of ac power.

- COL License Information Item 19.7 Procedures and Training for Use of AC-Independent Water Addition

This COL license information item specifies that the applicant develop and implement operating procedures and training for the ACIWA. These procedures will identify system valve actuations that provide the ACIWA via the RHR system, as a water source to the reactor pressure vessel (RPV) or to the containment. (COM 19.9-6).

- COL License Information Item 19.8 Actions to Avoid Common Cause Failures in the Essential Communications Function (ECF) and Other Common Cause Failures

This COL license information item specifies that the applicant develop and implement test, maintenance, surveillance, and administrative procedures before fuel loading to ensure that credible common mode failures cannot occur. (COM 19.9-7).

- COL License Information Item 19.9 Actions to Mitigate Station Blackout Events

This COL license information item specifies that the applicant develop analyses and procedures (before fuel loading) to confirm the assumptions modeled in the PRA. (COM 19.9-8).

- COL License Information Item 19.10 Actions to Reduce Risk of Internal Flooding

This COL license information item specifies that the applicant provide site-specific supplemental information for developing and implementing (before fuel loading) training, design, a site-specific PRA-based analysis, and procedures to reduce the risk of internal flooding. (COM 19.9-9).

- COL License Information Item 19.11 Actions to Avoid Loss of Decay Heat Removal and Minimize Shutdown Risk

This COL license information item specifies that the applicant develop and implement (before fuel loading) operating procedures to avoid the loss of decay heat removal during a shutdown condition. (COM 19.9-10).

- COL License Information Item 19.12 Procedures for Operation of RCIC from Outside the Control Room

This COL license information item specifies that the applicant develop procedures and conduct training for the RCIC operation. (COM 19.9-11).

- COL License Information Item 19.13 ECCS Test and Surveillance Intervals

This COL license information item specifies that the applicant provide standard supplemental information for developing and implementing (before fuel loading) a plan and procedures to identify departures from the test and surveillance intervals assumed in SSAR Tables 19D.6-1 through 19D.6-12. (COM 19.9-12).

- COL License Information Item 19.14 Accident Management

This COL license information item specifies that the applicant include operator actions in the operating and training procedures to be developed and implemented before fuel loading. (COM 19.9-13). Also, strategies for primary containment flooding in the emergency procedure guidelines will incorporate generic industry guidance, as necessary, and use existing site specific design features to the extent possible to provide indication of and address flooding in the lower drywell when the lower drywell flooder (1) does not operate, (2) does not operate as designed, (3) prematurely operates resulting in an inadvertent pool of water in the lower drywell, and (4) operates as designed during a severe accident scenario that involves a core melt and vessel failure. The procedures will be developed consistent with the plant operating procedure development plan in FSAR Section 13.5, and training on the procedures will be developed and implemented as described in FSAR Section 13.2. (COM 19.9-30).

- COL License Information Item 19.15 Manual Operation of MOVs

This COL license information item specifies that the applicant develop and implement before fuel loading a procedure for operating MOVs manually. (COM 19.9-14).

- COL License Information Item 19.16 High Pressure Core Flooder Discharge Valve

This COL license information item specifies that the applicant develop and implement a procedure for verifying that HPCF discharge valve is in the locked-open position before fuel loading. (COM 19.9-15).

- COL License Information Item 19.17 Capability of Containment Isolation Valves

This COL license information item specifies that the applicant demonstrate before fuel loading that the containment isolation valves will not exceed ASME Section III Service Level C limits and the ultimate pressure capability of the valves will be greater than 1.03 megapascal (MPa) (149.4 pounds per square inch [psi]). (COM 19.9-16).

- COL License Information Item 19.18 Procedure to Ensure Sample Lines and Drywell Purge Lines Remain Closed During Operation

This COL license information item specifies that the applicant develop operating procedures and administrative controls to ensure that sample lines and drywell purge lines will remain closed during operation. (COM 19.9-17).

- COL License Information Item 19.19 Procedures for Combustion Turbine Generator to Supply Power to Condensate and Condensate Booster Pumps

This COL license information item specifies that the applicant develop and implement before fuel loading operating procedures for manually transferring the CTG power to the condensate, condensate booster pumps, and the support systems. (COM 19.9-18).

- COL License Information Item 19.19a Actions to Assure Reliability of the Supporting RCW and Service Water Systems

This COL license information item specifies that the applicant develop and implement before fuel loading operating procedures for swapping RCW and RSW operating pumps and heat exchangers at least monthly. (COM 19.9-19).

- COL License Information Item 19.19b Housing of ACIWA Equipment

This COL license information item specifies that the applicant demonstrate (before fuel loading) the capability of the building that houses the ACIWA equipment to withstand site-specific seismic events, flooding, and other site-specific external events that will be confirmed and included in the plant-specific PRA. (COM 19.9-20). Also, before fuel loading, the applicant verifies that the building that houses the ACIWA equipment have a seismic high confidence low probability of failure (HCLPF) acceleration value of at least 0.5g. The methodology for HCLPF acceleration calculations will be consistent with that described in DCD Section 19I.1 for the ABWR seismic margins analysis. (COM 19.9-29).

- COL License Information Item 19.19c Procedures to Assure SRV Operability During Station Blackout

This COL license information item specifies that the applicant develop and implement (before fuel loading) operating procedures for aligning stored nitrogen bottles for the SRVs. (COM 19.9-21).

- COL License Information Item 19.19d Procedures for Ensuring Integrity of Freeze Seals

This COL license information item specifies that the applicant develop and implement (before fuel loading) procedures for using and administratively controlling freeze seals. (COM 19.9-22).

- COL License Information Item 19.19e Procedures for Controlling Combustibles During Shutdown

This COL license information item specifies that the applicant develop and implement (before fuel loading) administrative procedures for controlling combustibles and ignition sources. (COM 19.9-23).

- COL License Information Item 19.19f Outage Planning and Control

This COL license information item specifies that the applicant develop and implement (before fuel loading) an outage planning and control program that is consistent with the criteria in NUMARC 91-06, "Guidelines for Industry Actions to Assess Shutdown Management." (COM 19.9-24).

- COL License Information Item 19.19g Reactor Service Water Systems Definition

This COL license information item addressed the overall results of the STP RSW evaluation and considers the effect of Departure STP DEP 9.2-5.

- COL License Information Item 19.19h Capability of Vacuum Breaker

This COL license information item specifies that the applicant demonstrate (before fuel loading) the capability of the vacuum breaker seating material to withstand the temperature profiles associated with the equipment survivability requirements specified in Subsection 19E.2.1.2.3. (COM 19.9-25).

- COL License Information Item 19.19i Capability of the Containment Atmospheric Monitoring System

This COL license information item addressed the requirement that the containment atmospheric monitoring (CAM) system can be exposed to containment pressures consistent with the loading associated with the equipment survivability requirements specified in Subsection 19E.2.1.2.3 before fuel loading. (COM 19.9-26).

- COL License Information Item 19.19j Plant Specific Safety-Related Issues and Vendors Operating Guidance

This COL license information item specifies that the applicant develop (before fuel loading) plant operating procedures for maintaining important safety functions during shutdown operations. (COM 19.9-27).

- COL License Information Item 19.30 PRA Update

This COL license information item addressed the overall results. The applicant indicated that the PRA evaluation is bounded by the conclusions of the standard ABWR DCD, Subsection 19.3.1.5, "Results in Perspective."

### 19.9.3 Regulatory Basis

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

In addition, in RG 1.206, Regulatory Position C.III.4.3 provided guidance and requests that the applicant describe the implementation schedules and plans for the resolution of the COL licensing information.

### 19.9.4 Technical Evaluation

As documented in NUREG–1503, staff reviewed and approved Section 19.9 of the certified ABWR DCD. The staff reviewed Section 19.9 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to "COL License Information."

The staff reviewed the following information in the COL FSAR:

#### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump Design

The pump and turbine are a monoblock design (the pump and turbine are contained in the same casing), which simplifies the design and removes multiple components. See the evaluation in Section 19.3.4 of this SER.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

Departure STD DEP T1 3.4-1 can be characterized as five primary changes, two of which impact FSAR Section 19.9.8:

1. Elimination of references to the essential multiplexer system (EMS) and the nonessential multiplexer system (NEMS) originally envisioned in the ABWR architecture; these references are replaced with separate and independent system level data communication capabilities.
2. Clarification of digital controls nomenclature and systems.

The staff determined that these specific text changes are appropriate and address Departure STD DEP T1 3.4-1. See the evaluation in Section 19.1.4 of this SER.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

- STP DEP T1 5.0-1 Site Parameters

The site's design-basis flood level, the maximum design precipitation rate for rainfall, the humidity (represented by the wet-bulb temperature), and the shear wave velocity at the STP site are not bounded by the descriptions in the ABWR DCD.

Departure STP DEP T1 5.0-1 also impacts the external flooding analysis developed in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR, which is used in Section 19.9.3 to develop guidelines for event-specific procedures for external flooding. The staff determined that the departures under Section 19.9.3 appropriately reflect Departure STP DEP T1 5.0-1, as well as the departures related to the external flooding analysis under Appendix 19R. However, as a result of the open item identified in Appendix 19R that was associated with the external flooding analysis, the staff was unable to finalize the conclusions for these departures in Section 19.9.3. This issue was tracked as Open Item 19-12 (RAI 19-30) in the SER with open items. Based on (1) the change in the watertight door status to be normally closed, and (2) the proposed revisions to the affected COL FSAR sections, the staff concluded that the issues associated with Open Item 19-12 (RAI 19-30) have been resolved. The staff confirmed that the applicant has incorporated the proposed revisions into Revision 4 of the FSAR. Therefore, the staff determined the applicant's modeling of external floods to be acceptable.

Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 10.4-5 Condensate and Feedwater System

The departure adds an additional reactor feed pump, two heater drain pumps, and four condensate booster pumps to this system. See the evaluation of this departure in Section 19.1.4 above.

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 9.2-5 Reactor Service Water (RSW) System

The STP COL stated that the RSW and UHS have been modified to meet the increased heat removal requirements of the RCW system for STP Units 3 and 4. The potential impact is included in the delta-PRA analysis. The impact of these RSW design changes on plant risk is evaluated in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR.

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure eliminates vacuum breaker valves on the supply and return piping that connects to the RCW heat exchangers evaluated in the ABWR SSAR that were added to the STP Units 3 and 4 COL application. The impact of these RSW design changes on plant risk is evaluated in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR.

### COL License Information Items

- COL License Information Item 19.1 Post Accident Recovery Procedure for Unisolated CUW Line Break

In Section 19.9.1, the applicant commits (COM 19.9-1) to develop and implement (before fuel loading) an operating procedure for the post-accident recovery from a CUW line break. This commitment contains the provisions for procedural development described in the COL license information item in the DCD.

The staff reviewed the proposed commitment (including procedural development provisions) in the FSAR. The staff also examined the COL license information in the DCD and the evaluation of this COL license information item in the ABWR DCD FSER. The staff determined that the proposed commitment contains sufficient information for procedural development and is therefore acceptable.

- COL License Information Item 19.2 Confirmation of CUW Operation Beyond Design Basis

In Section 19.9.2, the applicant commits (COM 19.9-2) to complete an evaluation of the CUW operation in the heat removal mode, update the PRA before fuel loading, and develop and implement the emergency operating procedure for operating the CUW in the heat exchanger bypass mode before fuel loading.

The staff issued RAI 19-15, which asked how the applicant will complete and track the evaluation of the CUW operation in the heat removal mode and the PRA update.

The applicant's response to RAI 19-15 dated July 13, 2009 (ML092740559), notes that Section 19.9.2 of the COL FSAR will be revised to state that an evaluation of the CUW operation in the heat removal mode will be completed before fuel loading (COM 19.9-28). The applicant also stated that this evaluation will confirm that areas listed in STP FSAR Section 19.9.2 will remain functional while operating outside of their design-basis temperature values. The staff determined that this response to RAI 19-15 was sufficient to meet the guidance in RG 1.206 and SRP Chapter 19. The staff confirmed that the applicant has incorporated the proposed change into Chapter 19 of FSAR Revision 4. Therefore, this issue in RAI 19-15 is resolved and closed.

- COL License Information Item 19.3 Event Specific Procedures for Severe External Flooding

In Section 19.9.3, the applicant commits (COM 19.9-3) to develop and implement (before fuel loading) an operating procedure for external flooding.

The staff determined that the supplemental information in Section 19.9.3 is also consistent with the external flooding analysis developed in Appendix 19R. However, as a result of the open item identified under Appendix 19R that was associated with the external flooding analysis, the staff was unable to finalize the conclusions for the supplemental information in Section 19.9.3. This issue was tracked as Open Item 19-12 (RAI 19-30) in the SER with open items. In response to RAI 19-30 dated July 28, 2010 (ML102110184), the applicant stated that FSAR Section 19.9.3 will be revised to state that the event-specific procedures for severe external flooding assume that all watertight doors are closed and dogged to prevent floods from

propagating to another area or from the outside to the inside. The watertight doors are alarmed to alert security personnel that a watertight door is open. However, with the exception of the watertight doors in the RSW pump house, the watertight doors will not alarm to indicate that a door is not dogged. To guard against doors being left undogged, operators should check the doors at every shift to assure that they are closed and dogged. Procedures and training will be developed to ensure that observation of the main cooling reservoir is conducted so that main control room personnel will be alerted by indications of a main cooling reservoir breach. These procedures will direct that all watertight doors be verified closed immediately upon the receipt of such notification (Commitment 19.9-3).

Based on (1) the change in the watertight door status to be normally closed, and (2) the proposed revisions to the affected COL FSAR sections, the staff concluded that the issues associated with Open Item 19-12 (RAI 19-30) have been resolved. The staff confirmed that the applicant has incorporated the proposed revisions into Revision 4 of the FSAR. Therefore, the staff determined the applicant's modeling of external floods to be acceptable.

- COL License Information Item 19.4 Confirmation of Seismic Capacities Beyond the Plant Design Basis

In Section 19.9.4, the applicant commits (COM 19.9-4) to complete the seismic capacity analysis before fuel loading. COL License Information Item 19.4 in the ABWR DCD, Revision 4, calls for the implementation of actions specified in Section 19H.5.1, including the need for an evaluation of the site-specific plant-level HCLPF capacity of the generic SSCs, which are not part of the standard ABWR SSCs and whose fragilities are assumed to be based on typical component designs. The list of generic components in Section 19H.4.3 includes the plant-specific, safety-related SSCs (e.g., piping and service water pump house). The applicant's statement in Section 19.9.4 of STP Units 3 and 4 COL FSAR that the seismic capacity analysis will be completed before fuel loading and the PRA will be updated in accordance with 10 CFR 50.71(h)(1) lacks the necessary details to adequately address COL License Information Item 19.4. Therefore, the staff issued RAI 19-27 requesting the applicant to discuss in detail and elaborate how items listed in Section 19H.5.1 will be implemented, especially "Step 3 - Assessment of As-Built SMA [seismic margins analysis] SSC HCLPF Values" of the ABWR DCD. The applicant's response to RAI 19-27 dated August 26, 2009 (ML092430135), identifies the following revisions and additions to the FSAR Section 19.9.4, which will be revised as follows in a future update:

#### 19.9.4 Confirmation of Seismic Capacities beyond the Plant Design Basis

The following standard supplement addressed COL License Information Item 19.4. The following actions will be taken (COM 19.9-4):

1. The High-Confidence Low Probability of Failure (HCLPF) values for the important plant specific/as-built components corresponding to the generic components defined in Subsection 19H.4.3 shall be determined. The values will be compared to the assumed HCLPF values given in Tables 19H-1 or 19I-1. This will be completed prior to fuel load.
2. HCLPF values will be established for site-specific SSCs (UHS/pump house structure and cooling tower) that are not included in the analyses

described in Appendix 19H and whose failure may affect the plant response to seismic events.

3. The investigation for the potential for seismic induced soil failure at 1.67 times the site specific ground motion response spectra (GMRS) will be completed prior to fuel load.
4. The remainder of the actions specified in Appendix 19H.5 will be completed prior to fuel load.

The staff noted that the applicant's response to RAI 19-27 identifies the UHS/pump house structure and cooling tower as items not explicitly included among the generic SSCs in Appendix 19H, but items that need to be analyzed as part of the plant-specific seismic Category I structures. ABWR DCD, Revision 4, Section 19.9.26 directs the COL applicant to review RSW and UHS design configurations and performance capabilities against those assumed and modeled in the DCD and SSAR. The RSW system consists of piping, tunnel structures, and connections to the pump house and control building. Therefore, the applicant's response was considered incomplete and needed to be augmented. The staff issued RAI 19-29 requesting the applicant to include and describe the complete set of SSCs that make up the UHS/RSW system under Action Item 2 above. In a letter dated January 14, 2010 (ML100190245), the applicant responded to this request by explicitly including the RSW system in COL FSAR, Revision 6, Section 19.9.4. This RAI is therefore resolved and closed.

The staff determined the applicant's responses to RAI 19-27 and RAI 19-29 adequate and to be acceptable. The staff confirmed that the applicant has incorporated the proposed revisions into Revision 6 of the FSAR. Therefore, the staff considers RAIs 19-27 and 19-29 to be resolved and closed.

ABWR DCD Section 19H.5.1 requires the soil liquefaction evaluation and slope stability analysis to be performed for 1.67 times the site-specific, safe-shutdown earthquake (SSE). In RAI 19-25, the staff requested the applicant to confirm that such an evaluation will be performed or provide the basis for not performing the evaluation. The staff determined that the applicant's response to RAI 19-25 dated August 26, 2009 (ML092430135), confirms that an analysis for a potential liquefaction-induced failure will be performed for 1.67 times the site-specific GMRS before fuel loading. Furthermore, the applicant stated that there are no safety-related slopes at STP Units 3 and 4. The staff determined that this response is satisfactory and is in accordance with the ABWR DCD FSER (NUREG-1503) and COL Commitment (COM19.9-4). Therefore, the staff considers RAI 19-25 to be resolved and closed.

In accordance with ABWR DCD COL License Information Item 19.4, the applicant was directed to evaluate the HCLPF capacities of standard plant and site-specific SSCs for updating the PRA. In RAI 19-31, the staff requested the applicant to confirm that this COL license information item includes an update of the system model (seismic accident sequences) developed in the DCD to incorporate capacity reductions due to site-specific effects (soil liquefaction, slope failure, etc.) and site-specific SSCs (the UHS and the RSW including the pump house, cooling tower, and water reservoir) and to determine whether site-specific soil failures control the seismic HCLPF capacities of SSCs associated with the seismic accident sequences. Based on the results of the update, the applicant was also requested to demonstrate the sequence-level and plant-level seismic HCLPF capacity. The staff needed this information to ensure that the applicant's PRA-based SMA complies with pertinent requirements

of 10 CFR 52.79(a)(46) and 10 CFR 52.79(d)(1). This RAI was tracked as Open Item 19-17 in the SER with open items.

The applicant's RAI 19-31 response dated May 04, 2010 (ML101260119), confirms that the system model (seismic accident sequences) developed in the DCD will be updated to incorporate seismic capacity reductions due to site-specific effects (soil liquefaction) and site-specific SSCs (the UHS including the RSW pump house, cooling tower, RSW piping tunnel, and diesel generator oil storage vault). Then it will be determined whether site-specific soil failures control the seismic HCLPF capacities of SSCs associated with the seismic accident sequences. Based on this outcome, the sequence-and plant-level seismic HCLPF capacity will be determined. Section 19.9.4 of the COL application will be revised to reflect this action. In a supplemental response to RAI 19-31 dated November 22, 2010 (ML103300212), the applicant provided the HCLPF capacities for the following site-specific SSCs: the UHS pump house, the cooling tower structure, the RSW piping tunnel, the diesel generator fuel oil storage vault, and the service water cooling fans. The HCLPF capacities were calculated using the conservative deterministic failure margin (CDFM) method, which is accepted in DC/COL-ISG-020 (ISG-20), "Seismic Margin Analysis for New Reactors Based on Probabilistic Risk Assessment." The response shows that these HCLPF capacities are greater than 1.67 times the GMRS for STP Units 3 and 4. The staff determined the applicant's response to RAI 19-31 adequate and to be acceptable. Therefore, the staff considers RAI 19-31 and Open Item 19-17 to be resolved and closed. The staff also confirmed that the applicant has incorporated the proposed revision in Revision 6 of the COL FSAR Table 19H-1a.

The staff reviewed the contents of Section 19.9 against ISG-20. The PRA-based SMA as accepted in NUREG-1503 for DC generally meets ISG-20. Because the STP is referencing the certified design, the staff's review focused on whether the applicant has met the provisions of ISG-20 in the COL stage (ISG-20, Section 5.2). The applicant committed (COM 19.9-4) to perform COL License Information Items 19.4 and 19.5 before the initial fuel loading. The applicant's response to RAI 19-27 stated that: (1) the site-specific GMRS is enveloped by the certified seismic design response spectra (CSDRS), (2) the soil-induced failures will be addressed, and (3) the required seismic margins will be demonstrated.

The staff's evaluation according to ISG-20 concluded that the applicant has adequately considered the site-specific effects. In addition, the applicant's responses to the COL license information items and to other RAIs provide adequate confidence that the seismic fragility of the SSCs and the plant-level HCLPF will be maintained as stated in the DC. The bases for the staff's conclusion are the following:

- Soil effects, such as the potential for soil liquefaction and slope failures, are being addressed by the applicant per the response to RAI 19-25.
- Site-specific structures (e.g., the UHS) were not modeled in the DC SMA. Therefore, the plant-level HCLPF will not be impacted by the fragilities of site-specific structures.
- Site-specific structures will be designed so that they will not collapse on or impact with other seismic Category I structures modeled in the DC SMA.

Seismic Category I structures will be founded on soil with average shear wave velocities ranging from 236.5 meters per second (m/s) (776 feet per second [ft/s]) to 304.8 m/s (1,000 ft/s) or on

engineered structural fill. The applicant has committed (COM 19.9-4) to conduct site-specific soil-structure interaction (SSI) analyses, because the shear wave velocities are less than the 304.8 m/s (1,000 ft/s) specified in the DC. Furthermore, the HCLPF capacities of the SSCs shall be evaluated taking into account the site-specific effects and will be available before the initial fuel loading.

- COL License Information Item 19.5 Plant Walkdowns

In Section 19.9.5, the applicant commits (COM 19.9-5) to develop (before fuel loading) procedures for plant walkdowns to identify seismic, fire, and internal flooding vulnerabilities.

The staff determined this commitment to be appropriate.

- COL License Information Item 19.6 Confirmation of Loss of AC Power Event

In FSAR Section 19.9.6, the applicant assesses site-specific parameters, such as specific causes of the LOOP, and their impact on a timely recovery of ac power. The staff's review of this information is discussed in Section 19.3.4 of this SER.

- COL License Information Item 19.7 Procedures and Training for Use of AC-Independent Water Addition

In Section 19.9.7, the applicant commits (COM 19.9-6) to develop and implement operating procedures and training for the ACIWA. These procedures will identify the system valve actuations, which provide the ACIWA via the RHR system as a water source to the RPV or to the containment.

The staff verified the flow path by checking Figures 5.4-10 and 9.5-4 and concluded that once developed and implemented, the operating procedures and training for these system valve actuations would be reasonable.

- COL License Information Item 19.8 Actions to Avoid Common-Cause Failures in the Essential Communications Function (ECF) and Other Common-Cause Failures

In Section 19.9.8, the applicant commits (COM 19.9-7) to develop and implement (before fuel loading) test, maintenance, surveillance, and administrative procedures to ensure that credible common mode failures cannot occur. This commitment contains the provisions for procedural development described in the COL license information item in the DCD.

The staff reviewed the proposed commitment (including procedural development provisions) in the FSAR and also examined the COL license information in the DCD. The staff determined that the proposed commitment contains sufficient information for procedure development and is acceptable.

- COL License Information Item 19.9 Actions to Mitigate Station Blackout Events

In Section 19.9.9, the applicant commits (COM 19.9-8) to develop (before fuel loading) analyses and procedures to confirm the assumptions modeled in the PRA. Also, the PRA will be updated in accordance with 10 CFR 50.71(h)(1). This commitment contains the provisions for procedural development described in the COL license information item in the DCD.

The staff reviewed the proposed commitment (including procedural development provisions) in the FSAR and also examined the COL license information item in the DCD. The staff determined that the proposed commitment contains sufficient information for procedural development and is therefore acceptable.

- COL License Information Item 19.10 Actions to Reduce Risk of Internal Flooding

In Section 19.9.10, the applicant commits (COM 19.9-9) to develop and implement (before fuel loading) training; design; and site-specific, PRA-based analyses and procedures to reduce the risk of internal flooding.

The text in Section 19.9.10, Item 8 (related to anti-siphon capability), is deleted to address Departure STP DEP 19R-1. In addition, Departure STP DEP 19R-1 addressed internal flooding of the control building due to the elimination of vacuum breaker valves on the supply and return piping, which connect to the RCW heat exchangers. Elimination of the vacuum breaker valves is due to the RSW system design changes, including the use of horizontal-type pumps instead of vertical wet-pit type pumps and piping configuration changes between the UHS basin and the control building.

The deletion of text in Section 19.9.10, Item 8, appropriately reflects the RSW design changes under Departure STP DEP 19R-1, including the use of horizontal-type pumps instead of vertical wet-pit type pumps and piping configuration changes between the UHS basin and the control building. The impact of these RSW design changes on plant risk is evaluated in Appendix 19R of Chapter 19 of the STP Units 3 and 4 COL FSAR.

The staff determined that the supplemental information in Section 19.9.10 is also consistent with the internal flooding analysis developed in Appendix 19R. Based on this finding and the staff's safety evaluation of Appendix 19R associated with this probabilistic flooding analysis, the staff concluded that the supplemental information in Section 19.9.10 is acceptable.

- COL License Information Item 19.11 Actions to Avoid Loss of Decay Heat Removal and Minimize Shutdown Risk

In Section 19.9.11, the applicant commits (COM 19.9-10) to develop and implement (before fuel loading) operating procedures to avoid the loss of decay heat removal during a shutdown condition. The commitment contains the provisions for procedural development described in the COL license information item in the DCD.

The staff reviewed the proposed commitment (including procedural development provisions) in the FSAR. The staff also examined the COL license information in the DCD, as well as the evaluation of this COL action item in the ABWR DCD FSER. The staff determined that the proposed commitment contains sufficient information for procedural development and is therefore acceptable.

- COL License Information Item 19.12 Procedures for Operation of RCIC from Outside the Control Room

In Section 19.9.12, the applicant commits (COM 19.9-11) to develop procedures and conduct training for the RCIC operation. This commitment contains updated provisions for procedural development described in the COL license information item in the DCD.

The staff reviewed the proposed commitment (including updated procedural development provisions) in the FSAR and also examined the COL license information in the DCD. The staff determined that the proposed commitment contains sufficient information for procedural development and is therefore acceptable.

- COL License Information Item 19.13 ECCS Test and Surveillance Intervals

In Section 19.9.13, the applicant commits (COM 19.9-12) to develop and implement (before fuel loading) a plan and procedures for identifying departures from the testing and surveillance intervals assumed in the PRA.

The staff determined that the supplemental information in Section 19.9.13 is appropriate and meets the objective of COL License Information Item 19.13.

- COL License Information Item 19.14 Accident Management

In Section 19.9.14, the applicant commits (COM 19.9-13) to include operator actions in the operating procedures and to develop and implement the training for these procedures before fuel loading.

The human actions identified will be reviewed so that detailed procedures will be developed and the appropriate training will be conducted. These procedures will include the following:

- Directions and guidance for operating the COPS shutoff valves. Appropriate care will be taken in the development of these procedures to ensure that the recovery of the containment heat removal or containment sprays does not induce late containment structural failure. If a suppression pool water level of at least 1 meter above the top of the highest horizontal connecting vent can be maintained following the COPS operation, the licensee may leave the shutoff valves open until after the recovery of containment heat removal, because the fission product release will be dominated by the initial noble gas release. In addition, the procedure for closing the shutoff valves will include steps for reintroducing nitrogen into the containment. When developing these accident mitigation strategies, the licensee will examine the potential benefits of the drywell spray operation if the containment fails in the drywell.
- For human actions to be taken that rely on instrumentation possibly operating outside of the qualification range, the licensee will determine the expected performance of the instrumentation and will provide additional guidance to the operator, if needed.
- Accident management strategies will consider the potential for recriticality during the recovery. A possible strategy could be a caution for the operators and/or technical support staff to monitor the power level (perhaps indirectly via the rate of containment pressurization) and to enter procedures for anticipated transients without scram, as necessary.

The staff reviewed this information and determined that the information in the application does not address all of the items required to establish a sufficient technical basis for developing accident management procedures for STP Units 3 and 4. In particular, the licensee needs to further develop strategies for the containment to control the water level in the lower drywell and the suppression pool after a vessel breach. Several candidate actions need to be addressed to minimize the release of radioactive materials into the environment and to achieve a safe and

stable state, including the timely operation of the ACIWA, level control of the suppression pool and the lower drywell using the ACIWA, and cooling the upper drywell as much as possible after the containment has been vented through the COPS. For example, the premature actuation of the drywell flooder could lead to water being added into the lower drywell before a vessel breach. This could create the potential for a large ex-vessel steam explosion. The staff issued RAI 19-05 requesting the applicant to describe the necessary changes to the Boiling Water Reactor (BWR) Owner's Group (BWROG) emergency procedure guidelines (EPGs) and severe accident guidelines (SAGs), as applied to the STP Units 3 and 4, to ensure sound and severe accident mitigation strategies and procedures.

The applicant's supplemental response to RAI 19-05 dated September 15, 2009 (ML092600154), stated that the ABWR EPGs, which have been approved by the staff and incorporated by reference into the FSAR, were developed based on Revision 4 of the BWROG EPGs. During the process of reviewing the DCD for the ABWR, the staff evaluated major differences between the ABWR EPGs and Revision 4 of the BWROG EPGs. The results of this evaluation are documented in Section 18.8.5 of the ABWR FSER.

The applicant further stated in the response to RAI 19-05 that it intends to follow NEI 91-04 Revision 1, "Severe Accident Closure Guidelines," which includes a commitment the industry made to the NRC to incorporate severe accident strategies into the overall Accident Management Program. Changes in the EPGs and SAGs (such as the containment flood strategy) will be included as inputs to the plant-specific technical guidelines. This change is identified as a new Commitment (COM 19.9-30) in a letter dated October 5, 2010 (ML102861292). In Commitment (COM 19.9-30), the applicant stated:

Strategies for primary containment flooding in the emergency procedure guideline will incorporate generic industry guidance as necessary and use existing site specific design features to the extent possible to provide indication of and address flooding in the lower drywell when the lower drywell flooder: (1) does not operate, (2) does not operate as designed, (3) prematurely operates resulting in an inadvertent pool of water in the lower drywell, and (3 [sic]) operates as designed during a severe accident scenario that involves a core melt and vessel failure.

The staff determined this approach to be acceptable, because it would utilize the technical basis for severe accident management procedures developed by STP.

Section 19.8.7 of the ABWR SSAR, discusses the ABWR features to mitigate severe accidents. Three of the features in this section directly relate to the ABWR containment flooding strategy. These features include the RHR system, the ACIWA system, and the lower drywell flooder (LDF). Until the ac power is restored, keeping the COPS wetwell vent open is the only means of removing decay heat from the containment. The EPGs and SAGs should include a comprehensive strategy for utilizing all of the features related to the containment flooding strategies, minimizing releases of radioactivity, and maintaining a safe and stable state.

The technical basis for the ABWR EPGs was originally developed using the MAAP-ABWR, which was a version of the MAAP3.0B code modified to model the ABWR configuration. There were shortcomings in the MAAP3.0B, so it was superseded by the MAAP4 code. The staff's comparative analyses have shown that significant differences in core melt progression can result, such that the technical basis for severe accident management should be changed in

several respects. These changes should be identified for the ABWR and reflected in the ABWR EPGs and in equipment survivability determinations.

For example, the existing ABWR containment flood strategy emphasizes flooding the upper drywell to a level above the top of active fuel (TAF) to cool the debris in-vessel and prevent a vessel breach. According to ABWR EPG Step C6-2, containment flooding would be terminated if, despite best efforts, the RPV level is below the TAF and the water level in the drywell has reached the bottom of the RPV. For this case, the staff wrote in the ABWR FSER (NUREG-1503) that the containment flood strategy is acceptable provided that the COPS is successfully actuated to relieve the pressure generated by an ex-vessel event that would lead to pressurization of the containment. Note, however, that the existing containment flood strategy does not address flooding in the lower drywell or controlling the suppression pool level with the ACIWA, by supplying fire water in either the drywell spray or wetwell spray mode. Additionally, there are no statements in the current ABWR EPGs about actions, equipment, and instrumentation to monitor and control the water levels in the suppression pool and the lower drywell.

Regarding the steam explosion potential from a premature opening of the drywell flooder, the applicant notes in the supplemental response to RAI 19-05 that high drywell gas temperatures are required to open up the flow paths from the suppression pool to the lower drywell, and these temperatures will occur after debris relocation from the vessel to the lower drywell. The staff's confirmatory assessment, however, indicated that lower drywell temperatures in some of the more likely severe accident scenarios may exceed 533 degrees Kelvin (K) (about 500 degrees F), the temperature at which the fusible plugs will melt before a vessel breach. If this were the case, then molten core debris would fall into a water-filled lower drywell.

Even though the scenarios involved are highly unlikely, the staff believes that the existing containment flood guideline in the BWROG's EPGs and SAGs, as applied to STP Units 3 & 4, should be revised to consider actions to address ex-vessel steam explosions. Because meeting Commitment (COM 19.9-30) addressed this concern, the staff considered RAI 19-5 to be resolved and closed.

- COL License Information Item 19.15 Manual Operation of MOVs

In Section 19.9.15, the applicant commits (COM 19.9-14) to develop and implement (before fuel loading) a procedure for operating MOVs manually.

The staff reviewed the proposed statements to develop and implement a procedure for manually operating the MOVs and determined them to be reasonable and acceptable.

- COL License Information Item 19.16 High Pressure Core Flooder Discharge Valve

In Section 19.9.16, the applicant commits (COM 19.9-15) to develop and implement a procedure for verifying that the HPCF discharge valve is in the locked-open position before fuel loading.

The staff reviewed the proposed procedures and statements. The staff concluded that it is appropriate for the licensee to develop and implement a procedure for verifying that the HPCF discharge valve is in the locked-open position.

- COL License Information Item 19.17 Capability of Containment Isolation Valves

In Section 19.9.17 of the STP FSAR, the applicant commits (COM 19.9-16) to demonstrate that the stresses on the containment isolation valves will not exceed ASME Section III, Service Level C limits, and the ultimate pressure capacity of the containment isolation valves will be greater than 1.03 MPa (149.4 psi) at 260 degrees C (500 degrees F) before fuel loading.

When reviewing Revision 3 to the STP FSAR, staff issued RAI 19-32 requesting the applicant to describe the method and tracking mechanisms to address this COL license information item. This RAI was tracked as Open Item 19-6 in the SER with open items.

The applicant's response to RAI 19-32 dated May 4, 2010 (ML101260119), provided a planned revision to FSAR Section 19.9.17 to address the design process for containment isolation valves and to discuss associated ITAAC. Beginning with Revision 4, the STP Units 3 and 4 FSAR stated that containment isolation valves will be qualified by testing and analysis and by satisfying the stress and deformation criteria at the critical locations within the valves. Per the STP FSAR, operability will be assured by meeting the requirements of the programs described in Subsection 3.9.3.2, "Pump and Valve Operability Assurance," and in Section 3.9.6, "Testing of Pumps and Valves," as supplemental information in the response to RAI 03.09.06-1 and in Sections 3.10 and 3.11. For containment isolation valves, the STP FSAR stated that ASME Code Certified Stress Reports will demonstrate that the stresses of the containment isolation valves, when subjected to the severe accident loadings of 0.77 MPa (111.7 psi) internal pressure and 260 degrees C (500 degrees F), in load combination with dead loads, do not exceed ASME Section III Service Level C limits. The individual parts of each valve will be verified not to exceed allowable structural capability limits under these severe accident conditions. The ASME Code Certified Stress Report will demonstrate that the ultimate pressure capacity of the containment isolation valves will be greater than or equal to 1.03 MPa (149.4 psi) at 260 degrees C (500 degrees F). The STP FSAR also stated that acceptance criteria for ITAAC 2.14.1.2 will confirm the existence of an ASME Code Certified Stress Report for the containment pressure boundary components. The STP FSAR notes that the containment isolation valves are considered pressure boundary components and are included in the separate ASME Code Certified Stress Reports. The Certified Stress Reports for the containment isolation valves will include the stress analysis for the severe accident conditions of 0.77 MPa (111.7 psi) and 260 degrees C (500 degrees F). The STP FSAR stated that these actions will be completed before fuel loading, as part of Commitment (COM 19.9-16). The STP FSAR indicated that its provisions will be updated in accordance with 10 CFR 50.71(e) based on the results of these analyses.

The staff determined that the STP Units 3 and 4 COL FSAR provided an acceptable description of the process to demonstrate the capability of the containment isolation valves. The description is consistent with the methodology specified in ABWR DCD Tier 2, Section 3.9. The ABWR ITAAC will provide confirmation of the completion of the design and qualification process for the containment isolation valves. Based on the applicant's planned FSAR revision dated May 4, 2010, the staff determined that RAI 19-32 was resolved. The staff confirmed that the changes to COL License Information Item 19.17 are included in the STP FSAR (Revision 7). Therefore, the staff considers RAI 19-16 to be resolved and closed.

- COL License Information Item 19.18 Procedure to Ensure Sample Lines and Drywell Purge Lines Remain Closed During Operation

In Section 19.9.18, the applicant commits (COM 19.9-17) to develop operating procedures and administrative controls to ensure that sample lines and drywell purge lines remain closed during operation.

The staff reviewed the proposed statement and determined this commitment to be appropriate.

- COL License Information Item 19.19 Procedures for Combustion Turbine Generator to Supply Power to Condensate and Condensate Booster Pumps

In Section 19.9.19, the applicant commits (COM 19.9-18) to develop and implement (before fuel loading) operating procedures for manually transferring the CTG power to the condensate, condensate booster pumps, and support systems.

The staff reviewed the proposed statement and determined this commitment to be appropriate.

- COL License Information Item 19.19a Actions to Assure Reliability of the Supporting RCW and Service Water Systems

In Section 19.9.20, the applicant commits (COM 19.9-19) to develop and implement operating procedures for swapping the RCW and RSW operating pumps and heat exchangers at least monthly before fuel loading.

The staff reviewed the proposed statements to develop and implement a procedure. The staff concluded that it is appropriate for the licensee to develop and implement an operating procedure for swapping the RCW and RSW operating pumps and heat exchangers at least monthly.

- COL License Information Item 19.19b Housing of ACIWA Equipment

ABWR DCD, Revision 4, Section 19.9.21 stated that if the ACIWA equipment is housed in a separate building, that building must be capable of withstanding site-specific seismic events, flooding, and other site-specific external events such as high winds (e.g., hurricanes). The capability of the building housing the ACIWA equipment must be included in the plant-specific PRA. Accordingly, STP Units 3 and 4 COL FSAR, Revision 4, Section 19.9.21 addressed the COL License Information item with a standard supplement and Commitment (COM19.9-20) stating that the determination of the housing capability to withstand the site-specific seismic events, flooding, and other site-specific external events will be confirmed and will be included in the plant-specific PRA, which will be completed before fuel loading. The staff issued RAI 19-22 requesting the applicant to provide more detailed information addressing the approach, methods of analysis, computer codes, seismic structural modeling, damping, and pertinent sections of SRP acceptance criteria to be used in determining the housing structural capacity. The applicant's revised response to RAI 19-22 dated December 13, 2010 (ML103500240), describes in detail the location and the function of the ACIWA system, the analysis and design procedures, wind and seismic loadings, load combinations, codes and standards, SRP acceptance criteria, computer codes, and other design parameters to be used to evaluate the capability of the ACIWA housing to withstand the site-specific external events.

The staff's evaluation considered Table 19.8-2, "Important Features from Seismic Analyses," and ABWR DCD, Revision 4, which describes and lists the requirements for the ACIWA system as follows:

Seismic qualification of the ACIWA system including the pumps, valves, and water supply [2.15.6 (SSE only)]. The collapse of the ACIWA building (shed) should not prevent the pumps from starting and running [2.15.6 (SSE only)]. All needed valves for system operation can be accessed and operated manually (2.15.6, 2.4.1). ACIWA can provide either vessel injection or drywell spray using equipment that does not require ac power. In addition, support systems normally required for ECCS [emergency core cooling system] operation are not required for ACIWA operation. The ACIWA is an important system in preventing and mitigating severe accidents.

According to the above definition in the ABWR DCD, the ACIWA system is not a safety-related seismic Category I system, but a system that is important in preventing and mitigating severe accidents. The ACIWA system is located in a separate building (together with the fire protection system) whose collapse should not prevent the ACIWA SSCs from performing their intended functions. The ACIWA housing is therefore a structure with Category III/I interaction potential that needs to be designed to comply with Section 3.7.2 of NUREG-0800, SRP Acceptance Criteria Item II.8. The staff tracked RAI 19-22 as Open Item 19-16 in the SER with open items.

In the revised response to RAI 19-22 dated December 13, 2010 (ML103500240), the applicant stated that the fire water pump house (FWPH) will be designed to meet the provisions of American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI) Standard ASCE/SEI-7-05 using the design wind speed of 215.6 kilometers per hour (km/h) (134 miles per hour [mph]) (3-second gust) with a mean recurrence interval of 100 years. The load combinations and acceptance criteria for ordinary commercial structures as specified in ASCE/SEI-7-05 will be adopted. The capability of the ACIWA housing against site-specific external events will be demonstrated as follows:

- The FWPH and the ACIWA equipment such as the direct diesel-driven pump and the associated piping and manual valves will be shown to have a seismic HCLPF of 0.5 g peak ground acceleration.
- The FWPH is located above the design-basis flood level of the site (10 m [33 ft] mean sea level [MSL]) for nonsafety-related structures and therefore, flooding is not a design consideration for the nonsafety-related ACIWA housing. In addition, in the response to RAI 19-30 (on external flooding) dated July 28, 2010 (ML102110184), the applicant changes the status for all watertight doors and hatches to be normally closed. This change in door status is documented in FSAR Section 2.4S.10, "Flooding Protection Requirements." Also, the applicant screened external flooding using ASME/American Nuclear Society (ANS) RA-Sa-2009, Section 6-2.3, "The Fundamental Criteria for Screening External Events Other Than Fire and Seismic Events." Criterion (a) was used to screen external flood scenarios from detailed quantitative evaluation. Criterion (a) is satisfied because the STP design for safety-related SSCs satisfies the requirements of SRP Section 3.4.2, Revision 3, which was in effect at the time of the COL application.

- ABWR DCD Chapter 19 does not show tornadoes as a significant risk contributor, and accident sequences associated with tornado-initiating events do not take credit for the ACIWA system.
- In response to RAI 19.01-31 dated February 16, 2011 (ML110490542), the applicant provided a sensitivity study to evaluate the effects of hurricane winds that exceed the site's design-basis wind speeds. The wind speed mean recurrence interval selected was 200 years. The ACIWA function and the CTGs are assumed to fail at this wind speed. Credit for the compensatory measures documented in FSAR Section 19.4.6, "ABWR Shutdown Risk," and in Commitment 19.4-1 yields a CDF (less 1E-8/yr) that is significantly lower than Commission goals for new reactors. Additional information regarding the risk impact of hurricane winds at low-power and shutdown operations is discussed in Appendices 19L and 19Q of this SER.
- In a letter dated October 5, 2010 (ML102861292), the applicant adds a new Commitment (COM 19.9-29) to verify that the building that houses the ACIWA equipment will have a seismic HCLPF acceleration of at least 0.5 g. The methodology for the HCLPF acceleration calculation will be consistent with that described in DCD Section 19I.1 for the ABWR SMA.

Therefore, the staff determined that the design of the ACIWA system meets Commitment 19.9-20, and the response to RAI 19-22 is therefore satisfactory. Therefore, the staff considers RAI 19-22 and Open Item 19-16 to be resolved and closed.

- COL License Information Item 19.19c Procedures to Assure SRV Operability During Station Blackout

In Section 19.9.22, the applicant commits (COM 19.9-21) to develop and implement (before fuel loading) operating procedures to align stored nitrogen bottles for the SRVs.

The staff reviewed the proposed statement and determined this commitment to be appropriate.

- COL License Information Item 19.19d Procedures for Ensuring Integrity of Freeze Seals

In Section 19.9.23, the applicant commits (COM 19.9-22) to develop and implement (before fuel loading) procedures for using and administratively controlling freeze seals.

The staff reviewed the proposed statement and determined this commitment to be appropriate.

- COL License Information Item 19.19e Procedures for Controlling Combustibles During Shutdown

In Section 19.9.24, the applicant commits (COM 19.9-23) to develop and implement (before fuel loading) administrative procedures for controlling combustibles and ignition sources.

The staff reviewed the proposed statement and determined this commitment to be appropriate.

- COL License Information Item 19.19f Outage Planning and Control

In Section 19.9.25, the applicant commits (COM 19.9-24) to develop and implement (before fuel loading) an outage planning and control program that is consistent with NUMARC 91-06 criteria.

The staff reviewed the proposed statement and determined this commitment to be appropriate.

- COL License Information Item 19.19g Reactor Service Water Systems Definition

In Section 19.9.26, the applicant stated that the overall results of the STP RSW evaluation are bounded by the conclusions of the standard ABWR DCD. The overall CDF increase due to the RSW/UHS design is small. The staff performed an audit and confirmed that the effect on CDF is small.

- COL License Information Item 19.19h Capability of Vacuum Breaker

In Section 19.9.27, the applicant commits (COM 19.9-25) to demonstrate (before fuel loading) the capability of the vacuum breaker seating material to withstand the temperature profiles associated with the equipment survivability requirements specified in Subsection 19E.2.1.2.3. As part of the commitment, the FSAR will be updated in accordance with 10 CFR 50.71(e) to reflect the results of this demonstration. The staff determined this commitment to be acceptable.

- COL License Information Item 19.19i Capability of the Containment Atmospheric Monitoring System

In Section 19.9.28, the applicant commits (COM 19.9-26) to demonstrate (before fuel loading) that the containment atmospheric monitoring system can be exposed to containment pressure associated with the equipment survivability requirements specified in Subsection 19E.2.1.2.3. As part of the commitment, the FSAR will be updated in accordance with 10 CFR 50.71(e) to reflect the results of this demonstration. The staff determined this commitment to be acceptable.

- COL License Information Item 19.19j Plant Specific Safety-Related Issues and Vendors Operating Guidance

In Section 19.9.29, the applicant commits (COM 19.9-27) to develop and implement (before fuel loading) plant operating procedures for maintaining the important safety functions during shutdown operations. The operating guidance from the vendors to perform control rod drives and reactor internal pump maintenance activities will also be implemented before fuel loading. The staff reviewed the proposed COL activities during shutdown in the DCD and the supplemental FSAR statement, as well as the evaluation of the COL activities in the ABWR DCD FSER. The staff determined that the information was sufficient to accept the commitment.

- COL License Information Item 19.30 PRA Update

In Section 19.9.30, the applicant stated that the standard PRA design was reviewed against site-specific design information (e.g., the UHS) and interface requirements of the standard design and was updated to ensure that the PRA results remain bounding. A delta-PRA was performed for those site characteristics that were not bounded by the PRA design results. The

net impact of the STP-specific design shows a net decrease in risk compared to the standard ABWR PRA.

The staff also issued RAI 19.01-25 requesting the applicant to address how these commitments are being tracked. The applicant's response dated August 5, 2009 (ML092220163), stated that Sections 19.9 and 19.4S of the DCD and FSAR include a number of commitments originating from the PRA. These commitments can be essentially grouped into the following:

- Develop emergency operating procedures (EOPs) and Abnormal Operating Procedures (AOPs).
- Develop procedures for performing a plant-specific PRA.
- Develop other miscellaneous procedures relating to the PRA.

EOPs and AOPs will be verified and validated under the Human Factors Engineering Program and developed on a schedule to support the Plant Operations Training Program. Procedures for performing plant-specific PRA will be completed 1 year before fuel loading. The plant-specific PRA will be based on as-procured and as-built data and will be completed before fuel loading. Other miscellaneous procedures relating to the PRA will be completed 1 year before fuel loading.

The staff requested the applicant to provide more detailed information regarding the implementation schedules for the commitments in accordance with the guidance in RG 1.206, Regulatory Position C.III.4.3 for COL license information items that will not be available before the license is issued. This issue was tracked as Open Item 19-7 (RAI 19.01-25) in the SER with open items. The applicant's supplemental response to RAI 19.01-25 dated January 14, 2010 (ML100190245), stated that procedural requirements identified in "COL License Information" sections will be incorporated into the plant procedures. The milestones and program development plans are included in COL FSAR Section 13.5. For those "COL License Information Item" commitments that are related to new or conforming assessments, the FSAR will be updated in accordance with 10 CFR 50.71(e). The staff determined this response to be acceptable, and issues related to "COL License Information" in Section 19.9 are resolved. The staff confirmed that the proposed revisions are incorporated into Chapter 19 of FSAR Revision 4. Therefore, the staff considers RAI 19.01-25 to be resolved and closed.

#### **19.9.5 Post Combined License Activities**

The applicant identifies 30 commitments (COM 19.9-1 through 19.9-30) to be implemented in this section (see Section 19.9.4 above).

In addition to the COL license information items in this section, there are other COL license information items in Section 19.4S and Appendices 19A and 19B. The staff issued RAI 19.01-25 asking the applicant to describe the plan and implementation schedules for these information items. With the discussions in Sections 19.4S.5 and 19.9.4, issues related to "COL License Information" in Sections 19.9 and 19.4S are resolved. The staff's review of Appendices 19A and 19B are discussed in their corresponding sections of this SER.

## 19.9.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "COL License Information", and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to "COL License Information" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on the "COL License Information," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## 19.10 Assumptions and Insights Related to Systems Outside of the ABWR Design (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.1.1, "Design Phase"; 19.1.2.1, "PRA Scope"; and 19.1.4.1.2, "Results from the Level 1 PRA for Operations at Power")

### 19.10.1 Introduction

Section 19.10 of the FSAR describes the text changes and supplemental information in Section 19.10 of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### 19.10.2 Summary of Application

Section 19.10 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.10 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 19.10.1, the applicant provided the following:

#### Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure addressed the internal flooding of the control building due to the elimination of vacuum breaker valves on the supply and return piping connecting to the RCW heat exchangers.

#### Supplemental Information

#### *Section 19.10.1 "Reactor Service Water (RSW) System and Safety-Related Ultimate Heat Sink (UHS) Assumptions"*

In this section, the applicant changes the assumptions that all RSW isolation valves receive an automatic close signal on a high water level in the control building RSW/RCW rooms.

### 19.10.3 Regulatory Basis

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### 19.10.4 Technical Evaluation

As documented in NUREG–1503, staff reviewed and approved Section 19.10 of the certified ABWR DCD. The staff reviewed Section 19.10 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to "Assumptions and Insights Related to Systems Outside of the ABWR Design."

The staff reviewed the following information in the COL FSAR:

#### Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

The applicant deletes specific text in Section 19.10.1 related to "Anti-siphon Capability" to address Departure STP DEP 19R-1. These deletions do not affect the PRA and are therefore acceptable.

The applicant's evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. Within the review scope of this section, the staff determined it to be reasonable that this departure does not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

#### Supplemental Information

##### *Section 19.10.1 "Reactor Service Water (RSW) System and Safety-Related Ultimate Heat Sink (UHS) Assumptions"*

The applicant changes the PRA assumption that all RSW isolation valves receive an automatic close signal on a high water level in the control building RSW/RCW rooms. The applicant stated that in each RSW division, there are redundant supply-side isolation valves that receive an automatic close signal on a high water level (1.5 m [5 ft]) in the control building RSW/RCW room. This change in the PRA assumption is consistent with design Departure STP DEP 19R-1 and therefore, the staff determined this change to be acceptable.

### 19.10.5 Post Combined License Activities

There are no post COL activities related to this section.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

## 19.10.6 Conclusion

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Assumptions and Insights Related to Systems Outside of the ABWR Design", and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Assumptions and Insights Related to Systems Outside of the ABWR Design" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "Assumptions and Insights Related to Systems Outside of the ABWR Design," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## 19.11 Human Action Overview (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.1.2.1, "Use of PRA in Support of Licensee Programs"; 19.1.3.4, "Use of the PRA in the Design Process"; 19.1.7.1, "PRA Input to Design Programs and Processes"; and 19.1.8, "Conclusions and Findings")

### 19.11.1 Introduction

Section 19.11 of the FSAR describes the text changes and supplemental information in Section 19.11 of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### 19.11.2 Summary of Application

Section 19.11 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.11 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 19.11, the applicant provided the following:

#### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump

This departure addressed the issue that the RCIC pump and turbine are contained in the same casing on a monoblock. The design eliminates many supporting components.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and the unnecessary and inadvertent actuation of prevention logic and equipment. The departure also changes the implementation, architecture, testing, and surveillance descriptions of the SSLC.

### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This design departure utilizes two MVES (13.8 kV and 4.16 kV) instead of the one 6.9 kV electrical system described in the ABWR DCD.

The applicant has updated the risk rankings of the human error events in the Level 1, internal events PRA to reflect plant design changes for STP Units 3 and 4, site-specific characteristics, and PRA model enhancements. The four human actions after accident initiation determined to be most important by the updated risk rankings have not changed from those four identified to be most important in the ABWR DCD.

#### **19.11.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application, are described in Section 19.1.3 of this SER.

#### **19.11.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Section 19.11 of the certified ABWR DCD. The staff reviewed Section 19.11 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Human Action Overview."

The staff reviewed the following information in the COL FSAR:

#### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump

The RCIC pump and turbine are contained in the same casing on a monoblock. This design eliminates many supporting components. This departure does not affect the human error probabilities and associated risk rankings in the STP Units 3 and 4, site-specific, Level 1 PRA; and therefore, it is acceptable.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and the unnecessary and inadvertent actuation of prevention logic and equipment. This departure does not affect the human error probabilities and associated risk rankings in the STP Units 3 and 4, site-specific, Level 1 PRA.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This departure stated that a dual MVES consisting of 13.8 kV and 4.16 kV will be used to replace the single 6.9 kV MVES in the ABWR DCD.

Based on the evaluation of this departure described in Section 19.3.4 of this SER, this departure does not affect the human error probabilities and associated risk rankings in the STP Units 3 and 4, site-specific, Level 1 PRA.

#### **19.11.5 Post Combined License Activities**

The applicant identifies Commitment (COM 19.9-13) to address COL License Information Item 19.14, as discussed in SER Section 19.9.4.

#### **19.11.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Human Action Overview", and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Human Action Overview" that were incorporated by reference have been resolved.

In addition, based on the above discussion on "Human Action Overview," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

#### **19.12 Input to the Reliability Assurance Program (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.4.1.2, "Results from the Level 1 PRA for Operations at Power"; 19.1.4.2.2, "Results from the Level 2 PRA for Operations at Power"; 19.1.6.2, "Results from the Low-Power and Shutdown Operations PRA"; 19.1.7, "PRA-Related Input to Other Programs and Processes"; and 19.2.2, "Severe Accident Prevention")**

Section 19.12 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.12, "Input to the Reliability Assurance Program," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding information outside of the DCD related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Input to the Reliability Assurance Program" have been resolved.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

**19.13 Summary of Insights Gained from the PRA (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.1.1, “Design Phase”; 19.1.2.1, “PRA Scope”; 19.1.4.1.2, “Results from the Level 1 PRA for Operations at Power”; and 19.2, “Severe Accident”)**

**19.13.1 Introduction**

Section 19.13 of the FSAR describes the text changes and supplemental information in Section 19.13 of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

**19.13.2 Summary of Application**

Section 19.13 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19.13 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 19.13, the applicant provided the following:

*Tier 1 Departures*

- STD DEP T1 2.4-3 RCIC Turbine/Pump

This departure addressed the issue that the RCIC pump and turbine are contained in the same casing on a monoblock. The design eliminates many supporting components.

- STP DEP T1 5.0-1 Site Parameters

This departure addressed information pertaining to STP site parameters that are not bounded by those described in the ABWR DCD.

**19.13.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

**19.13.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Section 19.13 of the certified ABWR DCD. The staff reviewed Section 19.13 of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to the “Summary of Insights Gained from the PRA.”

The staff reviewed the following information in the COL FSAR:

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<sup>1</sup> See “*Finality of Referenced NRC Approvals*” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump

Due to the RCIC turbine/pump design departure, the text in Subsection 19.13.6.3 related to the RCIC lubricating oil cooling system is deleted. The ABWR DCD stated that the RCIC lubricating oil cooling is mechanically driven by the turbine or pump shaft. Because of the new RCIC turbine/pump design, this statement is no longer applicable to the STP Units 3 and 4 FSAR. Therefore, the applicant deleted this statement from the STP Units 3 and 4 COL FSAR. The staff determined that the text changes in Subsection 19.13.6.3 reflect this design departure.

- STP DEP T1 5.0-1 Site Parameters

FSAR Section 19.13.4 references FSAR Sections 19.4, 19.9.3, and Appendix 19R. FSAR Section 19.4 and Appendix 19R discuss the impact of Departure STP DEP T1 5.0-1 on the external flooding analysis. To further reduce the susceptibility of an external flood, the applicant will develop and implement plant and site-specific procedures for severe external flooding using the guidelines discussed in FSAR Section 19.9.3. The staff determined that FSAR Section 19.13.4 appropriately reflects Departure STP DEP T1 5.0-1, as well as the departures related to the external flooding analysis in Appendix 19R.

#### **19.13.5 Post Combined License Activities**

The applicant identifies Commitments (COM 19.9-3 and COM 19.9-13) to address COL License Information Items 19.3 and 19.14, respectively, as discussed in SER Section 19.9.4.

#### **19.13.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Summary of Insights Gained from the PRA", and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Summary of Insights Gained from the PRA" that were incorporated by reference have been resolved.

In addition, based on the above discussion on the "Summary of Insights Gained from the PRA," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

### **19.14 Loss of Large Areas of the Plant Due to Explosions or Fires**

#### **19.14.1 Introduction**

In a letter to the NRC dated May 26, 2009 (ML091470723), the STP Nuclear Operating Company (STPNOC) submitted Revision 0 of the STP Units 3 and 4 "Mitigative Strategies Report." This information is included in the COL application, Part 11 Revision 12.

In this submittal, the applicant describes how the requirements are met to address the loss of large areas (LOLAs) of the plant due to explosions or fires from a beyond design-basis event (BDBE). These requirements are in 10 CFR 52.80(d) and 10 CFR 50.54(hh)(2). It should be

noted that the attachment to this SER section (i.e., Attachment A), as well as some documents referenced in this SER section, include security-related or safeguards information that is not publicly available.

The provisions of 10 CFR 52.80(d) require an applicant for a COL to submit a description of and plans for implementing the guidance and strategies intended to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities, under the circumstances associated with the LOLAs of the plant due to explosions or fire as required by 10 CFR 50.54(hh)(2).

The provisions of 10 CFR 50.54(hh)(2) require licensees to develop and implement guidance and strategies for addressing the LOLAs of the plant due to explosions or fires from a BDBE. Specifically, guidance and strategies are intended to maintain or restore core cooling, containment, and SFP cooling capabilities that include:

- firefighting
- operations to mitigate fuel damage
- actions to minimize radiological release

#### **19.14.2 Summary of Application**

In a letter dated May 26, 2009 (sensitive information that is not publicly available), the applicant submits the "Mitigative Strategies Report." The applicant incorporated this report, including any applicable changes identified in the responses to the RAIs, into Part 11 of Revision 12 of the COL application. The applicant stated that the LOLA mitigative strategies, including the implementation of operational and programmatic aspects of responding to LOLA events, will be implemented before the initial fuel loading.

#### **19.14.3 Regulatory Basis**

The applicable regulatory requirements for LOLAs of the plant due to explosions or fires are as follows:

- 10 CFR 50.54(hh)(2)
- 10 CFR 52.80(d)

The applicable regulatory guidance includes DC/COL-ISG-016, "Staff Guidance on Interim Staff Guidance DC/COL-ISG-016 – Compliance with 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d), Loss of Large Areas of the Plant due to Explosions or Fires from a Beyond-Design Basis Event" (not publicly available), which provided an acceptable means of meeting the requirements of 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d). The DC/COL-ISG-016 references the February 25, 2005, guidance letter (not publicly available) to operating reactor licensees for Phase 1 and the NEI 06–12, "B.5.b Phase 2 & 3 Submittal Guideline," Revision 3, for Phases 2 and 3 (not publicly available). The DC/COL-ISG-016 takes exception to a few areas of NEI 06-12 and provided additional clarifications and enhancement of NEI 06–12 and the staff's guidance letter issued February 25, 2005, based on NRC inspections of operating reactor implementation. The DC/COL-ISG-016 has two attachments: Attachment 1, "Supplementary Guidance for Implementing Mitigation Strategies"; and Attachment 2, "Experience Gained from Implementation of Temporary Instruction 2515/171 at Currently Licensed Power Reactor Sites and Related Staff Positions."

#### 19.14.4 Technical Evaluation

The staff reviewed the applicant's submittal consistent with the requirements of 10 CFR 52.80(d) and 10 CFR 50.54(hh)(2). The staff also used the guidance in DC/COL-ISG-016 to perform the review. The DC/COL-ISG-016 references the February 25, 2005, guidance letter for Phase 1, and NEI 06–12 for Phases 2 and 3. A further discussion of the staff's technical evaluation of the STP Units 3 and 4 submittal is in Attachment A (not publicly available) to Chapter 19 of this SER.

The applicant provided the LOLA event evaluation via a three-phased approach similar to existing plants and consistent with Phases 1, 2, and 3 guidance of NEI 06–12. The applicant's mitigative strategies report (MSR) dated May 26, 2009 (ML091470723), provided information at the programmatic level for licensing approval, and the implementation details and documentation will be made available for inspection by the NRC before the initial fuel loading. In response to various RAIs, the applicant submits additional information to clarify the MSR. The staff documented the evaluations of the applicant's responses to these RAIs in Attachment A (not publicly available) to Chapter 19 of this SER. A summary of this review is provided below.

In the submittal of the MSR, the applicant provided a mitigative strategies table (MST), which follows the template guidance in Appendix D to NEI 06–12. The MST addressed various areas and issues pertinent to LOLAs and describes commitments for areas that are best resolved closer to the completion of construction of STP Units 3 and 4. All commitments made in the submittal will be implemented before the initial fuel loading of the units.

The MST addressed the three phases considered in NEI 06–12. The phases as described in the guidance documents can be mapped to the regulatory requirements and are as follows:

- Phase 1 – Firefighting Response Strategy
- Phase 2 – Spent Fuel Pool Cooling
- Phase 3 – Reactor Core Cooling and Fission Product Release Mitigation

Phases 1, 2, and 3 of NEI 06–12 are similar to the three areas included as part of the requirements in 10 CFR 50.54(hh)(2): firefighting, operations to mitigate fuel damage, and actions to minimize radiological release. However, the three phases are categorized differently. In 10 CFR 50.54(hh)(2), the category of operations to mitigate fuel damage includes both the reactor core and the spent fuel pool, and the category of actions to minimize radiological release is separate. In NEI 06–12, spent fuel pool and reactor core cooling are located in separate phases, and reactor core cooling and fission product release mitigation are combined. Despite the change in the categorization of the phases in NEI 06–12 and the areas of the regulatory requirements, the staff determined that all of the necessary information was included in the submittal.

The guidance for Phases 1, 2, and 3 suggests the development of certain strategies or processes to mitigate the consequences of a LOLA event. The applicant addressed all of these suggested strategies or processes. In evaluating each plant-specific mitigating strategy against its functional objective,<sup>1</sup> the staff weighed whether the strategy can be reasonably expected to successfully provide spent fuel pool cooling or to maintain or restore the key safety functions

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<sup>1</sup> As used here, the functional objective is the basic description of the capabilities of the conceptual strategy(s) as proposed for Phase 2 and 3 by the NEI and accepted by the NRC.

necessary to protect the reactor core and containment. The staff's review considered the expected effectiveness of the strategies and the ease and timeliness of their implementation.

Although some strategies that are needed to meet 10 CFR 50.54(hh)(2) can be developed and implemented in the near future, other strategies and planning efforts cannot be effectively determined or implemented until the plant is further along in construction. To identify such commitments for future action, the applicant documented areas that would be more appropriately completed before the initial fuel loading. The staff reviewed the commitments made by the applicant in its submittal and determined that the timing of all procedural or strategy development was appropriately scheduled before the initial fuel loading and is therefore satisfactory.

The staff reviewed the MSR for content using DC/COL-ISG-016. The staff determined that the MSR included all strategies considered essential for such a program and are thus acceptable. Therefore, the staff concludes that the applicant has met the regulatory requirements of 10 CFR 52.80(d) and 10 CFR 50.54(hh)(2).

#### **19.14.5 Post Combined License Activities**

The staff has included a license condition requiring the applicant to submit to the NRC an implementation schedule and to update it periodically for the strategies developed in accordance with 10 CFR 50.54(hh)(2). In addition, the license condition will require the licensee to appropriately maintain those strategies.

#### **19.14.6 Conclusion**

The staff reviewed the information provided by the applicant under 10 CFR 52.80(d). The staff concludes that the applicant has adequately followed the guidance of DC/COL-ISG-016; NEI 06-12; and the February 25, 2005, guidance letter. The staff determined that the applicant has provided sufficient information at the COL application stage, including commitments made in the COL application, to meet the requirements of 10 CFR 52.80(d) and to provide reasonable assurance that the requirements in 10 CFR 50.54(hh)(2) will be met before the initial fuel loading of STP Units 3 and 4, respectively.

### **19A Response to CP/ML Rule 10 CFR 50.34(f) (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.2.6, "Consideration of Potential Design Improvements Under 10 CFR 50.34(f))"**

#### **19A.1 Introduction**

FSAR Appendix 19A describes the text changes and supplemental information in Appendix 19A of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

#### **19A.2 Summary of Application**

Appendix 19A of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19A of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19A, the applicant provided the following:

Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination (Table 19A-1)

This departure eliminates the hydrogen recombinder requirements.

Supplemental Information

*Section 19A.2.12 "Evaluation of Alternative Hydrogen Control Systems (Item [1] [xii])"*

The ABWR primary containment is inerted and is, therefore, protected from hydrogen combustion.

FSAR Subsection 6.2.7.1 describes alternate hydrogen control. Section 6.2.5 describes the deletion of the flammability control system, including the recombiners, from the STP Units 3 and 4 design.

*Section 19A.2.21 "Hydrogen Control System Preliminary Design (Item [2] [ix])"*

The containment is inerted. See the above response in *Section 19A.2.12*.

*Section 19A.2.46 "Dedicated Penetration (Item [3][vi])"*

This item does not apply to the ABWR design.

COL License Information Items

In this FSAR section, the applicant provided supplemental information to address the following COL license information items:

- COL License Information Item 19.20 Long-Term Training Upgrade
- COL License Information Item 19.21 Long-Term Program of Upgrading of Procedures
- COL License Information Item 19.22 Purge System Reliability
- COL License Information Item 19.23 Licensing Emergency Support Facility
- COL License Information Item 19.24 In-Plant Radiation Monitoring
- COL License Information Item 19.25 Feedback of Operating, Design and Construction Experience
- COL License Information Item 19.26 Organization and Staffing to Oversee Design and Construction
- COL License Information Item 19.27 Develop More Detailed QA Criteria

### 19A.3 Regulatory Basis

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### 19A.4 Technical Evaluation

As documented in NUREG–1503, staff reviewed and approved Appendix 19A of the certified ABWR DCD. The staff reviewed Appendix 19A of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Response to CP/ML Rule 10 CFR 50.34(f)."

The staff reviewed the following information in the COL FSAR:

#### Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

Section 19E.4 of this SER evaluates this departure.

#### Supplemental Information

##### *Section 19A.2.12 "Evaluation of Alternative Hydrogen Control Systems (Item [1] [xii])"*

The ABWR primary containment is inerted and is therefore protected from hydrogen combustion. Increasing the amount of hydrogen moves the primary containment oxygen concentration further from the flammable regime. Radiolysis is the only potential source of oxygen in the ABWR primary containment.

FSAR Subsection 6.2.7.1 describes alternate hydrogen control. Section 6.2.5 describes the deletion of the flammability control system, including the recombiners, from the STP Units 3 and 4 design and the design's capability to accommodate oxygen from radiolysis.

The staff agreed with the deletion of the texts in this section of the FSAR.

##### *Section 19A.2.21 "Hydrogen Control System Preliminary Design (Item [2] [ix])"*

The containment is inerted. See the above discussion related to *Section 19A.2.12*.

The staff agreed with the modified text in this section of the FSAR.

##### *Section 19A.2.46 "Dedicated Penetration (Item [3][vi])"*

This item does not apply to the ABWR design, because the design has no external hydrogen recombiners. The staff agreed with this statement.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

### COL License Information Items

- COL License Information Item 19.20 Long-Term Training Upgrade

STP Units 3 and 4 will include simulation facilities in accordance with 10 CFR 55.46 requirements for operator testing and licensing. Long-term operator training is addressed in Sections 18.8 and 13.2 of this SER.

- COL License Information Item 19.21 Long-Term Program of Upgrading of Procedures

FSAR Section 13.5 describes a long-term program of upgrading procedures for integrating and expanding efforts to improve plant procedures. The scope of the program includes emergency procedures; a reliability analysis; human factors engineering; crisis management; operator training; and important industry operation and experience. This program is discussed in Section 13.5 of this SER.

- COL License Information Item 19.22 Purge System Reliability

FSAR Section 3.9 and Subsection 6.6.9.1 describe a testing program to ensure that the large containment ventilation valves close within the limits (e.g., closure time) assured in the radiologic design bases. The staff evaluated this item in Chapters 3 and 6 of this SER.

- COL License Information Item 19.23 Licensing Emergency Support Facility

Part 5 of the COL application provided a comprehensive site Emergency Plan that includes a description of the Emergency Operations Facility for STP Units 3 and 4. The staff evaluated this item in Section 13.3 of this SER.

- COL License Information Item 19.24 In-Plant Radiation Monitoring

FSAR Section 12.5.2 and Subsections 12.5.3.1 and 12.3.5.2 discuss personal monitoring and portable instrumentation of in-plant radiation and airborne radioactivity, as well as training and procedures appropriate for a broad range of routine and accident conditions. This item is addressed in Chapter 12 of this SER.

- COL License Information Item 19.25 Feedback of Operating, Design and Construction Experience

This COL license information item addressed administrative procedures for evaluating operation, design, and construction experience and for ensuring that applicable and important industry experiences shall be provided in a timely manner to those designing and constructing the ABWR standard plant. The applicant commits (COM 19A-1) to incorporate operator experience into training and procedures before fuel loading, as described in Sections 13.2.3 and 13.5.3, respectively. This item is addressed in Chapter 13 of this SER.

- COL License Information Item 19.26 Organization and Staffing to Oversee Design and Construction

FSAR Section 13.1 describes organization and staffing. This item is addressed in Chapter 13 of this SER.

- COL License Information Item 19.27 Develop More Detailed QA Criteria

The Quality Assurance (QA) Program description is a separate document titled, “STP Units 3 and 4 Quality Assurance Program Description.” This item is addressed in Chapter 17 of this SER.

In RAI 19.01-25, the staff requested the applicant to provide more detailed information regarding implementation schedules for the commitments in accordance with the guidance in RG 1.206, Regulatory Position C.III.4.3, for COL license information that will not be available before issuance of the license. This RAI was tracked as Open Item 19-7 in the SER with open items. The applicant’s supplemental response to RAI 19.01-25 dated May 19, 2010 (ML101410206), stated that procedural requirements identified in the “COL License Information” will be incorporated into the plant procedures. The milestones and program development plans are included in COL FSAR Section 13.5. The COL FSAR will be revised as shown in the response to incorporate additional information on the COL license information items in Appendix 19A. The staff determined this response to be acceptable, because it resolves the issues related to “COL License Information” in Appendix 19A. The staff confirmed that the applicant has incorporated the proposed revisions into Revision 4 of the FSAR.

#### **19A.5 Post Combined License Activities**

The applicant identifies the following commitment:

- Commitment (COM 19A-1) – Incorporate operator experience into training and procedures before fuel loading, as described in FSAR Sections 13.2.3 and 13.5.3, respectively.

#### **19A.6 Conclusion**

The staff’s finding related to information incorporated by reference is in NUREG–1503. The staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information relating to “Response to CP/ML Rule 10 CFR 50.34(f),” and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Response to CP/ML Rule 10 CFR 50.34(f)” that were incorporated by reference have been resolved.

In addition, based on the above discussion on the “Response to CP/ML Rule 10 CFR 50.34(f),” the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

### **19B Resolution of Applicable Unresolved Safety Issues and Generic Safety Issues (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.3.4, “Use of the PRA in the Design Phase”)**

#### **19B.1 Introduction**

FSAR Appendix 19B describes the text changes and supplemental information in Appendix 19B of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

## 19B.2 Summary of Application

Appendix 19B of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19B of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19B, the applicant provided the following:

### Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This departure addressed the elimination of the hydrogen recombinder requirements.

### *Section 19B.2.18 "A-48: Hydrogen Control Measures and Effects of Hydrogen Burns on Safety Equipment"*

This departure revises the above ABWR DCD section to indicate that an inerted containment is used as a hydrogen control measure, and the applicant has updated the 10 CFR 50.44 issuing date.

### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This departure addressed the design change to utilize two MVES (13.8 kV and 4.16 kV) instead of the one 6.9 kV MVES described in the ABWR DCD.

### *Section 19B.2.9 "A-25: Non-Safety Loads on Class 1E Power Sources"*

This departure revises the above ABWR DCD section to indicate that the load breakers in the Division 1 bus are part of the isolation scheme between the Class 1E power and the non-Class 1E FMCRD loads. The Class 1E load breakers provide the needed isolation between the Class 1E bus and the non-Class 1E loads.

### *Section 19B.2.11 "A-35: Adequacy of Offsite Power System"*

The ABWR onsite power systems were to include three redundant and independent 6.9 kV Class 1E safety buses. With this departure, the STP Units 3 and 4 onsite power systems include three redundant and independent 4.16 kV Class 1E safety buses.

### Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP Units 3 & 4

This departure clarifies that STP Units 3 and 4 is a dual-unit station on an existing site. Therefore, some supporting systems described in the DCD are single systems that support two or more units.

### *Section 19B.2.12 "A-36: Control of Heavy Loads Near Spent Fuel"*

This departure revises the above ABWR DCD section to indicate that STP Units 3 and 4 is a dual-unit station. However, the units do not share heavy load handling systems; therefore, GDC 5, "Sharing of Structures, Systems, and Components," is satisfied.

### Supplemental Information

The following sections of FSAR Appendix 19B provide supplemental information to address information required by the COL applicant in Appendix 19B:

- Section 19B.2.2, “A-1: Water Hammer”
- Section 19B.2.17, “A-47: Safety Implications of Control Systems”
- Section 19B.2.27, “C-1: Assurance of Continuous Long-Term Capability of Hermetic Seals on Instrumentation and Electrical Equipment”
- 19B.2.29, “C-17: Interim Acceptance Criteria for Solidification Agents for Radioactive Solid Wastes Issue”
- 19B.2.35, “51: Proposed Requirements for Improving the Reliability of Open Cycle Service Water Systems”
- 19B.2.38, “75: Generic Implications of ATWS Events at Salem Nuclear Plant Issue”
- 19B.2.45, “105: Interfacing Systems LOCA at BWRs”
- 19B.2.49, “120: On-Line Testability of Protection Systems Issue”
- 19B.2.55, “145: Actions to Reduce Common Cause Failures”
- 19B.2.56, “151: Reliability of Anticipated Transient Without Scram Recirculation Pump Trip (ATWSRPT) in BWRs Issue”
- 19B.2.57, “153: Loss of Essential Service Water in Light-Water Reactors Issue”
- 19B.2.60, “A-29: Nuclear Power Plant Design for the Reduction of Vulnerability to Industrial Sabotage Issue”
- 19B.2.68, “II.E.6.1: Test Adequacy Study Issue”
- 19B.3.1, “COL Applicant Safety Issues”
- 19B.3.2, “Testing of Isolators”

### **19B.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19B.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Appendix 19B of the certified ABWR DCD. The staff reviewed Appendix 19B of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to the “Resolution of Applicable Unresolved Safety Issues and Generic Safety Issues.”

The staff reviewed the following information in the COL FSAR:

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

Section 19E.4 of this SER evaluates this departure.

*Section 19B.2.18 “A-48: Hydrogen Control Measures and Effects of Hydrogen Burns on Safety Equipment”*

An inerted containment is used as a hydrogen control measure. This departure deletes the following words used in the acceptance criteria: “the provision for permanently installed hydrogen recombiners.”

In the resolution section, the applicant updated the 10 CFR 50.44 issuing date from December 2, 1981 to September 16, 2003, for the latest revision. This minor change is corrected in the text. The staff determined this change to be acceptable.

Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

Section 19.3.4 of this SER evaluates this departure.

*Section 19B.2.11 “A-35: Adequacy of Offsite Power System”*

The ABWR onsite power systems were to include three redundant and independent 6.9 kV Class 1E safety buses. With this standard departure, the onsite power systems now include three redundant and independent 4.16 kV Class 1E safety buses. This change is appropriately reflected in the text. The staff determined this change to be acceptable.

*Section 19B.2.9 “A-25: Non-Safety Loads on Class 1E Power Sources”*

This departure revises the above ABWR DCD section to indicate that the load breakers in the Division 1 bus are part of the isolation scheme between the Class 1E power and the non-Class 1E FMCRD loads. The Class 1E load breakers provide the needed isolation between the Class 1E bus and the non-Class 1E loads. This change is appropriately reflected in the text. The staff determined this change to be acceptable.

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP Units 3 & 4

Section 19L.4 of this SER evaluates this departure.

COL License Information Items

- COL License Information Item 19.28 COL Applicant Safety Issues

Section 1.9S of the COL FSAR summarizes the resolution of generic issues and unresolved safety issues related to Appendix 19B. See SER Section 1.9 for further details.

- COL License Information Item 19.28a Testing of Isolators

The applicant commits (COM 19B-1) to develop an inspection and testing program for fiber-optic-type isolators used between safety-related and nonsafety-related systems before fuel loading, consistent with the plant operating procedure development plan in FSAR Section 13.5.

The staff issued RAI 19.01-25 asking the applicant to describe the plan and implementation schedule for these information items. This RAI was tracked as Open Item 19-7 in the SER with open items.

The applicant's supplemental responses to RAI 19.01-25 dated May 19, 2010 (ML101410206) and August 18, 2010 (ML102320578), identify the updates of the following Generic Issues identified in Section 1.9S.

- Section 19B.2.12 "A-36: Control of Heavy Loads Near Spent Fuel"
- Section 19B.2.2, "A-1: Water Hammer"
- Section 19B.2.17, "A-47: Safety Implications of Control Systems," which includes a new commitment, COM 19B-2, for developing the required testing, inspection and replacement guidance consistent with the plant operating procedure development plan described in FSAR Section 13.5.
- Section 19B.2.27, "C-1: Assurance of Continuous Long-Term Capability of Hermetic Seals on Instrumentation and Electrical Equipment"
- 19B.2.29, "C-17: Interim Acceptance Criteria for Solidification Agents for Radioactive Solid Wastes Issue"
- 19B.2.35, "51: Proposed Requirements for Improving the Reliability of Open Cycle Service Water Systems"
- 19B.2.38, "75: Generic Implications of ATWS Events at Salem Nuclear Plant Issue"
- 19B.2.45, "105: Interfacing Systems LOCA at BWRs"
- 19B.2.49, "120: On-Line Testability of Protection Systems Issue"
- 19B.2.55, "145: Actions to Reduce Common Cause Failures"
- 19B.2.56, "151: Reliability of Anticipated Transient Without Scram Recirculation Pump Trip (ATWSRPT) in BWRs Issue"
- 19B.2.57, "153: Loss of Essential Service Water in Light-Water Reactors Issue"
- 19B.2.60, "A-29: Nuclear Power Plant Design for the Reduction of Vulnerability to Industrial Sabotage Issue"
- 19B.2.68, "II.E.6.1: Test Adequacy Study Issue"
- 19B.3.1, "COL Applicant Safety Issues"
- 19B.3.2, "Testing of Isolators"

The applicant stated that the COL FSAR would be revised as shown in these responses to incorporate additional information on the COL license information items in Appendix 19B. The staff determined these responses to be acceptable because they resolve the issues related to "COL License Information" in Appendix 19B. The staff confirmed that the applicant has incorporated the proposed revisions into Revision 4 of the COL FSAR.

### **19B.5 Post Combined License Activities**

The applicant identifies the following commitments:

- Commitment (COM 19B-1) – Establish the inspection and test program for fiber-optic type isolators used between safety-related and nonsafety-related systems before fuel loading, consistent with the plant operating procedure development plan in FSAR Section 13.5.
- Commitment (COM 19B-2) – The required testing, inspection and replacement guidance under Section 19B.2.17 (“A-47: Safety Implications of Control Systems”) will be developed consistent with the plant operating procedure development plan described in Section 13.5.

## **19B.6 Conclusion**

The staff’s finding related to information incorporated by reference is in NUREG–1503. The staff reviewed the application and checked the referenced DCD. The staff’s review confirmed that the applicant has addressed the required information, and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Resolution of Applicable Unresolved Safety Issues and Generic Safety Issues” that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on the “Resolution of Applicable Unresolved Safety Issues and Generic Safety Issues,” the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## **19C Design Considerations Reducing Sabotage Risk**

Section 19C of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19C, “Design Considerations Reducing Sabotage Risk,” of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff’s review confirmed that there is no outstanding information outside of the DCD related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Design Considerations Reducing Sabotage Risk” have been resolved.

## **19D Probabilistic Evaluations**

Section 19D of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 19D, “Probabilistic Evaluations,” of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.<sup>1</sup> The staff’s review confirmed that there is no outstanding information outside of the DCD related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52,

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<sup>1</sup> See “*Finality of Referenced NRC Approvals*” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

Appendix A, Section VI.B.1, all nuclear safety issues relating to “Probabilistic Evaluations” have been resolved.

**19E Deterministic Evaluations (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.3.3, “Design/Operational Features for Mitigating the Consequences of Releases from Containment”; 19.1.4.1.1, “Description of the Level 1 PRA for Operations at Power”; 19.1.4.3.1, “Description of the Level 3 PRA for Operations at Power (optional)”; 19.1.4.3.2, “Results from the Level 3 PRA for Operations at Power (optional)”; 19.2, “Severe Accident Evaluation”; 19.2.2, “Severe Accident Prevention”; 19.2.3, “Severe Accident Mitigation”; and 19.2.5, “Accident Management”)**

### **19E.1 Introduction**

FSAR Appendix 19E describes the text changes and supplemental information in Appendix 19E of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### **19E.2 Summary of Application**

Appendix 19E of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19E of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19E, the applicant provided the following:

#### Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This departure eliminates the hydrogen recombinder requirements.

#### Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 2.2-5 CRAC2 and MACCS2 Codes

This departure uses the MACCS2 code for the offsite consequence analysis, thus replacing the CRAC2 code used in the ABWR DCD.

Also, this change to the MACCS2 code causes text revisions in various subsections in this appendix.

- STD DEP 9.5-2 Lower Drywell Flooder Fusible Plug Valve

This departure replaces the fusible plug in the ABWR DCD design with a newer, temperature-sensitive fusible plug that melts at a specified temperature and, in turn, triggers the fusible plug valve to fully open.

Also, there are text revisions to the lower drywell flooder fusible plug valve description and opening time.

- STD DEP Admin

This departure corrects a typographical error in Table 19E.3-6, Case 5.

### 19E.3 Regulatory Basis

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### 19E.4 Technical Evaluation

As documented in NUREG–1503, staff reviewed and approved Appendix 19E of the certified ABWR DCD. The staff reviewed Appendix 19E of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to "Deterministic Evaluations."

The staff reviewed the following information in the COL FSAR:

#### Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

In the certified ABWR DCD, Revision 4, referenced in 10 CFR Part 52, Appendix A, there is a flammability control system (FCS) consisting of two permanently installed, safety-related thermal hydrogen recombiners with associated piping, valves, controls, and instrumentation. The FCS was designed to control a potential buildup of hydrogen and oxygen in the containment from the radiolysis of water after a postulated design-basis LOCA. The staff determined that this hydrogen release was not risk significant, because the design-basis LOCA hydrogen release does not contribute to the conditional probability of a large release up to approximately 24 hours after the onset of core damage. In addition, these systems are ineffective at mitigating hydrogen releases from risk-significant accident sequences that can threaten the containment integrity.

The NRC revised 10 CFR 50.44 to amend its standards for combustible gas control in light-water-cooled power reactors. As described in 10 CFR 50.44(c) for licenses issued after 2003, all containments must have an inerted atmosphere or must limit hydrogen concentrations in the containment during and following an accident that releases an equivalent amount of hydrogen as would be generated from a 100 percent fuel clad coolant reaction. The amended rule eliminates the requirements for hydrogen recombiners and relaxes the requirements for monitoring hydrogen and oxygen. The hydrogen/oxygen analyzers are maintained but as nonsafety-related. In STP COL Table 19.2-2, the applicant assesses no effect on the PRA because the recombiners are not modeled.

The staff reviewed STD DEP T1 2.14-1. The staff concurred that this change has no impact on the risk from severe accidents initiated during full power operation or on accident management strategies. During full power operation, the containment atmosphere is required by the TS to be inerted. The staff, however, does have concerns during startup and shutdown operations when the containment would not be inerted.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

Accordingly, the staff issued RAI 19-3 requesting the applicant to explain whether or not deleting the FCS, including the recombiners, would affect the consideration of hydrogen combustion when the containment may not be inerted. RAI 19-3 also requested a discussion of the impacts on the large release frequency (LRF) and conditional containment failure probability (CCFP) from low power and shutdown scenarios for STP Units 3 and 4. Subsequently, the staff issued RAI 19.01-31, which is related to Departure STP DEP 1.1-2, requesting the applicant to provide the shutdown and full power hurricane CDF and LRF when considering the shared fire water system. The staff also requested a description of the dominant sequences contributing to the shutdown and full power hurricane CDF and LRF estimates.

The applicant's final response to RAI 19-3 dated January 20, 2010 (ML100250138), addressed the question related to removing hydrogen recombiners. The applicant makes the following points pertaining to the risk significance from major hydrogen combustion during any severe accident that could be initiated during startup and shutdown operations.

For severe accidents from full power, the hydrogen generation rate is sufficiently large that the hydrogen recombiner is not effective in removing hydrogen fast enough to prevent a deflagration in a deinerted containment. Inerting is an effective hydrogen control system for all risk-significant degraded core and full core melt accidents in these containments.

For severe accidents from low power or shutdown with the containment intact, the hydrogen production would be similar to that from full power, although the time to reach the critical hydrogen production rate may be longer (i.e., more time available for recovery).

Because small differences in long duration recovery actions are not well characterized using available data or human reliability analysis (HRA) methods, it is judged that the differences between the effects of an at-power accident response or a shutdown accident response are not distinguishable.

For severe accidents from low power without the containment intact, the hydrogen recombiners are not effective and their presence is moot.

During typical refueling operations, the containment would be deinerted and opened within the first 24 hours.

The applicant acknowledges the importance of defense-in-depth by pointing out the following pertaining to low power shutdown (LPSD) events in the revised response:

An inerted containment atmosphere ensures that there is insufficient oxygen to burn with any hydrogen in the containment. When inerting systems are unavailable or incapable of controlling combustible gas concentrations, the decisions and actions governing the operation of drywell and suppression pool sprays provide a strategy to mitigate the consequences of a hydrogen generation event. A spray operation

- reduces containment pressure;
- reduces the flammability of combustible gases through the addition of water vapor to the gas mixture;

- suppresses the temperature and pressure increase following combustion if a deflagration does occur;
- scrubs the containment atmosphere in anticipation of radioactivity release; and
- mixes the containment atmosphere to reduce the localized buildup of combustible gases.

A successful spray operation may also prevent containment venting at rates beyond allowable offsite radioactivity release rate limits for combustible gas control or delay its requirement until systems designed to control combustible gas concentrations can be restored to service. Therefore, the BWROG EPGs provide the defense-in-depth procedures to cope with combustible gas mixtures when the containment is deinerted. The actions to be taken by the crew include the use of drywell sprays and judicious containment purge and vent operations. Removal of the hydrogen recombiners has no adverse effect on the availability of other systems included in plant-specific severe accident management guidelines (SAMGs) for controlling combustible gas. The applicant stated that if the reactor is shut down and deinerted:

- There is a longer allowable time to take mitigative actions because the decay heat is lower than for full power conditions.
- Recombiners would be ineffective because the containment is open to the environment.
- The primary method of combustible gas control under these conditions is the purging and venting of any gases from the containment to the environment via the secondary containment using normal ventilation systems.

In conclusion, the staff concurred with the applicant that the hydrogen recombiners will be ineffective for low-power and shutdown severe accidents with the containment deinerted. This conclusion applies for conditions when the containment is both isolated and not isolated. For low power and shutdown conditions where the containment is deinerted and containment is not isolated, the staff agreed that the hydrogen recombiners are ineffective in treating the risk-dominant, severe accident challenges of hydrogen production. However, for this review, the staff does not assume that the risks associated with these conditions are very low because a shutdown Level 1 and Level 2 PRA was not performed for the ABWR DC.

It is important to note that a risk evaluation of design departures and site-specific design features was performed as required by 10 CFR 52.79(d)(1) during low power and shutdown conditions. If applicable, the results of these evaluations were compared against Commission's safety goals for new reactors. For these risk evaluations, the LRF was assumed to be approximately equal to the CDF. Additional information regarding low-power and shutdown operations is discussed in Appendices 19L and 19Q of this SER.

In the second part of RAI 19-3, the applicant was asked to provide a discussion of the impacts on the LRF or CCFP for low power and shutdown core damage accidents. The staff realized that the response to RAI 19.01-31, which was tracked as Open Item 19-9 in the SER with open items, would also address the concerns of the second part of RAI 19-3. Because Open Item 19-9 is now resolved (see Appendix 19L below), the staff considers RAI 19-3 to be resolved and closed.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 2.2-5 CRAC2 and MACCS2 Code

In this departure, the applicant stated that the COL FSAR evaluation of the consequences from potential radioactive releases used the MACCS2 computer code for the STP site. For the same potential scenarios, the ABWR DCD used the CRAC2 computer code for five sites, which are representative of each major geographical area of the United States and are described in detail in the certified ABWR DCD, Revision 4, Section 19E.3.

Section 19E.2 provided supplemental information detailing the various input parameters that were used. The applicant adds MACCS2 information to the various FSAR subsections, while retaining the ABWR DCD CRAC2 input information for comparisons and bounding evaluations. The applicant compares the site-specific results for three goals. Two goals are based on the NRC safety goal policy of minimizing risk to an individual and to the public near a plant. The third goal is industry-based and seeks to minimize the dose close to the plant. The results of this study show that (1) STP Units 3 and 4 satisfy these goals, and (2) the results of the ABWR DCD analysis using the CRAC2 code are bounding.

The staff considers the MACCS2 code to be an acceptable code for consequence analyses and therefore determined the applicant's approach to be acceptable. The staff reviewed the site-specific inputs to the MACCS2 offsite consequence analyses for potential severe accidents in Tables 19E.3-2 through 19E.3-4, 19E.3-6, and 19E.3-8 through 19E.3-13, included under Section 19.E of the STP Units 3 and 4 COL FSAR. Except for the release fractions in Table 19E.3-6, the reported input quantities are reasonable and complete. Release fractions are only reported for three fission product groups: noble gases, iodine, and cesium. The applicant stated that the remaining groups had negligible releases. However, the assessment of severe accident mitigation alternatives (SAMA) requires the consideration of all releases. Accordingly, the staff issued RAI 19-4 requesting the applicant to provide the complete list of release fractions for all cases that were evaluated. The applicant's response carries out an additional analysis that uses very conservative values for the releases being tracked by the additional fission product groups. The averted dose and cost risks increase slightly, but not enough to affect the SAMA evaluations. The staff determined this reanalysis to be acceptable. Therefore, the staff considers RAI 19-4 to be resolved and closed.

- STD DEP 9.5-2 Lower Drywell Flooder Fusible Plug Valve

This departure replaces the fusible plug in the ABWR DCD design with a newer, temperature-sensitive fusible plug that melts at a specified temperature and, in turn, triggers the fusible plug valve to fully open. In addition, the applicant provided supplemental information on the lower drywell flooder fusible plug valve description and opening time.

The staff reviewed Departure STD DEP 9.5-2 included in Sections 9.5.12 and 19.E of the STP Units 3 and 4 COL FSAR. The text changes indicate that the LDF consists of ten pipes that run from the vertical pedestal vents into the lower drywell. Each pipe has an isolation valve and a fusible plug valve connected to the end of the pipe that extends into the lower drywell. The fusible plugs will melt when the surrounding air reaches a temperature of 533 degrees K (500 degrees F), after molten core debris enters the lower drywell. The fusible plug valve will open and will remain open to allow water to flow through each flooder pipe into the lower drywell and cover the core debris. The staff agreed that this concept would most certainly provide

water to cover the debris. But the staff was concerned that the containment liner failure may not be averted for 24 hours after core damage. Accordingly, the staff decided to carry out a confirmatory assessment. To facilitate this assessment, the staff issued RAIs 19-1 and 19-28 requesting the applicant to provide the results of MAAP 4.0.7 calculations for the more likely severe accident scenarios for STP Units 3 and 4. The applicant provided the necessary information in a timely fashion. While the confirmatory assessment was in progress, the staff identified it as Open Item 19-13 in the SER with open items.

The staff performed the confirmatory assessment using the MELCOR 1.8.6 and MAAP 4.0.7 computer codes for two of the representative scenarios analyzed in Section 19E.2 of the ABWR SSAR, with a modified version of MAAP3.0B known as MAAP-ABWR. These scenarios include a loss of core cooling with vessel failure occurring at high pressure (LCHP) and a large break LOCA with a failure of all core cooling (LBLC). In the SSAR, these scenarios contributed 27 percent and 0.2 percent to the CDF, respectively. The LCHP represented station blackout-initiated severe accidents and was selected to evaluate behavior in the lower drywell following a vessel failure at a high pressure. A sensitivity study was also carried out to determine the effects of vessel depressurization using the automatic depressurization system (ADS). This scenario is called the loss of core cooling with vessel failure occurring at low pressure (LCLP) sequence in the ABWR SSAR and contributes 62 percent to the CDF. Despite its low frequency, the LBLC was included to compare the simulations of a low pressure severe accident following a LOCA. In addition to the base-case scenarios, sensitivity studies were performed to evaluate the consequences of a failure of the lower drywell flooder. In addition, a thorough analysis was performed to show the effectiveness of the ACIWA system.

Key results for the LCHP scenario are shown below in Table 19.1. It is clear that the MAAP3-ABWR results reported in the DCD are considerably more optimistic than those calculated using the more up-to-date MAAP 4.0.7 and MELCOR 1.8.6 codes. The time to wetwell vent opening is considerably longer, the in-vessel hydrogen production is considerably less, and the fission product releases are much less. Similar differences are also calculated for the other two scenarios. The MAAP 4.0.7 results are also closer to the MELCOR 1.8.6 results than they are to the MAAP3-ABWR results.

**Table 19.1 Key Results for the LCHP Scenario**

Key Accident Parameter (times after initiation of accident)	MELCOR 1.8.6	MAAP 4.0.7	MAAP3-ABWR (DCD)
Top of core uncovered (minutes)	~7	27	18
Relocation of fuel to lower head (hours)	3.04	2.71	2.0
Drywell sprays on (hours)	6.0	6.0	4.0
Reactor Pressure Vessel failure (hours)	6.14	4.61	2.0
Start lower drywell flooding (hours)	6.14	4.61	2.0
Wetwell vent opens (hours)	14.0	17.9	25.0
Lower drywell flooding ceases (level in suppression pool below the bottom of the top vent) (hours)	82	79	Not analyzed (N/A)

Key Accident Parameter (times after initiation of accident)	MELCOR 1.8.6	MAAP 4.0.7	MAAP3-ABWR (DCD)
Dryout of lower drywell floor (hours)	86	111	N/A
Concrete erosion and noncondensable gas release resume (hours)	86	119	N/A
Total in-vessel hydrogen production (kilograms)	1410	543	177
Mass fraction of iodine released into environment after: 2 days (20 hours for MAAP3-ABWR) 4 days	9E-3 N/A	8E-4 9E-2	2E-7 N/A
Mass fraction of cesium released into environment after: 2 days (20 hours for MAAP3-ABWR) 4 days	1E-3 5E-2	9E-5 6E-3	1E-5 N/A
Mass fraction of barium released into environment after: 2 days 4 days (6 days for MAAP 4.0.7)	4E-5 3E-4	7E-6 2E-4	N/A N/A

For both base-case scenarios, the MELCOR and MAAP4 simulations predicted that containment overpressure failure would be averted for at least 24 hours after core damage. Without the proper functioning of the LDF (a very unlikely outcome), the MAAP4 predicted that liner integrity would not be maintained for at least 24 hours after core damage. The MELCOR calculation, however, predicted a basemat melt-through somewhat later (within 48 hours). The confirmatory assessments also show that as long as ac power is not recovered and no other water source is provided, the core debris would eventually boil away the water in the lower drywell. The water level in the suppression pool would also diminish and the upper vent would eventually be uncovered. Within four days after core damage, the core debris would become molten again and core debris-concrete interactions would resume, leading to large releases of hydrogen, carbon monoxide, and fission products into the containment. In addition, significant releases of volatile fission products into the environment are predicted to occur. To prevent this from happening, the ACIWA system would need to be implemented to provide water to the suppression pool and to the lower drywell in a controlled fashion, preferably within 10 to 12 hours but no more than two days after core damage.

The confirmatory assessments provide important insights for developing SAMGs. In the calculations that credit the activation of the LDF, the molten core debris is cooled below the ablation temperature (1,450 degrees K [2,150 degrees F] for the basaltic concrete), but the cooling is quick and fully effective only for the LCHP scenario, wherein the erosion is stopped at just 5 centimeters (cm) (2 inches [in.]). In the low pressure LCLP scenario, erosion is stopped at 17 cm (6.7 in.). In the base-case LBLC scenario, the erosion is never completely stopped, though it is greatly slowed starting 2 hours after vessel breach; at 48 hours, the erosion depth reaches 1.84 m (6 ft). For each scenario, MAAP4 predicted very little erosion as long as water covered the debris.

The containment can fail when the drywell head is lifted (incipient lifting occurs at 4.6 bar [66.72 psi]) if the elastomer head seal has previously been heated to above 533 degrees K (500 degrees F). This situation arises in the LBLC scenario but not in the two station blackout scenarios, wherein the upper drywell temperatures remain lower. When this mode of drywell failure occurs, it is the dominant radiological release path to the environment. However, because the discharge rates are small, this mechanism does not have a large direct effect on containment pressurization.

Activation of the LDF before the vessel breach has been considered in a sensitivity case for the LBLC scenario, since in the base case the required activation temperature is actually predicted to be just barely attained at about 7 hours before vessel breach. Because the precise peak containment temperature at such times depends on in-vessel conditions that are likely to be relatively model dependent, the base case discounted the premature flooders actuation and assumed flooders actuation to occur just after a vessel breach. In consequence, in the sensitivity case, 494 tonnes (544.5 tons) of water are in the lower drywell at the time of a vessel breach. Barring the unlikely possibility of a steam explosion (see the discussion of COL License Information Item 19.14 in Section 19.9.4), the premature flooding has little consequence on debris/concrete interactions, containment pressurization, or radiological releases.

Three variants of the LCHP scenario have investigated the consequences of realigning the drywell sprays source from the wetwell pool to externally-supplied firewater, assumed to occur 10 hours into the accident. The finding is that an injection rate of 0.008 cubic meters per second ( $m^3/s$ ) (126.82 gallons per minute [gpm]) is approximately optimal, in that it allows the level in the wetwell pool to stay roughly constant (neither uncovering the top vent nor flooding the vacuum breaker) for times as long as 100 hours or more. As long as this situation prevails, the fission product releases remain low, because the suppression pool effectively scrubs the aerosols. As discussed below, however, the MELCOR analysis predicted that when the wetwell vent opens, considerable quantities of fission product vapors flow through the water, into the wetwell air space, and out the wetwell vent into the environment.

A higher injection rate of 0.04  $m^3/s$  (634.1 gpm) causes the wetwell pool to fill until the rising water blows open the wetwell rupture disk, occurring at about 47 hours according to MELCOR. Large fission product releases are then predicted because the water contains so much radioactive material. Much of the radioactive water, however, should remain in the vent stack.

If no firewater is added, the wetwell level is predicted to fall until the water in the lower drywell becomes isolated from the suppression pool water (i.e., the connection afforded by the passive flooders becomes uncovered). Dryout of the lower drywell and resumption of the concrete attack is then predicted to occur at 86 hours; large environmental releases follow, via a pathway that becomes available for fission products to be transported from the vessel to the wetwell vent and out to the environment. These releases are caused by the revaporization of volatile fission products deposited in the vessel, leading to protracted releases days into the accident. These fission products flow out of the failed lower vessel head, into the drywell, and then into the downcomers and through the uncovered vents into the wetwell. From there, they flow out of the wetwell vent into the environment. It is clear that from an accident management perspective, it would be necessary to add firewater in a controlled manner preferably by 10 to 12 hours after the start of the accident.

The MAAP4 analysis generally predicted enhanced cooling of the molten core debris over the drywell floor as compared to the MELCOR results. The MELCOR analysis predicted

containment failure due to the lifting of the drywell head by pressure during the LCLB scenario, with the elastomer seal having failed due to the high temperature. In the MAAP4 analysis, this failure is predicted not to occur. Otherwise, the agreement between the codes on thermal-hydraulic predictions is generally reasonable. However, the MELCOR analysis predicted higher radiological releases and significant amounts of radioactive vapors in the vessel starting soon after the first gap releases. MAAP4 does not predict such vapors, so the higher MELCOR releases can be attributed to the less effective scrubbing of fission product vapors by the suppression pool (relative to the scrubbing of aerosols).

Most of the MAAP4 calculations indicate that the cumulative environmental releases are still slowly increasing even at 168 hours after the initiation of the accident. These releases are caused by the reevaporation of volatile fission products deposited in the vessel, leading to protracted releases late into the accident. These fission products flow out of the failed lower vessel head, into the drywell, and then into the downcomers and through the vents into the wetwell.

See the above discussion on “Accident Management” in Section 19.9.4 for further information.

The MELCOR simulation of the LBLC scenario identified a circumstance where the drywell flooder could open prematurely to deliver suppression pool water into the lower drywell before a vessel breach. This circumstance could create the potential for a large ex-vessel steam explosion. The MAAP calculation, however, did not produce the same result. Because this accident scenario has such a low probability of occurrence, the staff believes that the premature actuation of the lower drywell flooder is extremely unlikely.

With the confirmatory assessment now complete, the staff considers Open Item 19-13 to be resolved and closed.

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (e.g., misspellings, incorrect references, table headings). This departure corrects a typographical error in Table 19E.3-6. The applicant's evaluation determined that this departure does not require prior NRC approval in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. Within the review scope of this section, the staff determined it to be reasonable that this departure does not require prior NRC approval.

#### **19E.5 Post Combined License Activities**

The applicant identifies Commitments (COM 19.9-1, COM 19.9-8, COM 19.9-13, COM 19.9-21, COM 19.9-25, and COM 19.9-26) to address COL License Information Items 19.1, 19.9, 19.14, 19.19c, 19.19h, and 19.19i as discussed in SER Section 19.9.4.

The staff issued RAI 19.01-25 asking the applicant to describe the plan and implementation schedules for these information items. The staff reviewed the applicant's supplemental response to this RAI in Section 19.9 of this SER and determined the response to be acceptable. Therefore, all issues related to the above commitments are resolved.

## **19E.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Deterministic Evaluations," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Deterministic Evaluations" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "Deterministic Evaluations," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## **19EA Direct Containment Heating**

Appendix 19EA of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19EA, "Direct Containment Heating," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Direct Containment Heating" have been resolved.

## **19EB Fuel Coolant Interactions**

Appendix 19EB of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19EB, "Fuel Coolant Interactions," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to "Fuel Coolant Interactions" have been resolved.

## **19EC Debris Coolability and Core Concrete Interaction**

Appendix 19EC of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19EC, "Debris Coolability and Core Concrete Interaction," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Debris Coolability and Core Concrete Interactions" have been resolved.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

## **19ED Corium Shield**

Appendix 19ED of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19ED, “Corium Shield,” of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff’s review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Corium Shield” have been resolved.

## **19EE Suppression Pool Bypass**

Appendix 19EE of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19EE, “Suppression Pool Bypass,” of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff’s review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Suppression Pool Bypass” have been resolved.

## **19F Containment Ultimate Strength**

Appendix 19F of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19F “Containment Ultimate Strength” of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and considered the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff’s review confirmed that there is no outstanding information outside of the DCD related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the containment ultimate strength have been resolved.

## **19FA Containment Ultimate Strength**

Appendix 19FA of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19FA, “Containment Ultimate Strength,” of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff’s review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the “Containment Ultimate Strength” have been resolved.

## **19G Not Used**

This appendix is not used in both the ABWR DCD and the applicant’s FSAR.

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification

## **19H Seismic Capacity Analysis**

### **19H.1 Introduction**

FSAR Appendix 19H describes the text changes and supplemental information in Appendix 19H of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### **19H.2 Summary of Application**

Appendix 19H of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19H of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19H, the applicant provided the following:

#### Tier 1 Departure

- STD DEP T1 2.15-1 Re-classification of Radwaste Building Substructure from Seismic Category I to Non-Seismic

This departure reclassifies the RWB as a non-seismic structure.

#### Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP Admin

This departure addressed editorial/nomenclature changes in Table 19H-1.

### **19H.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19H.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Appendix 19H of the certified ABWR DCD. The staff reviewed Appendix 19H of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Seismic Capacity Analysis."

The HCLPF capacities of site-specific SSCs (UHS pump house, RSW piping tunnel, cooling tower structure, diesel generator fuel oil storage vault, and service water cooling fans) are provided in FSAR Table 19H-1a following the Staff Interim Guidance DC/COL-ISG-020. As stated in Section 19.9.4, these capacities are greater than 1.67 times the GMRS for STP Units 3 and 4 and are, therefore, acceptable according to DC/COL-ISG-020.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departure

- STD DEP T1 2.15-1 Re-classification of Radwaste Building Substructure from Seismic Category I to Non-Seismic

This departure deletes the description of the RWB as a seismic Category I structure from the ABWR DCD. See Sections 19.4 and 3.8 of this SER for the staff's evaluation of this departure.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP Admin

The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced ABWR DCD (e.g., misspellings, incorrect references, table headings). This departure addressed editorial/nomenclature changes in Table 19H-1. The staff determined this administrative departure to be reasonable.

The applicant's evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. Within the review scope of this section, the staff determined it to be reasonable that this departure does not require prior NRC approval.

**19H.5 Post Combined License Activities**

There are no post COL activities related to this section.

**19H.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Seismic Capacity Analysis," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Seismic Capacity Analysis" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "Seismic Capacity Analysis," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

**19I Seismic Margins Analysis**

**19I.1 Introduction**

FSAR Appendix 19I describes the text changes and supplemental information in Appendix 19I of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

## 19I.2 Summary of Application

Appendix 19I of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19I of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19I, the applicant provided the following:

### Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 19I.7-1 Atmospheric Control System Bypass Analysis

This departure replaces the MOVs with air-operated valves.

- STP DEP 1.1-2 Dual Units at STP Units 3 & 4

This departure clarifies that a single fire protection system water volume is used for dual units.

## 19I.3 Regulatory Basis

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

## 19I.4 Technical Evaluation

As documented in NUREG-1503, staff reviewed and approved Appendix 19I of the certified ABWR DCD. The staff reviewed Appendix 19I of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the ABWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Seismic Capacity Analysis."

The HCLPF capacities of site-specific SSCs (UHS pump house, RSW piping tunnel, cooling tower structure, diesel generator fuel oil storage vault, and service water cooling fans) are provided in FSAR Table 19I-1a following the Staff Interim Guidance DC/COL-ISG -020. As stated in Section 19.9.4, these capacities are greater than 1.67 times the GMRS for STP Units 3 and 4 and are, therefore, acceptable according to DC/COL-ISG-020.

The staff reviewed the information in the COL FSAR:

### Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP Units 3 & 4

In Section 19I.3.1, "Support State Event Tree," the applicant stated that:

The STP Units 3 and 4 ABWR dual unit design will use the same fire protection system water volume as the single unit design of the reference ABWR DCD as

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

described in STP DEP 1.1-2. This aspect does not change the SMA conclusions that no HCLPF accident sequence is less than two times the SSE.

The staff evaluated the above assertion from the standpoint of seismic capacity/fragility and determined the justification to be acceptable.

- **STD DEP 19I.7-1 Atmospheric Control System Bypass Analysis**

This departure changes the atmospheric control system crosstie to air-operated valves, which allows for remote operation in a seismic event. As indicated in Section 19I.7, "Containment Isolation and Bypass Analysis," the analysis in the STP Units 3 and 4 FSAR has been changed to reflect the design of air operators on these valves. As a result, the seismic-induced bypass analysis of these lines is the same as the analysis described for the drywell inerting/purge lines.

The staff concluded that changing the design input assumption used in the seismic margins PRA analysis, as it relates to the design of the atmospheric control system crosstie lines/valves, is a correction of the basis for the PRA analysis and has no effect on the plant design or the safety analysis.

The applicant's evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5 determined that the above Tier 2 departures do not require prior NRC approval. Within the review scope of this section, the staff determined it to be reasonable that these departures do not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

#### **19I.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **19I.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Seismic Margins Analysis," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Seismic Margins Analysis" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion of the "Seismic Margins Analysis," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

#### **19J Not Used**

This appendix is not used in both the ABWR DCD and the applicant's FSAR.

**19K PRA-Based Reliability and Maintenance (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.4.1.2, “Results from the Level 1 PRA for Operations at Power”; 19.1.4.2.2, “Results from the Level 2 PRA for Operations at Power”; 19.1.6.2, “Results from the Low-Power and Shutdown Operation PRA”; 19.1.7.4, “RA Input to the Reliability Assurance Program”; and 19.2.2, “Severe Accident Prevention”)**

### **19K.1 Introduction**

FSAR Appendix 19K describes the text changes and supplemental information in Appendix 19K of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### **19K.2 Summary of Application**

Appendix 19K of the STP Units 3 and 4 COL FSAR, Revision 12, incorporates by reference Appendix 19K of the certified ABWR DCD, Revision 4, referenced in 10 CFR Part 52, Appendix A.

In addition, in FSAR Appendix 19K, the applicant provided the following:

#### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump

This departure addressed the pump and turbine monoblock design (pump and turbine are contained in the same casing), which simplifies the design and removes multiple components.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and the unnecessary, inadvertent actuation of prevention logic and equipment. Clarifications in the I&C nomenclature reflect the changes in this departure.

- STP DEP T1 5.0-1 Site Parameters

This departure addressed the site design-basis flood level, the maximum design precipitation rate for rainfall, the humidity (represented by the wet-bulb temperature), and the shear wave velocity at the STP site that are not bounded by those parameters described in the ABWR DCD.

#### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This departure changes the design to utilize two MVES (13.8 kV and 4.16 kV) instead of the one 6.9 kV MVES described in the ABWR DCD.

### Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 10.4-2 Main Condenser

This departure describes how STP Units 3 and 4 will utilize three condenser shells cross-connected to equalize the pressure, with each shell containing four tube bundles and parallel circulating water flow. This departure provided four 25-percent capacity circulating water pumps discharging into a common header.

- STD DEP 19.3-1 Evaluation of Common Cause Failures

Common cause failures for specific systems were added to the ABWR PRA, which is used to quantify the effects of plant-specific factors for STP Units 3 and 4. The addition of the common cause failure terms represents a departure from the PRA that is described in the referenced DCD.

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure addressed the internal flooding of the control building due to the elimination of vacuum breaker valves on the supply and return piping that connects to the RCW heat exchangers. The departure deletes the words “anti-siphon capability” because the RSW no longer requires that capability.

### Supplemental Information

#### *19K.3 “Determination of ‘Important Structures, Systems and Components’ for Level 1 Analysis”*

The STP Units 3 and 4, Level 1 PRA identifies SSCs that have the greatest importance based on Fussell-Vesely (FV) and risk achievement worth (RAW) values. SSAR Section 19D.7 addressed significant human errors. Important SSCs under consideration for periodic testing and/or preventive maintenance as part of the Reliability Assurance Program (RAP) are identified in Section 19K.11.

#### *Section 19K.7 “Determination of ‘Important Structures, Systems and Components’ for Flood Analysis”*

The applicant provided site-specific supplemental information in Section 19K.7 of the STP Units 3 and 4 COL FSAR that identifies important SSCs in the probabilistic flooding analysis of the relocated RSW pump house.

The applicant provided site-specific supplemental information in Section 19K.7 of the STP Units 3 and 4 COL FSAR that identifies important SSCs in the probabilistic flooding analysis for external flooding, which addressed Departure STP DEP T1 5.0-1 (“Site Parameters”).

#### *Section 19K.10 “Identification of Important Capabilities Outside the Control Room”*

The applicant identifies the following additional important activity:

- Verifying that all watertight doors are closed upon notification of the main cooling reservoir breach.

### *Section 19K.11.1 “Component Inspections and Maintenance”*

The following additional SSCs also have a high FV importance:

The RCW and RSW systems have a high FV importance with respect to CCF impacts, because these systems support a number of front-line safety systems. There are maintenance and testing tasks for the key components in each division, including pumps, heat exchangers, and the service water cooling tower fans.

### *Section 19K.11.13 “Flood Protection”*

This section lists and describes the important SSCs for flood protection:

- Watertight doors on external entrances to the control and reactor buildings, including the watertight barriers on the equipment access to the diesel generator rooms and in the emergency core cooling systems (ECCS)
- RSW pump house, pump rooms, and other rooms
- RCW rooms
- RSW and CWS isolation valves
- Circuit breakers that trip the RSW pumps and water level sensors in the turbine building condenser pit

## **19K.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

## **19K.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Appendix 19K of the certified ABWR DCD. The staff reviewed Appendix 19K of the STP Units 3 and 4 COL FSAR, and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to the “PRA-Based Reliability and Maintenance.”

The staff reviewed the following information in the COL FSAR:

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<sup>1</sup> See “*Finality of Referenced NRC Approvals*” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

### Tier 1 Departures

- STD DEP T1 2.4-3 RCIC Turbine/Pump
- STD DEP T1 3.4-1 Safety-Related I&C Architecture
- STP DEP T1 5.0-1 Site Parameters

The above departures are evaluated in other sections of this SER (e.g., Sections 19.1.4 and 19.3.4, and Appendix 19R) and will not be discussed here.

### Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

The above departure is evaluated in other sections of this SER (e.g., Section 19.3.4) and will not be discussed here.

### Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 10.4-2 Main Condenser
- STD DEP 19.3-1 Evaluation of Common Cause Failures
- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

The above departures are evaluated in other sections of this SER (e.g., Section 19.3.4 and Appendix 19R) and will not be discussed here.

### Supplemental Information

#### *Section 19K.3 "Determination of 'Important Structures, Systems and Components' for Level 1 Analysis"*

The staff reviewed the supplemental information related to the identification of important SSCs in the Level 1 PRA analysis included in Section 19K.3 of the STP Units 3 and 4 COL FSAR. Based on audits (ML093560778 and ML120110172) of the STP Units 3 and 4, Level 1, plant-specific PRA and the staff's safety evaluation in Subsection 17.4S.4.3, the staff determined that Section 19K.3 of the STP Units 3 and 4 COL FSAR sufficiently identified the SSCs that have the greatest importance in the Level 1 PRA analysis. Based on this finding, the staff concluded that the supplemental information in Section 19K.3 is acceptable.

#### *Section 19K.7 "Determination of 'Important Structures, Systems and Components' for Flood Analysis"*

The staff reviewed the supplemental information related to the identification of important SSCs in the probabilistic flooding analysis of the relocated RSW pump house included in Section 19K.7 of the STP Units 3 and 4 COL FSAR. The staff determined that Section 19K.7 sufficiently identifies the important SSCs in this probabilistic flooding analysis developed in Appendix 19R. Based on this finding and the staff's safety evaluation of Appendix 19R associated with this probabilistic flooding analysis, the staff concluded that the supplemental information in Section 19K.7 is acceptable.

The staff reviewed the supplemental information related to the identification of important SSCs in the probabilistic flooding analysis for external flooding included under Section 19K.7 of the STP Units 3 and 4 COL FSAR. The staff determined that Section 19K.7 sufficiently identifies the important SSCs in this probabilistic flooding analysis developed in Appendix 19R. However, as a result of the open item identified in Appendix 19R of this SER that was associated with this probabilistic flooding analysis, the staff was unable to finalize the conclusions relating to the supplemental information in Section 19K.7 associated with the probabilistic flood analysis for external flooding. The staff tracked this issue as Open Item 19-12 (RAI 19-30) in the SER with open items. In response to RAI 19-30 dated July 28, 2010 (ML102110184), and as discussed in Appendix 19R of this SER, the applicant revised COL FSAR Section 2.4S.10, "Flooding Protection Requirements," to state that all watertight doors and hatches are normally closed. Based on (1) the change in the watertight door status to be normally closed, (2) the removal of the screening quantification for the postulated main cooling reservoir breach from the FSAR, and (3) the revisions to the affected COL FSAR sections, the staff concluded that the issues associated with Open Item 19-12 (RAI 19-30) are resolved. Therefore, the staff determined the applicant's modeling of external floods for a shutdown and full power to be acceptable.

#### *Section 19K.10 "Identification of Important Capabilities Outside the Control Room"*

The staff reviewed the supplemental information related to the identification of important capabilities outside the control room in FSAR Section 19K.10. From the probabilistic analysis for external flooding developed in Appendix 19R, the staff determined that Section 19K.10 sufficiently identifies the important capability to verify that all watertight doors are closed on notification of the main cooling reservoir breach. Based on this finding, the staff concluded that the supplemental information in FSAR Section 19K.10 is acceptable.

#### *Section 19K.11 "Reliability and Maintenance Actions"*

The staff reviewed the supplemental information in FSAR Section 19K.11 as part of the review of FSAR Section 17.4S. The discussion of this review is in SER Subsection 17.4S.4.3, in which the staff concluded that this information in the COL FSAR is acceptable and meets the applicable requirements. FSAR Section 19K.11 is also dependent on the probabilistic external flooding analysis in Appendix 19R, in which the staff identified Open Item 19-12. As stated above, the applicant has revised the FSAR to change the watertight status to be normally closed. The staff's review determined the applicant's modeling of external floods to be acceptable, and Open Item 19-12 is closed.

#### **19K.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **19K.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "PRA-Based Reliability and Maintenance," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "PRA-Based Reliability and Maintenance" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on “PRA-Based Reliability and Maintenance,” the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

**19L ABWR Shutdown Risk Evaluation (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.6.1, “Description of the Low-Power and Shutdown Operations PRA”)**

**19L.1 Introduction**

FSAR Appendix 19L describes the text changes and supplemental information in Appendix 19L of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

**19L.2 Summary of Application**

Appendix 19L of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19L of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19L, the applicant provided the following:

Tier 1 Departures

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

This departure changes the STP Units 3 and 4 plant-specific design by modifying Loop A of the RHR system to have a return to the fuel pool cooling system.

- STD DEP T1 2.12-2 I&C Power Divisions

This departure adds a fourth division of safety-related power to the Class 1E I&C power supply system.

Tier 2 Departures Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This departure changes the STP design by incorporating two reserve auxiliary transformers (RATs) in place of one in the original ABWR design.

- STD DEP 10.4-5 Condensate and Feedwater System (Table 19L-9)

Due to the changes in the condensate and the FW systems, the applicant has modified the success criteria to include the condensate booster pumps.

### Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP 3 & 4

This departure addressed the applicant's statement that the shared systems between STP Units 3 and 4 do not change the assessed risk associated with shutdown conditions.

- STD DEP 5.4-1 Reactor Water Cleanup System

This departure addressed the STP Units 3 and 4 plant-specific design that requires a single CUW pump to provide 100 percent capacity during operating Modes 4 and 5. This is a change from the ABWR DCD design, which requires both pumps.

- STD DEP 6C-1 Containment Debris Protection for ECCS Strainers

This departure changes the ECCS strainer model from a conical suction strainer to a cassette-type strainer, which satisfies the guidance in RG 1.82, Revision 3.

### **19L.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19L.4 Technical Evaluation**

As documented in NUREG-1503, staff reviewed and approved Appendix 19L of the certified ABWR DCD. The staff reviewed Appendix 19L of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "ABWR Shutdown Risk Evaluation."

The staff reviewed the following information in the COL FSAR:

### Tier 1 Departures

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

This departure changes the STP Units 3 and 4 plant-specific design by modifying Loop A of the RHR system to have a return to the fuel pool cooling system. The staff agreed that increasing the number of RHR loops that connect to the fuel pool cooling and cleanup system (FPCCS) from two to three decreases the risk associated with shutdown conditions.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

- STD DEP T1 2.12-2 I&C Power Divisions

This departure adds a fourth division of safety-related power to the Class 1E I&C power supply system. The staff agreed that this change represents an improvement and does not result in an increase in the risk associated with shutdown conditions.

Tier 2 Departures Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

The STP Units 3 and 4 design incorporates two reserve auxiliary transformers (RATs) in place of the one RAT in the original ABWR design. The applicant stated that this departure either improves the design and, therefore, decreases the CDF relative to the referenced ABWR design, or does not affect the CDF. The staff agreed that two RATs afford greater reliability for offsite electrical power by decreasing the frequency of a LOOP event.

- STD DEP 10.4-5 Condensate and Feedwater System (Table 19L-9)

Due to the changes in the condensate and the FW systems, the applicant has modified the success criteria to include the condensate booster pumps. This change is reflected in Table 19L-9, "Dependency of Core Cooling Systems on Electrical Power." The staff determined this change to be acceptable.

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP 3 & 4

The applicant stated that the shared systems between STP Units 3 and 4 do not result in any changes to the assessed risk associated with shutdown conditions. The staff questioned this statement. See the evaluation of this departure below in Section 19L.8, "Loss of Decay Heat Removal Events."

- STD DEP 5.4-1 Reactor Water Cleanup System

In the STP Units 3 and 4 plant-specific design, a single CUW pump is needed to provide 100 percent capacity during operating Modes 4 and 5. This is a change from the original ABWR design, which requires both pumps. The change has no quantifiable effect on the PRA, and the staff agreed with this assessment.

- STD DEP 6C-1 Containment Debris Protection for ECCS Strainers

This departure changes the ECCS strainer model from a conical suction strainer to a cassette-type strainer, which satisfies the requirements of RG 1.82, Revision 3, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident." This departure addressed the applicant's statement that the ECCS suction strainer departure meets NRC requirements and does not increase the shutdown risk profile. The staff agreed with this assessment. See Chapter 6 of this SER for the staff's review of this departure.

The applicant's evaluation determined that the above departures do not require prior NRC approval in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. Within the review scope of this section, the staff determined it to be reasonable that these departures do not

require prior NRC approval. The applicant's process for evaluating departures and other changes to the certified ABWR DCD is subject to NRC inspections.

Section 19L.6.4 "Reactor Water Cleanup System"

- STD DEP 5.4-1 Reactor Water Cleanup System

The staff evaluated this design change and agreed that it represents an improvement in the reliability of the CUW system and a reduction in the risk associated with shutdown conditions. The CUW can mitigate a loss of decay heat removal (DHR) after 8 days post-shutdown. The staff agreed with this assessment.

Section 19L.6.5 "Residual Heat Removal System"

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

The ABWR RHR system is a closed system consisting of three independent pump loops that inject water into the vessel and/or remove heat from the reactor core or the containment. Loop A differs from Loops B and C in that the Loop A return line goes to the RPV through the FW line, whereas the return lines for Loops B and C go directly to the RPV. In this design change, all three RHR loops are connected to the FPCCS instead of two loops for the referenced ABWR DCD, with normally closed inter-ties to permit additional supplemental cooling during refueling outages. The staff agreed that increasing the number of RHR loops that connect to the FPCCS from two to three decreases the risk associated with shutdown conditions.

Section 19L.6.6 "Summary of Reactor Pressure Vessel Draining Events"

- STD DEP 5.4-1 Reactor Water Cleanup System

See the discussion above in *Section 19L.6.4, "Reactor Water Cleanup System."*

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

See the discussion above in *Section 19L.6.5, "Residual Heat Removal System."*

- STD DEP T1 2.12-2 I&C Power Divisions

The I&C power supply system described in the DCD Tier 1 provided power to three mechanical safety-related divisions (I, II, and III) and not to safety-related distributed and control and information system (DCIS) Division IV. This departure adds a fourth division of safety-related power to the Class 1E I&C power supply system.

This design change represents an improvement and does not result in an increase in the risk associated with shutdown conditions. The staff agreed with this assessment.

### Section 19L.7.2 "Success Criteria"

- STD DEP 10.4-5 Condensate and Feedwater System

Not directly related to Departure STD DEP 10.4-5 but referenced in Table 19L-9 of the STP Units 3 and 4 FSAR is a list of core cooling systems that satisfy the core cooling system success criteria. However, the list in Table 19L-9 only contains pumps with the capability to keep the core covered. The core heat removal path is not listed. Missing information includes (1) the number of SRVs that need to be opened to remove heat from the vessel, and (2) where the core heat is to be discharged (e.g., the suppression pool) given an extended loss of DHR. The staff issued RAI 19-7 requesting the applicant to clarify the success criteria that need to be augmented to include all SSCs in the heat removal paths, not just the list of injection paths. The applicant's response to RAI 19-17 dated July 13, 2009 (ML092740559), stated that the SSCs necessary for decay heat removal are included in DCD Section 19Q.7 and in Table 19Q-2 of the FSAR. The staff determined this response to be acceptable. Therefore, the staff considers RAI 19-17 to be resolved and closed.

### Section 19L.8 "Loss of Decay Heat Removal Events"

- STD DEP 5.4-1 Reactor Water Cleanup System

See the discussion above in *Section 19L.6.4, "Reactor Water Cleanup System."*

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

See the discussion above in *Section 19L.6.5, "Residual Heat Removal System."*

- STP DEP 1.1-2 Dual Units at STP 3 & 4

The applicant stated that the shared systems between STP Units 3 and 4 do not result in any changes to the assessed risk associated with shutdown conditions. In the FSAR, the applicant stated that the shared fire water system between the STP Units 3 and 4 is not expected to result in any changes to the assessed risk associated with a shutdown, because the frequency for both units being in a shutdown condition and requiring backup cooling is extremely small. However, there are currently no administrative controls precluding both units entering into a refueling outage or a forced shutdown simultaneously. In addition, the Abnormal Procedures for STP Units 1 and 2 require a plant shutdown before the arrival of a hurricane. The staff identified the need for additional information before concluding that the shared fire water system does not change the risk associated with shutdown conditions. The staff then issued RAI 19-18 requesting the applicant to evaluate quantitatively the CDF resulting from a postulated dual unit station blackout event given a grid-related or severe weather LOOP (including hurricanes and tornadoes) during Modes 4 and 5.

The staff evaluated the applicant's response to RAI 19-18 dated July 13, 2009 (ML092740559), and identified a screening evaluation that used a LOOP frequency of 0.1 per year. But this screening evaluation did not include equipment failures following a postulated hurricane event. The staff then issued RAI 19.01-31 requesting the applicant to provide the shutdown and the full power hurricane risk estimates that considered the shared fire water system. The staff also requested a description of the dominant sequences contributing to the shutdown and the full-power hurricane risk estimates. RAI 19.01-31 also included the unresolved issues from

RAI 19-18. Therefore, the staff considers RAI 19-18 to be resolved and closed. RAI 19.01-31 was tracked as Open Item 19-9 in the SER with open items.

In the responses to RAI 19.01-31 dated February 16, 2011 (ML110490542), and November 10, 2011 (ML11318A314), the applicant augments the STP Units 3 and 4 FSAR Section 19.4.6, "ABWR Shutdown Risk," Revision 7, to document the specific bulleted requirements that will be included in the abnormal operating procedures to address hurricane preparations. The RAI response dated February 16, 2011, documents the design-basis wind speeds for the site as 215.6 km/h (134 mph) for a 3-second gust. This design-basis wind speed is applied to the combustion gas turbine structure, the 345 kV switchyard, and the fire water pump house. The return period of the 3-second gust wind is 1 in 100 years based on ASCE/SEI-7-05. The response dated February 16, 2011, also includes a simplified quantitative assessment that was performed independent of the PRA to satisfy the requirements of 10 CFR 52.79(d)(1) to evaluate the effect of a hurricane on STP Units 3 and 4 at the design-basis wind speeds. Crediting the specific bulleted requirements---- documented in FSAR Section 19.4.6, and Commitment (COM 19.4-1 CR 10-15528 Action 2), the estimated CDF with credit for the ACIWA function and with only limited credit for the CTGs (with a failure likelihood of 0.5) was 1.5E-8 per year. In this simplified screening assessment, no credit was given to the diesel generator recovery and the use of the RCIC. The estimated LRF would be less than or equal to this estimated CDF. Thus, this assessment shows that the Commission's LRF goal of 1E-6 per year for new reactors have been met with margin.

An additional sensitivity analysis was performed to evaluate the effects of hurricane winds at the beyond design-basis wind speeds for the STP site. This analysis was also performed independent of the PRA assuming the abnormal operating procedures for hurricane preparations for STP Units 3 and 4 will contain all of the specific bulleted requirements listed in FSAR Section 19.4.6. In this analysis, the selected wind speed recurrence interval was 200 years, which corresponds to approximately 228.5 km/h (142 mph) using the methodology described in ASC/SEI 7-05. This sensitivity analysis credits the compensatory measures documented in FSAR Section 19.4.6 and in Commitment (COM 19.4-1 CR 10-15528 Action 2). However, the ACIWA function and the CTGs were assumed to fail at this wind speed. Diesel generator recovery was credited based on operating the RCIC system for at least 8 hours. The estimated CDF per unit was 4.6E-7 per year.

This sensitivity study did not credit use of a portable diesel-driven fire pump. This portable pump will be staged in an onsite seismic Category I structure before the onsite arrival of sustained winds in excess of 117.5 km/h (73 mph). This fire pump is described in DCD Tier 2, Section 5.4.7. The portable pump and the valves that align this pump to the RHR system, F103C, F102C, and F101C, are included in the RAP described in Section 19K.11.5 of the DCD and are included in Table 19K-4 of the DCD. This information is included by reference in the STP Units 3 and 4 FSAR. The fire pump can take suction from any available water source including the fire water storage tank and the UHS system. Crediting the use of this fire pump further reduces the estimated CDF to less than 1E-8 per year. The estimated LRF would be less than or equal to this estimated CDF. Thus, the Commission's LRF goal of 1E-6 per year for new reactors have been met with margin.

For both assessments, one EDG for each unit is assumed to be running and loaded on its Class 1E bus at least 2 hours before the onsite arrival of winds in excess of 117.5 km/h (73 mph). Therefore, the CCF parameters were adjusted to remove one EDG train from the start (the diesel and ventilation fan) and run for the first hour, and closure of the same EDG

output breaker. In response to RAI 19.01-31, this specific compensatory action and the additional bulleted compensatory actions credited in the risk evaluations are documented in FSAR Section 19.4.6 and Commitment (COM 19.4-1, CR 10-15528 Action 2). These specific actions also include developing an abnormal operating procedure for severe weather that is consistent with NUMARC 87-00, Revision 1, Section 2.11, "Hurricane Preparations," and is discussed in Sections 19.4.4 and 19.4.5 of this SER. As stated in the STP Units 3 and 4 FSAR, Revision 6, Section 19.4.6, changes to the specific bulleted requirements listed in Section 19.4.6 require an assessment of the quantitative risk of hurricanes at the beyond design-basis windspeeds and a comparison with the full-scope assessment (all modes, internal and external events model), to assure that the Commission goals, stated in the STP FSAR, Revision 6, Section 19.4.6 will continue to be met, and that changes to the licensing basis would meet the key principles contained in Regulatory Guide 1.174.

In summary, the staff concludes that the issues associated with Open Item 19-9 (RAI 19.01-31) are resolved based on the following:

- (1) Results of the quantitative assessment and sensitivity analyses that satisfy the requirements of 10 CFR 52.79(d)(1). Completion of the specific bulleted requirements (referenced in FSAR Section 19.4.6, "Shutdown Risk") in the abnormal operating procedures to address hurricane preparations will assure that the risk from hurricanes for STP Units 3 and 4 remain below the Commission goals, discussed in SRM to SECY 90-016 for CDF and LRF. Completion of these requirements will also assure that the STP Units 3 and 4 design has levels of defense-in-depth by providing balance between prevention of core damage and consequences mitigation for hurricanes.
- (2) Commitment (COM 19.4-1, CR 10-15528 Action 2) to develop abnormal operating procedures for severe weather will contain the specific bulleted requirements documented in STP Units 3 and 4 FSAR Section 19.4.6.
- (3) The requirement that changes to the specific bulleted requirements listed in STP FSAR Section 19.4.6 require an assessment of the quantitative risk of hurricanes at the beyond design-basis wind speeds and a comparison with the full-scope assessment (all modes, internal and external events) to assure that the Commission goals stated in 19.4.6 will continue to be met, and that changes to the licensing basis would meet the key principles contained in Regulatory Guide 1.174.

- STD DEP T1 2.12-2 I&C Power Divisions

See the discussion above in Section 19L.6.6, "Summary of Reactor Pressure Vessel Draining Events."

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

The STP Units 3 and 4 design incorporates two RATs in place of one RAT in the original ABWR design.

The STP Units 3 and 4 FSAR stated that two RATs afford greater reliability for offsite electrical power and, therefore, decrease the frequency of a LOOP event. The staff agreed with the applicant.

- STD DEP 6C-1 Containment Debris Protection for ECCS Strainers

The applicant stated that the ECCS suction strainer departure meets NRC requirements and represents an improvement in the design.

The staff agreed that the improvement in the ECCS suction strainer design (1) addressed the staff's concerns noted in NRC Bulletin 93-02, "Debris Plugging of Emergency Core Cooling Suction Strainers"; and GL 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System After a Loss of Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment"; (2) is designed to meet the guidance referenced in RG 1.82, Revision 3, NUREG/CR-6224, "Parametric Study of the Potential for BWR ECCS Strainer Blockage Due to LOCA Generated Debris"; NUREG/CR-6808, "Knowledge Base for the Effect of Debris on Pressurized Water Reactor Emergency Core Cooling Sump Performance"; and NEDO 32686-A, "Utility Resolution Guidance, for ECCS Suction Strainer Blockage"; and (3) is acceptable to the staff because this design decreases the risk associated with shutdown conditions. A detailed review of this departure is in Section 6.2 of this SER.

#### Section 19L.9.4 "Loss of Fuel Pooling Cooling"

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

See the discussion above in Section 19L.6.5, "Residual Heat Removal System."

#### **19L.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **19L.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "ABWR Shutdown Risk Evaluation." No outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "ABWR Shutdown Risk Evaluation" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "ABWR Shutdown Risk Evaluation," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

**19M Fire Protection Probabilistic Risk Assessment (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.5.2.1, “Description of the Internal Fire Risk Evaluation”; 19.1.5.2.2, “Results from the Internal Fire Risk Evaluation”; 19.2.2, “Severe Accident Prevention”)**

**19M.1 Introduction**

FSAR Appendix 19M describes the text changes and supplemental information in Appendix 19M of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

**19M.2 Summary of Application**

Appendix 19M of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19M of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19M, the applicant provided the following:

*Tier 1 Departures*

- STD DEP T1 2.4-3 RCIC Turbine/Pump

This departure addressed the applicant’s statement that changes to the RCIC pump reduce the overall risk associated with fire.

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This departure eliminates the hydrogen recombinder requirements.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure eliminates obsolete data communication technology and unnecessary inadvertent actuation prevention logic and equipment in the safety-related I&C architecture. The departure also changes the implementation, architecture, testing, and surveillance descriptions of the SSLC.

*Tier 2 Departures Not Requiring Prior NRC Approval*

- STP DEP 1.1-2 Dual Units at STP Units 3 & 4

This departure addressed the statement that the use of a shared fire protection pump house and storage tanks does not affect the FIVE analysis results.

- STD DEP 1.2-1 Control Building Annex

This departure moves the reactor internal pump motor generator (MG) sets and their switchgear from the control building to the control building annex. The applicant stated that the relocation of the MG sets lowers the ignition frequencies for the fire compartment in the control building.

- STP DEP 1.2-2 Turbine Building

This departure addressed the applicant’s statement that the turbine building modifications will not affect the generic fire frequencies used to perform the FIVE analyses described in the

various sections of FSAR Chapter 19. Furthermore, changes to the turbine building design will not affect the LOOP event models used to quantify the effects of fire in the turbine building.

### **19M.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

### **19M.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Appendix 19M of the certified ABWR DCD. The staff reviewed Appendix 19M of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Fire Protection Probabilistic Risk Assessment."

The staff reviewed the information in the COL FSAR:

#### *Tier 1 Departures*

- STD DEP T1 2.4-3 RCIC Turbine/Pump

In FSAR Section 19M.6.3, "STP 3 & 4 FIVE Review," the applicant stated that changes to the RCIC pump as a result of this departure reduce the overall risk associated with fire. The new RCIC pump design is expected to increase RCIC reliability and reduce the fire loading in the RCIC pump room by the elimination of the lube oil subsystem and lube oil. Therefore, the staff agrees that this departure reduces the overall risk associated with fire.

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

In Table 19M-2 of the STP Units 3 and 4 FSAR, the reference to "hydrogen recombiner" was deleted. The staff determined that this specific text change is appropriate and addressed Departure STD T1 2.14-1. Also, see the evaluation in Section 19E.4 of this SER.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

In Table 19M-2 of the STP Units 3 and 4 FSAR, the reference to "multiplexed systems" (which was originally envisioned in the ABWR architecture) was deleted and replaced by the text "data communication functions." The staff determined that this specific text change is appropriate and addressed Departure STD DEP T1 3.4-1. Also, see the evaluation in Section 19.1.4 of this SER.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP Units 3 & 4

In FSAR Section 19M.6.3, the applicant stated that the use of a shared fire protection pump house and storage tanks does not affect the FIVE analysis results. The applicant's evaluation of this departure, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. The staff issued RAI 19-7 requesting the applicant to clarify the impact of this departure on the overall risk associated with fire.

The applicant's supplemental response to RAI 19-7 dated December 3, 2009 (ML093421266), indicated that Table 19.2-2 of the STP Units 3 and 4 COL FSAR will be revised to state that this departure has no significant effect on CDF. The staff confirmed that the proposed revision was incorporated into Chapter 19 of FSAR, Revision 4. The applicant also clarified in FSAR Section 19M.6.3 the impact of this departure on the fire risk analysis. The staff determined these changes to be acceptable. Therefore, the staff considers RAI 19-7 to be resolved and closed.

- STD DEP 1.2-1 Control Building Annex

This departure moves the reactor internal pump MG sets and their switchgear from the control building to the control building annex. In FSAR Section 19M.6.3, the applicant stated that the relocation of the MG sets lowers the ignition frequencies for the fire compartments in the control building. The applicant's evaluation of this departure, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. The staff issued RAI 19.01-16 requesting the applicant to clarify whether the control building annex is included in the fire risk analysis. In the response to this RAI 19.01-16 dated August 5, 2009 (ML092220163), the applicant stated that the control building annex was not included in the fire risk analysis, because the building is not safety-related and does not include any safety-related equipment. Loss of the building for any cause may result in a plant trip on loss of the reactor internal pumps and, as such, would be treated as any other general transient in the internal events risk analysis. The staff determined this response to be acceptable, and considers RAI 19.01-16 to be resolved and closed. The applicant also clarified in FSAR Section 19M.6.3 the impact of this departure on the fire risk analysis, which the staff determined to be acceptable.

- STP DEP 1.2-2 Turbine Building

In FSAR Section 19M.6.3, the applicant stated that the potential turbine building modifications do not affect the generic fire frequencies used to perform the FIVE analyses described in the various FSAR Chapter 19 sections. Also, potential changes to the turbine building design do not affect the LOOP event models used to quantify the effects of fire in the turbine building. The applicant's evaluation of this departure, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that this departure does not require prior NRC approval. A list of new components and their locations in the turbine building for STP Units 3 and 4 is provided in Table 9A.6-4 of STP FSAR Section 9A.6, "Fire Hazard Analysis Database." The staff issued RAI 19.01-23 requesting the applicant to clarify the impact of these new components on the fire risk analysis results. This RAI was tracked as Open Item 19-10 in the SER with open items. In the response to RAI 19.01-23 dated March 16, 2010 (ML100770391), the applicant stated that the equipment associated with the CTG is identified as the new equipment in the STP Units 3

and 4 turbine building. However, the fire risk analysis described in SSAR Appendix 19M notes that the turbine building fire area excludes the CTG area, which is its individual fire area. The CTG fire area was screened from analysis using the FIVE methodology, because fires in this area do not directly lead to a plant trip and do not affect offsite power distribution to the plant. Therefore, this new equipment in the turbine building does not affect the ABWR DCD conclusion using the FIVE methodology. Also, the applicant revised FSAR Section 19M to incorporate the discussion in this response. Based on the discussion above, the staff determined this response and the revised FSAR Section 19M to be acceptable, and considers RAI 19.01-23 and Open Item 19-10 to be resolved and closed.

#### **19M.5 Post Combined License Activities**

The applicant identifies Commitment (COM 19.9-11) to address COL License Information Item 19.12, as discussed in SER Section 19.9.4.

#### **19M.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to the "Fire Protection Probabilistic Risk Assessment," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Fire Protection Probabilistic Risk Assessment" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "Fire Protection Probabilistic Risk Assessment," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

### **19N Analysis of Common-Cause Failure of Essential Communications Equipment**

#### **19N.1 Introduction**

FSAR Appendix 19N describes the text changes and supplemental information in Appendix 19N of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

#### **19N.2 Summary of Application**

Appendix 19N of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19N of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19N, the applicant provided the following:

### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure introduces a new safety-related I&C architecture that causes the elimination of the obsolete data communication technology; elimination of unnecessary inadvertent actuation prevention logic and equipment; clarification of digital control systems and nomenclature; and implementation of architectural changes and testing and surveillance changes to the SSLC. Chapter 7 of this SER provided additional information on this departure.

### Supplemental Information

In the following sections, subsections and figures of the STP Units 3 and 4 COL FSAR, the applicant updated the associated text to be consistent with Departure STD DEP T1 3.4-1:

- Section 19N.1, "Introduction"
- Section 19N.2, "Results and Conclusions"
- Section 19N.3, "Basis for the Analysis"
- Section 19N.4, "Potential Causes of and Defenses Against ECF CCF"
- Section 19N.4.1, "Earthquake"
- Section 19N.4.2, "Loss of D.C. Power"
- Section 19N.4.3, "Loss of Cooling"
- Section 19N.4.4, "Sensor Miscalibration"
- Section 19N.4.5, "Remote DLC Miscalibration"
- Section 19N.4.7, "Maintenance/Test Error"
- Section 19N.4.9, "Electromagnetic Interference (EMI)"
- Section 19N.4.10, "Fire"
- Section 19N.4.11, "Software"
- Section 19N.4.12, "Summary"
- Section 19N.5, "Discussion of the Effect on Core Damage Frequency"
- Section 19N.5.1, "General Plant Transient Events"
- Section 19N.5.2, "Loss of Feedwater Event"
- Section 19N.5.3, "Loss of Coolant Accidents"
- Subsection 19N.5.4.1, "Loss of Offsite Power"
- Subsection 19N.5.4.2, "Loss of DC Power"
- Subsection 19N.5.4.3, "Inadvertent Open Relief Valve"
- Subsection 19N.5.4.4, "Loss of Service Water"
- Subsection 19N.5.4.5, "Loss of Instrument Air"
- Section 19N.5.5, "CCF of ECF During Normal Plant Operation"
- Section 19N.6, "Discussion of the Effect on Isolation Capability"
- Section 19N.7, "Summary"
- Figure 19N-3, "Event Tree for Analysis of Common-Cause Failure of ECF"
- Figure 19N-4, "Event Tree for Failure to Isolate Due to ECF CCF"

### **19N.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

#### **19N.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Appendix 19N of the certified ABWR DCD. The staff reviewed Appendix 19N of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Analysis of Common-Cause Failure of Essential Communications Equipment."

The staff reviewed the following information in the COL FSAR:

##### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

See the evaluation in Section 19.1.4 of this SER.

##### Supplemental Information

For the sections, subsections and figures of the STP Units 3 and 4 COL FSAR that are listed under "Supplemental Information" in Section 19N.2 of this SER, the applicant updated the nomenclature and text to be consistent with Departure STD DEP T1 3.4-1. The staff determined that the specific text changes in Appendix 19N of the STP Units 3 and 4 COL FSAR are appropriate and address Departure STD DEP T1 3.4-1.

#### **19N.5 Post Combined License Activities**

The applicant identifies Commitment (COM 19.9-7) to address COL License Information Item 19.8 as discussed in SER Section 19.9.4.

#### **19N.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG–1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to the "Analysis of Common-Cause Failure of Essential Communications Equipment," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Analysis of Common-Cause Failure of Essential Communications Equipment" that were incorporated by reference have been resolved.

In addition, based on the above discussion on the "Analysis of Common-Cause Failure of Essential Communications Equipment," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

## **19O Not Used**

This appendix is not used in the ABWR DCD or in the applicant's FSAR.

## **19P Evaluation of Potential Modifications to the ABWR Design**

Appendix 19P of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19P, "Evaluation of Potential Modifications to the ABWR Design," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Evaluation of Potential Modifications to the ABWR Design" have been resolved.

## **19Q ABWR Shutdown Risk Assessment (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.6.1, "Description of the Low-Power and Shutdown Operations PRA"; and 19.1.6.2, "Results from the Low-Power and Shutdown Operations PRA")**

### **19Q.1 Introduction**

FSAR Appendix 19Q describes the text changes and supplemental information in Appendix 19Q of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### **19Q.2 Summary of Application**

Appendix 19Q of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19Q of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19Q, the applicant provided the following:

#### Tier 1 Departures

- STD DEP T1 2.4-1 RHR System and Spent Fuel Pool Cooling

This departure changes the RHR design of the STP Units 3 and 4 design to three RHR loops connected to the FPCCS instead of the two RHR loops in the original ABWR design.

- STD DEP T1 2.12-2 I&C Power Divisions

This departure adds a fourth division of safety-related power to the Class 1E I&C power supply system.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure changes the safety-related I&C architecture, such as eliminating obsolete data communication technology. This departure eliminates references to the EMS and the NEMS and replaces them with separate and independent system-level data communication

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

capabilities. The departure also eliminates references to multiplexed functions of plant systems and the plant layout in relation to the risk of an ABWR fire.

- STP DEP T1 5.0-1 Site Parameters

This departure addressed the applicant's analysis of external flooding at STP Units 3 and 4 for power operation documented in Appendix 19R. The applicant stated that the incremental increase in risk during a shutdown due to external flooding is very small because of the fraction of time the plant is in a shutdown condition during a year and the small likelihood of an external flood occurrence during shutdown conditions. The applicant stated that the ABWR DCD remains bounding for the risk associated with shutdown conditions.

#### Tier 2 Departures Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

This departure changes the STP Units 3 and 4 design by incorporating two RATs in place of the one RAT in the ABWR original design.

- STD DEP 10.4-5 Condensate and Feedwater System

This departure addressed the applicant's statement that if all RHR systems failed, the RPV would pressurize and the main condenser could be made available by opening the main steam isolation valves (MSIVs); drawing a vacuum in the condenser; and operating the feedwater, condensate booster, and condensate pumps for makeup.

#### Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP 3 & 4

This departure addressed the applicant's statements that the shared systems between STP Units 3 and 4 do not result in any changes to the assessed risk associated with shutdown conditions.

- STD DEP 5.4-1 Reactor Water Cleanup System

This departure addressed changes in the plant-specific design to the need for a single CUW pump to operate and provide 100 percent capacity during operating Modes 4 and 5. The original ABWR design requires both pumps.

- STD DEP 6C-1 Containment Debris Protection for ECCS Strainers

This departure addressed the applicant's statement that the new ECCS suction strainer meets NRC requirements and does not result in an increase in the shutdown risk profile.

### **19Q.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

## 19Q.4 Technical Evaluation

As documented in NUREG–1503, staff reviewed and approved Appendix 19Q of the certified ABWR DCD. The staff reviewed Appendix 19Q of the STP Units 3 and 4 COL FSAR, and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "ABWR Shutdown Risk Assessment."

The staff reviewed the following information in the COL FSAR:

### Tier 1 Departures

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

This departure changes the RHR design of the STP Units 3 and 4 design to three RHR loops connected to the FPCCS instead of the two RHR loops in the original ABWR design. The staff agreed that increasing the number of RHR loops that connect to the FPCCS from two to three decreases the risk associated with shutdown conditions.

- STD DEP T1 2.12-2 I&C Power Divisions

This departure adds a fourth division of safety-related power to the Class 1E I&C power supply system. The staff agreed that this change represents an improvement and does not result in an increase in the risk associated with shutdown conditions.

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure changes the safety-related I&C architecture by eliminating obsolete data communication technology. This departure eliminates references to the EMS and the NEMS and replaces them with separate and independent system-level data communication capabilities. The departure also eliminates references to multiplexed functions of plant systems and the plant layout in relation to the risk of an ABWR fire. See Section 19.1.4 of this SER for the evaluation of this departure.

- STP DEP T1 5.0-1 Site Parameters

This departure addressed the applicant's analysis of external flooding at STP Units 3 and 4 for power operation documented in Appendix 19R. The applicant stated that the incremental increase in risk during a shutdown due to external flooding is very small because of the fraction of time the plant is in a shutdown condition during a year and the small likelihood of an external flood occurrence during shutdown conditions. The applicant stated that the ABWR DCD remains bounding for the risk associated with shutdown conditions. See Section 19R.4 for the evaluation of this departure.

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

Tier 2 Departures Requiring Prior NRC Approval

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

The STP Units 3 and 4 design incorporates two RATs in place of one RAT in the original ABWR design. The staff agreed that two RATs afford greater reliability for offsite ac power and therefore decrease the frequency of a LOOP event.

- STD DEP 10.4-5 Condensate and Feedwater System

This departure addressed the applicant's statement that if "all RHR systems failed, the RPV would pressurize and the main condenser could be made available by opening the MSIVs; drawing a vacuum in the condenser; and operating the FW, condensate booster, and condensate pumps for makeup." The staff agreed with the changes in the DCD text.

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 1.1-2 Dual Units at STP 3 & 4

This departure addressed the applicant's statements that the shared systems between STP Units 3 and 4 do not result in any changes to the assessed risk associated with shutdown conditions. The staff questioned this statement. See Section 19Q.4.4 below for further discussion.

- STD DEP 5.4-1 Reactor Water Cleanup System

This departure addressed changes in the plant-specific design regarding the need for a single CUW pump to operate and provide 100 percent capacity during operating Modes 4 and 5. The original ABWR design requires both pumps. The change has no quantifiable effect on the PRA. The staff agreed with this assessment.

- STD DEP 6C-1 Containment Debris Protection for ECCS Strainers

This departure changes the ECCS strainer model from a conical suction strainer to a cassette-type strainer, which satisfies the guidance in RG 1.82, Revision 3. This departure addressed the applicant's statement that the ECCS suction strainer departure meets NRC requirements and does not increase the shutdown risk profile. The staff agreed with this assessment.

The applicant's evaluation determined that the above departures do not require prior NRC approval in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. Within the review scope of this section, the staff determined it to be reasonable that the above departures do not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

### Section 19Q.3 “Summary of Results”

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling
- STD DEP T1 2.12-2 I&C Power Divisions
- STP DEP T1 5.0-1 Site Parameters
- STP DEP 1.1-2 Dual Units at STP 3 & 4
- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design
- STD DEP 5.4-1 Reactor Water Cleanup System
- STD DEP 6C-1 Containment Debris Protection for ECCS Strainers

The applicant stated that these departures either (1) improve the design and therefore decrease the CDF relative to the referenced ABWR design, or (2) do not affect the CDF. The staff agreed with this assessment.

### Section 19Q.4.1 “Decay Heat Removal”

The applicant provided other potential heat sinks including the suppression pool, the CUW system, or the FPCCS.

- STD DEP 5.4-1 Reactor Water Cleanup System

In the plant-specific design, a single CUW pump is needed to operate and provide 100 percent capacity during operating Modes 4 and 5, which is a change from the original ABWR design that requires both pumps. The staff evaluated this design change and agreed that it represents an improvement in the reliability of the CUW system and a reduction in the risk associated with shutdown conditions. The CUW can mitigate a loss of DHR after 8 days post-shutdown. This change has no quantifiable effect on the PRA. The staff agreed with this assessment.

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

In the plant-specific design, Loop A of the RHR system is modified to have a return to the fuel pool cooling system. In this design change, all three RHR loops are connected to the FPCCS instead of the two loops in the referenced ABWR DCD, with normally close inter-ties to permit additional supplemental cooling during refueling outages. The staff agreed that additional supplemental cooling to the fuel pool decreases the risk associated with shutdown conditions.

### Section 19Q.4.2 “Inventory Control”

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

In the plant-specific design, Loop A of the RHR system is modified to have a return to the fuel pool cooling system. In this design change, all three RHR loops are connected to the FPCCS instead of the two loops in the referenced ABWR DCD, with normally close inter-ties to permit additional supplemental cooling during refueling outages to reduce outage time. The staff agreed that additional supplemental cooling to the fuel pool decreases the risk associated with shutdown conditions.

- STD DEP 6C-1 Containment Debris Protection for ECCS Strainers

The applicant stated that the ECCS suction strainer departure meets NRC requirements and does not result in an increase in the shutdown risk profile. The staff agreed that an improvement in the ECCS suction strainer design (1) addressed the staff's concerns noted in NRC Bulletin 93-02 and GL 98-04; (2) is designed to the guidance referenced in RG 1.82, NUREG/CR-6224, NUREG/CR-6808, and NEDO 32686-A; and (3) is acceptable to the staff because there would be a decrease in the risk associated with shutdown conditions. A detailed review of this departure is in Section 6.2 of this SER.

#### Section 19Q.4.4 "Electrical Power"

The applicant stated that in the event that one phase of the main transformer fails, an installed spare is available to return the preferred source of offsite power to service without any delays.

- STP DEP 1.1-2 Dual Units at STP 3 & 4

The applicant stated that the shared systems between STP Units 3 and 4 does not result in any changes to the assessed risk associated with shutdown conditions, because the frequency that both units will be in a shutdown condition and will require backup cooling is extremely small. However, there are currently no administrative controls preventing both units from entering into a refueling outage or a forced shutdown simultaneously. Also, the Abnormal Procedures for STP Units 1 and 2 require a plant shutdown before the arrival of a hurricane. Therefore, staff needed additional information before concluding that the shared fire water system does not result in any change to the risk associated with shutdown conditions. The staff issued RAI 19-18 requesting the applicant to evaluate quantitatively the CDF resulting from a postulated dual-unit station blackout event given a grid-related or severe weather LOOP (including hurricanes and tornadoes) during operating Modes 4 and 5.

The staff evaluated the applicant's response to RAI 19-18 dated July 13, 2009 (ML092740559), and identified a screening evaluation that used a LOOP frequency of 0.1 per year. But this screening evaluation did not include equipment failures following a postulated hurricane event. The staff then issued RAI 19.01-31 requesting the applicant to provide the shutdown and the full-power hurricane risk estimates that considered the shared fire water system. The staff also requested a description of the dominant sequences contributing to the shutdown and the full-power hurricane risk estimates. The staff issued RAI 19.01-31 to include the unresolved issues of RAI 19-18. Therefore, the staff considers RAI 19-18 to be resolved and closed. RAI 19.01-31 was tracked as Open Item 19-9 in the SER with open items.

In the response to RAI 19.01-31 dated February 16, 2011 (ML110490542), and November 10, 2011 (ML11318A314), the applicant augmented the STP Units 3 and 4 FSAR Section 19.4.6, Revision 7, to document the specific bulleted requirements that will be included in the abnormal operating procedures to address hurricane preparations. The RAI response dated February 16, 2011, documents the design basis wind speeds for the site as 215.6 km/h (134 mph) for a 3-second gust. This design-basis wind speed is applied to the CTG structure, the 345 kV switchyard, and the fire pump house. The return period of the 3-second gust wind is 1 in 100 years based on ASCE/SEI-7-05. The staff's review of this RAI response is discussed in detail under "Hurricane Risk" later in this section. In summary, the staff concluded that the issues associated with Open Item 19-9 (RAI 19.01-31) are resolved based on the following:

- (1) Results of the quantitative assessment and sensitivity analyses that satisfy the requirements of 10 CFR 52.79(d)(1). Completion of the specific bulleted requirements (referenced in FSAR Section 19.4.6, "Shutdown Risk") in the abnormal operating procedures to address hurricane preparations will assure that the risk from hurricanes for STP Units 3 and 4 remains below the Commission goals, discussed in SRM to SECY 90-016 for CDF and LRF. Completion of these requirements will also assure that the STP Units 3 and 4 design has levels of defense-in-depth by providing balance between prevention of core damage and consequences mitigation for hurricanes.
- (2) Commitment (COM 19.4-1, CR 10-15528 Action 2) to develop abnormal operating procedures for severe weather will contain the specific bulleted requirements documented in STP Units 3 and 4 FSAR Section 19.4.6.
- (3) The requirement that changes to the specific bulleted requirements listed in STP FSAR Section 19.4.6 require an assessment of the quantitative risk of hurricanes at the beyond design-basis wind speeds and a comparison with the full-scope assessment (all modes, internal and external events) to assure that the Commission goals stated in 19.4.6 will continue to be met, and that changes to the licensing basis would meet the key principles contained in Regulatory Guide 1.174.

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design

The STP Units 3 and 4 design incorporates two RATs in place of the one RAT in the ABWR original design. The STP Units 3 and 4 FSAR stated that two RATs afford greater reliability for offsite ac power and therefore, a decrease in the frequency of a LOOP event. The staff agreed with this statement.

- STD DEP T1 2.12-2 I&C Power Divisions

This design departure adds a fourth division of safety-related power to the Class IE I&C power supply system. The staff agreed that increasing the number of safety-related divisions from three to four improves reliability and decreases the risk associated with shutdown conditions.

Section 19Q.6 "Flooding and Fire Protection"

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure changes safety-related I&C architecture, including the elimination of obsolete data communication technology. This departure eliminates references to the EMS and the NEMS, which are replaced with separate and independent system-level data communication capabilities. The departure also eliminates references to multiplexed functions of plant systems and plant layout in relation to the risk of an ABWR fire. See Section 19.1.4 of this SER for an evaluation of this departure.

**Internal Floods**

The applicant stated that the fire barriers will prevent water due to flooding from non-divisional sources from entering a divisional area and will contain water in the fire area from divisional sources. The applicant also stated that the practice of not routing unlimited sources of water (e.g., service water) through ECCS room areas and ensuring that other large water sources (e.g., suppression pool) can be contained will be beneficial in the event of a flood.

The applicant reviewed all ABWR sources of an internal flood and concluded that during shutdown conditions, at least one safety division will be unaffected by water damage from any postulated flood. Besides separation, features that contribute to these results include adequately sized room floor drains; water level alarms and the automatic isolation of flood sources for potentially affected rooms; mounted motors and other electrical equipment at least 20.32 cm (8 in.) above floor level; and watertight doors. Administrative controls will be implemented to assure that at least one safety division with intact barriers is available at all times during a plant shutdown. For RSW pump house floods, the watertight doors for the pump rooms and electrical equipment rooms are capable of withstanding floods from either direction.

## External Floods

- STP DEP T1 5.0-1

### Site Parameters

Appendix 19R presents the analysis performed for external flooding at STP Units 3 and 4 for power operation. The analysis considered the cascading failure of the upstream dams on the Colorado River, probable maximum precipitation (PMP) events, a main cooling reservoir breach, and tsunamis. The breach of the main cooling reservoir is the design-basis flood for STP Units 3 and 4. If external flood barriers are open or removed and cannot be restored before high water levels reach the site, then core damage is assumed. An operating procedure for severe external flooding will be developed and implemented before fuel loading (COM 19.9-3). The applicant stated that an incremental increase in risk during a shutdown from external flooding is very small because of the fraction of time the plant is in a shutdown condition during a year and the small likelihood of an external flood occurrence during shutdown conditions. The applicant stated that the ABWR DCD remains bounding for the risk associated with shutdown conditions.

Although site-specific internal and external full power flooding sequences are evaluated in Appendix 19R of the FSAR, there is no risk analysis or estimation of the site-specific shutdown frequency of internal and external floods. The staff issued RAI 19-21 requesting the applicant to provide a quantitative site-specific shutdown risk assessment from internal and external floods that determines the CDF and LRF.

The applicant's response to RAI 19-21 dated August 18 2009 (ML092310681), stated that internal flooding during a shutdown is evaluated in Section 19Q.6 of the DCD. Procedural controls were identified as a necessary barrier to prevent and minimize the effects of flooding and are incorporated by reference in FSAR Appendix 19Q. The applicant also noted that the external flooding analysis described in Appendix 19R of the STP Units 3 and 4 FSAR was performed on an annual frequency and was therefore performed independent of the operating mode. The applicant references the results of the external flooding assessment for a postulated breach of the main cooling reservoir in response to RAI 19.01-10.

The applicant's response to RAI 19.01-10 dated July 23, 2009 (ML092080083), stated that additional design requirements identified for the RSW pump rooms in FSAR Section 19Q.6 ensure that the DCD internal flood assessment for shutdown conditions (including procedural controls) remains bounding for STP Units 3 and 4. The applicant also provided results of the external flood assessment for the main cooling reservoir breach design-basis flooding event.

The staff determined the applicant's response to be acceptable regarding the risk associated with shutdown conditions from internal flooding. However, based on the staff's review of the

results of the external flooding assessment and the detailed screening evaluation for breaching the main cooling reservoir, the staff issued RAI 19-30 requesting additional information on the probabilities used for this evaluation. This RAI was tracked as Open Item 19-12 in the SER with open items and is discussed in detail in Section 19R.4 of this SER.

In response to Open Item 19-12, the applicant submitted the final response to RAI 19-30 on July 28, 2010 (ML102110184). This RAI response changes the status for all watertight doors and hatches to be normally closed. This RAI response also uses ASME/ANS RA-Sa-2009, Section 6-2.3, "The Fundamental Criteria for Screening External Events Other Than Fire and Seismic Events." Criterion (a) was used to screen external flood scenarios from a detailed quantitative evaluation. Criterion (a) is satisfied because the STP Units 3 and 4 design for safety-related SSCs satisfies the requirements of SRP Section 3.4.2, Revision 3, which was in effect at the time of the COL application. Based on (1) the change in the watertight door status to be normally closed, (2) the removal of the screening quantification for a postulated main cooling reservoir breach, and (3) the proposed revisions to the affected COL FSAR sections, the staff concluded that the issues associated with Open Item 19-12 (RAI 19-30) have been resolved. The staff confirmed that the proposed revisions are incorporated into Revision 4 of the FSAR. Therefore, the staff determined the applicant's modeling of external floods to be acceptable, and RAI 19-30 and Open Item 19-12 are resolved and closed.

### **Hurricane Risk**

The staff reviewed the risk associated with shutdown conditions from a postulated hurricane outlined in Section 19.Q.6 of the STP Units 3 and 4 FSAR, Revision 2. The Abnormal Procedure for STP Units 1 and 2 covers hurricanes and requires a plant to shut down before the onsite arrival of hurricane winds in excess of 73 miles per hour. In order to reduce the risk when responding to an approaching hurricane, the applicant commits (COM 19Q-1) to develop before fuel loading a procedure to cope with impending hurricanes. The applicant stated that the tornado analysis in the referenced ABWR DCD will bound the hurricane analysis with respect to high winds. The staff then noted that there is no site-specific analysis to support this assumption. The staff issued RAI 19-20 requesting the applicant to provide a quantitative site-specific, high-winds, shutdown risk assessment that determines the high-winds induced risk estimates given the shared fire water system. The applicant's response to RAI 19-20 dated August 18, 2009 (ML092310681), clarifies that because the STP Units 3 and 4 site is within the site parameters defined in the DCD and the high winds that were reviewed as part of the DCD approval, the paragraphs addressing "Hurricane Risk" were removed from FSAR Section 19Q.6, Revision 3. Also, the associated FSAR Commitment (COM19Q-1) was deleted.

The staff evaluated the applicant's responses to RAI 19-18 (discussed in previous sections) and RAI 19-20 and concluded that the shared fire water system design in Departure STP DEP 1.1-2 impacts the shutdown and the full power hurricane risk assessment for the site. The staff then issued RAI 19.01-31 requesting the applicant to provide the following information in accordance with 10 CFR Part 52.79(d)(1): the shutdown and full power hurricane risk estimates, a description of the dominant sequences, and the list of SSCs that are identified as risk significant for the RAP.

The staff issued RAI 19.01-31 to include the unresolved issues in RAIs 19-18 and 19-20. Therefore, the staff considers RAIs 19-18 and 19-20 to be resolved and closed. RAI 19.01-31 was tracked as Open Item 19-9 in the SER with open items. In the response to RAI 19.01-31 dated February 16, 2011 (ML110490542), and November 10, 2011 (ML11318A314), the

applicant augments the STP Units 3 and 4 FSAR Section 19.4.6, Revision 7, to document the specific bulleted requirements that will be included in the abnormal operating procedures to address hurricane preparations. The RAI response dated February 16, 2011, documents the design-basis wind speeds for the site as 215.6 km/h (134 mph) for a 3-second gust. This design-basis wind speed is applied to the CTG structure, the 345 kV switchyard, and the fire water pump house. The return period of the 3-second gust wind is 1 in 100 years based on the ASCE/SEI-7-05. This response also includes a simplified quantitative assessment that was performed independent of the PRA to satisfy the requirements of 10 CFR 52.79(d)(1) to evaluate the effects of a hurricane on STP Units 3 and 4 at the design-basis wind speeds. Crediting the specific bulleted requirements documented in FSAR Section 19.4.6 and Commitment (COM 19.4-1 CR 10-15528 Action 2), the CDF with credit for the ACIWA function and with only limited credit for the CTGs (failure likelihood of 0.5) was estimated to be 1.5E-8 per year. In this simplified screening assessment, no credit was given for the diesel generator recovery and the use of the RCIC. The estimated LRF would be less than or equal to this estimated CDF. Thus, the Commission's LRF goal of 1E-6 per year for new reactors have been met with margin.

An additional sensitivity analysis was performed independent of the PRA to evaluate the effects of hurricane winds at the beyond design-basis wind speeds. In this analysis, the selected wind speed recurrence interval was 200 years, which corresponds to approximately 228.5 km/h (142 mph) using the methodology described in ASCE/SEI-7-05. This sensitivity analysis credits the compensatory measures documented in FSAR Section 19.4.6 and Commitment (COM 19.4-1, CR 10-15528 Action 2). However, the ACIWA function and the CTGs were assumed to fail at this wind speed. Diesel generator recovery was credited based on operating the RCIC system for at least 8 hours. The CDF per unit was estimated to be 4.6E-7 per year.

This sensitivity study did not credit the use of a portable diesel-driven fire pump. This portable pump will be staged in an onsite seismic Category I structure before the onsite arrival of sustained winds in excess of 117.5 km/h (73 mph). This fire pump is described in DCD Tier 2, Section 5.4.7. The portable pump and the valves that align this pump to the RHR system, F103C, F102C, and F101C are included in the Reliability Assurance Program described in Section 19K.11.5 of the DCD and are included in Table 19K-4 of the DCD. This information is also included by reference in the STP Units 3 and 4 FSAR. The fire pump can take suction from any available water source including the fire water storage tank and the UHS system. Crediting the use of this fire pump further reduces the CDF to less than 1E-8 per year. The estimated LRF would be less than or equal to this estimated CDF. Thus, the Commission's LRF goal of 1E-6 per year for new reactors have been met with margin.

For both assessments, one EDG for each unit is assumed to be running and loaded on its Class 1E bus at least two hours before the onsite arrival of winds in excess of 117.5 km/h (73 mph). Therefore, the CCF parameters were adjusted to remove one EDG train from the start and run for the first hour (diesel and ventilation fan basic events), and closure of the output breakers for the removed EDG. In response to RAI 19.01-31, this specific compensatory action and the additional bulleted compensatory actions credited in the risk evaluations are documented in FSAR Section 19.4.6 and in Commitment (COM 19.4-1, CR 10-5528 Action 2). These specific actions include developing an abnormal operating procedure for severe weather that is consistent with NUMARC 87-00, Revisions 1, Section 2.11, "Hurricane Preparations," that will contain the specific bulleted requirements documented in FSAR Section 19.4.6. This commitment and the abnormal operating procedures are discussed in Section 19.4.6 of this



parameters. In Table 19Q-2, there is an updated list of success criteria for incorporating certain design departures to prevent core damage. The staff determined these changes to be acceptable.

#### **Loss of RHR in Mode 3 or 4**

- STD DEP 5.4-1 Reactor Water Cleanup System

For the CUW, the plant-specific design uses a single pump providing 100 percent capacity instead of the two pumps operating at 50 percent capacity in the original ABWR design. See the discussion in Section 19Q.4.1.

#### **Loss of RHR in Mode 5**

- STD DEP T1 2.4-1 Residual Heat Removal System and Spent Fuel Pool Cooling

The RHR design in the STP Units 3 and 4 design will have three RHR loops connected to the FPCCS instead of the two RHR loops in the original ABWR design. See the discussion in Section 19Q.4.2, "Inventory Control," above.

#### **Additional Design Departure**

Regarding Departure STD Departure 7.7-1 on RPV water level instrumentation, the DCD stated that all instrument lines are flushed even when they do not need to be. The STP Units 3 and 4 design addressed condensable gas buildup in the reactor vessel-referenced leg water level instrumentation by using the CRD to continually flush the instrument lines. The staff recognized that the CRD system may not be operating in Modes 4 and 5 and is not required to operate in Modes 4, 5, and 6, according to the TS. Therefore, the staff issued RAI 19-16 requesting the applicant to address in the STP Units 3 and 4 departure documentation and in the FSAR documentation, how the instrument lines will be flushed during Modes 4 and 5 and how this action will be controlled (e.g., COL license Information item).

The applicant's response to this RAI dated December 3, 2009 (ML093421266), revises Departure STD DEP 7.7-1 to address those instrument lines with a condensing chamber that will be continually flushed by the CRD system. The applicant also discusses GL 92-04, "Resolution of the Issues Related to Reactor Vessel Water Level Instrumentation in BWRs Pursuant to 10 CFR 50.54(f)," and IN 93-27, "Level Instrumentation Inaccuracies Observed During Normal Plant Depressurization," which cover the observed degassing in the BWR reference legs during a cooldown and the depressurization of operating BWRs. The applicant explains that once the plant enters Mode 4 and continues into Mode 5, the reactor is sub-cooled and fully depressurized. As a result, during Mode 4 and Mode 5, degassing in the reactor vessel reference legs is not of concern, and there is no need for a continued supply of reference leg purge from the CRD system. In addition, the shutdown level and reactor well indications do not require a purge flow from the CRD system. The staff determined the applicant's response to be acceptable and agreed that there is no effect on the shutdown PRA from this departure. Therefore, the staff considers RAI 19-16 to be resolved and closed.

## **19Q.5 Post Combined License Activities**

The applicant identifies Commitments (COM 19.9-10, COM 19.9-22, COM 19.9-23, COM 19.9-24, and COM 19.9-27) to address COL License Information Items 19.11, 19.19d, 19.19e, 19.19f, and 19.19j, as discussed in SER Section 19.9.4.

## **19Q.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "ABWR Shutdown Risk Assessment." No outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "ABWR Shutdown Risk Assessment" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on the "ABWR Shutdown Risk Assessment," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## **19QA Fault Trees**

Appendix 19QA of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19QA, "Fault Trees," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this appendix remains for review.<sup>1</sup> The staff's review confirmed that there is no outstanding issue related to this appendix. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to "Fault Trees" of the ABWR Design have been resolved.

## **19QB DHR Reliability Study**

### **19QB.1 Introduction**

FSAR Appendix 19QB describes the text changes and supplemental information in Appendix 19QB of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### **19QB.2 Summary of Application**

Appendix 19QB of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19QB of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19QB, the applicant provided the following:

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 5.4-1 Reactor Water Cleanup System

This departure addressed the plant-specific design change from requiring both pumps, as in the ABWR DCD design, to a single CUW pump operating at 100-percent capacity during operating Modes 4 and 5.

**19QB.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

**19QB.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Appendix 19QB of the certified ABWR DCD. The staff reviewed Appendix 19QB of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff’s review confirmed that the information in the application and the information incorporated by reference address the required information relating to the “DHR Reliability Study.”

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

*Section 19QB.5 “Decay Heat Removal Capability of CUW and FPC”*

- STD DEP 5.4-1 Reactor Water Cleanup System

In the STP Units 3 and 4 design, a single CUW pump is needed to operate and provide 100 percent capacity during operating Modes 4 and 5. This design is a change from the requirement of both pumps in the ABWR original design. The staff agreed that this design change represents an improvement in the reliability of the CUW system and a reduction in the risk associated with shutdown conditions. The CUW can mitigate a loss of DHR after 8 days post-shutdown.

The applicant’s evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5 determined that the departure does not require prior NRC approval. Within the review scope of this section, the staff determined it to be reasonable that this departure does not require prior NRC approval. The applicant’s process for evaluating departures and other changes to the DCD is subject to NRC inspections.

**19QB.5 Post Combined License Activities**

There are no post COL activities related to this section.

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<sup>1</sup> See “Finality of Referenced NRC Approvals” in SER Section 1.1.3, for a discussion on the staff’s review related to verification of the scope of information to be included in a COL application that references a design certification.

## **19QB.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "DHR Reliability Study," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "DHR Reliability Study" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on "DHR Reliability Study," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## **19QC Review of Significant Shutdown Events: Electrical Power and Decay Heat Removal**

### **19QC.1 Introduction**

FSAR Appendix 19QC describes the text changes and supplemental information in Appendix 19QC of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

### **19QC.2 Summary of Application**

Appendix 19QC of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19QC of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Appendix 19QC, the applicant provided the following:

#### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure changes the safety-related I&C architecture by eliminating obsolete data communication technology. Also, this departure eliminates reference to the multiplexed safety system logic in COL FSAR Table 19QC-2.

#### Supplemental Information

The applicant provided supplemental information concerning the review of Electric Power Research Institute (EPRI) Topical Report (TR)-1003113, "An Analysis of Loss of Decay Heat Removal Trends and Initiating Event Frequencies (1989-2000)."

### **19QC.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

#### **19QC.4 Technical Evaluation**

As documented in NUREG–1503, staff reviewed and approved Appendix 19QC of the certified ABWR DCD. The staff reviewed Appendix 19QC of the STP Units 3 and 4 COL FSAR and checked the referenced ABWR DCD to ensure that the combination of the information in the ABWR DCD and the information in the COL FSAR represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the "Review of Significant Shutdown Events: Electrical Power and Decay Heat Removal."

The staff reviewed the information in the COL FSAR:

##### Tier 1 Departure

- STD DEP T1 3.4-1 Safety-Related I&C Architecture

This departure changes the safety-related I&C architecture by eliminating obsolete data communication technology. This departure eliminates reference to the multiplexed safety system logic in COL FSAR Table 19QC-2. The staff agreed with the change in COL FSAR Table 19QC-2. Also, see Section 19.1.4 of this SER for the evaluation of this departure.

##### Supplemental Information

###### *Section 19QC.1 "Review of Significant Shutdown Events"*

A review of EPRI TR-1003113 provided additional information on more recent shutdown operating experiences. However, the information does not identify any new or unique challenges to shutdown safety that are not identified in the referenced ABWR DCD. The staff determined this updated review of significant shutdown events to be acceptable.

#### **19QC.5 Post Combined License Activities**

There are no post COL activities related to this section.

#### **19QC.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG–1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to the "Review of Significant Shutdown Events: Electrical Power and Decay Heat Removal," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Review of Significant Shutdown Events: Electrical Power and Decay Heat Removal" that were incorporated by reference have been resolved.

In addition, based on the above discussion on "Review of Significant Shutdown Events: Electrical Power and Decay Heat Removal," the staff concluded that the relevant information in

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

**19R Probabilistic Flooding Analysis (Related to RG 1.206, Part I, C.I.19, Appendix A, 19.1.4.1.1, “Description of the Level 1 PRA for Operations at Power”; 19.1.4.1.2, “Results from Level 1 PRA for Operations at Power”; and 19.1.5.3, “Other External Events”)**

**19R.1 Introduction**

FSAR Appendix 19R describes the text changes and supplemental information in Appendix 19R of the ABWR DCD due to the departures in the STP Units 3 and 4 design from those described in the ABWR DCD.

**19R.2 Summary of Application**

Appendix 19R of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Appendix 19R of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 19R, the applicant provided the following:

*Tier 1 Departure*

- STP DEP T1 5.0-1 Site Parameters

This departure identifies increases in the site’s design-basis flood level from 30.5 cm (1 ft) below grade to 182.9 cm (6 ft) above the grade level. To protect the safety-related SSCs, this departure replaces the exterior doors of the reactor building and the control building located below the maximum flood elevation with watertight doors.

*Tier 2 Departures Not Requiring Prior NRC Approval*

- STP DEP 10.4-2 Main Condenser

This departure describes how STP Units 3 and 4 will utilize three condenser shells cross-connected to equalize the pressure, with each shell containing four tube bundles and parallel circulating water flow. This departure provided four 25-percent capacity circulating water pumps discharging into a common header.

- STP DEP 1.2-2 Turbine Building

This departure addressed why the turbine generator described in the referenced ABWR DCD is now obsolete and how the replacement will differ dimensionally. The turbine cycle equipment, such as FW heaters and pumps, also differs from the cycle equipment described in the ABWR DCD. This departure replaces the power generation heat sink described in the DCD (natural draft cooling tower) with a cooling reservoir, and the design now includes condensate booster pumps. Also, a dual-voltage design that requires the relocation of major components into and within the turbine building replaces the MVES design.

- STP DEP 9.2-10 Turbine Service Water System  
(Table 19R-1)

This departure addressed the changes to the TSW that include the TSW pump head and discharge flow, the TSW system design pressure, the location of the TSW pump house, the temperature increase and pressure drop across the turbine cooling water (TCW) heat exchangers, and the number of TCW discharge lines. A filling line is also added to the TSW pump discharge, and the TSW system inlet and outlet are modified to reflect that these lines come from and go to the main cooling reservoir.

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

This departure addressed the internal flooding of the control building from the elimination of the RSW vacuum breaker valves on the supply and return piping connecting to the RCW heat exchangers. The elimination of the vacuum breaker valves is due to the RSW system design changes that include the use of horizontal-type pumps instead of vertical wet-pit type pumps and piping configuration changes between the UHS basin and the control building.

### Supplemental Information

Contents in FSAR Sections 19R.1, 19R.3, 19R.4, 19R.4.2.4, 19R.4.2.5, 19R.4.3, 19R.4.4, 19R.4.6, 19R.5.3, 19R.5.4.1, 19R.5.2, 19R.5.6, 19R.6.1, 19R.6.2, 19R.6.4, and 19R.6.6 are also revised. There is also a new FSAR Section 19R.7 that addressed STP Units 3 and 4 external flooding analysis.

### **External Flooding**

The applicant provided site-specific supplemental information in the following sections of the STP Units 3 and 4 COL FSAR. This supplemental information presented the analysis performed for external flooding and also addressed Departure STP DEP T1 5.0-1.

- Section 19R.4.2.4, "Watertight Doors"
- Section 19R.7, "External Flooding Evaluation"
- Section 19R.7.1, "Methodology"
- Figure 19R-6, "Reactor Building Arrangement - Elevation 12,300 mm (1F)"

### **Turbine Building Internal Flooding**

The applicant provided site-specific supplemental information in the following sections of the STP Units 3 and 4 COL FSAR. This supplemental information updated the analysis performed for turbine building internal flooding to address Departures STP DEP 1.2-2, STP DEP 10.4-2, and STP DEP 9.2-10.

- Section 19R.4.3, "Turbine Building Features"
- Section 19R.5.3, "Turbine Building"
- Section 19R.6.4, "Operator Actions"
- Section 19R.6.6, "Conclusions"
- Table 19R-1, "Sources of Water"
- Table 19R-6, "Internal Flooding Core Damage Frequency (CDF)"
- Figure 19R-7, "Turbine Building Flooding (Low PCHS)"

## **Control Building Internal Flooding**

The applicant provided site-specific supplemental information in the following sections of the STP Units 3 and 4 COL FSAR. This supplemental information updated the analysis performed for control building internal flooding to address Departure STP DEP 19R-1.

- Section 19R.1, "Introduction and Summary"
- Section 19R.4.4, "Control Building"
- Section 19R.5.4.1, "RSW Line Breaks"
- Section 19R.6.2, "Insights Gained from Analysis"
- Table 19R-1, "Sources of Water"
- Table 19R-6, "Internal Flooding Core Damage Frequency (CDF)"
- Table 19R-7, "ABWR Features to Prevent/Mitigate Flooding"

## **RSW Pump House Internal Flooding**

The applicant provided site-specific supplemental information in the following sections of the STP Units 3 and 4 COL FSAR. This supplemental information presents the analysis performed for RSW pump house internal flooding and also addressed Departure STP DEP 19R-1:

- Section 19R.1, "Introduction and Summary"
- Section 19R.3, "Screening Analysis - Water Sources and Buildings"
- Section 19R.4, "Deterministic Flood Analysis"
- Section 19R.4.2.4, "Watertight Doors"
- Section 19R.4.2.5, "Floor Drains"
- Section 19R.4.6, "RSW Pump House"
- Section 19R.5.2, "Methodology"
- Section 19R.5.6, "RSW Pump House"
- Section 19R.6.1, "Results"
- Section 19R.6.2, "Insights Gained from Analysis"
- Section 19R.6.4, "Operator Actions"
- Table 19R-1, "Sources of Water"
- Table 19R-6, "Internal Flooding Core Damage Frequency (CDF)"
- Table 19R-7, "ABWR Features to Prevent/Mitigate Flooding"

## **19R.3 Regulatory Basis**

The relevant requirements of the Commission regulations, and the associated acceptance criteria, for reviewing supplemental information to support the COL application are described in Section 19.1.3 of this SER.

## **19R.4 Technical Evaluation**

As documented in NUREG-1503, staff reviewed and approved Appendix 19R of the certified ABWR DCD. The staff reviewed Appendix 19R of the STP Units 3 and 4 COL FSAR, and checked the referenced ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.<sup>1</sup> The staff's review confirmed that the information in the

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<sup>1</sup> See "Finality of Referenced NRC Approvals" in SER Section 1.1.3, for a discussion on the staff's review related to verification of the scope of information to be included in a COL application that references a design certification.

application and the information incorporated by reference address the required information relating to the “Probabilistic Flooding Analysis.”

The staff reviewed the following information in the COL FSAR:

Tier 1 Departure

- STP DEP T1 5.0-1 Site Parameters

The staff’s evaluation of this departure on plant risk is addressed below under “External Flooding.”

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 10.4-2 Main Condenser

The staff’s evaluation of this departure on plant risk is presented below under “Turbine Building Internal Flooding.”

- STP DEP 1.2-2 Turbine Building

The staff’s evaluation of this departure on plant risk is presented below under “Turbine Building Internal Flooding.”

- STP DEP 9.2-10 Turbine Service Water System (Table 19R-1)

The staff’s evaluation of this departure on plant risk is presented below under “Turbine Building Internal Flooding.”

- STP DEP 19R-1 Internal Flooding Due to Removal of RSW Vacuum Breaker Valves

The staff’s evaluation of this departure on plant risk is addressed below under “Control Building Internal Flooding” and “RSW Pump House Internal Flooding.”

Supplemental Information

**External Flooding**

The staff reviewed the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the external flooding analysis (see “External Flooding” under Section 19R.2 of this SER). This supplemental information presented the analysis performed for external flooding and also addressed Departure STP DEP T1 5.0-1. The staff’s findings from the review of this supplemental information are as follows:

- a. FSAR Section 19R.7, Revision 2, qualitatively describes the plant-specific PRA for external flooding due to multiple concurrent upstream dam failures. The staff issued RAI 19.01-11 requesting the applicant to provide the quantitative information associated with the plant-specific risk for external flooding due to these dam failures.

The applicant's response to RAI 19.01-11 dated July 23, 2009 (ML092080083), stated that in response to RAI 02.04.04-9 in FSAR Section 2.4S the potential design-basis external flood has been reanalyzed. The new flood height associated with the non-mechanistic, multiple-cascading upstream dam failure scenario described in Section 2.4S is 9.91 m (32.5 ft) MSL. With a wave run-up, the maximum water level from the multiple cascading dam failure is 10.5 m (34.4 ft) MSL, which is below the openings to safety-related buildings at the STP Units 3 and 4 site. For this reason, this flood scenario is no longer considered a potential source of external flooding to be included in the site-specific PRA described in Appendix 19R. The applicant also stated that Appendix 19R, Appendix 19Q, and Chapter 19.4 of the STP Units 3 and 4 COL FSAR will be modified accordingly.

The staff determined that the applicant's response to RAI 19.01-11 sufficiently addressed the concerns associated with this RAI. The staff confirmed that the STP Units 3 and 4 COL FSAR has been revised accordingly. Based on the above discussion, the staff considers RAI 19.01-11 to be resolved and closed.

- b. FSAR Section 19R.7, Revision 2, qualitatively describes the plant-specific PRA for external flooding due to a main cooling reservoir breach. The staff issued RAI 19.01-10 requesting the applicant to provide the quantitative information associated with the plant-specific PRA for external flooding due to a main cooling reservoir breach.

The applicant's response to RAI 19.01-10 dated July 23, 2009 (ML092080083), stated that the main cooling reservoir breach evaluation results described in the STP Units 3 and 4 FSAR will not significantly affect the Level 1 results presented in the ABWR SSAR, if they were summed with the internal events results. In order to remain consistent with the evaluations performed for other traditional external events (e.g., fire and seismic), the external flooding analyses were treated as screening evaluations and were not considered for inclusion with the Level 1 results discussed in the DCD. The important risk insights are incorporated into FSAR Chapter 19, where appropriate (e.g., watertight doors, operator training). The initiating event frequency for a main cooling reservoir breach is an estimated  $1.0\text{E}-06$  per year. The CDF for a main cooling reservoir breach is an estimated  $1.1\text{E}-07$  per year. The applicant also provided the basis for the initiating event frequency of a main cooling reservoir breach, in addition to the significant accident sequences leading to core damage. The most significant sequence (CDF of  $1.0\text{E}-07$  per year) includes a main cooling reservoir breach with an operator failure to close the control building watertight access door. The applicant adds that the detailed screening evaluation is available at the site for review by the staff. The staff determined that the applicant's response to RAI 19.01-10 does not sufficiently address the concerns in this RAI. These concerns are addressed further during the staff's audit of the STP Units 3 and 4 PRA in September 2009 (ML093560778). The staff issued RAI 19-30 to include the unresolved issues of RAI 19.01-10. Therefore, the staff considers RAI 19.01-10 to be resolved and closed.

During the staff's audit of the STP Units 3 and 4 PRA in September 2009, the staff reviewed the applicant's detailed screening evaluation for external flooding due to a main cooling reservoir breach. This evaluation is in the Engineering/Licensing Evaluation titled, "External Flooding Event, Breach of the Main Cooling Reservoir," dated April 20, 2009 (ML093560778). The staff issued RAI 19-30 requesting the applicant to justify (1) the site-specific main cooling reservoir breach frequency of  $1.0\text{E}-6$  per year,

and (2) the reduction factors used to obtain this frequency from the generic dam failure frequency of 1E-4 per year. The staff also requested additional information on the human error probability (basic event - OCD) that the operator will fail to close the single, normally open, watertight access door between the service building and the control building.

RAI 19-30 was tracked as Open Item 19-12 in the SER with open items. In response to Open Item 19-12, the applicant submitted the final response to RAI 19-30 on July 28, 2010 (ML102110184). This RAI response changed the status for all watertight doors and hatches to be normally closed. This change in door status is documented in FSAR Section 2.4S.10, "Flooding Protection Requirements." This RAI response also used the ASME/ANS RA-Sa-2009, Section 6-2.3, Criterion (a) to screen external flood scenarios from detailed quantitative evaluations. Criterion (a) is satisfied because the STP Units 3 and 4 design for safety-related SSCs satisfies the requirements of SRP Section 3.4.2, Revision 3, which was in effect at the time of the COL application. Based on the proposed FSAR change in the watertight door status and the proposed removal of the screening quantification for a postulated main cooling reservoir breach, the following COL FSAR sections will be revised:

- Section 2.4S.10, "Flooding Protection Requirements"
- Section 2.4S.14, "Technical Specifications and Emergency Operation Requirements"
- Section 19.4.5, "ABWR Probabilistic Flooding Analysis"
- Subsection 19.8.5.3, "Features Selected"
- Section 19.9.3, "Event Specific Procedures for Severe Accident Flooding"
- Section 19.11, "Human Action Overview"
- Section 19K.10, "Identification of Important Capabilities Outside the Control Room"
- Section 19R.6.4, "Operation Actions"
- Section 19R.7, "External Flooding Evaluation"

Based on (1) the change in the watertight door status to be normally closed, (2) the removal of the screening quantification for a postulated main cooling reservoir breach, and (3) the proposed revisions to the affected COL FSAR sections, the staff concluded that the issues associated with Open Item 19-12 (RAI 19-30) have been resolved. The staff confirmed that the proposed revisions were incorporated into Revision 4 of the FSAR.

Based on the staff's review, the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the external flooding analysis is acceptable and appropriately addressed Departure STP DEP T1 5.0-1.

### **Turbine Building Internal Flooding**

The staff reviewed the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the turbine building internal flooding analysis (see "Turbine Building Internal Flooding" under Section 19R.2 of this SER). This supplemental information updated the probabilistic internal flooding analysis for the turbine building to address Departures STP DEP 1.2-2, STP DEP 10.4-2 and STP DEP 9.2-10. The staff's findings from the review of this supplemental information are as follows:

Departure STP DEP 10.4-2 increases the number of circulating water pumps to four. This increase can impact the PRA for turbine building flooding in Section 19R.5.3, "Turbine Building," of the STP FSAR. For example, this departure can impact the failure probabilities associated with top events "PTRIP" (all circulating water pumps trip) and "VCLOSE" (CWS isolation valves close to isolate flooding) in the turbine building flooding event tree (refer to Figure 19R-8, "Turbine Building Flooding, High PCHS," in the ABWR SSAR). In addition, the departures that were considered in the internal events PRA (e.g., STD DEP T1 2.4-3, STD DEP T1 3.4-1, STD DEP 8.3-1, STP DEP 9.2-5, and STD DEP 19.3-1) could impact the failure probabilities associated with the top event for bringing the reactor to a safe shutdown condition in the turbine building flooding event tree. The staff issued RAI 19.01-5 requesting the applicant to describe the risk impact from the departures on the PRA results for turbine building flooding.

The applicant's response to RAI 19.01-5 dated July 23, 2009 (ML092080083), stated that the response of the plant to a failure of the main circulating water piping assumes that even if the automatic protection does not work, the water will exit the turbine building through the truck doors according to DCD Section 19R.1:

In the unlikely event this automatic protection fails and the operator fails to take any action, potential flood waters would still be prevented from reaching the service building. Potential flood waters would be expected to exit the turbine building through the non-watertight truck entrance door.

Also, increasing the number of circulating water pumps does not affect the level setpoints at which the circulating water pumps trip and the pump isolation and condenser isolation valves close or the plant's response to a circulating water flooding event. Therefore, as described in the STP Units 3 and 4 COL FSAR, there is no change to the PRA results in the DCD. The top event "PTRIP" in the turbine building flooding (High PCHS) event tree (SSAR Figure 19R-8) has no branch in the event tree for the High PCHS design, because tripping the circulating water pumps does not stop the circulating water flow and is therefore unaffected by the number of circulating water pumps in the circulating water system. The top event "VCLOSE" is also unaffected by the changes associated with Departure STP DEP 10.4-2. The function modeled by the "VLCLOSE" includes the condenser isolation valves, one for each condenser element, and the circulating water pump isolation valves. The value in SSAR Figure 19R-8 derived from the data in SSAR Table 19R-4 represents the failure of one of three isolation valves (condenser isolation valves) and the CCF with any pump isolation valve represented by the beta factor in Table 19R-4. There is no change to the modeling of the turbine building flooding event tree in Figure 19R-8 of the SSAR. The departures that were considered in the internal events PRA do not significantly affect the PRA results described in the DCD and in Chapter 19.3, so there is no required change to turbine building flooding from these departures under RG 1.206, Regulatory Position C.III.I.19. The staff determined that the applicant's response to RAI 19.01-5 sufficiently addressed the concerns associated with this RAI. Based on the above discussion, the staff considers RAI 19.01-5 to be resolved and closed.

The applicant's evaluation in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that Departures STP DEP 1.2-2, STP DEP 10.4-2 and STP DEP 9.2-10 do not require prior NRC approval. Within the review scope of this section, the staff determined it to be reasonable that these departures do not require prior NRC approval.

Based on the staff's review, the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the turbine building internal flooding analysis is acceptable and appropriately addressed the associated departures.

### **Control Building Internal Flooding**

The staff reviewed the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the control building internal flooding analysis (see "Control Building Internal Flooding" under SER Subsection 19R.2). This supplemental information updated the probabilistic internal flooding analysis for the control building to address Departure STP DEP 19R-1. The staff's findings from the review of this supplemental information are as follows:

Departure STP DEP 9.2-5 of the STP Units 3 and 4 COL FSAR increases the RSW flow rate per pump and increases the RSW pipe sizes. This change can impact the plant-specific PRA for control building internal flooding in FSAR Section 19R.5.4, "Control Building." For example, this departure can impact the timing associated with operator actions to isolate flooding in top events "OPACT1," "OPACT2," and "OPACT3" in the event tree for control building flooding due to an RSW line break (refer to Figure 19R-9, "RSW Control Building Flood," in the ABWR SSAR). In addition, the departures that were considered in the internal events PRA (e.g., STD DEP T1 2.4-3, STD DEP T1 3.4-1, STD DEP 8.3-1, STP DEP 9.2-5, and STD DEP 19.3-1) can impact the failure probabilities associated with the top events for bringing the reactor to a safe-shutdown condition in the control building flooding event tree. The staff issued RAI 19.01-6 requesting the applicant to describe the risk impact that the departures have on the PRA results for control building internal flooding.

The applicant's response to RAI 19.01-6 dated July 23, 2009 (ML092080083), stated that the RSW pump flow rates do not directly affect the computed leakage from the postulated RSW pipe failure, as this leakage is based only on the operating pressure within the pipe, the pipe crack size, and the volume of the RSW piping that contribute to the flood source. Larger pipe diameters are offset by the reduced amount of piping associated with the redesigned RSW system. Because the break size associated with the increased pipe diameter is bound by the size assumed in the DCD, and the increased flow rate of the RSW pumps does not affect the flow rate out of the break, there is no significant effect on operator timing and no change to the PRA described in the DCD. The revised water volume in the control building basement from the RSW pipe failure described in Appendix 19R is approximately 184 m<sup>3</sup> (6,500 ft<sup>3</sup>), with automatic isolation. This volume results in a water level of about 2.3 m (7.6 ft), which is well below the 5 m (16.6 ft) maximum flood height of the RSW design description in DCD Tier 1, Section 2.11.9. The lower result is due to the significantly shorter length of the RSW pipe that drains into the RCW pump room from the RSW system following an RSW train isolation and draindown. The departures that were considered in the internal events PRA do not significantly affect the PRA results described in the DCD, as indicated in Section 19.3 of this SER, so there is no required change to control building flooding from these departures under RG 1.206, Regulatory Position C.III.I.19. The staff determined that the applicant's response to RAI 19.01-6 sufficiently addressed the concerns associated with this RAI. Based on the above discussion, this departure does not significantly affect the PRA results for control building internal flooding. Therefore, the staff considers RAI 19.01-6 to be resolved and closed.

Departure STP DEP 19R-1 addressed internal flooding of the control building from the elimination of the RSW vacuum breaker valves on the supply and return piping connected to the RCW heat exchangers. In the RSW system design of STP Units 3 and 4, the vacuum breaker

valves would not provide any protective measure against internal flooding of the control building due to siphoning. There are redundant safety-related, motor-operated valves in the supply and return piping to each of the three RCW heat exchangers. Even if one of these valves is postulated to fail in the open position, there is another motor-operated valve that automatically closes upon the detection of a high water level in the RCW heat exchanger room to prevent gravity drainage from the UHS basin into the control building. There are leak detection measures in the control building that would annunciate and require operators to investigate potential flooding, and if required, to trip the affected division's RSW pumps and to close redundant supply and return side motor-operated valves. The relocation of the UHS and RSW pump house results in a significant reduction of the stored water volume in the buried RSW piping, relative to the amount specified in the ABWR DCD. This reduction in stored water would result in considerably less water mass that could flow into the control building due to a postulated line crack. Consequently, there would be a lower flooding potential to the non-affected RSW divisions as a result of the lower water level in the RSW division postulated with the line crack. This departure does not significantly affect the PRA results described in the ABWR DCD.

The text changes in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the RSW design changes under Departure STP DEP 19R-1 are thus appropriate. The applicant's evaluation in accordance with 10 CFR Part 52 Appendix A, Section VIII.B.5, determined that Departure STP DEP 19R-1 does not require prior NRC approval. Within the review scope of this section, the staff determined it to be reasonable that this departure does not require prior NRC approval.

Based on the staff's review, the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the control building internal flooding analysis appropriately addressed the associated departure and is therefore acceptable.

### **RSW Pump House Internal Flooding**

The staff reviewed the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the internal flooding analysis of the RSW pump house. This supplemental information describes the probabilistic and deterministic internal flooding analysis for the RSW pump house, provided the results and risk insights, and also addressed Departure STP DEP 19R-1. The staff's findings from the review of this supplemental information are as follows:

FSAR Section 19R.5.6, "RSW Pump House," stated:

Unisolated breaks in the fire water system could cause inter-divisional flooding since the RSW divisional separation splits the RSW pump house into three watertight compartments.

However, Appendix 19R of the STP Units 3 and 4 FSAR does not provide or describe a PRA for internal flooding due to unisolated breaks in the fire water system in the RSW pump house. The staff issued RAI 19.01-7 requesting the applicant to describe the PRA internal flooding analysis for this scenario.

The applicant's response to RAI 19.01-7 dated July 23, 2009 (ML092080083), stated that floods associated with fire water system leaks and piping failures and usage in the RSW pump house are less significant than a flood from the RSW piping, as described in Section 19R.1 of the STP Units 3 and 4 COL FSAR, because of lower water flows and the external water isolation

capability. If analyzed, fire water floods would be bounded by the results of the RSW piping floods that are included in Appendix 19R.

The staff determined that the applicant's response to RAI 19.01-7 sufficiently addressed the concerns associated with this RAI. Based on the above discussion, the staff considers RAI 19.01-7 to be resolved and closed.

FSAR Subsection 19R.5.6.1, "RSW Line Breaks," qualitatively describes the plant-specific PRA for internal flooding due to RSW line breaks in the RSW pump house. The staff issued RAI 19.01-8 requesting the applicant to provide the quantitative information associated with the plant-specific PRA for internal flooding due to RSW line breaks in the RSW pump house.

The applicant's response to RAI 19.01-8 dated July 23, 2009 (ML092080083), stated that a screening evaluation was performed consistent with that of the ABWR DCD and SSAR. The evaluation used the PRA information in Appendix 19R of the SSAR and resulted in a very small change in the total CDF, when compared to the SSAR internal events results. The total CDF for this event from the screening evaluation is  $3.8E-08$  per year. The applicant's response also describes in detail the screening evaluation including the assumptions, significant accident sequences and their mean CDFs, initiating event frequency estimates and their bases, and the top event failure probabilities and their bases. The staff determined that the applicant's response to RAI 19.01-8, including the screening evaluation, sufficiently addressed the concerns associated with this RAI. Based on the above discussion, the staff considers RAI 19.01-8 to be resolved and closed.

Based on the staff's review, the supplemental information in Appendix 19R of the STP Units 3 and 4 COL FSAR related to the internal flooding analysis of the RSW pump house was determined to be acceptable and appropriately addressed Departure STP DEP 19R-1.

#### **19R.5 Post Combined License Activities**

The applicant identifies commitments (COM 19.9-3 and COM 19.9-9) to address COL License Information Items 19.3 and 19.10, respectively, as discussed in SER Section 19.9.4.

#### **19R.6 Conclusion**

The staff's finding related to information incorporated by reference is in NUREG-1503. The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information relating to "Probabilistic Flooding Analysis," and no outstanding information is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the "Probabilistic Flooding Analysis" that were incorporated by reference have been resolved.

Within the review scope of this section, the staff determined it to be reasonable that the identified Tier 2 departures are characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5. In addition, based on the above discussion on the "Probabilistic Flooding Analysis," the staff concluded that the relevant information in the COL FSAR is acceptable and meets the applicable requirements described in Section 19.1.3 of this SER.

## **19S Aircraft Impact Assessment**

FSAR Appendix 19S discusses the design features and functional capabilities of the ABWR design to mitigate the effects of a large, commercial aircraft in accordance with 10 CFR 50.150. This appendix also describes how the identified design features and functional capabilities show that with a reduced use of operator actions, the reactor core remains cooled or the containment remains intact, and the spent fuel cooling or spent fuel pool integrity is maintained.

Appendix 19S of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference, Appendix 19S, "Aircraft Impact Assessment," of Revision 3 of the application to amend the design certification rule for the ABWR to implement 10 CFR 50.150, with no departures or supplements. The staff reviewed the application and checked the referenced DCD amendment application to ensure that no issue relating to this section remains for review. The staff's review confirmed that there is no outstanding information outside of the DCD amendment related to this section. The aircraft impact assessment ABWR design certification amendment was issued in December, 2011. All nuclear safety issues relating to the aircraft impact assessment are resolved pursuant to 10 CFR 52.63(a)(5) and 10 CFR Part 52, Appendix A, Sections VI.B.1, 2, and 3.