9.0 AUXILIARY SYSTEM

The auxiliary systems include the support systems that are essential for the safe shutdown of the plant or the protection of the health and safety of the public. This area covers a wide range of systems and includes new and used fuel storage and handling; cooling and makeup water; compressed air; process sampling; drains; heating, ventilation, and air conditioning (HVAC); fire protection; and emergency diesel generators (EDGs).

9.1 Fuel Storage Handling

9.1.1 New-Fuel Storage (Related to Regulatory Guide 1.206 Sections 9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage Handling," and 9.1.2, "New and Spent Fuel Storage")

9.1.1.1 Introduction

This section of the Final Safety Analysis Report (FSAR) addresses the nuclear plant's facilities for storing new fuel. The new fuel storage facilities include the fuel assembly storage racks, the concrete storage vault that contains the storage racks, and the auxiliary components. The storage facilities must maintain the new fuel in subcritical arrays during all credible storage conditions. In addition, new fuel must remain subcritical during fuel handling.

9.1.1.2 Summary of Application

Section 9.1.1 of the South Texas Project (STP), Units 3 and 4, combined license (COL) FSAR Revision 12 incorporates by reference Section 9.1.1 of the certified Advanced Boiling Water Reactor (ABWR) design control document (DCD) Revision 4, referenced in Title 10 of the *Code of Federal Regulations* (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."

The applicant provides a complete text for Section 9.1.1, including the text from the referenced certified ABWR DCD. In addition, the applicant provides the following:

Tier 1 Departure

- STP DEP T 2.5-1 — Elimination of New Fuel Storage Racks From the New Fuel Vault

This departure states that following the receipt inspection, new fuel will be stored in the spent fuel storage racks in the spent fuel storage pool. The new fuel vault will no longer be used as described in the ABWR DCD.

COL License Information Items

- COL License Information Item 9.1 — New Fuel Storage Racks Criticality Analysis

COL License Information Item 9.1 (described in COL FSAR Subsection 9.1.6.1, "New Fuel Storage Racks Criticality Analysis") requires the applicant to provide the U.S. Nuclear Regulatory Commission (NRC) with a confirmatory criticality analysis of the inadvertent placement of a fuel assembly in other than the prescribed locations within the new fuel storage

rack. Because Departure STP DEP T1 2.5-1 eliminates the new fuel storage racks from the new fuel vault and specifies that new fuel will be stored in the spent fuel storage pool, the applicant references COL License Information Item 9.3, "Spent Fuel Storage Racks Criticality Analysis," in FSAR Subsection 9.1.6.3, "Spent Fuel Storage Racks Criticality Analysis," to address the requirements in COL License Information Item 9.1.

- COL License Information Item 9.2 Dynamic and Impact Analyses of New Fuel Storage Racks

COL License Information Item 9.2 (described in COL FSAR Subsection 9.1.6.2, "Dynamic and Impact Analyses of New Fuel Storage Racks") requires the applicant to provide confirmatory dynamic and impact analyses of the new fuel storage racks. Because Departure STP DEP T1 2.5-1 specifies that new fuel will be stored in the spent fuel storage racks, the applicant references COL License Information Item 9.4, "Spent Fuel Racks Load Drop Analysis," and COL License Information Item 9.7, "Spent Fuel Racks Structural Evaluation," in FSAR Subsections 9.1.6.4, "Spent Fuel Racks Load Drop Analysis," and 9.1.6.7, "Spent Fuel Racks Structural Evaluation," respectively, to address the requirements in COL License Information Item 9.2.

- COL License Information Item 9.5 New Fuel Inspection Stand Seismic Capability

COL License Information Item 9.5 (described in COL FSAR Subsection 9.1.6.5, "New Fuel Inspection Stand Seismic Capability") requires the applicant to install the new fuel inspection stand, so that it will not fall or dump personnel into the spent fuel pool (SFP) during a safe-shutdown earthquake (SSE).

9.1.1.3 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 Advanced Boiling Water Reactor Design." In addition, the relevant requirements of the Commission regulations for new fuel storage, and the associated acceptance criteria, are in Sections 9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage and Handling," and 9.1.2, "New and Spent Fuel Storage," of NUREG–0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)" (the Standard Review Plan [SRP]).

In particular, the regulatory basis and criteria for reviewing COL License Information Items 9.1 and 9.2 (which reference COL License Information Items 9.3, 9.4, and 9.7, as described in Subsection 9.1.1.2 of this safety evaluation report [SER]) are established in the following:

- 10 CFR 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria For Nuclear Power Plants," General Design Criterion (GDC) 2, "Design bases for protection against natural phenomena."

- GDC 61, "Fuel storage and handling and radioactivity control."

- GDC 62, "Prevention of criticality in fuel storage and handling."

- 10 CFR 50.68, "Criticality accident requirements."

Compliance with 10 CFR 50.68 requires the applicant to either follow the guidelines of 10 CFR 70.24, "Criticality accident requirements," by maintaining systems to monitor for criticality accidents; or the requirements in 10 CFR 50.68(b), which reduce the likelihood of a criticality accident.

SRP acceptance criteria that are adequate to meet the above requirements include a number of codes and standards:

- The criteria for GDC 2 as they relate to new fuel storage are based on Regulatory Position C.1 of Regulatory Guide (RG) 1.29 Revision 4, "Seismic Design Classification," and American National Standards Institute /American Nuclear Society (ANSI/ANS) 57.3–1983, "Design Requirements for New Fuel Storage Facilities at Light Water Reactor Plants."

- The criteria for GDC 61 as they relate to new fuel storage are based on ANSI/ANS 57.3-1983.

- The criteria for GDC 62 are specified in ANSI/ANS 57.1–1992, "Design Requirements for Light Water Reactor Fuel Handling Systems"; ANSI/ANS 57.2–1983, "Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants"; and ANSI/ANS 57.3–1983.

In addition, in accordance with Section VIII, "Processes for Changes and Departures," of Appendix A to Part 52, "Design Certification Rule for the U.S. Advanced Boiling Water Reactor," the applicant identifies one Tier 1 departure. Tier 1 departures require prior NRC approval and are subject to the requirements in 10 CFR Part 52 Appendix A, Section VIII.A.4.

9.1.1.4 Technical Evaluation

As documented in NUREG–1503, the staff reviewed and approved Section 9.1.1 of the certified ABWR DCD. The staff reviewed Section 9.1.1 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, appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to new fuel storage.

In addition, the applicant provides new and revised information on new fuel storage. The staff reviewed the following information in the COL FSAR:

[1] 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

- STP DEP T1 2.5-1 Elimination of New Fuel Storage Racks From the New Fuel Vault

This departure eliminates the new fuel storage racks from the new fuel vault. The STP, Units 3 and 4, new fuel will be stored in the spent fuel storage racks following the receipt inspection. The new fuel vault and new fuel storage racks will not be used to store new fuel as described in the ABWR DCD.

In 10 CFR Part 52 Appendix A, Section VIII.A.4 specifies in the pertinent part that exemptions from Tier 1 information are governed by the requirements in 10 CFR 52.63(b)(1). Exemptions will be denied if the design change results in a significant decrease in the level of safety otherwise provided by the design. 10 CFR 52.63(b)(1) states that exemptions must comply with the requirements of 10 CFR 52.7, "Specific exemption," and additionally, "the Commission shall consider whether the special circumstances that §52.7 requires to be present outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption." 10 CFR 52.7 directs the Commission's consideration of exemptions to be governed by 10 CFR 50.12, "Specific exemption." According to 10 CFR 50.12, exemptions may be granted if they are "authorized by law, will not present an undue risk to the public health and safety, and are consistent with the common defense and security." In addition, special circumstances defined by 10 CFR 50.12 must be present.

New and spent fuel storage racks are nonsafety-related components (ABWR DCD Tier 2 Table 3.2-1, "Classification Summary"). The disuse of the new fuel vault for storing new fuel has no safety implications, as it would just become an empty vault. However, the ABWR DCD requires the COL applicant to satisfy COL License Information Items 9.1, 9.2, and 9.5 for the design of new fuel storage. A more detailed discussion on satisfying these COL license information items will be provided later in this subsection. As described in Subsection 9.1.2.4.4.3, "Dynamic and Impact Analyses of New Fuel Storage Racks," of this SER, spent fuel rack (SFR) criticality analyses are performed with the assumption that all are fresh fuel. In addition, the spent fuel storage racks are identical to the new fuel storage racks and provide the same structural protections. Thus, the criticality analysis and the structural analysis performed for the SFRs are also applicable to the new fuel racks (NFRs). The design requirements described in COL License Information Items 9.1 and 9.2 for the NFRs are satisfied in the design for the SFRs described in Subsections 9.1.2.4.4, "Spent Fuel Storage Racks Criticality Analysis," 9.1.2.4.5, "Spent Fuel Racks Load Drop Analysis," and 9.1.2.4.6, "Spent Fuel Racks Structural Evaluation," of this SER. The staff therefore finds that the departure does not result in a significant decrease in the level of safety otherwise provided by the design.

In addition, the staff finds that the departure meets the specific requirements of 10 CFR 50.12 because it is legal, and it will not present a risk to public health and safety or to common defense and security because there will be no major change in the plant configuration that could significantly decrease safety. In addition, special circumstances (ii) and (iv) from 10 CFR 50.12(a) are present. Circumstance (ii) states that the "[A]pplication of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule." The special circumstance (ii) is present because storing new fuel in the new fuel storage rack is not necessary to achieve the underlying purpose of safely storing new fuel. This function is fulfilled by storage in the SFP as well. Circumstance (iv) provides that "[T]he exemption would result in benefit to the public health and safety that

compensates for any decrease in safety that may result from the grant of the exemption." The staff's review finds that special circumstance (iv) is also present because placing fuel directly into the SFP would eliminate one fuel handling evolution, thereby decreasing the likelihood of a fuel handling accident.

For the reasons stated above, and because the following COL license information items affected by the departure are adequately addressed, the staff finds that Departure STP DEP T 2.5-1 complies with 10 CFR 52 Appendix A, Section VIII.A.4.

COL License Information Items

- COL License Information Item 9.1 New Fuel Storage Racks Criticality Analysis

COL License Information Item 9.1 requires the applicant to provide the NRC with a confirmatory criticality analysis of the inadvertent placement of a fuel assembly in other than the prescribed locations within the new fuel storage rack. Because new fuel will be stored in the SFP instead, the applicant addresses this COL license information item by referring to COL License Information Item 9.3, "Spent Fuel Storage Racks Criticality Analysis." The staff finds this reference acceptable because it addresses the same scenario for the SFR as COL License Information Item 9.1 does for the new fuel storage rack—a confirmatory criticality analysis of the inadvertent placement of a fuel assembly in other than the prescribed locations. The details of the criticality analysis of the spent fuel storage racks are in Technical Report (TR) HI-2135462, "Licensing Report for South Texas Project Units 3 & 4 ABWR Spent Fuel Racks" (ML13218A292). The staff's evaluation of the criticality analysis in Subsection 9.1.2.4.4, "Spent Fuel Storage Racks Criticality Analysis," of this SER finds that the design of the SFRs considers the parameters of both spent fuel and new fuel. Therefore, the design bases of the racks, the modeling methodology, and the modeling assumptions of the criticality analyses are acceptable and conservative. They confirm that the analyses demonstrate a substantial margin for regulatory limits. Therefore, because COL License Information Item 9.3 is satisfied, using the SFRs for new fuel storage under COL License Information Item 9.1 is also acceptable.

- COL License Information Item 9.2 Dynamic and Impact Analyses of New Fuel Storage Racks

COL License Information Item 9.2 requires the applicant to provide confirmatory dynamic and impact analyses of the new fuel storage racks. Because new fuel will always be stored in the spent fuel storage racks, the applicant references COL License Information Item 9.4, "Spent Fuel Racks Load Drop Analysis," and COL License Information Item 9.7, "Spent Fuel Racks Structural Evaluation," to address the requirements in COL License Information Item 9.2. The staff finds these references acceptable because together, the load drop analysis of COL License Information Item 9.4 and the structural evaluation of COL License Information Item 9.7 encompass the dynamic and impact analyses of COL License Information Item 9.2 in the case where the new and spent fuel storage racks are identical. The details of the load drop analysis and the structural evaluation of the spent fuel storage racks are in TR HI-2135462 (ML13218A292). The staff's evaluation of the load drop analysis and the structural evaluation in Subsection 9.1.2.4.6, "Spent Fuel Racks Structural Evaluation," of this SER determines that the fuel rack description, design requirements, materials, quality control, construction technology, and applicable Codes and Standards are acceptable. In addition, the seismic and structural models, codes, and methodology used in the referenced technical report are valid. The seismic, load drop, and dynamic analyses indicate that the functional integrity of the fuel racks is

maintained throughout the analyzed conditions, and the staff finds these analyses acceptable. Therefore, because COL License Information Items 9.4 and 9.7 are satisfied, using the SFRs for new fuel storage also satisfies COL License Information Item 9.2.

- COL License Information Item 9.5 New Fuel Inspection Stand Seismic Capability

COL License Information Item 9.5 (described in COL FSAR Subsection 9.1.6.5, "New Fuel Inspection Stand Seismic Capability") requires the applicant to install the new fuel inspection stand so that it will not fall or dump personnel into the SFP during an SSE. The NRC issued request for additional information (RAI) 09.01.01-5 requesting the applicant to include, in the FSAR, the primary structural elements of the new fuel inspection stand and its anchorage. In its response to RAI 09.01.01-5, dated September 30, 2010 (ML102950089), the applicant provided a revised FSAR Figure 9.1-4 showing the new fuel inspection stand in a pit anchored at the top (on the refueling floor) and at the bottom (on the floor of the pit) to meet the SSE criteria. The staff confirmed that this information has been incorporated into Revision 6 of the FSAR. Therefore, RAI 09.01.01-5 is resolved and closed.

9.1.1.5 Post Combined License Activities

There are no post COL activities related to this section.

9.1.1.6 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 confirms that the applicant has addressed the required information relating to this section, 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 new fuel storage that were incorporated by reference are resolved. The staff's conclusion is based on the following:

- Departure STP DEP T 2.5-1 completely eliminates the use of the new fuel vault and new fuel storage racks for storing new fuel. Instead, new fuel will be stored in the spent fuel storage racks following the receipt inspection. This departure meets the regulatory requirements outlined in 10 CFR 52 Appendix A, Section VIII.A.4. This departure is therefore acceptable.

- COL Information Items 9.1 and 9.2 related to new fuel storage are adequately addressed by COL Information Items 9.3, 9.4, and 9.7, which are evaluated in Subsections 9.1.2.4.4, "Spent Fuel Storage Racks Criticality Analysis," and 9.1.2.4.6, "Spent Fuel Racks Structural Evaluation," of this SER. These evaluations find the criticality, load drop, and structural analyses of the NFRs acceptable.

9.1.2 Spent-Fuel Storage (Related to RG 1.206 Sections 9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage Handling," and 9.1.2, "New and Spent Fuel Storage")

9.1.2.1 Introduction

This section of the FSAR addresses the nuclear reactor plant's facilities for storing spent fuel. The spent fuel storage facilities are located in the reactor building (RB) and include the spent

fuel storage racks, the spent fuel storage pool that contains the storage racks, and the storage pits for associated equipment. The storage facilities must maintain the spent fuel in subcritical arrays during all credible storage conditions. In addition spent fuel must remain subcritical during fuel handling.

The STP, Units 3 and 4, SFP racks are identical and are designed to accommodate fresh and spent boiling-water reactor (BWR) fuel. Per Tier 1 Departure STP DEP T1 2.5-1, the design does not have a separate facility for storing fresh fuel. New and spent fuel are stored in a stainless steel-lined concrete SFP containing racks capable of holding a total of 2,380 fuel assemblies, an amount slightly higher than the DCD allowable capacity of 2,354 assemblies (270 percent of the reactor core). However, COL FSAR Subsection 9.1.3.3 states that the applicant may not utilize the additional storage capacity without revising the bounding SFP heat load evaluation.

9.1.2.2 Summary of Application

Section 9.1.2 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.1.2 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. Section 9.1.2 also incorporates by reference Section 9.1.2 of the STP Nuclear Operating Company Application to Amend the Design Certification Rule for the ABWR, "ABWR STP Aircraft Impact Assessment (AIA) Amendment Revision 3," dated September 3, 2010 (the AIA Amendment).

The applicant provides a complete text for Section 9.1.2, including the text from the referenced certified ABWR DCD. To support the information in the FSAR, the applicant submitted a proprietary TR on July 31, 2013, Holtec Report No. HI-2135462, "Licensing Report for South Texas Project Units 3 and 4 ABWR Spent Fuel Racks," Revision 1 (ML13218A291). This TR provides the design details of the fuel racks including criticality, thermal-hydraulic, seismic, and mechanical accident evaluations of the fuel racks. As such, the STP, Units 3 and 4, design for the SFRs incorporates by reference this Holtec TR as documented in Table 1.6-2, "Additional Topical Reports Incorporated by Reference," of the COL FSAR. In addition, the applicant provides the following:

Tier 1 Departure

- STP DEP T1 2.5-1 — Elimination of New Fuel Storage Racks From the New Fuel Vault

This departure states that following the receipt inspection, new fuel will be stored in the spent fuel storage racks in the spent fuel storage pool. The new fuel vault will no longer be used as described in the ABWR DCD.

COL License Information Items:

- COL License Information Item 9.1 — New Fuel Storage Racks Criticality Analysis

COL License Information Item 9.1 addresses the new fuel storage racks criticality analysis. (See Subsection 9.1.1.2 of this SER for the detailed description.)

- COL License Information Item 9.2 Dynamic and Impact Analysis of New Fuel Storage

COL License Information Item 9.2 addresses the dynamic and structural analyses of the new fuel storage racks. (See Subsection 9.1.1.2 of this SER for the detailed description.)

- COL License Information Item 9.3 Spent Fuel Storage Racks Criticality Analysis

COL License Information Item 9.3 addresses the criticality analysis of the spent fuel storage racks. COL License Information Item 9.3 (described in COL FSAR Subsection 9.1.6.3, "Spent Fuel Storage Racks Criticality Analysis") requires the applicant to provide a confirmatory critically analysis for the inadvertent placement of a fuel assembly in other than the prescribed locations, as required by FSAR Subsection 9.1.2.3.1, "Criticality Control."

- COL License Information Item 9.4 Spent Fuel Racks Load Drop Analysis

COL License Information Item 9.4 (described in COL FSAR Subsection 9.1.6.4, "Spent Fuel Racks Load Drop Analysis") requires the applicant to provide a confirmatory load drop analysis of the spent fuel storage racks.

- COL License Information Item 9.7 Spent Fuel Racks Structural Evaluation

COL License Information Item 9.7 (described in COL FSAR Subsection 9.1.6.7, "Spent Fuel Racks Structural Evaluation") requires the applicant to provide a confirmatory structural evaluation of the spent fuel storage racks as described in FSAR Subsection 9.1.2.1.3, "Mechanical and Structural Design."

- COL License Information Item 9.8 Spent Fuel Racks Thermal-Hydraulic Analysis

COL License Information Item 9.8 (described in COL FSAR Subsection 9.1.6.8, "Spent Fuel Racks Thermal-Hydraulic Analysis") requires the applicant to provide a confirmatory thermal-hydraulic analysis that evaluates the rate of the naturally circulated flow and the maximum rack water exit temperatures as required by FSAR Subsection 9.1.2.1.4, "Thermal-Hydraulic Design."

9.1.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the spent fuel storage, and the associated acceptance criteria, are in Sections 9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage and Handling," and 9.1.2, "New and Spent Fuel Storage," of NUREG–0800. COL License Information Items 9.1 and 9.3 are satisfied based on meeting the relevant requirements of the Commission regulations in Section 9.1.1 of the NUREG–0800, as summarized below. Review interfaces with other SRP sections can be found in SRP Section 9.1.1.

- GDC 1, "Quality standards and records," of Appendix A to 10 CFR Part 50 as it relates to structures, systems, and components (SSCs) being designed, fabricated, erected, constructed and tested to quality standards commensurate with the importance of the safety function to be performed.

- GDC 2, as it relates to SSCs important to safety being designed to withstand appropriate combinations of the effects of normal and accident conditions with the effects of earthquakes.

- GDC 62, as it relates to the prevention of criticality by physical systems or processes that use geometrically safe configurations.

- 10 CFR 50.68, as it relates to preventing a criticality accident and to mitigating the radiological consequences of a criticality accident.

- 10 CFR 52.80(a), as it relates to proposed inspections, tests, and analyses of the new and spent fuel storage facilities.

- 10 CFR Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants."

Acceptance criteria adequate to meet the above requirements are as follows:

- The criteria for GDC 62 are specified in ANSI/ANS 57.1, ANSI/ANS 57.2, and ANSI/ANS 57.3 as they relate to the prevention of criticality accidents in fuel storage and handling.

- Compliance with 10 CFR 50.68 requires that the licensee either maintain monitoring systems capable of detecting a criticality accident as described in 10 CFR 70.24, thereby reducing the consequences of a criticality accident; or comply with the requirements specified in 10 CFR 50.68(b), thereby reducing the likelihood that a criticality accident will occur.

- 10 CFR 52.80(a) requires a COL application (COLA) to include the proposed inspections, tests, and analyses that are necessary and sufficient to provide reasonable assurance that if the inspections, tests, and analyses are performed and the acceptance criteria are met, the facility has been constructed and will operate in conformity with the COL; the provisions of the Atomic Energy Act of 1954; and the NRC regulations.

9.1.2.4 Technical Evaluation

As documented in NUREG–1503, the staff reviewed and approved Sections 9.1.1, "New-Fuel Storage," and 9.1.2, "Spent Fuel Storage," of the certified ABWR DCD. The staff reviewed Section 9.1.2 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 appropriately represents the complete scope of information relating to the review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference, address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

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[1] 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

9.1.2.4.1 Tier 1 Departure

- STP DEP T1 2.5-1 Elimination of New Fuel Storage Racks From the New Fuel Vault

This departure was already discussed in Subsection 9.1.1.4 of this SER.

COL License Information Items:

9.1.2.4.2 New Fuel Storage Racks Criticality Analysis

- COL License Information Item 9.1 New Fuel Storage Racks Criticality Analysis

COL License Information Item 9.1 requires the applicant to provide the NRC with a confirmatory criticality analysis of the inadvertent placement of a fuel assembly in other than the prescribed locations within the new fuel storage rack. Per Departure STD DEP T1 2.5-1, new fuel will not be stored in the new fuel vault. Instead, new fuel will be temporarily stored in the SFP before loading it into the core. However, the requirements in GDC 62 for storing new fuel in the SFRs still apply. Therefore, the review of NFR criticality will be included in the evaluation of COL License Information Item 9.3, "Spent Fuel Storage Racks Criticality Analysis," in Subsection 9.1.2.4.4, "Spent Fuel Storage Racks Criticality Analysis," of this SER.

9.1.2.4.3 Dynamic and Impact Analyses of New Fuel Storage Racks

- COL License Information Item 9.2 Dynamic and Impact Analysis of New Fuel Storage

COL License Information Item 9.2 requires the applicant to provide the NRC with confirmatory dynamic and impact analyses of the new fuel storage racks. Per Departure T1 STD DEP 2.5-1, new fuel will not be stored in the new fuel vault. Instead, new fuel will be temporarily stored in the SFP before loading it into the core. The requirements in GDC 2 for this configuration and the applicability of SFR dynamic and impact analyses of the NFRs will be addressed in the evaluation of COL License Information Items 9.4, "Spent Fuel Rack Load Drop Analysis," and 9.7, "Spent Fuel Rack Structural Evaluation," in Subsection 9.1.2.4.6.

9.1.2.4.4 Spent Fuel Storage Racks Criticality Analysis

- COL License Information Item 9.3 Spent Fuel Storage Racks Criticality Analysis

COL License Information Item 9.3 requires that the COL applicant to provide the NRC with a confirmatory critically analysis for the inadvertent placement of a spent fuel assembly in other than prescribed locations within the spent fuel storage rack. In addition to the information in COL FSAR Section 9.1.2, "Spent-Fuel Pool," the applicant's TR HI-2135462 documents all of the design details and supporting analyses. The review of the criticality analysis of the SFRs is based on the technical details in this TR.

9.1.2.4.4.1 Design Bases

In TR HI-213562 Revision 2, Section 3.3 includes the applicant's description of Metamic, a neutron absorbing material utilized for criticality control in the fuel rack design. Metamic is an

aluminum metal matrix composite containing particle reinforcements of boron carbide (B_4C). The Metamic material will be manufactured by Holtec in accordance with the company's NRC-approved Quality Assurance (QA) Program that includes inspections of critical characteristics such as thickness, B_4C weight percent, and neutron attenuation. Conformance to the QA Program and the verification of critical characteristics ensures that the Metamic material's neutron absorbing properties conform to the criticality analysis detailed in HI-213562 Revision 2, Chapter 4, "Criticality Safety Evaluation."

The Metamic plates are encapsulated by a stainless steel sheath that is stitch-welded onto the outside of the storage cells. The sheath incorporates venting holes at the top that allow oxidation gasses and water within the sheaths to be circulated through the fuel pool cleanup system. This design allows for active detection of Metamic degradation by monitoring the amount and composition of suspended solids within the pool cleanup system.

The applicant has proposed to use Metamic plates with B_4C as a neutron absorber. For many years, the staff limited the B_4C content in Metamic in license amendment applications submitted by nuclear power plant licensees. However, in more recent applications, the manufacturer of Metamic provided test data showing that there are no technical issues with the use of Metamic with a B_4C weight percent content as high as the STP, Units 3 and 4, applicant has proposed. The staff evaluated the use of this type of Metamic in its review of a license amendment application requested by Entergy for its Palisades Nuclear Plant on February 28, 2012. The staff then approved its use in a safety evaluation dated February 28, 2013 (ML13032A514).

The applicant has committed to a neutron absorber material surveillance program to detect degradation of the Metamic material during the fuel rack's lifetime and to assess the capability of the Metamic material to perform its intended function. Sample coupons from the fabrication lots will be placed within the SFR in locations that will expose the material to the highest levels of neutron fluence and temperatures typical of the full-length Metamic plates. The coupons will be removed at set intervals for visual inspections, neutron attenuation measurements, dimensional inspections, and weight and specific gravity measurements. This program is consistent with the multilevel, defense-in-depth strategy used for spent fuel storage in currently operating nuclear power plants. In addition, the staff reviewed the acceptance criteria for the program and found it to be consistent with currently accepted practices.

The staff finds that material specification, verification of characteristics, design, and material monitoring programs for the neutron absorbers are sufficient to provide assurance that the fuel rack will conform to the criticality analysis presented in Chapter 4 of HI-213562, Revision 2, and are thus acceptable. The qualifications of fresh and spent fuel assembly lattices for storage in the SFP are based on two administratively controlled requirements and Technical Specification (TS) 4.3.1.1. The two administratively controlled requirements are designed to meet the regulatory requirement for k_{eff} in a storage rack of less than 0.95. The two administrative requirements for the fresh fuel are: (1) fresh fuel without gadolinium (Gd), which has an upper limit uranium-235 (U-235) enrichment of 2.95 weight percent; and (2) fresh fuel with Gd, which has a U-235 enrichment limit of 5.0 weight percent and a lattice design limit on the number of Gd rods, the Gd rod locations, and the Gd rod loading. TS 4.3.1.1 sets a limit on Standard Cold Core Geometry (SCCG) of less than or equal to a k_{inf} of 1.35.

The applicant's TR states that criticality analyses demonstrate that the fuel storage rack geometry in combination with the integral neutron absorber material is sufficient to maintain the fuel in a subcritical condition as noted above. Compliance with the guidance in ANSI/ANS-57.1,

ANSI/ANS-57.2, and ANSI/ANS-57.3 with regard to criticality prevention is also indicated in this TR.

The staff finds that the design bases described above for the fuel storage and handling systems meet the requirements of GDC 62 and 10 CFR 50.68(b).

9.1.2.4.4.2 Criticality Analysis Methodology

The criticality analysis of the STP, Units 3 and 4, SFR was performed by Holtec International, the company that is also the designer and supplier of the storage racks.

The criticality analyses utilized the MCNP5-1.51 computer code developed at the Los Alamos National Laboratory. MCNP5-1.51 employs a Monte Carlo numerical methodology to perform neutron transport calculations. The neutron cross section data from the ENDF/B-VI libraries were used.

The MCNP code is a widely accepted analytical tool previously utilized for licensing applications, including fuel storage criticality analyses. The licensee has validated both this code and the neutron cross-section combination.

9.1.2.4.4.3 Criticality Analysis Model Inputs and Assumptions

Criticality analyses are performed for the STP NFR and SFR to demonstrate $K_{eff} \leq 0.95$ during normal and credible abnormal conditions and assuming fuel with the most limiting enrichment, with consideration for uncertainties due to fuel and rack manufacturing tolerances. In the case of a mislocated and misloaded fuel assembly in the SFP, a fresh fuel assembly with a 5.0 weight percent U-235 and without Gd rods was used to demonstrate $K_{eff} \leq 0.95$. Based on a review of the STP SFP layout, the worst case location for a mislocated fuel assembly was determined to be the corner between two racks, with the mislocated fuel assembly being adjacent to racks on two sides.

The applicant performed sensitivity studies to support that fuel meeting the administrative requirements is most reactive when it is fresh. Therefore, no fuel depletion credit was taken when estimating the material compositions of spent fuel. In all of the limiting analyses presented, fresh fuel is assumed, with no credit taken for depletion due to burnup. Finally, the analysis includes the following assumptions, which the staff found to be conservative and therefore acceptable: the use of an infinite array model, no credit for neutron absorption in minor structural members, and an evaluation at the moderator temperature of the highest reactivity.

The fuel storage rack design inputs used in the criticality analyses are summarized in the applicant's TR.

9.1.2.4.4.4 Criticality Analysis Results

As stated in NUREG–0800 Section 9.1.1, "Criticality Safety of Fresh and Spent Fuel Storage and Handling," and in accordance with GDC 62 and 10 CFR 50.68, new and spent fuel must be verified to remain subcritical during all credible storage and handling conditions. Descriptions of the STP fuel storage facilities are in the applicant's TR HI-2135462.

The spent fuel storage racks are contained in a stainless steel-lined, concrete-reinforced, water-filled pool within the RB. The racks are designed to meet Seismic Category I requirements and therefore they remain functional (i.e., maintain fuel in a safe and subcritical array) during an SSE.

New and spent fuel are stored in the stainless steel-lined concrete SFP containing racks capable of holding a total of 2,380 fuel assemblies, an amount slightly higher than the DCD allowable capacity of 2,354 assemblies (270 percent of the reactor core). The SFRs are divided into seven modules within the common pool. Each module is 20 by 17 cells and has space for 340 cells. The racks contain neutron absorbing material with spatial flux traps between storage locations for reactivity control. The racks are fabricated with stainless steel sheet. STP has selected Metamic as the neutron absorber material, which was developed by Holtec. The criticality analysis included in Section 4 of the Holtec TR indicates Metamic as the neutron absorber material. The Metamic sheets are contained in sheathed structures attached to the outside of the storage cells. In addition, once the rack design is loaded to capacity it precludes any deformation, and the inadvertent placement of a fuel assembly on top of the storage rack maintains a minimum separation of more than 12 inches (in.) (30.5 centimeters [cm])—which is sufficient to preclude neutron coupling.

The acceptance criterion for meeting the regulatory requirements to verify subcriticality in the spent fuel storage facility is as follows:

- $K_{eff} \leq 0.95$ under fully loaded and flooded conditions for all normal and credible abnormal conditions.

As stated in ANSI/ANS 57.2–1983, it must be demonstrated that criticality could not occur without at least two unlikely, independent, and concurrent abnormal occurrences. This double contingency principle is endorsed in the NRC Memorandum from L. Kopp to T. Collins, "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light Water Reactor Power Plants," dated August 19, 1998 (ML072710248). Therefore, concurrent multiple abnormal conditions need not be considered in the fuel storage rack design.

The SFR criticality analyses documented in the TR are evaluated below.

The description outlines the design criteria, evaluation methodology, and assumptions used in the SFP analysis. The results indicate that the multiplication factors are well within the limits set by the acceptance criteria, for the conditions in the analysis. The uncertainty associated with the placement of the fuel assemblies within the SFR is determined by carrying out calculations for 4, 100, and 400 cells with reflecting boundary conditions. Accidents associated with dropped fuel assemblies are also discussed. For the horizontal drop case, the applicant dropped fuel assembly minimum separation from the active fuel region remains greater than 12 in. (30.5 cm), which is sufficient to preclude neutronic coupling. Mislocated fuel assemblies are also discussed. In addition, the applicant conducted a sensitivity case in which every assembly in the racks was moved toward the mislocated fuel assembly.

In RAI 09.01.02-51, the staff requested the applicant to provide a technical basis for not considering the deep drop case into a cell along the perimeter and half way between the peripheral support pedestals. In its response to RAI 09.01.02-51, dated July 10, 2014 (ML14196A084), the applicant provided the analysis and stated that there is the potential for the active region of the fuel to be below the Metamic absorber panel as a result of a deep drop

accident. During the audit conducted from April 8, 2014, through April 9, 2014 (ML14230A870), the staff reviewed criticality calculations that conservatively assumed that the active region of the dropped fuel assembly was 6 in. (15 cm) below the absorber panel; and the active regions of the eight surrounding fuel assemblies were 3 in. (7.5 cm) below the absorber panel. The applicant included a discussion of the analysis in Subsection 4.2.4.3, "Assembly Dropped Vertically into a Storage Cell," and the results are in Tables 4.6.11(a), "Results of the MCNP5-1.51 Calculation of the Abnormal and Accident Conditions for Lattice 0 with 2.95 wt% of ^{235}U," and 4.6.11(b), "Results of the MCNP5-1.51 Calculations of the Abnormal and Accident Conditions for Lattice 4a with 4.0 wt% of Gd_2O_3," of the TR. Based on the staff's review of the applicant's response to RAI 09.01.02-51, and the additional analysis and results in the Holtec report, which demonstrate that the fuel remains safely subcritical, the staff finds this issue acceptable. Therefore, RAI 09.01.02-51 is resolved and closed.

In RAI 09.01.01-16, the staff asked the applicant to justify that the Design Commitment in Item 3 of Table 2.5.6, "Fuel Storage Facility," of the ABWR DCD Tier 1, has been met; because it is physically possible for a fuel assembly that is rotated 45 degrees to fit into the space between corners of multiple racks. In its response to RAI 09.01.01-16, dated August 13, 2014 (ML14231A023), the applicant provided an explanation of the procedures that would prevent the placement of a rotated fuel assembly in the space between multiple racks. The applicant also stated that the spacing between adjacent faces of the racks is 5.25 in. (13.33 cm), which results in a 4.25-in. (10.8-cm) gap between the bumper bars. Because a fuel assembly is 5.48 in. (13.91 cm) square, a fuel assembly cannot be accidently inserted between adjacent racks. The applicant included in TR Subsection 4.2.4.6, "Rack Movement," a discussion of and the results from the criticality analysis of the mislocated assembly in the space between four racks. Based on the applicant's response, the staff found the applicant's response acceptable, therefore, RAI 09.01.01-16, is resolved and closed.

A misloaded fuel assembly event does not apply in this case, because the most reactive fuel can be placed anywhere in the rack. However, to demonstrate defense–in-depth, a fuel assembly with a U-235 enrichment of 5.0 weight percent without Gd rods was analyzed for the misloaded fuel assembly case. The values used to determine Δk_{calc} are in the applicant's TR. In addition, the staff performed a confirmatory analysis of selected fresh fuel cases for a four-cell infinite array using SCALE 6.1. The results were similar to those presented by the applicant. The staff also performed depletion studies to confirm that the fresh fuel with Gd was the most reactive for three Gd-loading patterns. Those results showed good agreement with the applicant's sensitivity studies. Based on the staff's review of the applicant's results demonstrating a substantial margin to the regulatory limits, the staff finds that the acceptance criteria as described in GDC 62 and 10 CFR 50.68(b) are satisfied.

9.1.2.4.5 Spent Fuel Racks Load Drop Analysis

- COL License Information Item 9.4 Spent Fuel Racks Load Drop Analysis

The staff's evaluation of the load drop analysis of the SFRs to address COL License Information Item 9.4 is in Subsection 9.1.2.4.6 of this SER.

9.1.2.4.6 Spent Fuel Racks Structural Evaluation

- COL License Information Item 9.7 Spent Fuel Racks Structural Evaluation

9.1.2.4.6.1 Background

The STP, Units 3 and 4, SFP is located in the RB of each unit for storing new and spent fuel assemblies. To provide the information needed in COL License Information Items 9.2, 9.4, and 9.7, the applicant submitted proprietary TR HI-2135462, Revision 1, on July 31, 2013 (ML13218A291). This TR provides the design and analytical details of the fuel racks including criticality, thermal-hydraulic, seismic, and mechanical accident evaluations of the fuel racks. Based on an initial review of the report, the staff provided feedback to the applicant regarding the completeness of the report during a public meeting on September 18, 2013 (ML13266A205). The applicant subsequently provided a supplement to the TR on November 14, 2013 (ML13326A573). The TR is structured so that Sections 1, "Introduction," 2, "Fuel Storage Racks Design, Design Criteria, and Codes & Standards to Meet Safety Requirements," and 3, "Material Considerations," include the description, layout, design criteria, design and fabrication, and material considerations of the SFRs; Sections 4, "Criticality Safety Evaluation," and 5, "Thermal-Hydraulic Evaluation," present a criticality safety evaluation and a thermal hydraulic evaluation of the spent fuel storage racks; Section 6, "Structural/Seismic Evaluation," describes the structural/seismic evaluation of the SFRs; and Section 7, "Mechanical Accident Evaluation," provides the mechanical accident evaluation of the SFRs for postulated fuel assembly drop scenarios. The staff reviewed the TR along with the supplemental information provided on November 14, 2013. Below is a summary of the SFR design and analyses described in TR Sections 1, 2, 3, 6, and 7, and the additional information in the supplement to the TR. Evaluations of the information in these sections address how the applicant satisfies the requirements in COL License Information Items 9.2, 9.4, and 9.7.

(I) Design, Design Criteria and Codes and Standards

The SFP is located inside the plant's RB. The SFP is a reinforced concrete fuel storage pool with a stainless steel liner. The fuel pool contains seven rack modules for storing new and spent fuel assemblies. The rack modules are freestanding structures placed on top of the fuel pool floor liner, and they are not connected to one another or to the fuel pool walls. TR Figure 1.1.1 shows the layout of the racks inside the SFP.

TR Sections 2.1, "Introduction," 2.5, "Mechanical Design," and 2.6, "Rack Fabrication," describe the design and fabrication of the storage racks. The individual cells are fabricated from two precision formed sheet metal channels seam welded to form a box. The boxes are welded together in a honeycomb arrangement to form a 17 x 20 arrangement of cells that are welded to a baseplate to form a single rack module (see Figures 1.1.1, "Layout for STP 3&4 ABWR Fuel Storage Racks," and 2.1, "Pictorial View of a Typical BWR Rack Module," through 2.16, "Female Pedestal Center," for the fuel rack configurations). The baseplate of a single rack module is supported by five support pedestals, one at each of the four corners and one at the center of the baseplate. The support pedestals are remotely adjustable by using a long-handled tool to accommodate minor level variations in the SFP floor flatness. Each rack module has a nominal dimension of 129.88-in. (330-cm) length, 111.12-in. (282.24-cm) width, and an overall height of 181.25 in. (460 cm). The overall height is later increased to 181.75 in. (461.65 cm) from an increase in the thickness of the bearing pads by 0.5 in. (1.27 cm). The

racks are equipped with intercellular neutron absorbing panels made from Metamic material, a patented boron carbide and aluminum metal matrix composite, between adjacent fuel assemblies. The Metamic panels are attached to the cell walls using a non-structural metal sheathing welded to the cell walls. TR Figures 2.1 through 2.16 depict structural details of the storage rack modules.

TR Section 2.2, "Isometric View of Composite Box Assembly," summarizes the principal design criteria for the storage racks. The freestanding rack modules must remain kinematically stable against tipping and overturning under the postulated SSE ground motion. All primary stresses in the rack modules must satisfy the limits for linear structures in Subsection NF of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Section III, Division 1. The subcritical geometry of the rack structure must not be compromised in the event of a postulated fuel assembly drop scenario.

TR Section 2.3, "Typical Array of Storage Cells," provides the codes and standards used to design the racks. This section also lists the pertinent regulations and regulatory guides. The primary design codes are ASME B&PV Code Section III, Division 1 Subsection NF, and Appendix F. ASME B&PV Code, Section II, Part D is used for the material properties in the design.

TR Section 2.4, "Elevation View of a Typical BWR Storage Rack Module," details the QA requirements. The spent fuel storage racks are classified as nonsafety-related and Seismic Category I per ABWR DCD Tier 2 Table 3.2-1, "Classification Summary." The governing QA requirements for design and construction are in 10CFR Part 50, Appendix B. Holtec's Nuclear QA Program (QAP) complies with this regulation.

(II) Materials

TR Section 3.2, "Structural Materials," lists the structural materials used for the fabrication of the SFRs. The racks are made primarily from stainless steel sheet and plate stock, except for the adjustable support pedestals. The weld material used is ASME Type 308L.

(III) Seismic Evaluation

TR Section 6, "Structural/Seismic Evaluation," describes the seismic evaluation and structural design of the fuel racks. The fuel racks structurally support and protect the fuel assemblies outside the reactor core and were designed by analysis in accordance with the ASME B&PV Code, Class 3 component supports. The fuel racks are freestanding structures permanently submerged in the SFP water, which has a highly nonlinear response during an earthquake event. A three-dimensional, nonlinear, time history integration method of analysis was performed to estimate the seismic response of the fuel racks using the Holtec proprietary computer program DYNARACK.

Modified real recorded time histories in three orthogonal directions were generated following the guidance in SRP Section 3.7.1. Five sets of acceleration time histories corresponding to the design-basis floor response spectra for the SFP were generated and used in the seismic analysis.

Each rack module was modeled as a beam with the mass lumped at the top and at the baseplate level. Each mass has six degrees of freedom that are coupled using six springs to represent the bending, shear, axial, and torsional behavior of the racks. Fuel assemblies within the rack were modeled by five lumped masses. Impact springs with compression-only gap elements were used to simulate an impact between the fuel assembly and the cell wall, between adjacent racks, and between racks and fuel pool walls and the floor. The model for each rack was considered to be supported at the baseplate level by five support pedestals. Pedestals were modeled as rigid links. The interface between each pedestal and the bearing pad was provided with a compression-only gap element in the vertical direction and piecewise linear friction spring elements in two orthogonal horizontal directions. TR Figure 6.4.1 "Single Rack Dynamic Model," depicts a schematic model of a single rack. All seven racks were included in the whole pool, multi-rack (WPMR) model of a seismic analysis.

Loads and load combinations used in the analysis are in TR Table 6.1.1, "Load Combinations and Acceptance Limits." The seismic analysis considered dead weight that included fuel assembly weight, hydrostatic loads, and SSE loads. Live loads were not considered applicable, and thermal loads were not considered significant because of water submergence and the freestanding disposition of the fuel racks.

Fluid coupling between the rack and the fuel assemblies and between the racks and the fuel pool walls was simulated by appropriate inertial coupling in the system kinetic energy.

To account for variations in the coefficient of friction at the rack and pool floor interface, the racks were analyzed for three values of coefficient of friction of 0.2, 0.5, and 0.8.

A seismic analysis of the WPMR model consisted of 15 basic cases where the fully loaded racks were analyzed for each of the five seismic time history input motions for each of the three values of coefficient of friction. Additional sensitivity analyses were performed to address potential partial loading of the rack assembly, uncertainty in the values of spring constants, the impact from reducing the integration time steps, and tolerance in rack-to-rack gaps. TR Section 6.6, "Dynamic Simulations," lists all of the analytical cases used in the seismic evaluation. (This information was transferred to Table 6.6.1a, "Simulation Listing," in Revision 2 of the TR.)

Results from the DYNARACK analyses were used to calculate stresses in the rack using a post-processor program. Ratios of computed stresses for axial, bending, shear, and combined flexure and tension/compression and the corresponding allowable stresses were calculated as stress factors for demonstrating compliance with the ASME Code allowable stresses. Maximum calculated stress factors are reported in TR Table 6.6.1, "Maximum Values of Stress Factors and Impact Loads," (Table 6.6.1b, "Maximum Values of Stress Factors and Impact Loads," in Revision 2 of the TR).

(IV) Stuck Fuel Assembly Evaluation

In STP Units 3 and 4 FSAR Subsection 9.1.2.3.2, "Structural Design and Material Compatibility Requirements," Item (7) requires that fuel racks be designed to withstand a pull-up force of 17.9 kilonewton (kN) (4,024 pound force [lbf]) and a horizontal force of

4.45 kN (1,000 lbf). TR Section 6.10, "Conclusion," describes the design of the racks for the postulated stuck fuel assembly loading and provides the results of the evaluation.

(V) Mechanical Accident Evaluation

TR Chapter 7, "Mechanical Accident Evaluation," and Item 9 in Attachment 5, "Spent Fuel Rack (SFR) Issue Resolution Sheets," to the supplemental TR provide information on the performance of the fuel storage racks under mechanical accident conditions. To ensure that the racks maintain their functional integrity under fuel assembly drop events, three categories of mechanical accidents were considered (i.e., shallow drop, deep drop away from the support pedestal, and deep drop above the support pedestal).

The energy balance method was used for the impact analysis of the postulated drop accidents. In the first step of the solution process of the energy balance method, the velocity of the dropped object (impactor) was computed for the condition of underwater free fall. The drop was assumed to occur in a vertical configuration to minimize the drag area. In the second step of the solution, an energy balance model for each drop event was prepared using the computer program Mathcad. The model computed the collision event for the three drop cases including plastic deformation, wave propagation, and full energy dissipation. More information regarding the evaluation using the energy balance method is in Item 9 of Attachment 5 of the supplemental TR.

9.1.2.4.6.2 Structural and Mechanical Accident Evaluations of TR HI-2135462

Fuel storage racks provide storage for fuel assemblies and are designed to protect the fuel against postulated design and accidental loading conditions. The staff's review assessed the adequacy of the fuel storage racks to perform their intended design function. The review included applicable codes and standards for the design of the racks using analyses, material properties, the analytical procedures used to perform the dynamic analyses of the racks, load combinations, and structural acceptance criteria for conformance with GDC 1 and 2 as well as other regulatory requirements identified in Subsection 9.1.2.3 of this SER. The staff's technical review is in accordance with the guidance in NUREG–0800 Section 3.8.4, "Other Seismic Category I Structures," Appendix D, "Guidance on Spent Fuel Pool Racks," Revision 3, issued May 2010.

(I) General Description

The new and spent fuel storage racks consist of seven freestanding stainless steel racks in the RB SFP. TR Figure 1.1.1, "Layout for STP 3&4 ABWR Fuel Storage Racks," shows a plan view of the seven racks in relation to the SPF boundary, including the gaps between adjacent racks. TR Chapter 2, "Fuel Storage Racks Design, Design Criteria, and Codes & Standards to Meet Safety Requirements," describes the mechanical design and fabrication of the rack modules, which are constructed of an array of 17 x 20 storage cells made by joining together 6-in. (15-cm) square (inside dimension) sheet metal boxes welded to a baseplate. The individual rack module baseplate is supported by five pedestals, one at each corner of the baseplate and one at the center of the baseplate. TR Figures 2.1, "Pictorial View of a Typical BWR Rack Module," through 2.16, "Female Pedestal Center," provide details of the rack modules and their components, including an elevation view of a fuel assembly in a storage cell.

In TR Section 2.6, “Rack Fabrication,” the applicant states that manufacturing the rack module begins with fabricating the “box.” The boxes are fabricated from two precision formed channels by seam welding. The minimum weld seam penetration target is 80 percent of the box metal gage. In RAI 09.01.02-34, the staff requested a description of the evaluation procedure of the seam welds to account for: (a) how the weld seam target penetration of 80 percent is guaranteed; (b) how the material eccentricity at the weld is considered in the local stress evaluation; and (c) the significant loads that cause membrane and bending stress across the weld seam. In its response to RAI 09.01.02-34,dated July 7, 2014 (ML14196A117), the applicant stated that the minimum weld seam penetration target of 80 percent will be revised to require full penetration over the entire length of the box seam. The response also stated that the most significant load that drives the seismic response of the racks and causes membrane and bending stresses in the cell assemblage is the fuel-to-cell impact load. As described in its response to RAI 09.01.02-49 (ML14196A117), dated July 7, 2014, the applicant states that the cell walls are designed to withstand that load. The applicant also provided a markup of the TR reflecting the change. The staff concluded that using the full penetration weld across the seam adequately addresses the questions in Items (a) and (b) above. The staff also agreed that stresses resulting from the fuel assembly impact load would be the most significant load on the cell walls, and it therefore adequately addresses the question in Item (c) above. The proposed change to the TR was subsequently incorporated into Revision 2 of the TR (ML14199A604). Based on the above evaluations, the staff found the applicant’s response acceptable, therefore, RAI 09.01.02-34, is resolved and closed. The staff’s review of the adequacy of the cell walls to withstand the effects of fuel-to-cell wall impact loads is discussed in Subsection 9.1.2.4.6.2 (III).3, “Evaluation of Fuel to Cell Wall Impact,” of this SER.

The staff’s review of the description of the SFRs included in the TR finds that the description provides sufficient information about the location and layout of the storage racks in relation to other plant structures, as well as providing sufficient details about the racks in terms of the storage of fuel assemblies in the racks and the transfer of loads from the rack modules to the SFP floor. All principal structural elements of the racks, including their fabrication and assembly, are described in the TR. The TR also identifies all of the gaps around and between the racks, including the gaps between the fuel assembly and storage cells. The description of the SFRs in the TR is thus consistent with the guidance of SRP Section 3.8.4, “Other Seismic Category I Structures,” Appendix D, and the staff therefore finds the description acceptable.

(II) Applicable Codes and Standards

In TR Section 2.3, “Applicable Codes and Standards,” the applicant provides the list of codes and standards used to design, construct, and assemble the fuel storage racks. ASME B&PV Code Section III, Subsection NF is the principal design code referenced in this Section. ASME B&PV Code Section II is referenced for material specifications. According to the guidance in SRP Section 3.8.4 Appendix D the design, fabrication, and installation of spent fuel racks made from stainless steel material may be based on ASME Code Section III Division 1 Subsection NF requirements for Class 3 component supports. Therefore, the staff finds that the applicant used the appropriate Code for the design and construction of the fuel racks. However, the staff noted some discrepancies in the editions of the codes the applicant used, as described below.

During the review, the staff noted that different editions of the ASME Code were identified in TR Section 2.3. In RAI 09.01.02-41, the NRC requested the applicant to explain why different editions of the ASME Code were used (i.e., ASME Codes 1989 and 2007 editions for Section III and the 2010 edition for Section II). Furthermore, during a public teleconference on May 6, 2014 (ML14190A327), the staff asked the applicant to clarify the following discrepancies:

- FSAR Subsection 9.1.2.1.5, "Materials Considerations," specifies using the latest American Society for Testing and Materials (ASTM) material specifications, whereas TR Section 2.3 references ASME B&PV Code Section II (2010).

- TR Section 2.3 references American Society for Nondestructive Testing SNT-TC-1A, 2011 Edition, for personnel qualifications to perform nondestructive examinations. This reference is not consistent with the required version specified in ASME B&PV Code Section III Subsection NF-5000, 1989 Edition, referenced in the TR. In addition, the referenced version of SNT-TC-1A is not endorsed by the ASME or the NRC.

In its response to RAI 09.01.02-41, dated July 7, 2014 (ML14196A239), the applicant addressed the staff's concerns regarding the different codes referenced in Section 2.3 (a) of Revision 1 of the TR (ML13218A293) as described below.

In Reference (4), "ASME B&PV Code Section III, Subsection NF-3000 and NF-5000, 1989 Edition", the applicant states that the use of the 1989 edition of ASME B&PV Code Section III, Subsections NF-3000 and NF-5000, for the design, fabrication, and examination of the supports for the SFP racks is consistent with the ABWR DCD and FSAR Table 1.8-21, "Industrial Codes and Standards Applicable to ABWR." The staff agrees with the applicant's explanation and finds the use of the 1989 edition of the ASME Code acceptable.

In Reference (5), "ASME B&PV Code Section III, Subsection NCA-3862, 2007 Edition", the applicant states that the use of the 2007 edition of ASME B&PV Code Section III, Subsection NCA-3862 to certify materials, is not used in the TR and has no material effect on the analysis or the results of the analysis. ABWR DCD Tier 2 Section 9.1.2, "Spent-Fuel Storage," requires the SFRs to be fabricated from materials "specified in accordance with the latest issue of applicable ASTM specifications at the time of equipment order," which facilitates material procurement. Therefore, the applicant proposed to delete Reference (5) "ASME B&PV Code Section III, Subsection NCA-3862, 2007," from TR Section 2.3(a) and provided a markup of the TR showing the deletion. The staff considers the response acceptable because paragraph NCA-3862 of Section III is not needed for this application, and the ambiguous reference is deleted from the TR.

In Reference (7), "ASME B&PV Code Section II, 2010 Edition", the applicant states that TR HI-2135462 Subsection 6.2.3.1, "Limits from the ASME Code," does reference the 2010 edition of ASME B&PV Code Section II, in that the material properties listed in Table 6.5.1, "Rack Material Data (200°F)," are from ASME Code Section II Part D. The specifications for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels in ASME 2010, Section II, Part A, SA-240 states that the code specifications are "Identical with ASTM A240/A 240M-04." Regarding the requirement to

use the latest ASTM material specifications per FSAR Subsection 9.1.2.1.5, “Material Consideration,” the applicant states that at the time of procurement and fabrication, codes and standards used that are later than what was specified will be reconciled to ensure that the codes and standards in effect meet or exceed those specified in the licensing requirements. The applicant also provided a markup of TR Section 2.3, which explains the above reconciliation of material specifications at the time of procurement and fabrication. ASME B&PV Code Subsubarticle NCA-1220 allows ASTM material to be ASME certified by qualified certificate holders. The vendor (Holtec) submitted the TR. Holtec is a holder of ASME certificate N-2918 and is allowed to verify and certify material properties as ASME material. Use of the 2010 edition of Section II of the ASME B&PV Code is permitted by Subsubarticle NCA-1140 of Section III, and a specific Section II edition is not required by 10 CFR 50.55a. In this context, the staff finds the use of this material acceptable because it meets the requirements stated in the ASME B&PV Code and the ABWR DCD as approved by the staff.

In Reference (6), “American Society for Nondestructive Testing SNT-TC-1A, Recommended Practice for Personnel Qualifications and Certification in Nondestructive Testing”, 2011 Edition, the applicant states that the 2011 edition of ASNT SNT-TC-1A was inadvertently referenced in the licensing report but is not needed, because ASME B&PV Code, Section III Subsection NF-5000 (1989) already cites SNT-TC-1A (1984 Edition). Therefore, HI-2135462 Reference (6) in Section 2.3 will be deleted. The applicant provided a markup of the TR showing the deletion with the response. The staff finds the response acceptable, because the applicant deleted the inapplicable reference from the TR.

Discussions in the above paragraphs resolve the issues identified by the staff regarding the applicant’s use of codes and standards for the design, construction, and assembly of the fuel storage racks. The staff reviewed the TR markup provided with the response and found it to be consistent with the response and therefore acceptable. The proposed changes to the TR were subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-41 is resolved and closed. The codes and standards the applicant used are in accordance with the guidance in Appendix D of SRP 3.8.4, “Other Seismic Category I Structures,” and are thus acceptable.

(III) Seismic and Impact Loads

The ABWR SFRs to be installed at STP, Units 3 and 4, are designed as freestanding and autonomously supported structures resting on the liner plate of the SFP floor in the RB. The racks are permanently submerged in water. There are seven racks arranged as shown in TR Figure 1.1.1, “Layout for STP 3&4 ABWR Fuel Storage Racks,” with gaps between the adjacent racks and between the racks and the surrounding fuel pool walls. These racks are likely to slide and tilt during a seismic event, and they may potentially impact one another or the fuel pool walls. The racks support pedestals that may also lift up and impact the fuel pool liner. There are also gaps between the individual fuel assemblies and the walls of the cells where they are stored. The applicant performed a three-dimensional, nonlinear, time history analysis of the rack assembly to assess the seismic behavior of the racks. In addition to potential impacts during a seismic event, the accidental drop of a fuel assembly may also impact the racks. The staff’s evaluation of the analysis and the design of the racks for seismic and impact loads is described in this section.

TR Chapter 6, “Structural/Seismic Evaluation,” provides details of seismic and structural evaluations of the racks. In Section 6.4, “Dynamic Analysis Methodology,” the applicant describes the methodology used to analyze the racks. Seismic behaviors of the array of racks submerged in the SFP are simulated in a WPMR model that represents each rack as a 12 degree-of-freedom structure. Movement of the rack cross-section at any height is described by six degrees of freedom at the rack base and six degrees of freedom at the rack top. Rattling fuel assemblies within the rack are modeled by five decoupled lumped masses spaced uniformly along the height of the fuel assembly. Each lumped fuel mass has two horizontal degrees of freedom. A vertical motion of the fuel assembly mass is coupled to rack a vertical motion at the baseplate level. Fluid coupling between the rack and fuel assemblies and between the rack and wall is simulated by the appropriate inertial coupling in the system’s kinetic energy. Potential impacts between the cell walls of the racks and the contained fuel assemblies, between adjacent racks, between racks and fuel pool walls, and between rack pedestals and the fuel pool floor are accounted for by appropriate impact springs with compression-only gap elements. A potential sliding of the racks is accounted for by using bilinear friction springs at the base of the pedestals. The dynamic model of a single rack is depicted in TR Figure 6.4.1, “Single Rack Dynamic Model,”. The Holtec proprietary computer program DYNARACK was used for analysis of the WPMR model by performing a direct integration of the nonlinear equations of motion resulting from three pool slab acceleration time histories applied as forcing functions act simultaneously.

The staff reviewed the methodology of the seismic analysis described in the TR and the additional information in the supplemental TR. The staff’s review finds the methodology of the seismic analysis described above to be generally acceptable. The staff has previously reviewed and accepted similar dynamic analyses methodology using the Holtec International DYNARACK program in other licensing applications (e.g., AP1000 Standard COL Technical Report Submittal of APP-GW-GLR-033, Revision 4, TR54, in ML101580475). The staff, however, had several questions regarding various aspects of the seismic analysis and the calculation of impact loads described below.

(III).1 Modeling of Fuel Assembly

Item 38 of Attachment 5, “Spent Fuel Rack (SFR) Issue Resolution Sheets,” to the supplemental TR (ML13326A573) discusses the stiffness and damping of fuel assemblies. The staff noted that the applicant had modeled the fuel assembly in the WPMR analysis as five decoupled and lumped masses spaced uniformly along the height of the fuel assembly and connected to the rack model by compression-only gap elements, which simulate the motion of the fuel assembly in the horizontal direction. It was not clear to the staff that modeling the fuel assembly as uncoupled masses, which does not take into account the elastic properties of the fuel assembly and the lateral support at the baseplate, will result in a conservative estimate of impact loads on the fuel assembly. The staff also noted that the impact spring stiffness of the fuel assembly lumped masses is calculated assuming impact is simulated by a uniform pressure on a circular section of the cell wall with a radius larger than half of the inside dimension of the cell. In RAI 09.01.02-60, the staff requested the applicant to provide the technical basis for the assumptions in the fuel assembly model.

In its response to RAI 09.01.02-60, dated July 7, 2014 (ML14196A117), the applicant stated that the underlying rationale for modeling features such as the computation of the

contact stiffness between the fuel and the rack's cell wall and the depiction of fuel assemblies as lumped mass elements lies in the specific mission of the rack's dynamic model. The objective of the dynamic model is to adequately capture the dynamic characteristics of the freestanding racks under seismic loading. Within the framework of the simplified model, it was necessary to simulate the mass of the fuel assemblies and their internal rattling effect in a manner that maximizes the kinematic response of the rack. For this purpose, all of the fuel assemblies in the rack are lumped into the physical space occupied by one assembly, thus postulating that they will all vibrate in unison. The impulse of the impact between the fuel and the cell wall is maximized by assuming the fuel lumped mass to be rigid. The stiffness of the impacted surfaces (the cell wall) is likewise overestimated by assuming that it is defined by a circular plate of the cell wall's thickness fixed at its periphery. In order to demonstrate that the five lumped mass model employed by the computer code DYNARACK conservatively predicts the maximum fuel-to-cell impact loads, the applicant performed a series of DYNARACK simulations in which the stiffness properties of the stored fuel varied from infinitely flexible (i.e., zero bending stiffness) to essentially rigid. The stiffness properties of the stored fuel are incorporated into the lumped mass model by introducing two linear springs (one each in x and y directions) between each pair of adjacent fuel masses. Twelve DYNARACK simulations were performed in which the stiffness values assigned to the springs varied from a minimum of 10 lbf/in. (1.75 kN/meter [m]) to 107 lbf/in. (18.74 kN/m). The calculated estimate of the spring stiffness using the elastic properties of the fuel assembly is 340,000 lbf/in. (59.54 mega-newton [MN]/m). The results show that when the stored fuel assemblies are considered to be infinitely flexible, the maximum fuel-to-cell impact load is conservatively estimated (1774 lbf [7.89 kN]) compared to the solution corresponding to the calculated fuel assembly stiffness (1,452 lbf [6.46 kN]). However, the maximum impact loads at the top and bottom node locations were greater (1,251 lbf [5.565 kN]) for the case with a calculated fuel assembly stiffness compared to the case with an infinitely flexible fuel assembly stiffness (1,018 lbf [4.81 kN]). The higher impact load at the top/bottom fuel nodes is used for the fuel assembly qualification. There is an observed increase in the fuel-to-cell impact loads due to the resonance effect when the spring stiffness value is 1,000,000 lbf/in. (175.1 MN/m). The calculated stiffness used as an input to the DYNARACK model is verified by comparing the first mode frequency of the lumped mass model with the natural frequency of the ABWR fuel assembly that is considered to be a simply supported beam. The frequency of the five lumped mass model is 5.827 Hertz (Hz) compared to the frequency of 5.438 Hz for the simply supported beam. These results also compare favorably to physical test measurements of a BWR fuel assembly, which yielded a natural frequency of approximately 4.8 Hz. The observed resonance effect is not considered credible, because it occurs when fuel assembly stiffness is roughly three times the calculated spring stiffness value.

The staff reviewed the applicant's response and found it acceptable. The applicant appropriately included in the five lumped mass DYNARACK model the effect of fuel assembly stiffness properties for calculation of impact loads, and used the results in the fuel assembly evaluation. The staff also considers that the calculated stiffness of the fuel assembly used in the DYNARACK model may be regarded as an upper-bound value, because it yields the highest natural frequency when compared with the natural frequency of the fuel assembly treated as a simply supported beam and the natural frequency value from physical test measurements. Based on this finding, the staff agrees with the applicant that the resonant effect on impact loads that is observed at

higher spring stiffness values of the fuel assembly needs to be considered. The staff also reviewed the markup of the TR the applicant provided with the response. The staff found that the markup adequately addresses the modeling issues discussed above and is therefore acceptable. The proposed change to the TR is incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-60, is resolved and closed.

(III).2 Rack to Rack Impact

Item 6 of Attachment 5, "Spent Fuel Rack (SFR) Issue Resolution Sheets," to the supplemental TR includes a markup of TR Section 6.7.6, "Rack-to-Rack and Rack-to-Wall Impacts," which describes an evaluation of the rack-to-rack impact during a seismic event. The maximum impact load at the top from all of the runs is 188,870 lbf (840.1 kN). The impact force time history is obtained from the WPMR analysis and multiplied by a factor of three, so that it has a peak value of 557 kilopound force (kips) (2,478 kN). The force is applied to the back surface of the rigid impactor as a uniform pressure across the full width. The ability of the rack to withstand the maximum rack-to-rack impact load is analyzed using the Holtec QA validated commercial finite element code LS-DYNA. The displacement time history of the impactor for the analyzed rack-to-rack top impact is presented in Figure 6.7.6, "Displacement Time History of the Impactor," which shows no sudden increase until 0.015 seconds when the impact force reaches 310 kips (1379 kN). The impact force at the onset of buckling is thus determined as 310 kips (1,379 kN), which is 1.64 times the maximum impact load of 188.8 kips (839.8 kN), thus exceeding the minimum required value of 1.5 per ASME Code Section III Appendix F, Section F-1331.5.

In RAI 09.01.02-49, the staff requested additional information. Item (2) of the RAI requested the applicant to provide the technical basis for the assumption of the uniform pressure across the full width of the rack. Additionally, the staff asked the applicant to explain why the impact force time history was amplified to have a peak value of 557 kips (2478 kN) and how the displacement time history of the impactor was computed. During the conducted from March 3 to 7, 2014 (ML14153A393), the staff reviewed the calculation of the impact spring constant for the rack-to-rack impact analysis. The staff noted that the spring constant was calculated with the assumption that the impact load is resisted only by the two perimeter cell walls over a depth that is equal to three times the cell inner dimension. The staff considered that this calculation may potentially underestimate the impact spring constant and the resulting calculated rack-to-rack impact load. The staff identified the issue in Item 7 of the audit report. The applicant proposed to perform two additional sensitivity runs in order to assess the sensitivity of the rack-to-rack impact load to the spring rate. Subsequently, the applicant's responses to in RAI 09.01.02-49 are dated July 7, 2014 (ML14196A117), addressed the staff's questions and are summarized below:

a) The impact load is applied across the full width of the rigid impactor when the DYNARACK solution indicates that both ends of the bumper bar (along the side of the rack at top) are in contact at the time that the maximum rack-to-rack impact occurs. The impact force time history is multiplied by a factor of three to demonstrate that the critical buckling load is at least 1.5 times the maximum predicted impact load. The displacement time history of the impactor is computed using LS-DYNA and is based on the geometry and strength properties of the rack and the impact force time history. The staff considers the applicant's

approach of applying the impact load as uniform pressure across the full width of the rack to be reasonable. Based on the DYNARACK simulation results, both ends of the bumper bar are in contact during the impact. The staff also finds that the applicant adequately clarified the application of the amplified impact load to the LS-DYNA model because the amplified load was large enough to demonstrate the occurrence of buckling, and the displacement time history included in the TR was computed from the results of the LS-DYNA analysis.

b) In order to assess the sensitivity of the rack-to-rack impact load to the spring rate, two additional sensitivity runs were performed. In the first run (Run No. 28), the spring rate was calculated with the assumption that the impact load is resisted by six cells (three per corner) over a depth that is equal to one-half of the rack width. The resulting spring rate is about 20 percent greater than the original spring rate. The resulting impact load increased by 6.2 percent to 200,540 lbf (891.8 kN). In the second sensitivity run (Run No. 29), the original spring rate was increased by 50 percent, which caused the impact load to increase by 11.5 percent to 210,480 lbf (936.3 kN). The results from these two runs show that the impact load is starting to plateau (i.e., the increase in impact load diminishes as the spring rate increases). The applicant also revised the critical buckling load estimate to a more precise value of 339,420 lbf (1,510 kN), which is more than 1.5 times the maximum impact load of 210,480 lbf (936.3 kN). The applicant updated TR Section 6.7.6 with the revised maximum impact load. Based on a review of the results of the sensitivity study performed by the applicant, the staff concludes that the applicant has adequately evaluated the rack-to-rack impact effects using a reasonable estimate of the impact spring rate. The impact force is expected to be shared primarily by the corner cells because of the rigidity of the bumper bars. Therefore, the staff considers it reasonable that the spring rate was determined by using three or four corner cell walls. This finding was also confirmed during the audit conducted from April 8, 2014, through April 9, 2014 (ML14203A241), of the applicant's presentation of the LS-DYNA animation results showing that buckling had occurred primarily in the corner cells.

Based on the above review, the staff finds the applicant's rack-to-rack impact evaluation acceptable because it adequately addressed the distribution of the impact load and the sensitivity of the impact load to the spring rate discussed above. These findings are consistent with the guidance of SRP Section 3.8.4, "Other Seismic Category I Structures," Appendix D. The proposed change to the TR is incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-49, Item (2) is resolved and closed.

(III).3 Evaluation of Fuel to Cell Wall Impact

Item 6 in Attachment 5, "Spent Fuel Rack (SFR) Issue Resolution Sheets," to the supplemental TR states that the design check of the cell wall for the fuel assembly impact load was performed by comparing the maximum calculated impact load obtained from the computer code DYNARACK with the limit load for an individual cell wall. The applicant also described the methodology for determining the plastic capacity of the cell wall. TR Section 6.7.5, "Storage Cell Deformation," states that the primary stresses in the cell wall under the lateral impact load from the rattling of the fuel assemblies remain in the elastic range, and plastic deformation of the cell wall from the rattling action was ruled out. The description of the analysis methodology described did not appear to be

consistent with the text in TR Section 6.7.5. Also, the effective width of the cell wall used to compute the plastic capacity of the cell wall was not clearly defined. In RAI 09.01.02-49 Item (1), the staff asked the applicant to explain the inconsistency identified above. The staff also asked the applicant: (a) to provide the assumed effective width of the cell wall and its basis; and (b) to explain how the stress limits in TR Section 6.2.3, "Stress Limits for the NF Structure," are satisfied; or (c) to provide the technical basis if the stress limits are not satisfied.

In its response to RAI 09.01.02-49 (ML14196A117), dated July 7, 2014, the applicant stated that the SFRs are designed and analyzed as Class 3 component supports per ASME Code Section III, Subsection NF, according to the guidance in Appendix D of SRP Section 3.8.4, "Other Seismic Category I Structures." As such, the rack cell structure is considered as a beam type member; and the stress limits for NF structures are only applied to the primary stresses on the cell's gross cross section. The fuel-to-cell impacts produce local stresses in the cell wall, which are not subject to the primary stress limits given in TR Section 6.2.3. In order to ensure that the fuel-to-cell wall impacts do not cause significant plastic deformation that may affect the sub-criticality of the stored fuel array, a limit analysis was performed to establish the maximum fuel-to-cell impact load that can be sustained without exceeding the ultimate moment capacity of the cell wall, while maintaining a factor of safety of two. The applicant also calculated the bending stress in the cell wall for the maximum predicted impact load of 1,774 lbf (7.89 kN) to be well below the minimum yield stress for the material. The applicant further stated in the response that a one-way beam strip with an effective width of 10 in. (25.4 cm) was considered for computing the bending stress and ultimate moment capacity of the cell wall, and the bending stress would remain below elastic limit even if the effective width of the cell wall is reduced to 6 in (15 cm). The applicant also provided a markup of TR Section 6.7.5, "Storage Cell Deformation," to clarify the technical basis for cell wall evaluations of impact loads.

The staff's evaluation determined that the fuel assembly is expected to impact the cell wall along a line rather than at a point during the rattling in a seismic event that considered the configuration of the fuel assembly and the cell. Therefore, using a six-in. (15-cm) effective width of the cell wall in a one-way beam strip to compute stresses in the cell wall is considered a reasonable assumption for the effective load distribution. Because the primary bending stress in the cell wall under the maximum lateral impact load from the rattling of the fuel assemblies remains below the yield strength of the cell wall material, there would not be any plastic deformation of the cell walls. Based on this review, the staff considers the applicant's evaluation of the cell wall against the rattling of fuel assemblies acceptable. The staff also reviewed the markup of TR Section 6.7.5 provided with the response and found it acceptable. The proposed change to the TR is incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-49, Item (1), is resolved and closed.

(III).4 Evaluation of Bearing Pressure on Pool Slab Due to Pedestal Impact Load

TR Section 6.9, "Qualification of the Bearing Pad and Bearing Pressure on the Pool Slab," evaluates the bearing pressure on the pool slab as a result of the impact from rack pedestals during a seismic event. Subsequently, in Item 6 of Attachment 5, "Spent Fuel Rack (SFR) Issue Resolution Sheets," to the supplemental TR, the applicant described the bearing plate as a shim plate under compression. However, the area

under the entire bearing plate is assumed for the computation of the bearing pressure on the pool slab. In RAI 09.01.02-49, Item (4) requested the applicant to provide the technical basis for assuming that the bearing plate applies a uniform bearing stress in the concrete over the entire bearing plate area.

In itsresponse to RAI 09.01.02-49 (ML14196A117), dated July 7, 2014, the applicant proposed to increase the bearing plate thickness from 2 in. (5.08 cm) to 2.5 in (6.35 cm); and to credit only the area under the 13-in. (33-cm) diameter circle of the bearing plate for computing the bearing stress on the concrete floor. The assumption of the 13-in (33-cm) diameter circle means that the pedestal force spreads laterally through the bearing plate at roughly a 50 degree angle. The calculated bearing stress is 3,880 pounds per square inch (psi) (26.75 megapascal [MPa]) compared to an allowable bearing stress of 4.760 psi (32.82 MPa) for the 4,000-psi (27.58-MPa) concrete using the provisions in American Concrete Institute (ACI) 349–97, "Code Requirements for Nuclear Safety Related Concrete Structures and Commentary." The calculated safety factor is 1.227. The applicant also provided a markup of TR Section 6.9 with the response.

The staff considers that a 50 degree dispersion of compressive load through stainless steel bearing plate material provides a reasonable distribution of the pedestal load through the plate. Because the calculated bearing stress in the concrete pool slab is below the corresponding allowable bearing pressure for concrete, the staff considers the applicant's evaluation of the bearing pressure on the pool slab acceptable. The staff also reviewed the markup of TR Section 6.9 provided with the response and found it acceptable. The proposed change to the TR is incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-49, Item (4), is resolved and closed.

The staff reviewed the response to the issue identified in RAI 09.01.02-49 Item (3) regarding the baseplate design check. The staff found the response acceptable because bending stresses in the baseplate are secondary and insignificant; and punching shear stress in the baseplate is addressed in the response to RAI 09.01.02-65, dated July 7, 2014, (ML14196A117). Also, the applicant has provided all necessary updates requested in Item (5) of RAI 09.01.02-49. The staff reviewed the updates, and confirmed that the proposed changes to the TR are incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-49 is resolved and closed.

(III).5 Mechanical Accident Evaluation

In TR Chapter 7, "Mechanical Accident Evaluation," the applicant provides information on the performance of the fuel racks under mechanical accident conditions using the energy balance method. Three postulated fuel assembly drop scenarios were considered in the evaluation (shallow drop, deep drop away from the support pedestal, and deep drop above the support pedestal). In Item 9 of Attachment 5 to the supplemental TR, the applicant provides additional details of the analysis, including the methods used to perform the calculations and the formulas used to evaluate the postulated fuel assembly drop scenarios.

During the review, the staff found that the three fuel assembly drop scenarios considered by the applicant were consistent with those the staff has traditionally accepted in previous licensing applications for the review of accidental fuel assembly drop events. However, the staff noted that the deep drop event away from the pedestal considered

the drop of the impactor (fuel assembly plus its handling tool) into an empty cell nearest the center of the rack, with no credit taken for the center support leg at the location. In RAI 09.01.02-51, the NRC requested the technical basis for not considering a deep drop case into a cell along the perimeter and half way between the supports. In RAI 09.01.02-52, the NRC requested the derivation of the equations used for the deep drop scenarios. Subsequently, during the audit conducted from March 3, 2014, through March 7, 2014, (ML14153A393), in Holtec's office in Marlton, New Jersey, the staff reviewed the calculations supporting the mechanical accident evaluation. The staff confirmed that the formulations described in the TR for calculating the incident impact velocity in the shallow and deep drop scenarios were appropriately implemented using conservative assumptions. However, the staff identified several concerns about the technical adequacy of the assumptions made for the derivation of the equations used in the energy balance method, as identified in Item 11 of the audit report. To address the issue, the applicant proposed to change the method of the analysis and use the LS-DYNA model to evaluate the performance of the fuel storage racks under mechanical accident conditions. In its response to RAI 09.01.02-51 (ML14196A084), dated July 10, 2014, the applicant submitted the revised TR Chapter 7 with details of the LS-DYNA analyses and results for the fuel assembly drop accident events. The staff reviewed the various elements of the applicant's finite element analysis (FEA), including the fuel assembly drop scenarios considered; the acceptance criteria established for the fuel drop events; the finite element model (FEM) with the key input data and the material properties used; and the results of the analysis. The staff's review of the new LS-DYNA model and the results is discussed in the following paragraphs.

Fuel Assembly Drop Scenarios:

The applicant revised the fuel assembly drop scenarios considered in the analysis of the July 10, 2014, response to RAI 09.01.02-51 and considered the following scenarios:

Shallow Drop Scenario: For the shallow drop, the impactor (i.e., a fuel assembly plus its handling tool) is assumed to drop vertically and strike the top edge of a single cell wall near the center of the rack. Because the perimeter cells are reinforced by the bumper bars, the staff finds this to be the most critical scenario for the shallow drop and therefore acceptable.

Deep Drop Scenario 1: For this drop scenario, the impactor strikes the rack baseplate at a perimeter cell location midway between the support pedestals, where the baseplate is the most flexible. The staff considers this scenario to represent the worst drop configuration, because it produces a maximum deformation of the baseplate. This scenario is therefore acceptable.

Deep Drop Scenario 2: For this drop scenario, the impactor impacts the rack baseplate directly above the support pedestal. The staff finds this scenario acceptable, because it will transmit the maximum impact force to the reinforced concrete slab through the pool liner.

Finite Element Analysis using LS-DYNA:

LS-DYNA is a nonlinear, explicit, three–dimensional, finite element code used to numerically simulate dynamic impact events. It has been independently subjected to QA

validation by Holtec. This analytical methodology is widely used in the industry and has been applied by Holtec to drop analyses for numerous wet storage projects approved by the NRC. Based on the above information, the staff considers the use of the LS-DYNA program acceptable for the FEA of the postulated fuel drop accidents.

Acceptance Criteria:

Shallow Drop: The fuel rack module includes a crush zone that is defined as the region from the top of the rack to the top of neutron absorber. The crush zone provides the sacrificial material that serves no criticality function. The depth of the damage is considered to be the distance from the top of the rack to the lowest point on the impacted cell wall, where the plastic strain diminishes to zero. By ensuring that the neutron absorber panels reside fully in the elastic region of the rack, the induced strains in the panels are guaranteed to be less than the elastic strain limit of the cell walls (approximately 0.1 percent), which is one-tenth of the minimum elongation of the Metamic per Holtec Report HI-2043215, "Sourcebook for Metamic Performance Assessment," Revision 3. It is a requirement that the depth of the damage must not extend beyond the crush zone. The staff reviewed the acceptance criteria used by the applicant for the shallow drop event and noted that the depth of the damage is defined as the distance from the top of the rack to the lowest point on the impacted cell, where the plastic strain diminishes to zero; and the neutron absorbers reside outside the depth of the damage within the elastic region of the cell wall (strain limit of 0.1 percent). Because the Metamic panels are not structurally attached to the cell walls, the consequent strain in the Metamic panels would be less than the elastic strain limit of 0.1 percent of the cell walls, which is significantly less than the minimum elongation of the Metamic panels per the referenced Holtec Report HI-2043215. Therefore, the staff finds the acceptance criterion acceptable because the crush zone has sufficient sacrificial material to protect the Metamic plates from damage due to a shallow drop event.

Deep Drop Scenario 1: The rack structure is required to be sufficiently stiff so that the maximum lowering of the fuel assembly (d) in the impacted cell and the cells surrounding it must remain less than w, where w is the lesser of the distance from the bottom surface of the rack's baseplate to the top surface of the liner plate; and the active fuel assembly length can be lowered below the neutron absorber region without violating the reactivity limit for accident conditions. For the STP, Units 3 and 4, SFRs, w is limited to 6 in. (15 cm) based on the criticality analysis in TR Subsection 4.2.4.3, "Assembly Dropped Vertically into a Storage Cell." The factor of safety is defined as the ratio of w/d. The staff finds the acceptance criteria acceptable because it provides adequate protection to the pool floor and maintains the reactivity limits for accident conditions.

Deep Drop Scenario 2: The acceptance criterion for this drop scenario states that the impact must not result in the local failure of the liner plate, which leads to a potential leakage of SFP water or damage to the support pedestal.

Finite Element Model and Material Properties:

In TR Section 7.4.2, "Numerical Simulation," the applicant describes the solution process and modeling of the fuel rack for the postulated fuel assembly drop scenarios that were analyzed. The fuel assembly is modeled as a thin, rigid, shell that defines the enveloping size and shape with a rigid bottom end fitting and a lumped mass at the top.

The fuel rods are modeled as an elastic beam. Shell elements are used to model the thin cell walls and weld connections. The rack baseplate is modeled with thick shell elements, and the support pedestal components are modeled by solid elements. Other structural components such as the liner plate and the reinforced concrete slab are modeled using shell and solid elements, respectively. The staff's review finds that the elements used in the applicant's FEM are consistent with the guidance in the LS-DYNA user's manual. They are thus appropriate for simulating the behavior of the rack due to the impact load and are therefore acceptable.

The impact velocities of the impactor for underwater free fall conditions were calculated using the formula in TR Table 7.4.1, "Impact Event Data."

Material properties used in the analysis are in TR Table 7.3.2, "Material Properties." Since fuel handling occurs under normal conditions, material properties are based on the maximum pool temperature of 150 degrees Fahrenheit (°F) (65.56 degrees Celsius [°C]) per Subsection 9.1.2.1.5 of the ABWR DCD. The welding material properties are based on the engineering stress-strain relationship. The true stress-strain curve is used for the material properties of the cell wall and baseplate. The ultimate failure strain limit is 0.4 in/in. The staff finds that the material properties used by the applicant are based on ASME Code Section II Part D, plus other accepted engineering standards, and are therefore acceptable. The staff considers the use of true stress-strain curves for the cell walls and baseplate acceptable, because compatible finite elements are used in the LS-DYNA for these components of the fuel rack.

Analysis Results:

The results of the LS-DYNA analysis for the shallow drop show that the plastic deformation of the cell wall is confined in the crush zone. The maximum depth of the plastic strain (≥ 0.001 in/in) calculated from the rack top is 13.95 in. (35.43 cm), which is less than the maximum allowable crush zone depth of 14 in. (35.56 cm). The conclusion is that the Metamic panels are unharmed and the damage will not result in a criticality concern or unacceptable consequences.

For the deep drop away from the support pedestal, it is observed that the maximum vertical deflection of the baseplate in the impacted cell is 4.2 in. (10.67 cm). The allowable vertical deflection of the baseplate in the impacted cell is 6.0 in. (15 cm). Therefore, the pool liner will not be contacted by the deformed baseplate, and the deformation is within the limit considered in the criticality evaluation in TR Subsection 4.2.4.3, "Assembly Dropped Vertically into a Storage Cell." The factor of safety is greater than 1.0.

For the deep drop above the support pedestal, the results show that the maximum impact load on the pedestal is 628,560 lbf (2,796 kN); and the maximum compressive stress in the pedestal is about 44 kilo-pound per square inch (ksi) (303.4 MPa). The yield strength of the pedestal material is 106.3 ksi (732.9 MPa). The factor of safety is calculated to be 2.42. Also, the maximum bearing stress in the concrete underlying the pool liner plate is calculated to be 4,736 psi (32.65 MPa) and compared to an allowable bearing stress of 4,760 psi (32.82 MPa). Therefore, no damage to the pool liner plate or the reinforced concrete slab occurs due to the impact. Based on the above information,

the conclusion is that the structural integrity of the support pedestal; the pool liner plate; and the reinforced concrete slab is not compromised by the impact.

Based on the above review of the LS-DYNA analysis, the staff concludes that the design of the fuel storage rack modules is adequate to withstand the effects of postulated fuel assembly drop accidents and will maintain the functional integrity of the racks.

The proposed revision to TR Section 7, "Mechanical Accident Evaluation," is incorporated into Revision 2 of the TR (ML14199A604). RAI 09.01.02-51 is resolved and closed because the applicant has adequately addressed the issue of the deep drop scenario away from the pedestal, by considering the drop at the most critical location and by revising the TR accordingly. RAI 09.01.02-52 is also resolved and closed because the applicant did not use the energy balance method for the postulated fuel assembly drop accident cases. Therefore, the subject of the RAI is no longer applicable.

(IV) Loads and Load Combinations

In TR Section 6.2, "Acceptance Criteria Applicable to the Fuel Racks and their Contents," the applicant describes the loads and load combinations used for the analysis and design of the fuel storage racks. TR Table 6.1.1, "Load Combinations and Acceptance Limits," provides the load combinations corresponding to the applicable service level limits. The applicable loads and their combinations are excerpted from SRP Section 3.8.4, "Other Seismic Category I Structures," Appendix D. Dead load, live load, thermal loads, seismic load, stuck fuel assembly load, and load caused by an accidental fuel assembly drop of the heaviest load from the maximum possible height are identified as the various components of the loads that were considered. However, live loads and thermal loads were not considered in the analysis since there are no moving objects in the rack load path; and the fuel racks experience minimal stresses from differential thermal expansions because of water submergence and the freestanding disposition.

The staff reviewed the loads and load combinations used by the applicant for the analysis and design of the racks. The staff found them acceptable because they are consistent with the criteria in SRP Section 3.8.4, Appendix D. The staff reviewed the dead weights of the rack and fuel assemblies in TR Subsection 6.7.3.1, "Primary Stresses under Dead Load Conditions," and found them to be appropriate. The racks are conservatively assumed to be 100 percent full with fuel assemblies. The staff agrees with the applicant that thermal stresses in the rack due to differential thermal expansions during normal plant operation and accident conditions are insignificant compared to stresses in the rack from design-basis seismic loads. Because of the freestanding disposition of the racks, the rocking motion during a seismic event would cause a momentary lift off of the rack pedestals, thus relieving the restraint of the thermal expansion. However, the applicant performed an additional evaluation of the thermal effect in TR Subsection 6.7.3.2, "Analysis of Thermal Effects," to address the differential heating effect between a full and an empty cell in accordance with the guidance in SRP Section 3.8.4, Appendix D. The stuck fuel assembly loads and the loads resulting from fuel assembly drop accident events are in accordance with those specified in STP, Units 3 and 4, FSAR Subsection 9.1.2.3.2, "Structural Design and Material Compatibility Requirements." The loads and load combinations that were used also conform to those in STP, Units 3 and 4, FSAR Subsection 9.1.2.1.3, "Mechanical

and Structural Design." Based on the above information, the staff concludes that the loads and load combinations used by the applicant for the analysis and design of the fuel storage racks are acceptable.

(V) Design and Analysis Procedures

TR Chapter 6, "Structural/Seismic Evaluation," describes the various aspects of the procedures for the design and analysis of the fuel storage racks. TR Chapter 7, "Mechanical Accident Evaluation," describes the performance of the fuel storage racks under mechanical accident conditions. The staff's evaluation of the racks under mechanical accident conditions is included in Subsection 9.1.2.4.6.2 (III).5, "Mechanical Accident Evaluation," of this SER.

The STP fuel storage racks are designed for the storage and structural protection of new and spent fuel assemblies. The TR classifies the storage racks as Seismic Category I structures. The storage racks are made of stainless steel material and are designed by analysis to meet the requirements of ASME Code Section III Division 1, Subsection NF, for Class 3 linear type supports. The classification of the fuel storage racks as Seismic Category I, and the approach to design the racks by analysis based on ASME B&PV Code Section III Division 1, Subsection NF, Class 3 component supports are consistent with RG 1.29 and with the guidance in Appendix D to SRP Section 3.8.4. On this basis, the staff concludes that the classification and design by analysis approach for the fuel storage racks in the TR are acceptable.

TR Table 6.1.1 provides the postulated load combinations and the corresponding Service Limits for design of the fuel storage racks. In addition to the three Service Limits (Level A, Level B, and Level D), the racks are designed to maintain functional capability for accidental fuel drop events. The postulated load combinations and the corresponding Service Limits are consistent with the guidance in Appendix D to SRP Section 3.8.4 and are therefore acceptable. The staff's evaluation of the design and analytical procedures for the various Levels of Service Limits is discussed in the following paragraphs.

(V).1 Level A Service Limits

Level A Service Limits apply to load combinations including dead load, live load, and differential temperature-induced loads based on the most critical transient or steady-state conditions under normal operation or shutdown conditions. Live loads are not considered applicable, because there are no moving objects in the rack load path. Thermal loads are also considered to be insignificant because of the submergence and freestanding disposition of the racks. In TR Subsection 6.7.3.1, "Primary Stresses under Dead Load Conditions," the applicant states that the dead load is not a governing condition for the rack modules because of their honeycomb construction. The applicant also compares the load on a pedestal from dead load as being only 11 percent of the loads on a pedestal resulting from an SSE loading condition, while the Level A allowable stress limits equal or exceed 50 percent of the Level D limits. The applicant concludes that the SSE load condition bounds the dead load condition. The applicant did not perform any explicit evaluation of stresses in the rack as a result of handling the racks during installation. The staff agrees with the applicant that stresses in the racks due to dead loads and thermal loads would not be significant compared to stresses from

seismic loads because of the honeycomb construction and the freestanding disposition of the racks. The staff also considers stresses in the racks from handling during installation to be minimal because of the configuration of the rack structure. Therefore, the staff concludes that no explicit evaluation for dead load, thermal load, or loads from handling the racks is needed.

In TR Subsection 6.7.3.2, "Analysis of Thermal Effects," the applicant includes an analysis of a special case of the adverse thermal stress field that may develop in the pool to ensure safety from weld failure in the cellular region of the racks. In TR Section 6.2.2, "Rack Acceptance Criteria," the applicant states that the worst thermal stress field in a fuel rack is obtained when an isolated storage location has a fuel assembly generating heat, at a maximum postulated rate and surrounding storage locations that contain no fuel. However, the staff noted that the maximum temperature gradient was based on the results of the thermal hydraulic analysis in TR Chapter 5, "Thermal-Hydraulic Evaluation," that used the local cell maximum temperature (185 °F [85 °C]); the corresponding bulk pool temperature (150.8 °F [66 °C]); and a bounding temperature gradient value of 50 °F (27.78 °C). The maximum bulk pool temperature assumes that all rack storage locations are occupied and not empty. In RAI 09.01.02-39, the NRC requested the applicant to provide additional details. In Item (b) of the RAI, the applicant was asked to describe the basis for the 50 °F (27.28 °C) temperature differential used in the calculation. The staff also noted that the calculation of stress in the weld considered a continuous weld between the cell walls, and not the intermittent weld used in the design of the racks.

In its response to RAI 09.01.02-49 (ML14196A117), dated July 7, 2014, the applicant explained that the calculations described in TR Chapter 5, "Thermal-Hydraulic Evaluation," do not include a scenario with a maximum heat fuel assembly surrounded by empty cells, because such a scenario would not yield the maximum local temperature. The maximum local water temperature is computed based on the maximum bulk water temperature assuming that all spent fuel storage location racks are occupied. The difference between the local and bulk water temperatures provides a reasonable estimate for the temperature gradient between an empty cell location and a loaded cell. This is because the local water temperature increases/decreases commensurately with the bulk water temperature, as the total heat load in the SFP rises/falls. Per TR Table 5.5.1, "Summary of Local Temperature Results," the maximum calculated local water temperature is 185 °F (85 °C). The corresponding bulk water temperature for the same heat load conditions is 150.8 °F (66 °C). Thus, the difference between the local and bulk water temperatures is 34.2 °F (19 °C). To insure that the results of the analysis are conservative, a bounding temperature gradient of 50 °F (27.78 °C) is used in the evaluation. The applicant also revised the weld calculation conservatively by assuming that only a 6-in. (15 cm) length of the weld carries the stress from the differential thermal growth of an individual cell. The staff considers the basis for the assumed thermal gradient provided by the applicant acceptable, since it is based on the thermal hydraulic analysis for the most severe differential thermal conditions with a significant margin. The staff also notes that a thermal gradient of 50 °F (27.78 °C) is traditionally used in other licensing applications for the evaluation of an isolated hot cell. The staff also found the calculation of weld stresses to be conservative and therefore acceptable. The staff also reviewed the markup of the TR provided by the applicant and found it to be consistent with the response and therefore acceptable. The proposed

change to the TR is subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-39, Item (b), is resolved and closed.

(V).2 Level B Service Limits

Level B Service Limits apply to dead load, thermal loads, and the upward force on the racks caused by a postulated stuck fuel assembly. The applicant added Section 6.10, "Stuck Fuel Assembly Evaluation," in Item 3 of Attachment 5, "Spent Fuel Rack (SFR) Issue Resolution Sheets," to the supplemental TR to describe the evaluation of the racks due to loads from a postulated stuck fuel assembly. The racks were analyzed using the strength of the materials formula for a bounding vertical pull force of 17.9 kN (4,024 lbf), plus a horizontal pull force of 4.45 kN (1,000 lbf) applied simultaneously, with the results reported in the TR. Effects due to dead load and thermal loads are not included in the evaluation. This is considered acceptable since effects due to dead load and thermal load are not significant. The staff reviewed the applicant's analysis and the results and found them acceptable, because the postulated loads from a stuck fuel assembly assumed in the analysis are the same as those specified in ABWR DCD Subsection 9.1.2.3.2, "Structural Design and Material Compatibility Requirements," and the calculated stresses are less than the more conservative allowable stresses for Level A Service Limits.

(V).3 Level D Service Limits

Level D Service Limits apply to the evaluation of racks for dead load, live load, differential temperature-induced loads based on postulated abnormal design conditions, and SSE-induced loads. TR Sections 6.4, "Dynamic Analysis Methodology," through 6.7, "Compliance with the Acceptance Criteria under the Seismic Loads," describe the analysis and design of the racks for Level D loads. As discussed in Subsection 9.1.2.4.6.2 (IV), "Loads and Load Combinations," of this SER, live load and thermal loads are not considered for Level D load combinations. This is determined to be acceptable to the staff. The Staff's evaluation of the analysis and design of the racks for Level D loads is described in the following paragraphs.

(V).3.1 Dynamic Model

The seismic response of the freestanding fuel storage rack modules is highly nonlinear and involves a complex combination of motions (sliding, rocking, twisting, and turning) resulting in impacts and friction effects. The applicant used a proprietary computer program DYNARACK for the analysis and design of the racks for Level D load combinations. The fuel rack structure motion under the SSE is captured by modeling each storage rack as a 12 degree-of-freedom structure. The movement of the rack cross-section at any height is described by six degrees of freedom at the rack's base and six degrees of freedom at the top. Six beam springs are introduced to couple the rack's degrees of freedom and to simulate rack stiffness. The model for each rack is considered to be supported at the base level on five pedestals. Pedestals are modeled by nonlinear compression-only gap elements in the vertical direction and as rigid links for transferring horizontal stress. Each pedestal support is linked to the bearing pad by two piecewise linear friction spring elements. These springs are properly located with respect to the centerline of the rack beam, and allow for arbitrary rocking and sliding motions. Local pedestal vertical spring stiffness accounts for the floor elasticity and for

local rack elasticity just above the pedestal. Fuel assemblies within the rack are modeled by five lumped masses along the height of the rack. Each lumped mass has two horizontal degrees of freedom. Four compression-only springs with gaps are provided at each fuel mass to simulate the potential impact between the cell walls of the rack and the contained fuel. The possible incidence of a rack-to-wall or rack-to-rack impact is simulated by spring and gap elements at the top and bottom of the rack at each corner in two horizontal directions. Fluid coupling between the rack and the fuel assemblies, between adjacent racks, and between the rack and wall is simulated by appropriate inertial coupling in the system's kinetic energy. All seven racks are analyzed in a three dimensional WPMR model applying the acceleration time histories for the pool slab in three directions simultaneously, while performing a direct integration of the nonlinear equations of motion.

The staff reviewed the basic features of the dynamic model used for simulating the behavior of the racks under seismic excitation. The staff considers the simplified model used by the applicant to incorporate the key attributes of the actual structure. The stick model representation of the rack is considered adequate for predicting the dynamic response of the rack structure because the natural frequency of the rack, which is based on its mass and geometric properties, is approximately equal to the cut-off frequency of the input response spectra; and the rack cellular structure behaves as essentially rigid. Lumped mass modeling of the fuel assembly is considered adequate for predicting the dynamic response of the rack with the fuel assembly in it, since it includes the entire fuel assembly mass in the model. The staff, however, identified a concern that modeling the fuel assembly as uncoupled masses may not result in a conservative estimate of the impact loads on the fuel assembly. The issue is discussed in Subsection 9.1.2.4.6.2 (III).1, "Modeling of Fuel Assembly," of this SER. The contribution of the fluid forces on racks is considered in the analysis by including fluid coupling effects. Derivation of the fluid coupling matrix relies on the classical inviscid fluid mechanics principles, and the fluid coupling coefficients are calculated using an accepted engineering method such as R. J. Fritz ("The Effect of Liquids on the Dynamic Motions of Immersed Solids," *Journal of Manufacturing Science and Engineering*, ASME 1972). Therefore, the staff concludes that the methodology of including the fluid coupling effects in the dynamic model by the applicant is acceptable. During the audit conducted from March 3, 2014, through March 7, 2014, (ML14153A393), the staff reviewed the methodologies for determining various spring constants used in the DYNARACK model. Based on this review, the staff finds that the various springs, nonlinear gap elements, and the friction springs used in the WPMR model provide a reasonable mathematical model for predicting the kinematic behavior of the racks under an SSE. The staff, however, identified an issue with the calculation of the spring constant for simulating the rack-to-rack impact. This issue is discussed in Subsection 9.1.2.4.6.2 (III).2, "Rack to Rack Impact," of this SER. Based on the above information, the staff considers the dynamic modeling of the fuel racks acceptable.

(V).3.2 Analysis Procedure

The applicant uses of the Holtec proprietary program DYNARACK for the seismic analysis and design of the fuel storage racks. A nonlinear time history of the racks is performed using the input acceleration time history at the pool level. The numerical solution is obtained by direct integration of the nonlinear equations of motion using a central difference scheme built into the DYNARACK program. Sensitivity runs are

performed to verify the solution convergence. The analytical procedure using DYNARACK was used in earlier license applications by Holtec and is accepted by the NRC. Validation of the DYNARACK program for this application is discussed in Subsection 9.1.2.4.6.2 (VIII), "Validation of Computer Programs," of this SER. The use of a nonlinear dynamic time history analysis is considered to be appropriate for predicting the response of freestanding fuel racks involving a complex combination of motions and is consistent with the guidance in SRP Section 3.8.4, "Other Seismic Category I Structures," Appendix D. Also, numerical solution of nonlinear equations of motion using a central difference scheme with checks for solution convergence is an accepted engineering approach. Based on this information, the staff finds the analytical procedure used by the applicant acceptable.

Input acceleration time histories are developed to match the SSE floor response spectra (target spectra) shown in Figures 3A-161, "ABWR Reactor Bldg. Broadened (Env of all Cases) Node 100-Horizontal," and 3A-199 "ABWR Reactor Bldg. Broadened (Env of all Cases) Node 100-Vertical" of ABWR DCD. These response spectra are the horizontal and vertical envelope acceleration spectra for Node 100 of the ABWR RB stick model. The elevation of Node 100 is at an intermediate height between the SFP floor and top elevations and is close to the top elevation of the fuel racks. The staff considers the selection of the target spectra acceptable because the target spectra were selected as the SSE floor response spectra at the intermediate height between the SFP floor and top elevations, and they are conservatively applied at the base of the fuel racks.

Five sets of acceleration time histories were developed to match the target spectra in each of the three orthogonal directions: two horizontal and one vertical. Five sets of real recorded ground motions were chosen as the seed motions for spectral matching. Each of the five sets of time histories is checked for statistical independence. TR Section 6.5.2, "Modified Real Time-Histories," provides a description of the development of the five sets of time histories used as inputs to the DYNARACK program. The staff reviewed the development of the time histories described in the TR and found it to be consistent with the guidance in SRP Section 3.7.1, "Seismic Design Parameters," and therefore acceptable.

Analyses were performed for three values of coefficient of friction: 0.2, 0.5, and 0.8. The TR states that these values were chosen based on tests performed on austenitic stainless steel submerged in water. The staff has also traditionally used these values of coefficients of friction for analyses of submerged freestanding storage racks in other license applications. Based on the above information, the staff finds the range of coefficients of friction used in the analyses acceptable because it is consistent with the guidance in SRP Section 3.8.4, "Other Seismic Category I Structures," Appendix D.

(V).3.3 Dynamic Simulation

The applicant performed 15 basic DYNARACK runs of the WPMR model. The fully loaded racks are subjected to each of the five sets of acceleration time histories for each of the three coefficient of friction values using the integration time step of 5×10^{-5} seconds. Results from each run consist of the maximum stress factors, the maximum vertical and shear loads on each pedestal, and the maximum fuel to cell impact loads are tabulated in TR Table 6.6.1, "Load Combinations and Acceptance Limits," (Table 6.6.1b, "Maximum Values of Stress Factors and Impact Loads," in Revision 2 of the TR).

TR Table 6.6.2, “Maximum Values of Lateral Displacements,” shows the maximum values of lateral displacements of the racks at the baseplate and the top of the racks. Stress factors are calculated as the ratios of calculated stresses and the corresponding allowable stresses using the output from the DYNARACK analysis in a post-processor program. Based on the results from the 15 base runs, run number 11 (a fully loaded rack subjected to time history set 1 and a 0.8 coefficient of friction using the integration time step of 5×10^{-5} second) was chosen as the bounding case for subsequent sensitivity runs. The applicant then performed six additional sensitivity runs to incorporate the effects of parametric variations in the dynamic simulation results. These effects are from a maximum gap tolerance between racks, partially loaded and empty racks, variations in spring rates and rack beam stiffness by +/-20 percent, and reducing the integration time steps by a factor of 10. Results from all 21 runs were used to design the racks.

The staff reviewed the simulation runs performed by the applicant and determined that additional information was needed, as described below, to confirm that the simulations are adequate for predicting the dynamic response of the racks.

The staff noted that TR Table 6.6.2 includes very limited displacement data. In RAI 09.01.02-39 Item (e), the staff asked the applicant to expand the table to include the top-of-rack and baseplate displacements for all 21 cases analyzed, in order to assist the staff in its technical review. Furthermore, the staff noted that the maximum rack displacement relative to the floor of 4.7 in. (11.94 cm) is close to the minimum distance (5 in. [12.70 cm]) of the pedestal to the edge of the bearing pad, which occurs for run number 2 (fully loaded rack with a coefficient of friction 0.2, Set 2 seismic input, and 5×10^{-5} integration time step). However, there was no sensitivity run performed for this loading case to confirm that the rack displacements will be within the limits of the bearing pads for partial loading, empty rack, or reduced integration time steps. The staff communicated the concern to the applicant during a public meeting held on September 18, 2013, (ML13266A205). Subsequently, in Item 11 of Attachment 5 to the supplemental TR, the applicant revised Table 6.6.2 to include rack displacements for all 21 runs and also included the rack displacements for two additional sensitivity runs: run numbers 22 and 23. The staff noted that run number 22 is the same as run number 17 (partially loaded rack) but with a coefficient of friction 0.2 instead of 0.8; and run number 23 is the same as run number 2 but with a reduced time step. Since run number 2 has the largest displacement at the baseplate level, and partial loading may potentially yield a larger displacement, in RAI 09.01.02-54, the staff asked the applicant to conduct an additional analysis for run number 2 with partial loading. In its response to RAI 09.01.02-54, dated July 7, 2014, (ML14196A117), the applicant performed an additional WPMR run (run number 24), which is identical to run number 2 except that the racks are partially loaded. The staff reviewed the rack displacement results for the 3 sensitivity runs (run numbers 22, 23, and 24). The staff found that except for run number 23, for which the displacement at the baseplate level was slightly larger, all displacement results were enveloped by the initial 21 simulation runs performed by the applicant. The applicant also increased the size of the bearing pads to have a minimum edge distance of 5.5 in. (13.97 cm) from the pedestals. Based on the above information, the staff concluded that the applicant has performed sufficient simulation runs to predict the rack displacements, and there is reasonable assurance that the rack pedestals will remain within the perimeter of the bearing pads during a seismic event. The staff also reviewed

the markup of Table 6.6.2 provided with the July 7, 2014, response to RAI 09.01.02-66 (ML14196A117), and found it acceptable.

The applicant used an integration time step of 5 x 10^{-5} seconds for the 15 base simulation runs. Run number 11 was established as the basis for the sensitivity runs, because it is judged to be the most severe loading condition based on a review of the results of the 15 base runs. Run number 20, which is the same as run number 11, is performed with an integration time step of 5 x10^{-6} second to check the solution convergence. The staff noted that the maximum shear load on a single pedestal for run number 20 was approximately 9.5 percent larger compared to that for run number 11. The staff discussed the issue with the applicant during one of the weekly conference calls, and the applicant performed an additional simulation of run number 27 with a time step of 2.5 x 10^{-6}, in order to insure that the time step size is sufficiently small and achieves a solution convergence. The results of the convergence study from run numbers 11, 20, and 27 are included in the July 7, 2014, response to RAI 09.01.02-54 (ML14196A117), which show that even when the time step size is reduced by a factor of 10 and 20, the results agree within 10 percent. This finding indicates that the time step size of 5 x 10^{-5} seconds is sufficient to achieve a converged solution. Based on a review of convergence study results, the staff concludes that the integration of the time step size used by the applicant is adequate for predicting the response of the racks. Therefore, RAI 09.01.02-54 is resolved and closed.

Item 65 in Attachment 5 to the supplemental TR states that the areas between the racks and the SFP walls are likely to be partially occupied by other equipment, and establishes an exclusion zone of 7 in. (17.78 cm) around the perimeter of the racks based on maximum rack displacements to ensure that there are no impacts between the racks and the equipment stored around the racks. The staff noted that the applicant did not address the effect that the fluid gap reductions may have on the rack's structural response as a result of changes in the fluid coupling loads. In RAI 09.01.02-66**,** the staff requested the technical basis for assuming that fluid gap reductions from adding equipment has an insignificant effect on the rack's structural response. In its response to RAI 09.01.02-66, dated July 7, 2014 (ML14196A117), the applicant performed two additional WPMR simulation runs—run numbers 25 and 26—in which the rack-to-wall gaps were reduced to 7 in. (17.78 cm). Apart from a reduction in the rack-to-wall gaps, run number 25 is identical to run number 18 (which produced the maximum top-of-rack displacement), and run number 26 is identical to run number 19 (which produced the maximum stress factor). The results of the two additional runs show that all of the major parameters of interest decrease when the rack-to-wall gaps are reduced to 7 in (17.78 cm). Based on a review of the results of the two additional runs, the staff concludes that the applicant has provided an adequate technical basis for establishing the 7-in. (17.78-cm) exclusion zone. The applicant subsequently increased the exclusion zone to 11 in. (27.94 cm), in order to prevent the bearing pads from encroaching into the equipment storage area. The staff considers the applicant's response acceptable, because the rack responses were evaluated for the maximum rack-to-wall gaps as well as for the minimum gap of 7 in. (17.78 cm).

The response to RAI 09.01.02-66 included a markup of TR Section 6.6, "Dynamic Simulations," and TR Tables 6.6.1a, 6.6.1b, and 6.6.2. This response provided a comprehensive description and listing of all simulation runs performed by the applicant. Based on the review of the original 15 base runs (runs 1 through 15) and six sensitivity

runs (runs 16 through 21), additional six sensitivity runs (runs 22 through 27) to address the staff's concerns described above, and two simulation runs (runs 28 and 29) described in Subsection 9.1.2.4.6.2 (III).2, "Rack to Rack Impact," of this SER, the staff concludes that the applicant has performed sufficient dynamic simulation analyses of the fuel storage racks for a reasonable prediction of the response of the racks under the design-basis seismic event. The applicant also updated the TR appropriately to reflect the analyses that were performed. The proposed change to the TR was subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, the staff finds the dynamic simulations performed by the applicant acceptable. RAI 09.01.02-66 is resolved and closed.

(V).3.4 Rack Design

In TR Section 6.7, "Compliance with the Acceptance Criteria under the Seismic Loads," the applicant describes the various elements of design of the rack structure. The time history results from the DYNARACK solver provide the pedestal normal and lateral interface forces, which were converted to the limiting bending moment and shear force at the bottom baseplate-to-pedestal interface. Stress factors, which are computed stresses to their corresponding allowable values as defined in TR Subsection 6.2.3.2, "Dimensionless Stress Factors," were determined for the support pedestals and rack cell walls using the output forces from the DYNARACK solver in a post-processor program. Table 6.6.1b, "Maximum Values of Stress Factors and Impact Loads," provides the maximum calculated stress factors for the racks. Section 6.7, "Compliance with the Acceptance Criteria under the Seismic Loads," also describes the computation of stresses in the various welds and the pedestal thread shear stress. In addition, an evaluation of the potential for cell wall buckling is described in TR Section 6.7.10, "Potential for Cell Wall Buckling." An evaluation of the fuel assemblies for rattling loads is described in TR Section 6.7.1, "Fuel Rattling Loads." The applicant also provided additional information on various aspects of the design of the racks in the supplemental TR.

The staff reviewed the rack design information in the TR and the supplemental TR submitted by the applicant. The staff determined that additional information was needed to complete its evaluation as described in the following paragraphs.

<u>Weld Stresses and Stress Factors:</u>

Item 5 in Attachment 5, "Spent Fuel Rack (SFR) Issue Resolution Sheets," to the supplemental TR discusses an evaluation of cell-to-cell welds. Although the discussion provided a general description of the forces considered in the evaluation, it did not provide any descriptions of how the stresses in the weld were calculated. In RAI 09.01.02-48, the staff requested details of how the stresses in the cell-to-cell welds were determined, including explaining how the loads were transferred through the tie bars in a free-body diagram. Subsequently, the staff reviewed the supporting calculations for the cell-to-cell welds as well as the cell-to-baseplate welds and rack pedestal-to-baseplate welds during the audits held between February 4 - 5, 2014 (ML14057A649), at the Westinghouse Twinbrook office in Rockville, Maryland; and between March 3 - 7, 2014 (ML14153A393), at the Holtec office in Marlton, New Jersey. The staff reviewed the free-body diagram of forces used to evaluate the cell-to-cell welds and found it to be based on conservative assumptions. However, the staff noted that the shear stress

factors used to calculate the stresses in the cell-to-cell welds and cell-to-baseplate welds were based on full cross-sectional areas of the rack instead of the effective shear areas in the plane of loading, which is approximately half of the full cross-sectional area of the rack cellular structure. The staff discussed the issue with the applicant and the applicant revised the calculations of the shear stress factors for the rack cellular region, as well as the cell-to-cell and cell-to-baseplate weld stresses. In its response to RAI 09.01.02-48, dated July 7, 2014 (ML14196A117), the applicant provided a markup of Section 6.7.9, "Weld Stresses," Parts (a) and (c) of the TR and revisions to baseplate-to-rack cell welds and cell-to-cell welds. The staff found the response and the accompanying TR markup acceptable because it addressed the staff's concerns by re-evaluating the weld stresses by considering effective shear areas of the rack cellular region for the calculations of the weld stresses. Since the shear stress factors are small compared to the stress factors in the rack pedestals, the reported maximum stress factors in Table 6.6.1b, "Maximum Values of Stress Factors and Impact Loads," are not affected by the revised shear stress factors for the rack structure. The maximum stress factors reported are all less than one and are thus acceptable. The proposed change to the TR is incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-48 is resolved and closed.

During the audit conducted from March 3, 2014, through March 7, 2014 (ML14153A393), at the Holtec office in Marlton, New Jersey, the staff reviewed the supporting calculations for the baseplate-to-pedestal welds. The staff noted that the calculation of the weld stresses did not consider the stresses in the weld from the vertical load on the support pedestal. Because any gap between the support pedestal and the baseplate after welding the support pedestal to the baseplate may potentially transfer a significant vertical load through the weld, the staff asked the applicant during the audit to provide the technical basis for not considering any vertical load for the calculation of stresses in the weld. This concern was captured in Item 7 of the audit report (ML14153A393). In its response to a related question in RAI 09.01.02-61, dated July 7, 2014 (ML14196A117), the applicant explained that the vertical load was assumed to be transferred to the baseplate through metal to metal contact between the top of the support pedestal and the baseplate. The applicant also stated in the response that Holtec drawing 8946 has been revised to include a note that requires the female pedestal to be clamped in place before welding to maximize the contact with the baseplate. In addition, the top surface of the female pedestal is specified as having a machined surface to ensure that it is smooth and flat and with no gaps between the support pedestal and the baseplate after welding. The applicant also revised Section 2.6, "Rack Fabrication," to state that support pedestals are welded to the underside of the baseplate to maintain the metal to metal contact between the top of the pedestal and the baseplate. The staff finds the applicant's response and the markup of TR Section 2.6 provided with the response acceptable, because ensuring the metal to metal contact between the support pedestal and the baseplate would accomplish a transfer of the vertical load from the support pedestal to the baseplate through direct bearing, and stresses in the weld from the vertical load need not be considered. The proposed change to the TR is been incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-61 is resolved and closed.

<u>Buckling Evaluation for Cell Walls:</u>

In TR Section 6.7.10, "Potential for Cell Wall Buckling," which was later revised in Item 50 of Attachment 5 to the supplemental TR, the applicant provides the details of the

buckling evaluation of the rack cellular structure. The TR states that the highest potential for cell wall buckling is at the base of the cell along the perimeter of the rack, because under seismic loading the perimeter cell walls experience the maximum compressive stress from the axial load plus bending. Per TR Section 6.2.3, "Stress Limits for the "NF" Structure," the maximum compressive stress must not exceed two-thirds of the critical buckling load. In order to demonstrate compliance with this criterion, the applicant performed a finite element analysis of the most heavily loaded cell region that considered a 3 x 3 array of storage cells 4.875 in. (12.38 cm) high, at a rack corner location using the ANSYS computer program. The cell walls were assigned bi-linear elastic plastic material properties that are consistent with the strength properties of SA-240, Type 304 at 200 ºF (93.33 ºC). Maximum compressive stress on the outermost cell wall from the DYNARACK analysis was multiplied by a factor of 1.5 to determine the minimum required critical buckling stress. A uniform load of 170,000 lbf (756 kN), which exceeds the calculated minimum required critical buckling stress, is then applied over the top edges of the cells in the finite element model. To initiate buckling, a 1 lbf (4.448 N) was applied in the lateral direction at the center of each cell wall. The lateral displacement of the node showing a maximum displacement was plotted as a function of the applied load. Since the displacement plot is nearly linear, the applicant concluded that there is no onset of buckling even at 1.5 times the maximum compressive load, the cells remain in a stable configuration, and the compressive stress limit from TR Section 6.2.3 is met.

The staff reviewed the applicant's evaluation to ensure that the maximum compressive stress in the cell walls does not exceed two-thirds of the buckling load. The staff found the evaluation to be technically acceptable, because it demonstrated no onset of buckling in the cell walls at 1.5 times the maximum compressive stress in the cell walls. However, the staff noted that the top edges of the FEM were laterally restrained in the x and y directions. The applicant stated that above 4.875 in. (12.38 cm), the buckling potential is diminished as a result of the presence of the neutron absorber sheathing that is welded directly to the cell wall. The staff determined that the justification provided by the applicant for the assumed boundary conditions for the top edges of the FEM was adequate, but additional justifications were needed. Therefore, RAI 09.01.02-64 requested the technical basis for the boundary constraint assumed in the analysis, including the basis for assuming the integrity of the welding between the cell wall and the neutron absorber sheathing, because this weld was not evaluated as a structural weld in the TR. In its response to RAI 09.01.02-64, dated July 7, 2014 (ML14196A117), the applicant revised the FEM; increased the height of the model to 10 in. (25.4 cm); and repeated the analysis using the same boundary constraint for the top edges as before. The applicant stated in the response that the 10 in. (25.4 cm) length is sufficient to eliminate the effects from the imposed boundary conditions based on Article 9.5 of the text book "Theory of Elasticity," 2nd Edition, by Timoshenko and Goodire, where the critical buckling force for a rectangular plate simply supported along two opposite sides (and uniformly compressed in the direction parallel to those sides) is shown to be relatively constant for plates having a length to width ratio above 1.316. For the STP, Units 3 and 4, SFRs, the cell width is equal to 6 in. (15 cm). Therefore, the critical buckling load will not vary significantly for cell lengths greater than 1.316 x 6 = 7.896 in. (20.06 cm). For this reason, a cell length of 10 in. (25.4 cm) was chosen for the FEM. The staff reviewed the applicant's revised model and cited reference and concluded that the finite element model used in the analysis is adequate for predicting the buckling behavior of the rack, because the assumed boundary constraint will not have any

significant effect on the buckling load. The load displacement plot obtained from the revised analysis is also nearly linear with no apparent onset of buckling. Based on the above information, the staff finds the applicant's buckling evaluation and the markup of TR Section 6.7.10 provided with the response to RAI 09.01.02-64 acceptable. The proposed change to the TR is incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-64 is resolved and closed.

Fuel Assembly Integrity:

TR Section 6.7.1, "Fuel Rattling Loads," which was subsequently revised in Item 57 of Attachment 5 to the supplemental TR, provides an evaluation of the structural integrity of the stored fuel assemblies under an SSE event. The fuel assembly is simulated as five uncoupled lumped masses in the dynamic analysis with 25 percent of the mass at each of the three intermediate heights and 12.5 percent of the mass at the top and bottom. During the review, the staff noted that in Subsection 6.7.1.1, "Fuel Impact Loads," the applicant calculated the maximum g-load that the rack imparts onto the fuel assembly by dividing the maximum fuel-to-cell wall impact force of 1,774 lbf (7.89 kN) by 25 percent of the weight of the fuel assembly. However, the location of the assumed impact along the length of the fuel assembly was not clearly identified. In RAI 09.01.02-45, the staff requested additional information on where the maximum impact load occurs and to check the impact at both the top of the fuel assembly, as well as at an intermediate height to determine the maximum g-load, because only 12.5 percent of the mass is assumed at the ends of the fuel assembly. In its response to RAI 09.01.02-45, dated July 7, 2014 (ML14196A117), the applicant included a revised markup of TR Section 6.7.1 and the g-loads on the fuel assembly both at the top for the maximum impact load of 1,251 lbf (5.565 kN), and at an intermediate height for the maximum impact load of 1774 lbf (7.89 kN). The maximum g-load on the fuel assembly at the top is 14.83g compared to 10.51g at an intermediate height. Subsequently the higher g-load is used to evaluate the structural integrity of the fuel assembly. The staff found the response acceptable. The applicant determined the maximum g-load on the fuel assembly considering lumped mass locations both at the top and at the intermediate height, and used the maximum g-load for subsequent fuel assembly structural integrity evaluations.

In Subsection 6.7.1.2, "Fuel Acceptance Criteria," the applicant identified the acceptance criteria used for the evaluation as the fuel cladding yield stress; the fuel cladding strain; and the fuel spacer grid buckling. The applicant subsequently used the above acceptance criteria in the evaluation. The material properties for the fuel cladding are based on data from NUREG–1864, "A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant," which provides temperature-dependent mechanical properties for the zircaloy cladding material on high-burnup fuel. The critical buckling load for the 8 x 8 fuel spacer grid used for STP, Units 3 and 4, was determined based on Sandia Report SAND90-2406, "A Method for Determining the Spent-Fuel Contribution to Transport Cask Containment Requirements," which provides an analysis for predicting the onset of buckling for the BWR 7 x 7 fuel spacer grid, and accounts for the smaller cell size of the 8 x 8 fuel spacer grid. TR Subsection 6.7.1.3, "Buckling Evaluation of Fuel Spacer Grid," provides the buckling evaluation of the fuel spacer grid, and TR Subsection 6.7.1.4, "Stress/Strain Evaluation of Fuel Cladding," provides the stress/strain evaluation of fuel cladding. The staff reviewed the above evaluations and found them acceptable because they were performed using the basic strength of materials, principles, and accepted engineering standards and practices and meet the

previously described acceptance criteria. The applicant also calculated the bending stress in the fuel channel by obtaining an upper-bound estimate of the bending stress on the channel based on the maximum possible deflection of 0.52 in. (1.32 cm) of the channel inside a storage cell. The computed bending stress is significantly less than the yield strength of zircaloy. Based on the above information, the staff finds that the applicant adequately demonstrated that the stored fuel assembly inside the racks would maintain the structural integrity against rattling loads from a design-basis SSE. The applicant also appropriately updated the TR to reflect the performed analysis. The proposed change to the TR was subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-45 is resolved and closed.

Punching Shear Evaluation:

TR Subsection 6.7.11, "Punching Shear Analysis of Rack Baseplate," included in Item 51 of Attachment 5 to the supplemental TR of the punching shear evaluation of the baseplate against the rack pedestal impact loads. During the review, the staff noted that the calculation uses a punching shear area that is four times the length of one side of the female pedestal block; whereas for a corner pedestal, the effective punching shear area should be based on only 2 times the length of the female pedestal block. In RAI 09.01.02-65, the staff requested the applicant to provide the technical basis for using 4 times the length of one side of the pedestal block in the calculation for the shear area. In its response to RAI 09.01.02-65, dated July 7, 2014, (ML14196A117), the applicant corrected the anomaly and provided a markup of the revised TR Section 6.7.11. However, the results were not affected because only half of the thickness of the baseplate had been considered previously. The capacity of the baseplate against the punching shear is determined to be 624,024 lbf (2.776 MN), which is less than the maximum rack pedestal impact load of 515,000 lbf (2.291 MN). The staff finds the punching shear evaluation performed by the applicant and the markup of TR Section 6.7.11 provided with the response to RAI 09.01.02-65 to be acceptable, because the capacity of the baseplate against the punching is larger than the calculated rack pedestal impact load. The proposed change to the TR was subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-65 is resolved and closed.

Based on the above discussions, the staff concludes that the applicant used technically acceptable procedures for the analysis of fuel storage racks and performed an adequate design of the structure of the racks.

(VI) Structural Acceptance Criteria

In TR Section 6.2.2, "Rack Acceptance Criteria," the applicant states that the rack structures are designed to meet the requirements of ASME Code Section III Division 1, Subsection NF, for Class 3 linear type supports. Based on the configuration of the rack structure, the staff considers that the racks may be treated as linear structures. The staff finds the design requirements for the racks to be consistent with the guidance in SRP Section 3.8.4 Appendix D, and they are therefore acceptable. The principal elements of the structural acceptance criteria are discussed below.

Kinematic Criteria:

In TR Section 6.2.2(a), “Kinematic Criteria,” the applicant describes the kinematic criteria for the racks. In TR Section 6.7.2, “Kinematic Stability Determination,” the applicant describes the kinematic stability determination and states that the maximum rack displacements are small compared to the dimensions of the racks. Also, a large margin of safety exists against the rack overturning. Per TR Table 6.6.2, “Maximum Values of Lateral Displacements,” the maximum displacements of the racks are limited to 6.78 in. (17.22 cm) at the top and 4.72 in. (12 cm) at the baseplate elevation. In RAI 09.01.02-63, the staff asked the applicant to include the evaluation results for the rocking and uplift of the racks. In the revised TR Section 6.7.2 response to RAI 09.01.02-63, dated July 7, 2014 (ML14196A117), the applicant states that the maximum rocking angle of the racks is 2.17 degrees compared to the critical rocking angle of 29.2 degrees that may cause overturning. The staff’s review of TR Section 6.7.2 and the markup provided with the response to RAI 09.01.02-63 finds that the racks do not impact the pool walls during an SSE, and the racks are designed to withstand the impact with adjacent racks. Based on the above information, the staff finds that the sliding and tilting motions of the racks are consistent with the kinematic criteria in SRP Section 3.8.4, “Other Seismic Category I Structures,” Appendix D and are therefore acceptable. The proposed change to the TR was subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-63 is resolved and closed.

Code Stress Limits Criteria:

In TR Section 6.2.2(b), “Code Stress Limits under Different Service Conditions,” the applicant states that the stress limits under the postulated load combinations must be within the limits defined in ASME Code Section III, Subsection NF. The applicant provided the load combinations and acceptance limits in Table 6.1.1. The reference Code, the load combinations, and the acceptance limits that were used are consistent with Table 1, SRP Section 3.8.4, “Other Seismic Category I Structures,” Appendix D, and are therefore acceptable.

TR Section 6.2.3, “Stress Limits for the “NF” Structure,” provides the stress limits for the various Service Level conditions. TR Table 6.5.1, “Rack Material Data (200°F),” shows the material properties used to develop the stress limits for various Service Level conditions. The staff reviewed the stress limits used for Service Level A conditions and found them acceptable. They are consistent with those specified in ASME Code Section III, Subsection NF-3320. The applicant conservatively used Service Level A stress limits to evaluate Service Level B loading combinations, and that is acceptable.

The applicant used the increase factors for Service Level D stress limits following the criteria in ASME Code Section III Appendix F, Section F-1334, “Criteria for Linear Type Supports.” The applicant also identified the exceptions to the use of the general increase factors following the provisions in the subsections of Section F-1334.

During the review, the staff noted that the applicant did not specifically identify the exceptions to the use of general increase factors regarding tension and bending for the Level D condition. In RAI 09.01.02-44, the staff asked the applicant to include in the TR the stress limits for tension and bending for the Level D condition. In its response to RAI 09.01.02-44, dated July 7, 2014 (ML14196A117), the applicant provided the allowable Level D stress limits for axial tension and bending, which were consistent with the provisions of Appendix F, Section F-1334, and Section F-1334.1. The staff noted that

the provisions of Section F-1334 meet the additional criteria in Section F-1334.1 for axial tension and the materials used for rack fabrication. The applicant also provided the equation for the combined axial tension and bending following the provisions of Appendix F, Section F-1334.4(a), and the allowable stresses to be used in the equation for axial tension. The applicant also explained that because of the unusual geometry of the rack (non-compact section), the applicable Code Section for allowable bending stresses to be used for the combined axial tension and bending is Section F-1334.4(c), which requires that one of the two methods specified be used to determine the allowable bending stress. The applicant explains that the design meets the intent of Section F-1334.4(c)(2) regarding the allowable stress for bending, because a rigorous analysis of member stability was performed to demonstrate that the maximum compressive stress in the cells from combined bending plus the axial load is less than the critical buckling stress by at least a factor of 1.5. The applicant also provided a markup of TR Subsection 6.2.3.1.2, "Level D Service Limits," and stated that the allowable bending stress is conservatively set to 8,200 psi (56.54 MPa) based on the results of the analysis. The staff finds the applicant's response and the markup of the TR acceptable. The applicant included in the report the special provisions to be considered for the axial tension and bending following the criteria in ASME Code Section III Appendix F, Section F-1334.4. The proposed change to the TR was subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-44 is resolved and closed.

Bearing Pad Acceptance Criteria:

TR Section 6.3, "Acceptance Criteria for the Bearing Pads," states that the bearing pads must be adequately sized so that it is capable of safely diffusing the maximum vertical load from the rack pedestals into the concrete floor during a seismic event. The applicant established the maximum allowable bearing stress on concrete to be 4,760 psi (32.82 MPa) using the criteria in Section 10.14 of ACI 349–89. The staff's review finds that the applicant used the provisions of the ACI Code appropriately for determining the allowable bearing stress on concrete.

Fatigue Evaluation:

The applicant also provided the criteria and evaluation against fatigue failure. However, the staff did not review the applicant's fatigue evaluation because ASME Code Section III, Subsection NF, does not require a fatigue evaluation for Class 3 linear type supports.

Based on the above review, the staff concludes that the structural acceptance criteria identified by the applicant are acceptable. They are consistent with the guidance in SRP Section 3.8.4 Appendix D, and they meet the requirements of ASME Code Section III, Subsection NF and Appendix F.

(VII) Material, Quality Control, and Special Construction Techniques

The principal construction materials for the racks are stainless steel sheet and plate stock. SA564 Type 630 precipitation hardened the stainless steel bar that is used for the adjustable male pedestal support. Weld material used for the racks is ASME Type 308L. The only non-stainless steel material utilized in the racks is the neutron absorbing material, which is a patented boron carbide and aluminum metal matrix composite available under the product name Metamic. Although the neutron absorbing is attached

to the fuel rack structure, the material does not perform any structural function and is not considered a structural material. In TR Section 3.2, “Structural Materials,” the applicant identifies the structural materials used and states that they have been widely used in spent fuel racks for the past three decades without any report of degradation. Structural and welding material used for fabrication of the fuel storage racks are in accordance with the provisions of ASME Code Section III, Subsection NF, and are acceptable. Based on the extensive use of stainless steel material in addition to the Metamic panels, with no observed degradation in the SFP environment, the staff finds the structural materials used to be acceptable.

In Section 2.4, “Quality Assurance,” of the TR, the applicant states that the governing QA requirements for design and construction for the spent fuel storage racks are stated in 10CFR Part 50, Appendix B. Holtec’s Nuclear QAP complies with this regulation. The QA requirements identified by the applicant are consistent with the guidance in SRP Section 3.8.4, Appendix D, and considered to be acceptable.

In TR Section 2.6, “Rack Fabrication,” the applicant describes the manufacturing process; special fabrication techniques; and the sequences used for constructing the fuel storage racks to reduce fabrication distortions and to provide accessibility for inspection. The manufacturing process for the rack modules starts with the fabrication of the individual storage cell boxes, which are equipped with a stainless steel sheathing on each external face to hold the Metamic sheets. The composite box assemblies are joined together in a fixture using tie bars. The baseplate is attached to the bottom of the box assemblage by welding each cell and around the perimeter of the box assembly to select component connection sequences and welding the process to reduce fabrication distortions. The staff reviewed the fabrication details of the rack modules described by the applicant. The staff finds that the special construction techniques described by the applicant are sufficient and therefore acceptable.

(VIII) Validation of Computer Programs

During the review of the TR, the staff noted that the applicant did not provide sufficient information on the validation of computer codes used in the analyses. In RAI 09.01.02-62, the NRC requested the applicant to provide a list of the computer codes used and a description of the scope, use, and validation information.

During the audit conducted from March 3, 2014, through March 7, 2014 (ML14153A393), at the Holtec office in Marlton, New Jersey, the staff reviewed validation documentation for the computer codes used by the applicant. The staff used the SRP Acceptance Criterion II.4.F in Section 3.8.1 of NUREG–0800, as stated below:

(i) The computer program is recognized in the public domain and has had sufficient history of use to justify its applicability and validity without further demonstration,

(ii) The computer program’s solutions to a series of test problems have been demonstrated to be substantially identical to those obtained by a similar and independently written and recognized program in the public domain, and

(iii) The computer program's solutions to a series of test problems have been demonstrated to be substantially identical to those obtained from classical solutions or from accepted experimental tests or to analytical results published in technical literature.

The staff's review of the validation documentation of the computer programs used by the applicant for the analysis and design of the fuel storage racks is described in the following paragraphs.

EZ-FRISK software package is used to develop modified real recorded acceleration time histories from design-basis floor response spectra to be used in nonlinear time history analyses.

EZ-FRISK is a general purpose software package for performing site-specific earthquake analyses. The validation was achieved by comparing the response spectra generated from EZ-FRISK against the corresponding response spectra generated using SHAKE2000 (Version 7.7.0), and was validated under Holtec's QAP in Report HI-2135536, Revision 1, "Validation of EZ-FRISK Computer Code." The staff concluded that the EZ-FRISK software package is recognized in the public domain, commercially available, and has sufficient history of use; and therefore, it is in compliance with Item (i) of SRP Acceptance Criterion II.4.F in Section 3.8.1 of NUREG–0800.

DYNAMO/DYNARACK is used to perform three-dimensional, nonlinear time history analyses of freestanding SFRs under earthquake loading. DYNAMO is the Holtec proprietary computer code, which is also referred as DYNARACK in previous licensing applications. DYNAMO was developed to provide dynamic stability analyses of one or more empty or loaded spent fuel storage racks subject to known acceleration time-histories representing seismic events of a given duration. DYNAMO was validated under Holtec's QAP in Report HI-2114848, "QA Validation of DYNAMO Codes for Whole Pool Multi Rack Analysis"; hereafter called "DYNARACK." During the audit, the applicant made a presentation of DYNARACK computer program that included a history of use, the basis of the DYNARACK methodology, model program execution, and validation. DYNARACK originated in the late 1970s as a general purpose dynamic analysis code. Later, in 1979–1980, special subroutines were added to make it especially adaptable for simulations of fuel rack structures. Since that time, Holtec has used it in more than 1,000 dynamic simulations of freestanding fuel rack structures. Holtec has provided thousands of storage cells of this design to various nuclear power plants around the world, which may set a precedent for this application. The DYNARACK rack cellular structures are modeled as a beam member based on the guidance in SRP Section 3.8.4, "Other Seismic Category I Structures," Appendix D, which states that the "design, fabrication, and installation of spent fuel racks of stainless steel material may be performed based on ASME Code, Section III, Division 1, Subsection NF requirements for Class 3 component support." The solution method is based on a publication titled "The Component Element Method in Dynamics," by S. Levy and J. Wilkinson, dated June 1, 1976. The spring stiffnesses are based on the technical paper titled "Seismic Responses of Free Standing Fuel Rack Construction to 3-D Motions," by A. I. Soler and K. P. Singh, January, 1984. The entire DYNARACK model is comprised of 22 degrees of freedom to represent the dynamic behavior of each rack module.

The applicant provided a proprietary copy of HI-91700 Revision 1, “DYNARACK Validation Manual,” which provided a series of problems with known solutions compared against the DYNARACK results. Based on the review of this validation manual, the staff determined that the validation manual basically provided capabilities of the DYNARACK program only. Therefore, the staff was not able to accept HI-91700, Revision 1 as the validation document, which could be in compliance with any of the items of SRP Acceptance Criterion II.4.F in Section 3.8.1, “Concrete Containment,” of NUREG–0800.

The applicant referred to a letter to NRC from FirstEnergy Nuclear Operation Corporation (FENOC), dated May 10, 2010, for a NRC RAI response related to “Beaver Valley Power Station Unit No. 2 SFP Re-rack License Amendment Request,” (ML101460057) for benchmarking the DYNARACK simplified mass model against a detailed LS-DYNA FEM (for the Sizewell Nuclear Plant Rack in England) to demonstrate the adequacy to predict the anticipated accelerated time-history seismic responses. The LS-DYNA analysis was performed on a detailed freestanding SFR model in-air (no fluid effect) for simultaneously applying three orthogonal acceleration time-history inputs. The seismic attenuation factor (multiplier to earthquake accelerations) was applied to account for the effect of the pool water. During the audit, the applicant also provided two tables depicting: (1) a benchmark comparison that was previously performed between a 22 degree of freedom DYNARACK model and a detailed three-dimensional FEM created from LS-DYNA; and (2) how the seismic attenuation factor was determined. In summary, the first table compares the solutions of DYNARACK and LS-DYNA in-air with a coefficient of friction factor of 0.8 at the base, with an applied seismic attenuation factor of 0.45 for the DYNARACK model in-water, and provides DYNARACK results in-water for the same model subject to identical seismic inputs. The second table provides the methodology used to determine the attenuation factor of 0.45 by running several DYNARACK cases in-air, which would provide comparable results to the governing case in-water when the attenuation factor is applied to the same rack geometry and is subjected to identical seismic inputs for DYNARACK model in-air.

The staff reviewed the tabulated solutions with respect to the LS-DYNA and DYNARACK runs for the same geometry, which were subjected to the identical seismic input in-air and determined that the DYNARACK results in-air compared to the LS-DYNA results (larger rack displacements and fuel impact loads) in-air that are more conservative. The staff also concluded that the DYNARACK results in-water should produce more conservative results compared to the LS-DYNA results in-water and therefore DYNARACK is in compliance with Item (ii) of SRP Acceptance Criterion II.4.F in Section 3.8.1 of NUREG–0800.

Analysis System (ANSYS) is used to model the stresses in the pedestal-to-baseplate weld and to evaluate the potential for cell wall buckling. ANSYS is a general purpose, FEA program that is used to simulate interactions of physics and that are structural, vibrational, fluid dynamics, heat transfer, and electromagnetic for engineering problems. The validation was achieved by comparisons with the test cases in the ANSYS, Inc. verification manual and validated under the Holtec QAP HI-2012627 Revision 10, “QA Documentation Package for ANSYS, version 11.0 and higher.” The staff concluded that the ANSYS FEA program is recognized in the public domain, is commercially available, and has a sufficient history of use to determine that it is in compliance with Item (i) of SRP Acceptance Criterion II.4.F in Section 3.8.1 of NUREG–0800.

LS-DYNA is used to evaluate the capacity of the rack bumper bars to withstand rack-to-rack impact loads and to analyze fuel drop accidents. LS-DYNA is a general-purpose FEA program capable of simulating complex, real world problems. Validation was achieved under the Holtec QAP in Report HI-961519, Revision 7, "LS-DYNA QA Validation." The staff concluded that the LS-DYNA FEA program is recognized in the public domain, is commercially available, and has a sufficient history of use to determine that it is in compliance with Item (i) of SRP Acceptance Criterion II.4.F in Section 3.8.1 of NUREG–0800.

Mathcad Version 15, is used to perform miscellaneous stress calculations for the SFRs. Mathcad is a computer software program primarily intended for solving, analyzing, documenting, and re-using engineering calculations. The staff concluded that the Mathcad computer software program is recognized in the public domain, is commercially available, and has a sufficient history of use to determine that it is in compliance with Item (i) of SRP Acceptance Criterion II.4.F in Section 3.8.1 of NUREG–0800.

Based on the above review, the staff concludes that the computer codes used by the applicant for the analysis and design of the fuel storage racks have been validated by using the validation criteria for computer codes that are consistent with the SRP Acceptance Criterion II.4.F in Section 3.8.1 of NUREG–0800. The use of the above computer codes is therefore considered acceptable. The staff also reviewed the applicant's response to RAI 09.01.02-62 dated July 7, 2014 (ML14196A117), with the markup of a new TR Section 6.4.4, "Computer Codes," that includes the description and validation information of all of the computer programs the applicant used. The staff thus finds the response acceptable. The proposed change to the TR was subsequently incorporated into Revision 2 of the TR (ML14199A604). Therefore, RAI 09.01.02-62 is resolved and closed.

9.1.2.4.7 Spent Fuel Racks Thermal-Hydraulic Analysis

- COL License Information Item 9.8 Spent Fuel Racks Thermal-Hydraulic Analysis

COL License Information Item 9.8 (in COL FSAR Subsection 9.1.6.8, "Spent Fuel Racks Thermal-Hydraulic Analysis") requires the COL applicant to provide the NRC with a confirmatory thermal-hydraulic analysis that evaluates the rate of naturally circulated flow and the SFRs maximum water exit temperatures, as required by Subsection 9.1.2.1.4, "Thermal-Hydraulic Design." In its response to RAI 09.01.2-39, dated July 7, 2014 (ML14196A239), the applicant states that the Holtec International TR HI-2135462, Chapter 5, "Thermal-Hydraulic Evaluation," provides the required analyses. This report was incorporated by reference as shown in Table 1.6-2, "Additional Topical Reports Incorporated by Reference," of the COL FSAR. The report concludes that the SFP local temperature does not exceed 100 ºC (212 ºF) under any anticipated condition.

The staff reviewed the report, which describes a methodology previously evaluated by the NRC and found to be acceptable. The staff reviewed the inputs and assumptions of the analysis described in the report and found them acceptable and in accordance with the plant design. The staff concludes that the SFP rack design does provide sufficient flow area to preclude SFP water boiling, and the local temperature of the SFP does not exceed the temperature limit of 100 ºC (212 ºF) specified in Subsection 9.1.2.1.4 the ABWR DCD. Therefore, COL License Information Item 9.8 is considered complete. The July 7, 2014, response also proposed

changes to FSAR Subsections 9.1.2.1.4 and 9.1.6.8 to refer to the Holtec Report HI-2135462 with the completed thermal-hydraulic analysis. The staff confirmed that the proposed FSAR changes are incorporated in the FSAR Revision 11. Therefore, RAI 09.01.02-39 is resolved and closed..

9.1.2.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.1.2.6 *Conclusions*

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 relevant 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 new and spent fuel storage system that were incorporated by reference have been resolved.

In addition, the staff compared the standard departure, COL license information items, and additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.1.2 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the Tier 1 departure and demonstrated compliance with NRC regulations. The staff's review also confirmed that the applicant has adequately addressed the COL license information items in accordance with the relevant guidance in Section 9.1.2 of NUREG–0800. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

9.1.3 Fuel Pool Cooling and Cleanup

9.1.3.1 *Introduction*

This section of the FSAR addresses the system that removes the decay heat from the fuel pool, maintains pool water level and quality, and removes radioactive materials from the pool to minimize the release of radioactive materials into the environment.

9.1.3.2 *Summary of Application*

Section 9.1.3 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.1.3 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.1.3, the applicant provides the following:

Tier 1 Departure

- STD DEP T1 2.4-1 — Residual Heat Removal System and Spent Fuel Pool Cooling

This departure adds the capability to choose a third loop of residual heat removal (RHR) in the augmented fuel pool cooling (FPC) and fuel pool makeup modes. The connection of RHR Loop A to FPC increases the flexibility and redundancy of the spent FPC system.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.1-1 Update of Fuel Storage and Handling Equipment

This departure provides minor wording and design changes that make Section 9.1.3 in the COL FSAR only slightly different from the ABWR DCD. The major impact of this departure on Section 9.1.3 is one of clarity. With this departure, the COL FSAR now clearly states that the maximum capacity of the SFP is equal to 270 percent of the core load capacity, until the bounding heat load evaluation is revised.

COL License Information Items

- COL License Information Item 9.9 Spent Fuel Firewater Makeup Procedures and Training

This COL license information item concerns the spent fuel firewater makeup procedures and training. The applicant proposed to provide the required information with Commitment (COM) 9.1-5 before fuel loading.

- COL information item 9.10 Protection of RHR System Connections to FPC System

This COL license information item concerns the protection of RHR system connections to the FPC system. The applicant proposed to provide the required information with COM 9.1-6 before fuel loading.

9.1.3.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the FPC and cleanup, and the associated acceptance criteria, are given in Section 9.1.3 of NUREG-0800.

In addition, in accordance with Section VIII, “Processes for Changes and Departures,” of “Appendix A to Part 52-Design Certification Rule for the ABWR Design,” the applicant identifies Tier 1 and Tier 2 departures. Tier 1 departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2 departures not requiring 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.

In particular, the regulatory basis and review criteria for COL License Information Items 9.9 and 9.10 and the Tier 1 and Tier 2 departures described above as they relate to the FPC systems, are specified in Section 9.1.3 of NUREG–0800.

9.1.3.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.1.3 of the certified ABWR DCD. The staff reviewed Section 9.1.3 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departure

In general, Tier 1 Departure identified by the applicant in this section requires prior NRC approval in the form of an exemption and the full scope of their technical impact may be evaluated in the other sections (and chapters) of this SER. For more information, refer to COLA Part 7, Section 5.0, "Tables and Indexes," for a listing of all FSAR sections affected by this Tier 1 departure. 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 the SER.

- STD DEP T1 2.4-1 — Residual Heat Removal System and Spent Fuel Pool Cooling

The staff reviewed Departure STD DEP T1 2.4-1, which involves the connection of a third RHR system to the FPC system (the DCD only had two of the three RHR systems configured to allow a connection to the FPC system). This connection results in greater flexibility in operations, higher system reliability, and redundancy during emergencies. By allowing the potential of all three RHR systems to connect to the SFP, refueling operations can proceed at higher decay heat levels even when a single RHR system is unavailable. The staff found the proposed departure will improve plant safety. This departure is therefore acceptable.

Tier 2 Departure Not Requiring Prior NRC Approval

In general, Tier 2 Departures not requiring prior NRC approval identified by the applicant in this section may also be evaluated in other sections (and chapters) of this SER. For more information, refer to COLA Part 7, Section 5.0, "Tables and Indexes," for a listing of all FSAR sections affected by these departures.

- STD DEP 9.1-1 — Update of Fuel Storage and Handling Equipment

The staff reviewed Departure STD DEP 9.1-1, which inserts a number of editorial changes in FSAR Section 9.1.3 to clarify the language. The major impact of this departure on Section 9.1.3 is one of clarity. With this departure, the COL FSAR now clearly states that the maximum capacity of the SFP is equal to 270 percent of the core load capacity, until the bounding heat load evaluation is revised. Many of the changes in this departure impact other COL FSAR sections, and the changes are evaluated in the respective SER sections. The changes also make Tier 2 consistent with Tier 1.

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[1] 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 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 found it reasonable that the 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.

COL License Information Items

- COL License Information Item 9.9 Spent Fuel Firewater Makeup Procedures and Training

COL License Information Item 9.9 concerns the spent fuel firewater makeup procedures and training. The applicant established a commitment item (COM-9.1-5) stating that firewater makeup procedures and training will be in place and available onsite for inspection before fuel loading. The staff found this commitment acceptable.

- COL Information Item 9.10 Protection of RHR System Connections to FPC System

COL License Information Item 9.10 specifies that a confirmatory analysis needs to be performed to demonstrate that the RHR system connections to the FPC system are adequately protected from the effects of pipe whip, internal flooding, internally generated missiles, and a moderate energy pipe rupture in the vicinity. The applicant states that these protections cannot be accomplished until the plant is built and the as-built plant conditions are available for inspection. The applicant has proposed a commitment item (COM-9.1-6) to satisfy this COL license information item before fuel loading.

The staff determined that the applicant has not adequately addressed COL License Information Item 9.10. The staff issued RAI 09.01.03-01 requesting the applicant to justify why this COL license information item cannot be completed within the COLA review period or be addressed by a new inspections, tests, analyses, and acceptance criteria (ITAAC). In its response to RAI 09.01.03-01, dated June 12, 2008 (ML081710126), the applicant states that the staff will be notified (before the installation of RHR system components) of the availability of the design analysis that ensures the RHR system connections are adequately protected. The applicant commits to perform an as-built analysis that identifies as-built conditions in the vicinity of the RHR connections.

The staff acknowledges that the design of some pipe systems has not been finalized. Sections 3.6.1, "Postulated Piping Failures in Fluid Systems Inside and Outside of Containment (Related to RG 1.206, Section C.I.3.6.1, "Postulated Piping Failures in Fluid Systems Outside of Containment")," and 3.6.2, "Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping," of this SER evaluates the protection of all safety-related SSCs from pipe failures. In Section 3.6.1, a site-specific ITAAC has been created to evaluate the as-designed protections of safety-related SSCs against pipe failures. The protection of the RHR connections will be evaluated in the pipe break hazard analysis. The staff's evaluation of flood protection considerations for all SSCs is discussed in Section 3.4.1, "Flood Protection for Onsite Equipment Failure," of this SER. The staff's evaluation of internal missile protection for SSCs is discussed in Section 3.5.1, "Missile Selection," of this SER. The staff has already evaluated the methodology used in designing the SSCs protections from the effects of pipe whip, internal flood, internally-generated missiles, and a moderate energy pipe rupture.

The applicant's proposed commitment (COM 9.1-6) to notify the staff of the completion of the design analysis for the RHR connection protections and to complete an as-built evaluation of the conditions in the vicinity of the RHR connections will demonstrate that the new RHR system connections to FPC have been protected from the effects of pipe whip, internal flooding, internally-generated missiles, and a moderate pipe rupture following the approved methodology. Based on this evaluation, the staff found the applicant's response acceptable, and therefore, RAI 09.01.03-1 is resolved and closed.

9.1.3.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.1-5) – Provide the firewater makeup procedures and make them available onsite for inspection before fuel loading.
- Commitment (COM 9.1-6) – Describe an analysis ensuring that the RHR system connections are adequately protected from the effects of pipe whip, internal flooding, internally generated missiles, and a moderate energy pipe rupture in an FSAR amendment in accordance with 10 CFR 50.71(e) before fuel loading.

9.1.3.6 *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, 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 fuel pool cooling and cleanup system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.1.3 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information items and the identified Tier 1 departure in accordance with the relevant guidance in Section 9.1.3 of NUREG–0800, and found it 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. Thus, the staff finds that this information demonstrates compliance with NRC regulations. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

9.1.4 Light Load Handling System (Related to Refueling)

9.1.4.1 *Introduction*

This section of the FSAR addresses the light load handling system (LLHS). The LLHS consists of all components and equipment used for handling new fuel from the receiving station to loading spent fuel into the shipping cask. The objective of the LLHS review is to ensure criticality accidents, radioactivity releases from damage to irradiated fuel, and unacceptable personnel radiation exposures are avoided.

9.1.4.2 *Summary of Application*

Section 9.1.4 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.1.4 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In STP FSAR Section 9.1.4, the information in Section 9.1.4 of the certified ABWR DCD was subject to numerous design revisions. Therefore, for purposes of clarity, the applicant presents Section 9.1.4 of the certified ABWR DCD with the proposed changes in the COL FSAR. In addition, the applicant provides the following:

Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 16.3-25 LCO 3.9.1, Refueling Equipment Interlocks

This departure affects TS. In this departure, the applicant limits the Limiting Conditions of Operation (LCO) 3.9.1, "Refueling Equipment Interlocks," by stating that these interlocks are only applicable when the reactor mode switch is in the refueling position.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.1-1 Update of Fuel Storage and Handling Equipment

The applicable portion of this departure identifies updates to this section addressing refueling tools, deleting outdated equipment, and clarifying safety and seismic classifications for various pieces of equipment associated with light load handling. This departure also states that there are other specific text changes in FSAR Section 9.1.4.

COL License Information Items

- COL License Information Item 9.4 Spent Fuel Rack Load Drop Analysis

In FSAR Subsection 9.1.6.4, "Spent Fuel Racks Load Drop Analysis," the applicant provides additional information to address the SFR load drop analysis.

- COL License Information Item 9.5 New Fuel Inspection Stand Seismic Capability

In FSAR Subsection 9.1.6.5, "New Fuel Inspection Stand Seismic Capability," the applicant provides additional information to address the new fuel inspection stand seismic capability. The applicant adds that the fuel inspection "stand design elevates fuel bundles rather than personnel and is anchored in a refueling floor pit such that it cannot fall into the fuel pool during an SSE [safe-shutdown earthquake]."

- COL License Information Item 9.6 Overhead Load Handling System information

The applicant provides additional information in FSAR Subsection 9.1.6.6, "New Fuel Inspection Stand Seismic Capability," to address the provision of data and information related to the overhead heavy load handling (OHLH) systems. The applicant adds that the "information is either vendor specific and will be established following equipment procurement, or involves associated programs that will be developed as the equipment is procured." The applicant commits (COM 9.1-3) to provide appropriate descriptions on the OHLH system in an FSAR amendment in accordance with 10 CFR 50.71(e), before receiving fuel.

9.1.4.3 *Regulatory Basis*

The regulatory basis for the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the LLHS and the associated acceptance criteria are in Section 9.1.4 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures affecting 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 not requiring 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.

In addition, the regulatory basis and review criteria that the staff used for COL License Information Items 9.4, 9.5, and 9.6, are in Section 9.1.4 of NUREG–0800.

9.1.4.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.1.4 of the certified ABWR DCD. The staff reviewed Section 9.1.4 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR.

Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 16.3-25 LCO 3.9.1, Refueling Equipment Interlocks

This departure affects TS and is reviewed in Chapter 16, "Technical Specifications," of this SER.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.1-1 Update of Fuel Storage and Handling Equipment

The staff reviewed Departure STD DEP 9.1-1, which updated the equipment and special tools utilized in ABWR refueling operations, including the inspection of new fuel. Specific modifications proposed by the departure include the following:

Subsection 9.1.4.1, "Design Bases"

Changes include the applicant's clarification that the minimum water level for shielding of 2.951 meters (m) (8.5 feet [ft]) is referenced from the top of the active fuel. The clarification of the

[1] 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.

minimum water level height reference does not change conformance of the systems to the SRP, as documented in NUREG–1503.

Subsection 9.1.4.2.1, "Spent Fuel Cask"

This section was expanded to include a reference to the load handling equipment and the major steps necessary to bring a spent fuel cask into the RB. The applicant states that the FSAR will require an amendment in accordance with 10 CFR 50.71, "Maintenance of records, making of reports," at a future date to incorporate equipment-specific information for an actual Department of Transportation approved spent fuel cask. The additional detail on the future spent fuel cask design does not change the conformance of the systems to the SRP, as documented in NUREG–1503.

Subsections 9.1.4.2.3.7, "Jib Crane"; 9.1.4.2.7.3, "Fuel Assembly Sampler"; and 9.1.4.2.3.5, "Fuel Pool Vacuum Sipper"

This jib crane and fuel assembly sampler equipment were deleted in FSAR Revision 1 because they are outdated and are no longer used in current designs. The stated new design of the sampler in FSAR Subsection 9.1.4.2.7.3, "Fuel Assembly Sampler," described an updated design and revised the name of some of the sampler components. However, Subsection 9.1.4.2.7.3 indicated that the sampler performs the same function as the ABWR DCD design. Subsequently, STP FSAR Revision 2 was revised to restore the design for the jib crane and fuel assembly sampler.

The fuel pool vacuum sipper was deleted in FSAR Revision 2 because it is outdated and was replaced with the fuel assembly sampler in the FSAR design. STD DEP 9.1-1 of the Departures Report states that "outdated equipment (e.g., vacuum sipper) that is no longer utilized was deleted."

Section 9.1.4 of STD DEP 9.1-1 in the Departure Report was revised to include the fuel assembly sampler and jib crane in the STP FSAR Revision 2 design. These components were previously removed from FSAR Revision 1 because they were declared outdated equipment that will no longer be utilized. Both of these components were then restored in FSAR Revision 2 to incorporate the ABWR DCD design that was reviewed and approved in NUREG–1503. However, Figure 9.1-10, "Jib Crane Channel Handling Boom," which was in the ABWR DCD had not been restored in the STP FSAR. The staff was unable to determine whether the jib crane design was modified or whether it was the same design as in the ABWR DCD. The staff issued RAI 09.01.04-6 requesting the applicant to provide the reason for not restoring the ABWR DCD jib crane in Figure 9.1-10 in the STP COLA. In its response to RAI 09.01.04-6, dated August 20, 2009 (ML092360771), the applicant proposed a revision to the FSAR. The applicant stated that DCD Figure 9.1-10, "Jib Crane Channel Handling Boom," would be restored to FSAR Section 9.1, "New-Fuel Storage." The applicant also included, as part of its response, a markup of the affected FSAR pages including FSAR Figure 9.1-10, which shows the jib crane design for STP.

The staff reviewed the applicant RAI response including the proposed FSAR Figure 9.1-10 and found it acceptable because the proposed STP jib crane design does not differ from the approved design in the ABWR design certification (DC). The staff confirmed that Figure 9.1-10 "Jib Crane Channel-Handling Boom" was restored in Revision 4 of the FSAR as committed to in

the RAI response. Accordingly, the staff found that the applicant has adequately addressed this issue and, therefore, RAI 09.01.04-6, is resolved and closed.

Subsection 9.1.4.2.5.1, "Reactor Vessel Service Tools"

The requirements for heavy lifting tools were updated to allow for a safety factor of five if a dual load path is maintained for the lifting tool. This update is in accordance with Section 5 of NUREG–0612, "Control of Heavy Loads at Nuclear Power Plants."

Subsections 9.1.4.2.5.6, "Dryer and Separator Strongback," and 9.1.4.2.10.2, "Refueling Procedure"

Load test requirements were updated for lifting strongbacks. The load tests are now performed in accordance with ANSI N14.6, "Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4,500 kg) or More," which specifies a 150 percent test of rated load versus the original 125 percent test.

Subsection 9.1.4.2.7.1, "Refueling Machine"

The applicant upgrades one auxiliary hoist on the refueling machine from 9.81 to 14.71 kN. The design, installation, and test codes remain the same.

Subsection 9.1.4.2.7.2, "Auxiliary Platform"

This auxiliary platform in Revision 1 of the STP FSAR was completely redesigned from the original platform described in the ABWR DCD. The new platform performs similar functions as the original platform, but the location and construction are different. The staff requested additional information related to the auxiliary platform including the weight, construction and testing requirements, and storage location/requirements. Subsection 9.1.4.2.7.2, "Auxiliary Platform," of the STP COLA did not provide sufficient information to verify conformance with the acceptance criteria in the SRP. Therefore, the staff issued RAI 09.01.04-1, requesting the applicant to provide this information. There was also inconsistency between the Tier 1 and Tier 2 information. The staff issued RAI 09.01.04-2, requesting the applicant to clarify this information.

In its response to RAI 09.01.04-1, dated June 26, 2008 (ML081970231), the applicant stated that the description of the auxiliary platform would be restored to be consistent with the ABWR DCD description in the next FSAR revision. The staff reviewed Revision 2 of the STP FSAR and determined that the description of the auxiliary platform reflects the approved ABWR DCD design. Therefore, RAI 09.01.04-1 is resolved and closed.

In its response to RAI 09.01.04-2, dated June 26, 2008 (ML081970231), the applicant again stated that the description of the auxiliary platform would be restored to the ABWR DCD description in the next STP FSAR revision. In addition, the applicant addressed the Tier 1/Tier 2 inconsistency by clarifying that the refueling machine is a gantry crane as indicated in Tier 1. The staff verified that the revised STP FSAR properly classifies the refueling machine as a gantry crane and as a result, Tier 1 and Tier 2 are now consistent. The additional details provided for the auxiliary design and refueling machine do not affect conformance of the system to the SRP, as documented in NUREG–1503. Therefore, RAI 09.01.04-2 is resolved and closed.

Table 9.1.2, “Fuel Servicing Equipment”

In Table 9.1-2, “Fuel Servicing Equipment,” of the STP FSAR, the applicant changed the safety classification of the refueling machine from Safety Class 2 to nonsafety-related. The applicant also changes the seismic classification to Seismic Category 1. Both these changes make Table 9.1.2 consistent with the Tier 1 information in ABWR DCD Section 2.5.5, “Refueling Equipment.”

However, Table 9.1-2 does not specifically designate the QA elements applicable to the refueling machine, which is a single-failure proof crane. Because the refueling machine is single-failure proof, the applicable guidance is in NUREG–0554, “Single-Failure Proof Cranes for Nuclear Power Plants.” Section 10, “Quality Assurance,” of NUREG–0554 lists QA elements that are applicable to single failure proof cranes. The staff issued RAI 09.01.04-3 requesting the applicant to provide additional information to ensure that the QA elements of the refueling machine conform to NUREG–0554.

In its response to RAI 09.01.04-3, dated June 26, 2008 (ML081970231), the applicant states that the QA requirements for the refueling machine are distinguished from other equipment by its function as a single-failure proof crane designed to meet the requirements of NUREG–0554. The staff verified that the STP FSAR states in Subsection 9.1.4.2.7.1 states that the refueling machine is designed to meet the requirements of NUREG–0554, which lists the applicable QA elements. Based on the above information, RAI 09.01.04-3 is resolved and closed.

Subsection 14.2.12.1.50, “Fuel-Handling and Reactor Component Servicing Equipment Preoperational Test”

The Initial Test Program is described in Chapter 14, “Initial Test Program,” Subsection 14.2.12.1.50, “Fuel-Handling and Reactor Component Servicing Equipment Preoperational Test.” STD DEP 9.1-1 updated the equipment and special tools that are tested by this preoperational test.

The applicant’s evaluation of STD DEP 9.1-1, 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 found it reasonable that the 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.

COL License Information Items

- COL License Information Item 9.4 Spent Fuel Rack Load Drop Analysis

COL License Information Item 9.4 addresses the load drop analysis for the SFRs. The staff’s evaluation of the load drop analysis of the SFRs to address COL License Information Item 9.4 is in Subsection 9.1.2.4.6 of this SER.

- COL License Information Item 9.5 New Fuel Inspection Stand Seismic Capability

The staff reviewed COL License Information Item 9.5, as described in Subsection 9.1.6.5, “New Fuel Inspection Stand Seismic Capability,” of the FSAR. This COL license information item addresses seismic capabilities of the new fuel inspection stand. The applicant’s redesign of the inspection stand includes installing the stand in a pit and anchoring the stand to the floor. As indicated in FSAR Subsection 9.1.4.2.3.2, “New-Fuel Inspection Stand,” the new fuel inspection

stand cannot fall or tip and will retain the fuel assembly and maintain the structural integrity of the stand during an SSE. Because the improved stand design elevates fuel bundles rather than personnel and is anchored in a refueling floor pit so that it cannot fall into the fuel pool during an SSE, the staff found that the new fuel inspection stand complies with the requirements of GDC 2 by satisfying Regulatory Position C2 of RG 1.29 and Section 2.5 of NUREG–0554.

- COL License Information Item 9.6 Overhead Load Handling System Information

The staff reviewed COL License Information Item 9.6, as described in Subsection 9.1.6.6, "Overhead Load Handling System Information," of the FSAR, which states that the COL applicant shall provide a list of all cranes, hoists, and elevators and their lifting capacities, including any limit and safety devices required for automatic and manual operation.

The FSAR states that this information is dependent on specific vendor information and will be available following equipment procurement. Appropriate descriptions will be added through an FSAR amendment in accordance with 10 CFR 50.71(e), before receiving fuel. This item is captured in the FSAR as commitment COM 9.1-3.

In addition, COL License Information Item 9.6, as described in Subsection 9.1.6.6 of the FSAR, also specifies that the COL applicant should provide specific information summarized in a list of six items for all such equipment, as listed in Subsection 9.1.6.6 of the FSAR. The applicant does not provide this information and did not commit to providing the information for the fuel handling cranes following equipment procurement. Therefore, the staff issued RAI 09.01.05-1 requesting the applicant to provide the information.

In its response to RAI 09.01.05-1, dated July 2, 2008 (ML081890239), the applicant provides a standard supplement to address COL License Information Item 9.6 in Subsection 9.1.6.6. The supplement includes a commitment (COM 9.1-3) to provide a list of items relating to heavy load handling systems before fuel loading. Because Subsection 9.1.6.6 includes a scheduled commitment for the heavy load handling procedure, the staff determined that the operational procedures governing fuel handling, including administrative controls, should also be implemented before handling new fuel. The staff issued RAI 09.01.04-7 requesting the applicant to provide a similar commitment on when fuel handling information and procedures will be developed. In its response to this RAI dated August 20, 2009 (ML092360771), clarifies that the development of operational procedures is included in STP Tier 2 FSAR Subsection 13.5.3.4, "Procedures Included In Scope Of Plan," which includes refueling and core alterations in a list of general plant procedures. Subsection 9.1.4.4.2 also provides a list of procedures to be developed for review before receiving fuel. The staff found this response acceptable and therefore, RAI 09.01.04-7 is resolved and closed.

RAI 09.01.05-1 is evaluated by the staff in Section 9.1.5, "Overhead Heavy Load Handling Systems (OHLH)," of this SER

9.1.4.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.1-3) – This commitment is addressed in Section 9.1.5 of this SER.

9.1.4.6 *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 the light load handling. 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 light load handling that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.1.4 of NUREG–0800. The staff's review concluded that the applicant has provided adequate information to address the COL license information items in accordance with the relevant guidance in Section 9.1.4 of NUREG–0800, and found it 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. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

9.1.5 Overhead Heavy Load Handling Systems (OHLH)

9.1.5.1 *Introduction*

This section of the FSAR addresses the OHLH consisting of all components and equipment for moving all heavy loads (i.e., loads weighing more than one fuel assembly and its handling device—loads greater than 4.45 kilo Newton [kN] [1,000 pound force (lbf)])— at the plant site. The staff reviewed the OHLH systems to ensure that inadvertent operations or equipment malfunctions—separately or in combination—will not cause a release of radioactivity, a criticality accident, or an inability to cool fuel within the reactor vessel or SFP or to safely shut down the reactor.

9.1.5.2 *Summary of Application*

Section 9.1.5 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.1.5 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In FSAR Section 9.1.5, the certified ABWR DCD was subject to numerous design revisions. Therefore, the applicant presents Section 9.1.5 of the certified ABWR DCD with the proposed changes in the COL FSAR. In addition, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.1-1 Update of Fuel Storage and Handling Equipment

This departure identifies the inclusion of ASME NOG-1, "Rules for Construction of Overhead and Gantry Cranes," as a technical standard for the Type 1 RB crane. Additionally, the description and use of the under-vessel rotating platform were updated with minor changes, and the description of the auxiliary hoist on the refueling machine was clarified.

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

The reference ABWR DCD is based on a single-unit site. STP, Units 3 and 4, is a dual unit project on an existing site with STP, Units 1 and 2.

COL License Information Items

- COL Information Item 9.6 Overhead Load Handling System Information

The applicant provides additional information in FSAR Subsection 9.1.6.6 to address the data and information related to the overhead load handling systems. The applicant adds that the "information is either vendor specific and will be established following equipment procurement, or involves associated programs that will be developed as the equipment is procured." The applicant commits (COM 9.1-3) to provide appropriate descriptions of the OHLH systems in an FSAR amendment in accordance with 10 CFR 50.71(e), before receiving fuel.

9.1.5.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the OHLH systems and associated acceptance criteria are in Section 9.1.5 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

In addition, the regulatory basis and review criteria used by the staff for COL License Information Item 9.6 are specified in Section 9.1.5 of NUREG–0800.

9.1.5.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.1.5 of the certified ABWR DCD. The staff reviewed Section 9.1.5 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

The following Tier 2 departures were identified by the COL applicant as not requiring the NRC's review and approval.

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[1] 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 9.1-1 Update of Fuel Storage and Handling Equipment

The staff reviewed Departure STD DEP 9.1-1, which involves updated to the fuel handling and storage equipment. Section 9.1.1, "New-Fuel Storage (Related to RG 1.206 Sections 9.1.1, 'Criticality Safety of Fresh and Spent Fuel Storage Handling,' and 9.1.2, 'New and Spent Fuel Storage')"; Section 9.1.2, "Spent Fuel Storage (Related to RG 1.206 Sections 9.1.1, 'Criticality Safety of Fresh and Spent Fuel Storage Handling,' and 9.1.2, 'New and Spent Fuel Storage')"; Section 9.1.3, "Fuel Pool Cooling and Cleanup"; and Section 9.1.4, "Light Load Handling System (Related to Refueling)," of this SER also include discussions regarding this departure.

Subsection 9.1.5.2.1 "Reactor Building Crane"

The ABWR DCD originally referenced NUREG–0554, "Single Failure Proof Cranes for Nuclear Power Plants," as the design standard for the RB single-failure proof crane. In the STP FSAR, the applicant references the updated ASME NOG-1 standard, "Rules for Construction of Overhead and Gantry Cranes," as the design standard for the RB crane. The RB crane is now designed as a Type 1 single-failure proof crane and meets the guidelines of NUREG–0554 and ASME NOG-1. Additionally, the RB crane is seismically designed to maintain its position and to hold a load during SSE conditions. SRP Section 9.1.5 states that cranes designed to the criteria of ASME NOG-1 2004 for a Type 1 crane are acceptable under the guidelines of NUREG–0554, for the construction of a single-failure proof crane. Subsection 9.1.5.1 of the STP Units 3 and 4 FSAR for the RB crane specifies ASME NOG-1 without citing the year of the edition. The staff issued RAI 09.01.05-2, requesting the applicant to provide the reference year for ASME NOG-1.

In its response to RAI 09.01.05-2, dated July 2, 2008 (ML081890239), the applicant stated that the 2004 edition of ASME NOG-1 will be applied to the RB crane, and STP FSAR Subsection 9.1.5.1 would be revised. Furthermore, in its revised RAI response dated April 2, 2009 (ML090960321), the applicant specifyied that Table 1.8-21a "Codes and Standards of Site-Specific Systems" in STP FSAR will be revised to reflect the correct reference year of the NOG-1 2004 code. The staff found that providing the reference to the NOG-1 2004 edition in Table 1.8-21a and only NOG-1 in Section 9.1.5 is acceptable and consistent with the other codes referenced in Section 9.1.5 and Table 1-8-21a, "Codes and Standards for Site-Specific Systems," of the FSAR.

The applicant has revised Table 1.8-21a in Revision 3 to the FSAR to incorporate the correct reference year of NOG-1. Use of the 2004 edition meets the guidance in SRP Section 9.1.5. The staff found this RAI response acceptable. Therefore, RAI 09.01.05-2 is resolved and closed.

Subsection 9.1.5.2.2.2, "Lower Drywell Servicing Equipment"

The applicant made editorial changes to this subsection. Several pieces of equipment were renamed and minor changes were made in the process of servicing the reactor internal pumps (RIPs).

Subsection 9.1.5.5, "Safety Evaluations"

In this subsection, the applicant identifies an upgrade for the auxiliary hoist on the refueling machine. The capacity of the hoist was increased from 9.81 kN (2205 lbf) to 12.33 kN (2772 lbf). The increased capacity allows the auxiliary hoist to lift the parts from the RIPs for

servicing. The hoist is attached to the refueling machine and both pieces of equipment are single-failure proof, in accordance with NUREG–0554. The ABWR DCD also designated the refueling machine and auxiliary hoist as single-failure proof.

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. Within the review scope of this section, the staff found it reasonable that the 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.

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

The staff reviewed Departure STD DEP 1.1-2, which lists the systems shared by the STP Units 3 and 4 and the systems shared with the STP Units 1 and 2. None of these systems include the OHLH system. 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. Within the review scope of this section, the staff found it reasonable that the 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. The acceptance of the STP, Units 3 and 4, with regard to GDC 5 is documented in the applicable SER sections.

COL License Information Item

- COL License Information Item 9.6 Overhead Load Handling System information

The staff reviewed COL License Information Item 9.6 described in Subsection 9.1.6.6 of the FSAR, which states that the COL applicant shall provide a list of all cranes, hoists, and elevators and their lifting capacities, including any limit and safety devices required for automatic and manual operation. This COL license information item further states that the following information shall be provided for the OHLH systems equipment:

1. Heavy load handling system operating and equipment maintenance procedures.

2. Heavy load handling system and equipment maintenance procedures and manuals.

3. Heavy load handling system and equipment inspection and test plans; ([nondestructive examination] NDE, visual, etc.).

4. Heavy load handling safe load paths and routing plans.

5. QAP to monitor and assure implementation and compliance of heavy load handling operations and controls.

6. Operator Qualifications, Training and Control Program.

The applicant states that the above information is dependent on specific vendor information and will be available following equipment procurement. According to the applicant, appropriate descriptions will be added in an FSAR amendment in accordance with 10 CFR 50.71(e) before receiving fuel. This item is captured as commitment COM 9.1-3. The staff has determined that the six items listed above are not captured in COM 9.1-3. Therefore, the staff issued RAI 09.01.05-1, requesting the applicant to provide this information.

In its response to RAI 09.01.05-1, dated July 2, 2008 (ML081890239), the applicant stated that the original response to the COL License Information Item 9.6 in the STP FSAR should have indicated that all of the information requested will be provided as it becomes available. Revision 2 of the STP COL FSAR was revised to capture all six items listed above in Commitment (COM 9.1-3), in addition to provisions of the commitment to provide a list of all cranes, hoists, and elevators and their lifting capacities, including any limit and safety devices required for automatic and manual operation. The staff found that the addition of the six items listed above meets the guidance of NUREG–0612 and SRP Section 9.1.5.

However, the applicant did not include all elements of the Heavy Load Handling Program of RG 1.206 Regulatory Position C.I.9.1.5 "Overhead Heavy Load Handling System." RG 1.206 states that the COL applicant is to include a listing of all heavy loads and heavy load handling equipment outside the scope of the loads described in the referenced certified design and the associated heavy load attributes (load weight and typical load paths). RG 1.206 also requests a safety evaluation for heavy loads outside the scope of the loads described in the certified design that are handled by non-single-failure-proof handling systems. Therefore, the staff in supplemental RAI 09.01.05-3 requested that the applicant provide this information.

In its response to RAI 09.01.05-3, dated August 20, 2009 (ML092360771), the applicant amended the response to RAI 09.01.05-1. In the amended response, the applicant proposed to update Subsection 9.1.6.6 to include the following information:

> Procedures containing elements of the heavy load handling program outlined in Regulatory Guide 1.206, Section C.I.9.1.5 and NUREG-0612 will be developed as part of the Plant Operating Procedures Development Plan contained in Subsections 13.5.3.1 and 13.5.3.4.1.

The staff found that the applicant's response to RAI 09.01.05-1 and RAI 09.01.05-3, adequately addresses COL License Information Item 9.6 in FSAR Section 9.6.6, because the heavy load handling procedures will include all the applicable guidance of NUREG–0612, SRP Section 9.1.5, and RG 1.206. The staff confirmed that Revision 4 of FSAR Section 9.1.6.6 was revised as committed to in the RAI response. Therefore based on Commitment (COM 9.1-3), RAI 09.01.05-1, and RAI 09.01.05-3, are resolved and closed.

In its response to RAI 09.01.05-1, dated July 2, 2008, the applicant also provides additional information stating that heavy load handling at the plant will begin during plant construction and therefore a heavy load handling program that meets Section 5.1.1, "Recommended Guidelines," of NUREG–0612 should be in place at the time that heavy load handling begins. The applicant's response also provides an additional discussion on the use of the heavy load handling system during construction. The applicant states, "In regard to the application of a heavy load handling program during construction, conditions do not exist during construction prior to fuel load that require a heavy loads handling system in accordance with NUREG–0612." Furthermore, the applicant states that during construction, lifts of significant loads are regarded and addressed as occupational safety hazards and are recognized risks to cost and schedules. According to NUREG–0554 Section 2.1, "Construction and Operating Periods," when the overhead crane handling system is used during plant construction, separate performance specifications may be needed to reflect the duty cycles and loading requirements for each service. The staff found that the use of overhead load handling cranes during construction is acceptable and does not violate any NRC guidelines.

9.1.5.5 *Post Combined License Activities*

The applicant identifies the following commitment:

- Commitment (COM 9.1-3) – Procedures containing elements of the heavy load handling program outlined in RG 1.206 Regulatory Position C.I.9.1.5 and NUREG–0612 will be developed as part of the Plant Operating Procedures Development Plan in Subsections 13.5.3.1 and 13.5.3.4.1. Appropriate descriptions will be added with an FSAR amendment in accordance with 10 CFR 50.71(e) before receiving fuel.

9.1.5.6 *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 OHLH systems. 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 OHLH systems that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.1.5 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information item 9.6 in accordance with the relevant guidance in Section 9.1.5 of NUREG–0800 and has demonstrated compliance with NRC regulations. The staff found it 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.

9.2 <u>Water Systems</u>

9.2.1 Station Service Water System

See SER Section 9.2.15, "Reactor Service Water System."

9.2.2 Closed Cooling Water System

See SER Section 9.2.11, "Reactor Building Cooling Water System," Section 9.2.12, "HVAC Normal Cooling Water System," Section 9.2.13, "HVAC Emergency Cooling Water System, and Section 9.2.14, "Turbine Building Cooling Water System."

9.2.3 Demineralized Water Makeup System

See SER Section 9.2.8, "Makeup Water System (Preparation)"; Section 9.2.9, "Makeup Water System (Condensate)"; and Section 9.2.10, "Makeup Water System (Purified)" of this SER.

9.2.4 Potable and Sanitary Water System

9.2.4.1 *Introduction*

This section of the FSAR addresses the plant's potable and sanitary water (PSW) system. This PSW is composed of a potable water subsystem, a sanitary water subsystem, and a sewage treatment subsystem

9.2.4.2 *Summary of Application*

Section 9.2.4 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.4 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.2.4, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 9.2-8 Potable and Sanitary Water System

This departure addresses several plant modifications, including the change from a single unit to dual units (STP, Units 3 and 4,) that is described in Departure STP DEP 1.1-2. In conjunction with Departure STP DEP 9.2-8, the flow capacity of the PSW system has been doubled to provide potable water to both of the new units. Other changes included in this departure are as follows:

1. Potable water will be directly supplied by unfiltered but chemically treated water from the well water system.

2. The sewage treatment and sanitary drainage systems will collect and process sanitary waste from all four units at the site.

3. Tepid water will be required for emergency eyewash and shower stations.

4. The system supply pressure will be regulated at a maximum of 60 psig (515.01 Kpa).

As discussed in Section 3.0, "Departures Not Requiring Prior NRC Approval" in Part 7 "Departures Report," the applicant evaluated this departure against the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.5. Based on this review, the applicant determined that prior NRC approval of this departure is not required.

Interface Requirements

The applicant provides information to address the Tier 2 interface requirements in STP FSAR Subsection 9.2.4.2.2, "Power Generation Design Bases (Interface Requirements)."

COL License Information Item

- COL License Information Item 9.2.4.2.5 Evaluation of Potable and Sanitary Water System Performance (Interface Requirements)

This COL license information item states that the COL applicant will analyze the PSW system to assure that all applicable regulatory requirements are met and that the PSW is compatible with site conditions. Note that the DCD identifies this statement as an interface requirement, and the

statement is not cross-referenced in DCD Tier 2 Table 1.9-1, "Summary of ABWR Standard Plant COL License Information." However, in STP COL FSAR Subsection 9.2.4.2.5, "Evaluation of Potable and Sanitary Water System Performance (Interface Requirements)," the applicant refers to it as a "COL License Information Item."

9.2.4.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the potable and sanitary water, and the associated acceptance criteria, are given in Section 9.2.4 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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 reviewing the COL License Information Item is in Section 9.2.4 of NUREG-0800.

9.2.4.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.4 of the certified ABWR DCD. The staff reviewed Section 9.2.4 of the STP, Units 3 and 4, COL FSAR and checked the referenced ABWR DCD to ensure that the combination of information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring NRC Approval

- STP DEP 9.2-8 Potable and Sanitary Water System

Although no Tier 2 departures requiring NRC review and approval are proposed, the applicant plans to implement Tier 2 departures that do not require NRC review and approval as permitted by 10 CFR Part 52, Appendix A, Section VIII.B.5. This regulation allows the applicant to depart from the ABWR DCD Tier 2 information without obtaining NRC approval if (among other provisions) the departure does not result in more than a minimal increase in: (a) the likelihood of occurrence or the consequences of a malfunction of a SSC important to safety, or (b) the consequences of an accident previously evaluated in the plant-specific DCD. However, in order to assure that this requirement is being properly implemented, this departure was selected for evaluation: The staff reviewed Departure STP DEP 9.2-8, which addresses several plant modifications including the change from a single unit design to the dual units (STP, Units 3 and

[1] 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.

4) described above. This change means that there may be a possibility that radioactive contamination introduced into the PSW system of one unit will spread into another unit by means of shared equipment and/or cross-connections. As previously noted, the sewage treatment and sanitary drainage systems will collect and process sanitary waste from all four units at the site. The STP COLA did not appear to explicitly indicate whether there are any cross-connections between the potable water supply systems. Therefore, to assure that NRC approval is not required for this departure, the staff requested the applicant to provide information to sufficiently demonstrate that the PSW system is designed to preclude the potential for cross-contamination between units, in the event that radiological contamination occurs in the PSW system of one of the units. A review of the design for potential cross-contamination is also consistent with the acceptance criteria specified in SRP 9.2.4 related to multi-unit facilities. More specifically, SRP Section 9.2.4, Subsection II specifies that an evaluation needs to be performed to determine the potential for radiological contamination that includes a consideration of the safety implications inherent in shared multi-unit facilities. Accordingly, the staff issued RAI 09.02.04-03, requesting the applicant to demonstrate that the design of the PSW system precludes the potential for cross-contamination between units.

In its response to RAI 09.02.04-03, dated August 26, 2009 (ML092430133), the applicant stated that backflow preventers will be provided for both STP, Units 3 and 4, to prevent possible cross contamination. The response included an FSAR markup incorporating this information. The staff determined that the installed backflow preventers will adequately address the possibility for cross contamination. The staff confirmed that the proposed FSAR change are incorporated into Revision 4 of the FSAR. Therefore, RAI 09.02.04-03 is resolved and closed.

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 found it reasonable that this departure does not require prior NRC approval. In addition, the applicant's process for evaluating departures from and changes to the DCD are subject to NRC inspections.

Interface Requirements

The staff reviewed the applicant's information in Section 9.2.4 of the application addressing the Tier 2 interface requirements that include Table 9.2-15, "Potable and Sanitary Water System Components (Interface Requirements)"; Figure 9.2-9, "Potable and Sanitary Water System (Sheet 1 of 2)," and Figure 9.2-9b, "Potable Water System P&ID." As described in STP COL FSAR Subsection 9.2.4.2.5, the design and installation of the PSW system will meet the requirements of International Plumbing Code 2003 and all state and local codes. The Tier 2 interface requirements related to compliance with GDC 60 are satisfied because this system will not have any interconnections with other systems that might potentially contain radioactive material. Furthermore, air gaps will be used where necessary to protect against radioactive contamination of the PSW system. Upon reviewing the application, the staff noted that in Figure 9.2-9, Sheet 2 of 2 was not included. Therefore, the staff issued RAI 09.02.04-4 requesting the applicant to provide the missing portion of this figure. In its response to RAI 09.02.04-4, dated August 26, 2009 (ML092430133), the applicant stated that Figure 9.2-9 Sheet 2 is FSAR Figure 9.2-9b. The applicant has since revised the title of FSAR Figure 9.2-9b to provide clarification. The staff found the applicant's response acceptable and therefore, RAI 09.02.04-4 is resolved and closed.

The staff reviewed Section 9.2.4 of the FSAR to determine the methods used to monitor, measure, and analyze any radioactive effluent released from the non-radioactive drainage (NRD) system to determine the potential for carrying radioactive contamination into the environment. The staff issued RAI 09.02.04-2 requesting the applicant to provide additional information concerning monitoring, measuring, and analyzing radioactive liquid effluent from this system. In its response to RAI 09.02.04-2, dated August 20, 2009 (ML092360771), the applicant states that the effluents from this system are released to the main cooling reservoir. The sanitary system will be shared between STP, Units 1 and 2, and STP, Units 3 and 4. It is anticipated that releases are measured and monitored in accordance with the current processes in effect at STP, Units 1 and 2.

Samples of effluents released from the NRD system will be analyzed—they will undergo radiological and non-radiological monitoring after combining with the sanitary system discharge and prior to being released into the environment. The program for monitoring and sampling of the non-radioactive waste system, including the determination of batch discharge limits, is in accordance with the Offsite Dose Calculation Manual (ODCM), IEN 80-10, and RG 1.21. FSAR Subsection 13.5.3.4.3, "Radiation Control Procedures," states, "procedures will be developed for handling discharge of effluents and dose calculations for STP units 3 and 4." These procedures will be issued six months before the Preoperational Test Program per FSAR Subsection 13.5.3.3.2, "Maintenance and Other Procedures." Also, sufficient hold up capacity is provided by the main cooling reservoir and the 209 million cubic meters (7.35 billion cubic feet) of dilution water, before any site environmental conditions that would release any liquid effluents to the environment, per GDC 60. The staff evaluated the applicant's response and found it acceptable, because it complies with GDC 60. The staff found the applicant's response acceptable and therefore, RAI 9.02.04-2 is resolved and closed.

The staff reviewed Section 9.2.4 of the FSAR to determine the radiological methods used to sample and monitor the onsite well water supplying STP, Units 3 and 4. The staff issued RAI 09.02.04-1, requesting the applicant to provide information concerning sampling and monitoring of the onsite wells. In its response to RAI 09.02.04-1, dated August 20, 2009 (ML092360771), the applicant states that onsite wells that are the source of water for the PSW system are monitored for radioactive contamination under the existing site Radiological Environmental Monitoring Program (REMP). The applicant also committed to add a sentence changing FSAR Subsection 9.2.4.2.2, "Power Generation Design Bases (Interface Requirements)," to state, "Radiological monitoring of the well water system will continue to be performed under the site Radiological Environmental Monitoring Program (REMP)." The staff found this response acceptable. The staff has confirmed that the change to COL FSAR Subsection 9.2.4.2.2 was incorporated in the FSAR Revision 4. Therefore, RAI 09.02-04 is resolved and closed.

9.2.4.5 *Post Combined License Activities*

There are no post COL activities related to this subsection.

9.2.4.6 *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 PSW system, 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 PSW system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.2.4 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information item 9.2.4.2.5 in accordance with the relevant guidance in Section 9.2.4 of NUREG–0800, and found it 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. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

Based on the results of this evaluation, the staff determined that the applicant's additional information addressing the COL license information and interface requirements referred to above are acceptable as described in the technical evaluation section, and that the applicant has adequately addressed the STP PSW design in compliance with NRC regulations.

9.2.5 Ultimate Heat Sink

9.2.5.1 *Introduction*

This section of the FSAR addresses the STP, Units 3 and 4, ultimate heat sinks (UHS). The UHS typically consists of an assured supply of water that is credited for dissipating reactor decay heat and essential station heat loads after a normal reactor shutdown or a shutdown following an accident or transient, including a loss-of-coolant accident (LOCA). The water sources that make up the UHS are reviewed to assure that they are capable of performing their safety functions.

9.2.5.2 *Summary of Application*

In the ABWR DCD Section 9.2.5, the UHS design relied upon a spray pond cooling system. However, the COL applicant replaced that conceptual design, including all subsections, tables, and figures, with plant specific information, along with supplemental information to address the Interface Requirements. The applicant replaces the conceptual design information of the referenced ABWR DCD with that of the site-specific design information. The STP UHS design incorporates multiple forced convection cooling towers above a single water storage basin for each unit. Each unit provides cooling to three redundant reactor service water (RSW) trains. Each train consists of two parallel pumps and two parallel cooling towers. In normal plant operations, one pump and one cooling tower will be in operation from each train. During accident conditions, all pumps and all cooling towers will operate; however, only four pumps and four cooling towers are required to cool the nuclear plant. This allows safe operation with a single failure. The design change from the DCD conceptual UHS design resulted in significant departures from the certified design. The applicant provides information to address interfaces between the site-specific design and the certified ABWR DCD design. Interfaces for standard design item 9.2.5 addresses the safety design bases and the power generation design bases for UHS system.

In addition, in the COL FSAR, Revision 2, the applicant provided a description of departures and supplemental information in the following paragraphs. Because the FSAR were continually revised to respond to staff's review, the staff review and safety conclusion is based on Revision 12 of the FSAR:

Tier 1 Departure

- STD DEP T1 2.14-1 — Hydrogen Recombiner Requirements Elimination

This departure eliminates the flammability control system that was called for in the ABWR DCD.

Tier 2 Departure*

- STD DEP 1.8-1 — Tier 2* Codes, Standards, and Regulatory Guide Edition Changes

This departure updated the references to codes and standards to more current revisions or editions.

Tier 2 Departures Requiring Prior NRC Approval

The following departures affect TS and require prior NRC approval.

- STD DEP 16.3-16 — LCO 3.7.1, Reactor Building Cooling Water (RCW) System, Reactor Service Water (RSW) System, and Ultimate Heat Sink (UHS) - Operating and LCO 3.7.2, RCW/RSW System and UHS – Shutdown

This departure eliminates some LCO items by claiming that they are redundant.

- STD DEP 16.3-46 — LCO 3.7.2, RCW, RSW, and UHS Applicability

This departure alters some wording in the TS to make it more consistent with other sections.

The staff's evaluation of the above two TS departures is addressed in Section 9.2.11, "Reactor Building Cooling Water System," of this SER.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.2-1 — Reactor Building Cooling Water System

This departure revises the design characteristics of the reactor building cooling water (RCW) system and corrects inconsistencies in the system design description in Subsection 9.2.11.2, "System Description," of the ABWR DCD. It also clarifies that all heat exchanger pumps are normally placed in operation, rather than required for shutdown cooling as stated in Subsection 9.2.11.3.2, "Safety Evaluation of Equipment," of the ABWR DCD. The major impact of this departure is increased heat removal capacities and resulting higher performance margins.

- STD DEP 9.2-5 — Reactor Service Water (RSW) System

This departure revises the RSW design flow rate specified in the ABWR DCD in order for the site specific RSW system to accomplish its safety and power generation design basis. This departure is largely the result of Departure STD DEP 9.2-1, which increases the capacity of the RCW heat exchangers to provide for additional heat removal capability and increased margin due to fouling and other requirements.

Interface Requirements

The applicant provides supplemental information to address UHS interface requirements for the certified design on safety design bases; power generation design bases; safety evaluation; conformance to RG 1.27 Revision 2, "Ultimate Heat Sink for Nuclear Power Plants," and RG 1.72, Revision 2, "Spray Pond Piping Made from Fiberglass-Reinforced Thermosetting Resin"; instrumentation and alarms; and tests and inspections.

9.2.5.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the UHS, and the associated acceptance criteria, are in Section 9.2.5 of NUREG–0800. The staff acceptance of the design is based on meeting the following requirements:

- GDC 2, as it relates to the capability of the structures housing the system and the system itself to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods.
- GDC 5, as it relates to the capability of shared systems and components important to safety to perform required safety functions.
- GDC 44, as it relates to:
    - The capability to transfer heat loads from safety related SSCs to the UHS under both normal and accident conditions.
    - Suitable component redundancy so that functions can be performed assuming a single, active component failure coincident with a loss of offsite power components (SSCs) to the UHS under both normal and accident conditions.
    - The capability to isolate components, systems, or piping if required so safety functions are not compromised.
    - GDC 45, as it relates to the design provisions to permit inservice inspection of safety-related systems or components.
- GDC 46, as it relates to the design provisions to permit operational and functional testing of safety-related systems or components.

In addition, in accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 1, Tier 2* and Tier 2 departures. Tier 1 and Tier 2* departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52 Appendix A, Section VIII.A.4, and Section VIII.B.6, respectively. Tier 2 departures affecting 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 not requiring prior approval are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.5, which are similar to the requirements of 10 CFR 50.59.

9.2.5.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.5 of the certified ABWR DCD. However, as indicated in the ABWR DCD, Tier 1, Section 4.1, the UHS is not within the scope of the certified design. Therefore, Section 9.2.5 of the ABWR DCD provides a conceptual UHS design. The plant-specific UHS design in Section 9.2.5 of the STP COL FSAR differs significantly from the conceptual design in the ABWR DCD. The staff reviewed the information in Revision 7 of the STP COL FSAR Section 9.2.5 related to the site-specific design of the UHS, in accordance with NUREG–0800, Section 9.2.5. Conformance with the acceptance criteria of SRP Section 9.2.5 formed the basis for the evaluation of the UHS, with respect to the applicable regulations.

ABWR DCD Section 9.2.5 provides a conceptual design of the UHS and interface requirements. The ABWR DCD conceptual design may be adopted by a COLA, in which case the COL applicant must indicate the adoption of the conceptual design and address the interface requirements. The applicant may also choose to depart from the conceptual design in the DCD and provide a plant specific UHS design. The UHS conceptual design in the DCD utilized a Seismic Category I spray pond that provided sufficient cooling water for reactor operations, shutdown cooling, and accident mitigation. The STP COLA did not adopt the DCD conceptual design. Instead, the STP plant specific UHS design incorporates multiple forced convection cooling towers above a single water storage basin for each unit.

The STP UHS utilizes a dedicated UHS water storage basin in a Seismic Category I concrete structure built partially below grade, and sized for a water volume sufficient to meet the cooling requirements for 30 days following a design basis accident (DBA) with no makeup water and without exceeding design basis temperature and chemistry limits. Above the basin is a counterflow mechanical induced draft cooling tower with six cooling tower cells, of which two cells are dedicated to each of the three RSW divisions. The RSW pump house is contiguous with the UHS storage basin and houses the RSW pumps and associated piping and valves. The RSW pump house is partially located below grade and is integral with the UHS water storage basin.

The UHS for STP, Units 3 and 4, consists of separate stand-alone structures with no cross ties. The UHS is composed of three divisions of cooling water supply and return; each division has two fans for cooling water being returned to the basin, two 50-percent RSW pumps, spray nozzles, and associated piping and valves. Each UHS division is physically and electronically separated and emergency power is provided for essential RSW system pumps, fans, valves, and controls.

System Design Considerations

1. GDC 2, “Design bases for protection against natural phenomena,” and RG 1.27.

   The staff reviewed the UHS for compliance with the GDC 2 requirements with respect to protection against the effects of natural phenomena such as earthquakes, tornados, hurricanes and floods. Compliance with the GDC 2 requirements is based on adherence to Regulatory Positions C.2, and C.3 of RG 1.27.

   GDC 2, requires SSCs important to safety such as the UHS, to be capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods without losing the capability to perform safety functions with and

without available offsite power. The applicant states in FSAR Subsection 9.2.5.1, "Safety Design Bases," that the UHS and any pumps, fans, valves, structure, and other safety systems are designed to Seismic Category I and ASME Code, Section III, Class 3. FSAR Subsection 9.2.5.8, "Conformance to RG 1.27 and 1.72," states that the UHS is capable of withstanding, without the loss of its safety function, the most severe single natural phenomena expected at the site, site-related events, and a single failure of manmade structural features. Analyses, design features, and provisions that are credited for satisfying GDC 2 requirements are described in STP Tier 2 FSAR Chapter 3, "Design of Structures, Components, Equipment, and Systems," (Sections 3.4, "Water Level (Flood) Design," and 3H.6, "Site-Specific Seismic Category I Structures") and are discussed in the staff's evaluations of the analyses, design features, and provisions in the corresponding Chapter 3 sections of this SER. The staff confirmed that the safety and nonsafety-related parts of the UHS are properly classified so that the analyses, design features, and provisions described in Chapter 3 will ensure that the UHS is capable of performing its safety functions during natural phenomena. Also, because each of the safety-related UHS trains has its own safety-related emergency power source that is protected from the effects of natural phenomena, as described in Chapter 3, the loss of offsite power as a result of natural phenomena will not adversely affect the capability of the UHS to perform its safety functions.

The applicant also demonstrates UHS compliance with GDC 2 requirements by addressing Interface Requirement 5, which the applicant responds to in Tier 2, Subsection 9.2.5.8, "Conformance to RG 1.27 and 1.72 (Interface Requirements)," of the STP COL FSAR. FSAR Subsection 9.2.5.8 also discusses conformance with RG 1.27. The staff reviewed the applicable interface requirements and found them to be acceptable as detailed in the interface requirement reviews below. Based on this review, the staff concluded that the UHS design conforms to the guidelines of Regulatory Positions C.2 and C.3 of RG 1.27 and the requirements of GDC 2, as they relate to the protection of the UHS against natural phenomena such as earthquakes, tornados, hurricanes, and floods.

2. GDC 5, "Sharing of structures, systems, and components"

GDC 5 requires that SSCs important to safety shall not be shared unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units. The staff reviewed the UHS design for compliance with the requirements of GDC 5 with respect to sharing SSCs. Acceptance is based on the failure of any component, including a pipe break and a single active failure, not preventing the safe shutdown and cool down of either unit (together or singularly).

NUREG–1503 concludes that, for the ABWR, the requirements of GDC 5 for sharing SSCs do not apply because the ABWR is designed as a single unit plant. The NUREG goes on to state that any application for a multi-unit facility requires a review of the design for compliance with GDC 5. This COLA is for two new units at the STP site that already has two units in operation. The STP COLA identifies Departure STP DEP 1.1-2, "Dual Units at STP 3 & 4," which addresses this issue for the facility. This departure identifies the set of STP systems that the units share. The UHS components are not identified as a shared system. Therefore, the staff concluded that the UHS site-specific

design described in the COLA meets GDC 5 requirements relative to the sharing of SSCs.

3. GDC 44, “Cooling water,” RG 1.27, “Ultimate Heat Sink,”

   GDC 44 requires systems to transfer heat from SSCs important to safety to a UHS. Systems must be able to function under normal and accident conditions assuming a single failure. This criterion is covered in the applicant’s response to interface requirements. The staff reviewed these interface requirements. As discussed in Subsection 9.2.5.4.2, “Cold Weather Operation,” the staff found that the UHS design adequately addressed the applicable interface requirements, and therefore, the staff finds the UHS design meets the requirements of GDC 44.

4. GDC 45, “Inspection of cooling water system”

   GDC 45 requires that the cooling water system be designed to permit appropriate periodic inspections of important components (e.g., heat exchangers and piping) to ensure the integrity and capability of the system. The staff found the design acceptable because it meets the GDC 45 requirement, and the applicant’s response to Interface Requirement 11 adequately addresses conformance with this criterion, which is reviewed later in SER Subsection 9.2.5.4.2.

5. GDC 46, “Testing of cooling water system”

   GDC 46 requires that the cooling water system be designed to permit appropriate periodic pressure and functional testing to ensure the leaktight integrity and operability of its components, as well as the operability of the system as a whole, under conditions as close to the design basis as is practical. This criterion is addressed in the applicant’s response to Interface Requirement 11. The staff reviewed the applicant’s response and determined that the applicant meets the GDC 46 requirement.

Safety Design Bases (Interface Requirements)

FSAR Subsection 9.2.5.1 presents 13 interface items that relate to the UHS and are referred to below in quotes. The staff’s review follows each item:

1. “The UHS is designed to provide sufficient cooling water to the RSW system to permit safe shutdown and cooldown of the unit and maintain the unit in a safe shutdown condition. The RSW water temperature at the inlet to the RCW/RSW heat exchangers is not to exceed 35°C during a LOCA.”

The staff reviewed the application and found that the design is adequate to remove the required heat load from the site to allow a safe shutdown of the unit. However, the performance of the UHS system should be validated through ITAAC 3.0-1.2a, because the final design (including piping and component sizes) is not yet complete at this point in time. The RSW pumps need to be designed to operate properly. However, no ITAAC item was provided to assure that the pump design is adequate in regards to net positive suction head (NPSH). In Section 9.2.15, “Reactor Service Water System,” of this SER, the staff issued RAI 09.02.01-6 requesting the applicant to provide an ITAAC to verify, through tests and verification, the NPSH requirements for the RSW pumps.

In its response to RAI 09.02.01-6, dated September 8, 2009 (ML092530407), the applicant adds a site-specific ITAAC item to verify the NPSH requirements for the RSW pumps. The staff reviewed the proposed site-specific ITACC (in Table 3.0-5, "Reactor Service Water System (RSW)") and found it acceptable because it requires through inspection, tests, and analysis, verification that the RSW pump NPSH requirements are met. The staff's review of RAI 09.02.01-6 is included in Section 9.2.15 of this SER and is resolved and closed.

The staff also noted that the minimum water level above the pump suction was not consistently stated in the application. The staff issued RAI 09.02.05-1, requesting the applicant to clarify the minimum water level above the pump suction and to correct inconsistencies in the COLA.

In its response to RAI 09.02.05-1, dated August 28, 2009 (ML092450155), the applicant stated that the COLA would be modified to make all of the elevations cited within the application consistent. Some of the apparent discrepancies were due to the use of different elevation data points. In its response, the applicant proposed changes to COLA Part 9, Table 3.0-1, "Ultimate Heat Sink (UHS)," Acceptance Criteria 2.(a), and to the following portions of COLA Part 2, Tier 2: Subsections 9.2.5.5.2(7), "UHS Water Storage Basin Requirements," and 9.2.5.7.3, "Freezing Considerations"; Table 9.2-17, "Design Data for Reactor Service Water System"; Subsection 9.2.15.2.1(2), "Safety Design Bases (Interface Requirements)"; Table 9.2-18, "RSW System Performance Data for Various Modes of Operation"; Section 19R.1(5), Introduction and Summary"; Subsections 3H.6.3.1, "Ultimate Heat Sink Basin," and 3H.6.3.3, "Reactor Service Water Pump Houses"; and Figure 1.2-35, "UHS Tower Sections." The applicant's RAI response highlighted portions of Figure 1.2-35 that will be modified. However, the minimum pool level height shown did not agree with the version of this figure in Revision 2 of the COLA, but the applicant's response did not identify or modify this discrepancy. This discrepancy was identified as a modification in the applicant's response to RAI 09.02.05-4, dated August 28, 2009 (ML092450155) (summarized below), and thus it is acceptable. However, the curb identified in COLA Tier 2 Subsection 9.2.5.2(5), "Power Generation Design Bases (Interface Requirements)," and also in the old version of Figure 1.2-35 was not visible on the new version of Figure 1.2-35. This curb was included to prevent sediment migration to the pump. The applicant provided no justification for the elimination of the curb. Thus, the staff found the response to RAI 09.02.05-1 inadequate and issued RAI 09.02.05-8 requesting the applicant to clarify whether the curb has been eliminated from the UHS design.

In its response to RAI 09.02.05-8, dated February 18, 2010 (ML100550029), the applicant stated that the curb described in COL FSAR Revision 3, Tier 2 Subsection 9.2.5.2(5) and also identified in COLA Tier 2, Revision 2 Figure 1.2-35 has not been eliminated from the UHS design. The applicant provided a detailed drawing (sketch) of the section of Figure 1.2-35 that contains the curb. The staff reviewed the applicant's response and COL FSAR Revision 3 Figure 1.2-35 and determined that the curb is indicated on the drawing and the curb has not been eliminated. Because the applicant's information verifies that the curb continues to be part of the UHS design, the applicant has adequately addressed the concern raised in RAI 09.02.05-1 and therefore, RAI 09.02.05-8 is resolved. The applicant also advised that in the response to RAI 03.07.01-13, Supplement 2 dated December 30, 2009 (ML100050225), the curb height in Figure 1.2-35 was shown as 0.6 meters (2 feet). Supplement 1 to RAI response 09.02.05-1 was submitted on September 19, 2011 (ML11264A127) to correct the curb height to 0.6 meters (2 feet) to be consistent. This information has been incorporated and confirmed in Subsection 9.2.5.5.2, Revision 7 of the FSAR. Therefore, RAI 09.02.05-1 and RAI 09.02.05-8 are resolved and closed.

Finally, in the COLA, Tier 2 Table 9.2-26, the data for the UHS basin temperature are missing. The staff issued RAI 09.02.05-2 requesting the applicant to revise Table 9.2-26 to include the UHS basin temperature.

In the response to RAI 09.02.05-2 dated August 28, 2009 (ML092450155), the applicant stated that the COLA would be modified to include the missing data for the UHS basin temperature in Table 9.2-26. These data are presented graphically in Figure 9.2-17, "UHS Basin Water Maximum Temperature (Case D2)," in the COLA. The applicant's response includes the requested data in Table 9.2-26, "UHS Basin Water Maximum Temperature (Case D2)." The staff has confirmed that COL FSAR Revision 4, Table 9.2-26 was revised as committed to in the RAI response. Therefore, RAI 09.02.05-2 is resolved and closed.

2. "In the event of an accident, the UHS is designed to provide sufficient cooling water to the RSW system to safely dissipate the heat for that accident. The amount of heat to be removed is provided in Tables 9.2-4a, 9.2-4b and 9.2-4c of the ABWR DCD."

The staff reviewed the water usage calculations in the COLA and found that they conservatively demonstrate that the UHS basin capacity is adequate and demonstrates 30 days of operation without makeup. However, this calculation is based on numerical values presented in Tables 9.2-4a, "Reactor Building Cooling Water Division A," 9.2-4b, "Reactor Building Cooling Water Division B," and 9.2-4c, "Reactor Building Cooling Water Division C," of DCD Tier 2. The applicant did not justify the amount of excess margins included in the design to account for uncertainties, component wear and aging effects, fouling of heat transfer surfaces and spray nozzles, and strainer debris collection (among other areas of concern). The staff issued RAI 09.02.05-3 requesting the applicant to address the excess margins and to justify that the margins are adequate. In addition, the performance of the UHS system will have to be validated through ITAAC 3.0-1 Acceptance Criteria 2(a) because the final design is not yet complete at this point in time. Finally, the amount of water required for 30 days of operation without makeup is not consistently stated in the COLA. The staff issued RAI 09.02.05-4 requesting the applicant to clarify the minimum water level required to operate the plant for 30 days and to correct inconsistencies in the COLA.

In its response to RAI 09.02.05-3, dated August 28, 2009 (ML092450155), the applicant states that the UHS design has not been finalized so the margins requested in RAI 09.02.05-3 are not available. The applicant adds that the goal is to provide the margins, and margins are provided for related systems. The applicant also states that margins for the UHS will be included in the performance requirements in the procurement process. The staff issued RAI 09.02.05-9 requesting the applicant to specify the margins.

In its response to RAI 09.02.05-9, dated April 26, 2010 (ML101190118), the applicant provides additional information about the system design margin, including specific margins for procurement specifications of major system components. The applicant also indicates that the design values specified in the FSAR are based on the most limiting input parameters. For example, the performance of the RSW heat exchanger is based on accident heat loads with a performance margin of 20 percent for fouling. The NPSH available for the UHS is based on equipment, piping, and components assumed to be in their most fouled or degraded conditions, and the total developed head (TDH) calculation required for the UHS is based on cold water cases that maximize the service water density.

The applicant's response to the RAI also states that the RSW system is integral to the UHS and relies on three major components to transfer heat from the RCW heat exchangers to the UHS: the RSW system pumps, the RCW system heat exchangers, and the UHS cooling towers. The applicant also states in the RAI response that the RSW self-cleaning strainers are also of interest due to the increased pressure drop experience across the component with an increase in debris accumulation. The applicant provides the following information about the design process and preliminary design margins for these components.

The RSW system pumps will be specified with an additional 10 percent margin for the TDH and flow rate above the required values using the most limiting input parameters. A minimum available NPSH was also determined using the most limiting parameters and conservatively reduced by 10 percent for the RSW pump procurement.

The stated capacities of the RSW system heat exchangers in FSAR Table 9.2-4d, "Design Characteristics for Reactor Building Cooling Water System Components," are based on accident loads and provide a performance margin of 20 percent to allow for fouling.

The RCW system UHS cooling tower total head load for the most bounding RSW division was considered in determining the required cooling tower range (the difference between the hot water inlet temperature and the cold water outlet temperature). The selected range of 8 °Celsius (46 °Fahrenheit)) in FSAR Subsection 9.2.5.6, "Evaluation of UHS Performance (Interface Requirements)," bounds the required cooling tower range. The divisional heat transfer capacities of the UHS cooling tower will be specified to be greater than the divisional heat transfer capacities of the RCW heat exchangers, which preserve the 20 percent margin of the RCW heat exchangers.

The RSW system hydraulic calculations assume a conservative RSW system strainer differential pressure.

The applicant also states that in addition to applying a margin during the design phase, the RSW system performance will be monitored to ensure that system components are in an adequate operating condition and a significant margin exists to perform their safety function. The applicant proposed revising FSAR Subsections 9.2.5.6 and 9.2.15.2.3 to include an additional discussion on margins associated with the UHS and RWS system designs. As part of the response to RAI 09.02.05-9, the applicant included a markup of those subsections.

The staff reviewed the applicant's response to RAI 09.02.05-9 and found it acceptable, because the applicant's design requirements are based on evaluations that took into consideration component and system degradation based on industry experience. The applicant also provides an additional margin of 10 to 20 percent in the specified requirements for the major RCW and RSW components. Therefore, RAI 09.02.05-9 is resolved. The staff confirmed that COL FSAR Revision 4, Subsections 9.2.5.6 and 9.2.15.2.3 were revised as committed to in the RAI response. Therefore, RAIs 09.02.05-3 and 09.02.05-9, are resolved and closed.

In its response to RAI 09.02.05-4, dated August 28, 2009 (ML092450155), the applicant clearly restates the minimum water level required to operate for 30 days on a consistent basis in the COLA. In this response, the applicant proposed changes to Figure 1.2-35, "UHS Tower Sections," in Tier 2, Chapter 21, "Large-Scale Drawings," and Subsection 9.2.5.7.1, "Thermal Performance." With these changes, the application consistently reports the same minimum water level for the UHS basin. Thus, the staff found the response acceptable and RAI 09.02.05-

4 is resolved. The staff confirmed that COL FSAR Revision 4, Figure 1.2-35 was revised as committed to in the RAI response. Therefore, RAI 09.02.05-4 is resolved and closed.

3. "The UHS is sized so that makeup water is not required for at least 30 days following an accident and design basis temperature and chemistry limits for safety-related equipment are not exceeded."

The COLA addresses the water temperature interface requirement but did not demonstrate that the water chemistry is acceptable after 30 days of water loss without makeup. The staff issued RAI 09.02.05-5 requesting the applicant to address this interface requirement in the COLA.

In its response to RAI 09.02.05-5, dated August 28, 2009 (ML092450155), the applicant states that through the procurement process the applicant will obtain UHS equipment that is designed to operate using the worst projected water that might exist in the UHS after 30 days of operation without makeup. The applicant also states that the heat loads will be lower at the end of this time period, so the potential fouling will not cause the system to operate without significant margin. The staff found this response inadequate because the applicant included no calculations to demonstrate that the design can accommodate the potential change in the water chemistry. The applicant also failed to provide an estimate of the water chemistry that might be obtained after 30 days of evaporation. The staff issued RAI 09.02.05-10, requesting the applicant to demonstrate that the final design can successfully operate with the worst possible water chemistry.

In its response to RAI 09.02.05-10, dated February 18, 2010 (ML100550029), the applicant provides UHS water chemistry analysis results for 30 days of operation without makeup. The applicant states that their specifications will specify that RSW equipment are able to perform their safety function for the estimated chemistry conditions for the 30 days of operation. The staff reviewed the applicant's response and found it acceptable, because the applicant has provided the requested water chemistry information and is including it in the equipment procurement specification. The procurement of RSW equipment based on the applicant's water chemistry information will ensure that the RSW system is designed to successfully operate under the worst water chemistry case possible that might exist in the UHS after 30 days of operation. Therefore, RAI 09.02.05-10, RAI 09.02.05-5, and RAI 09.02.05-10 are resolved and closed.

4. "The UHS is designed to perform its safety function during periods of adverse site conditions, resulting in maximum water consumption and minimum cooling capability."

The COL applicant identifies from the Victoria, Texas, weather database the worst 30 consecutive days of meteorological data for use in determining the water usage rate of the UHS. The database covers a 45-year historical period and is consistent with the guidance in RG 1.27. The applicant has also identified two sources of water to supply the UHS past the initial 30 days, which is consistent with RG 1.27. The primary water source is well water, and the secondary water source is the main cooling reservoir. Therefore, the staff found the information acceptable and this interface requirement satisfied. The design of the UHS needs to enable operation under all anticipated conditions. The COLA addresses how the RSW pumps are protected from large debris that can end up in the service water basin, either from makeup water sources or due to basin or cooling tower degradation, and how clogging due to silt accumulation will be prevented in accordance with Information Notice (IN) 2006-017, "Recent Operating Experience of Service Water Systems Due to External Conditions," dated July 31, 2006. FSAR Subsection

9.2.5.5.2(5) states that the UHS basin includes a lip to minimize ingestion of silt from the basin. FSAR Subsection 9.2.5.5.2(7) states that a perforated plate is installed above the intake to prevent ingestion of large debris. However, FSAR Section 9.2.5, "Ultimate Heat Sink," did not discuss the specific problems of biological fouling, corrosion, and erosion of the UHS components. These problem areas are specifically addressed in NRC Generic Letter (GL) 1989-013, "Service Water System Problems Affecting Safety-Related Equipment." The staff issued RAI 09.02.05-6, requesting the applicant to address these issues.

In its response to RAI 09.02.05-6, dated August 28, 2009 (ML092450155), the applicant identifies the various sections in the current COLA that address the specific problems of biological fouling, corrosion, and erosion of the UHS components. The applicant directs the staff to particular sections in Tier 2, Sections 9.2.5, "Ultimate Heat Sink," 9.2.15, "Reactor Service Water System," and 9.2.17, "COL License Information," which discuss the testing programs and chemical treatments that are in place to address the issues raised in NRC GL 1989-013. The staff found this response acceptable, and no changes to the COLA are necessary. Therefore, RAI 09.02.05-6 is resolved and closed.

5. "The UHS is designed to withstand the most severe natural phenomenon or site-related event (e. g., Safe Shutdown Earthquake, tornado, hurricane, flood, freezing, spraying, pipe whip, jet forces, missiles, fire, failure of non-Seismic Category I equipment, flooding as a result of pipe failures or transportation accident), and reasonably probable combinations of less severe phenomena and/or events, without impairing its safety function."

FSAR Subsection 9.2.5.7.2, "Effects of Severe Natural Events or Site-Related Events," states that the UHS basin, cooling tower, and RSW pump house are designed to Seismic Category I and can thus withstand an SSE. The three cooling divisions are separated by concrete walls to prevent a common mode failure such as a fire. The HVAC inlets and outlets for the pump houses are protected from tornado-driven missiles. The UHS is protected from floods and from the failure of the main cooling reservoir embankment. The UHS is protected against freezing because the basins are partially below ground. The UHS operations allow for bypassing the cooling towers in the event of cold ambient temperatures. Because the UHS is in service under all operational modes, freezing is not possible with this bypass. Therefore, the staff concluded that this interface requirement is met.

6. "The safety-related portion of the UHS is designed to perform its required cooling function assuming a single active failure in any mechanical or electrical system."

As stated in DCD Section 9.2.5, the UHS is connected to three cooling divisions, and any two are sufficient to provide the required cooling after the DBA. Each division resides on a separate emergency electrical bus. Thus, the staff determined that the cooling system is demonstrated to perform its required cooling function assuming a single active failure in any mechanical or electrical system. Therefore, the staff concluded that this interface requirement is met.

7. "The UHS is designed to withstand any credible single failure of man-made structural features without impairing its safety function."

FSAR Subsection 9.2.5.7.2, "Effects of Severe Natural Events or Site-Related Events," states that in the case of a main cooling reservoir embankment breach, the UHS structure is designed to withstand the dynamic and hydrostatic forces caused by a flood wave propagating from the

reservoir for the duration of the postulated accident. Also, FSAR Subsection 9.2.5.6, "Evaluation of UHS Performance (Interface Requirements)," states that the UHS can withstand the failure of any single component. The UHS is arranged in three divisions, and only two are required to successfully operate after any accident. Thus, the staff concluded that this interface requirement is met.

8. "All safety-related heat rejection systems are redundant so that the essential cooling function can be performed even with the complete loss of one division. Single failures of components in electrical systems may lead to the loss of the affected pump, valve or other components and the partial or complete loss of cooling capability of that division but not of other divisions."

The staff reviewed the safety-related heat rejection systems described in the DCD and the COLA, including the RCW system, and the RSW system. Both the RCW and RSW are composed of three mechanically and electrically independent divisions, each powered by a different division of the emergency safety features (ESFs) power system. Any two divisions are sufficient to provide the required cooling after the DBA. Therefore, in the event of a complete loss of one division of a safety-related heat rejection system, the system remains capable of performing its design cooling function. Based on this review, the staff determined that this interface requirement is met.

9. "The UHS and any pumps, fans, valves, structures, or other components that remove heat from safety systems are designed to Seismic Category I and ASME Code, Section III, Class 3, Quality Assurance B, Quality Group C, IEEE-379, IEEE-603, and IEEE-308 requirements."

The proposed design meets the requirements of Seismic Category I quality group and ASME code requirements, as stated in DCD Tier 2 Table 3.2-1, "Classification Summary," and in COL FSAR Subsection 9.2.5.7.2, "Effects of Severe Natural Events or Site-Related Events." The COLA states that the UHS design will meet Institute of Electrical and Electronics Engineers (IEEE) Standard (Std)-308, "Criteria for Class 1E Power Systems for Nuclear Power Generation Stations," by using class 1E electrical supplies. The COLA also states that the UHS design will meet the single failure requirements, which are defined in IEEE Std-379, Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems," and IEEE Std-603, "Criteria for Safety Systems for Nuclear Power Generating Stations." It should be noted that the ABWR DCD cites IEEE Std-279, "Criteria for Protection Systems for Nuclear Power Generating Stations," in this interface requirement, and the STP COLA replaces this standard with IEEE Std-379 and IEEE Std-603. This replacement is discussed in Departure STD DEP 1.8-1. Based on this review, the staff concluded that this update of the standard is appropriate. Therefore, the staff concluded that this interface requirement is met.

10. "The safety-related portions of the UHS are mechanically and electrically separated. The UHS is arranged in three divisions. Active components within each division are powered by their respective Class 1E divisions. Each division is physically separated and electrically independent of the other divisions."

The staff's review of the COLA found that the UHS design satisfies this interface requirement and will be verified by ITAAC 3.0-1.3. The ITAAC items are reviewed in further detail below. Therefore, the staff found that this interface requirement is met.

11. “The UHS is designed to include the capability for full operational inspection and testing.”

FSAR Subsection 9.2.5.3.1, “General Description,” states that the UHS system allows for periodic pressure and functional testing. Subsection 14.2.12.1.77, “Automatic Power Regulator Preoperational Test,” describes the Preoperational Test Program. COLA Part 9, “Inspection Tests Analysis and Acceptance Criteria,” identifies additional tests. The drawings in FSAR Chapter 21, “Large Scale Drawings,” indicate that sufficient space is available for the inspections and tests. Subsections 16.3.7.1, “Reactor Building Cooling Water (RCW) System, Reactor Service Water (RSW) System and Ultimate Heat Sink (UHS) – Operating,” and 16.3.7.2, “Reactor Building Cooling Water (RCW) System, Reactor Service Water (RSW) System and Ultimate Heat Sink (UHS) - Shutdown,” present surveillance requirements (SRs) that require daily inspections in all modes (except for conditions when the reactor head is off, the water gate to the drier storage pool is open, and the reactor flange is covered by greater than 7 m of water). The staff found that this interface requirement is satisfied.

The COL applicant adds two additional interface requirements for the UHS design beyond what was specified in the Tier 2 ABWR DCD Subsection 9.2.5.1, “Safety Design Bases (Interface Requirements).” These cover the aspects of the Tier 1 interface requirements in ABWR DCD Tier 1, Section 4.1 that are not explicitly covered in the above interface requirements.

12. “In the event of loss of preferred power source, the UHS is designed to be powered by the onsite emergency power system.”

FSAR Table 8.3-1, “D/G Load Table—LOCA + LOPP,” shows that the three diesel generator (DG) emergency power buses provide power to the three independent UHS trains (including the cooling tower fan, the HVAC fan, and the RSW pumps). Section 9.2.5 also states that the UHS is powered by the emergency power system. The staff found that this interface requirement is met.

13. “UHS System Divisions A and B components have control interfaces with the remote shutdown system (RSS) as required to support UHS operation during RSS design basis conditions.”

FSAR Subsection 9.2.5.9, “Instrumentation and Alarms (Interface Requirements),” of the COLA states that Divisions A and B of the UHS will have controls available in the RSS, which is also required by ITAAC 3.0-1.4. COLA Part 9 states that Figure 3.0-1, “UHS and Reactor Service Water System,” illustrates where the controls are sent. FSAR Subsection 9.2.5.9 states that the controls for Divisions A and B are treated differently from the controls for Division C. However, Figure 3.0-1 does not specify where the displays and controls are sent. Because there is only a single figure, there is an implied assumption that all three divisions are treated in a similar fashion, which is not consistent with Tier 2 Section 9.2.5. Finally, the acceptance criteria for ITAAC 3.0-1.4 state that the controls will exist in the main control room (MCR), and does not validate their existence in the RSS. The staff issued RAI 09.02.05-7, requesting the applicant to include more details in the ITAAC section, and to ensure that these details are consistent with the design presented in Tier 2 Section 9.2.5.

In its response to RAI 09.02.05-7, dated August 28, 2009 (ML092450155), the applicant refers to ABWR DCD Tier 2 Figure 7.3-7, “Reactor Building Cooling Water System IBD (Sheets 1–19),” as showing that the controls for all three divisions of the UHS will be available in the MCR. The applicant’s response identifies ABWR DCD Subsection 7.4.1.4.4, “Remote Shutdown

Capability Controls and Instrumentation–Equipment, Panels, and Displays," as defining the controls and instrumentation that are available in the RSS. Finally, the RAI response proposed modifications to ITAAC Item 4 of Table 3.0-1 in the COLA Part 9, Section 3 to more clearly define the locations of controls and displays of the various UHS divisions. The staff found that the RAI response clearly identified where in the COLA the requested information can be found. The staff also found that the proposed modification to the ITAAC item clearly stated that the displays and controls of the UHS system exist in the MCR for all three divisions, and the displays and controls for Divisions A and B exist in the remote shutdown system. The staff has confirmed that ITAAC Item 4 of Table 3.01-1 in the COLA Part 9, Section 3, Revision 4, was revised as committed to in the RAI response. Therefore, RAI 09.02.05-7 is closed.

As stated above, ABWR DCD, Tier 1, Section 4.1 provides additional interface requirements for the UHS that are incorporated by reference into the Tier 1 COL FSAR. They are reproduced here in quotes followed by the staff's review of each item:

a) "Provide cooling water to the RSW System for normal plant operation and to permit safe shutdown and cooldown of the plant and maintain the plant in a safe shutdown condition for design basis events."

This is equivalent to Item 1 in the COL FSAR Subsection 9.2.5.1, "Safety Design Bases (Interface Requirements)," list provided above and is therefore acceptable.

b) "Makeup water for the UHS shall not be required for at least 30 days following a design basis accident."

This is equivalent to Item 3 in the COL FSAR Subsection 9.2.5.1 list provided above and is therefore acceptable.

c) "Any active safety-related system, structure, or components within the UHS shall have three divisions powered by their respective Class 1E divisions. Each division shall be physically separated and electrically independent of the other divisions."

This is similar to Item 8 in the COL FSAR Subsection 9.2.5.1 list provided above and more specifically identifies the number of trains. The staff's review determined that the design in the COLA meets this interface requirement.

d) "UHS System Divisions A and B components shall have control interfaces with the Remote Shutdown System (RSS) as required to support UHS operation during RSS design basis conditions."

This is equivalent to Item 13 in the COLA FSAR Subsection 9.2.5.1 list provided above and is therefore acceptable.

e) "Be classified as Seismic Category I."

This is a subset of Item 9 in the COLA FSAR Subsection 9.2.5.1 list provided above and is therefore acceptable.

ITAAC

The ITAAC items for the UHS are discussed in Part 9 of the COLA. The first item in Table 3.0-1 requires the as-built UHS to conform to Figure 3.0-1 in Part 9, which is a functional arrangement diagram of the UHS. Item 2a requires an inspection to assure that the RSW pump suction line is correctly placed in the UHS basin. Item 2b requires the UHS basin to contain sufficient water above the RSW suction line to remove the anticipated heat loads for 30 days without makeup. Item 3 requires inspections and tests to assure that the three UHS divisions are physically separated and powered on independent electrical buses. Item 4 requires inspections to assure that the displays and controls for the UHS exist in the MCR and in the RSS. Item 5 requires a structural analysis to be performed to demonstrate that the UHS can withstand the design-basis loads. The NRC found that these ITAAC items are sufficient to verify that the as built UHS is consistent with the approved UHS design with the following exception:

The acceptance criteria for Item 4 only require that the displays and controls be available in the MCR and does not specify any RSS operability of the UHS. This item also implies that all three trains of the UHS are treated identically, and yet the Tier 2 documentation indicates that the train C control is significantly different. The staff issued RAI 09.02.05-7 requesting the applicant to include more details in the ITAAC section and to ensure that these details are consistent with the design described in Tier 2 Section 9.2.5.

As discussed above, in its response to RAI 09.02.05-7, dated August 28, 2009 (ML092450155), the applicant modifies Item 4 of Table 3.0-1 in the COLA Part 9 Section 3 to more clearly define the locations of controls and displays of the various UHS Divisions. Thus, RAI 09.02.05-7 is resolved and closed.

Based on a detailed review of FSAR Tier 1 Table 3.0-1, the staff found the proposed ITAAC appropriate because the ITAAC will adequately verify the capabilities, design features, and systems interfaces of the UHS design.

Tier 1 Departure

- STD DEP T1 2.14-1 — Hydrogen Recombiner Requirements Elimination

This departure results in the elimination of the flammability control system that was called for in the ABWR DCD. The staff reviewed Departure STD DEP T1 2.14-1 and determined that the only impact of this departure on the UHS system is the removal of that system from the heat load required to be serviced. This is reflected in changes to Tables 9.2.4a “Reactor Building Cooling Water Division A,” through 9.2.4.c, “Reactor Building Cooling Water Division C.” Therefore, the staff found this departure acceptable in regards to its impact on the UHS.

Tier 2 Departure*

- STD DEP 1.8-1 — Tier 2* Codes, Standards, and Regulatory Guide Edition Changes

The staff reviewed this departure, which updated the references to more current revisions/editions of codes and standards. In FSAR Section 9.2.5, “Safety Design Basis,” the reference to IEEE Std-279 is replaced with a reference to IEEE Std-603. This change is a departure from Tier 2* information and thus requires NRC review and approval. IEEE Std-279 addresses considerations such as design bases, redundancy, independence, single failures,

qualifications, bypasses, status indication, and testing. IEEE Std-603, "Criteria for Safety Systems for Nuclear Power Generating Stations," has since superseded IEEE Std-279. The guidance in IEEE Std-603 is endorsed by RG 1.153 "Criteria for Safety Systems," and incorporates the guidance of IEEE Std-279. Therefore, the staff found the proposed departure acceptable.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.2-1 Reactor Building Cooling Water System

The staff reviewed Departure STD DEP 9.2-1 in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5.b. This departure increases the heat removal capabilities of the RCW system to account for fouling. These changes add margin to the system and are not safety-significant because they do not affect the performance requirements of the system.

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

- STD DEP 9.2-5 Reactor Service Water System

The staff reviewed Departure STD DEP 9.2-5 in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5.b. This departure revises the RSW design flow rate specified in the ABWR DCD in order for the site-specific RSW system to accomplish its safety and power generation design basis. This departure is largely the result of Departure STD DEP 9.2-1, which increased the capacity of the RCW heat exchangers to provide additional heat removal capability and an increased margin due to fouling and other requirements. The staff found this departure acceptable in terms of its impact on the UHS system. The impact of the departure on the RSW system is evaluated in Section 9.2.15 of this SER.

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

9.2.5.5 *Post Combined License Activities*

In addition to the site specific ITAAC items provided in Table 3.0-1, "Ultimate Heat Sink (UHS)," of Part 9 of the COLA, the applicant must also satisfy the acceptance criteria in Table 3.0-5, "Reactor Service Water System (RSW)".

9.2.5.6 *Conclusion*

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the UHS. There is no outstanding information expected to be addressed in the COL FSAR related to this section.

In addition, the staff reviewed the design information provided to address DCD interface requirements and the Tier 1 and Tier 2* departures against the relevant NRC regulations and the guidance in Section 9.2.5 of NUREG-0800. The staff's review concluded that the applicant has provided the information specified by the referenced DCD relating to the UHS and justified the Tier 1 and Tier 2* departures, in accordance with the requirements in 10 CFR Part 50, Appendix A, GDC 2, 5, 44, 45, and 46.

Furthermore, the staff found it 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.

9.2.6 Condensate Storage Facility

See SER Section 9.2.9, "Makeup Water Condensate System," of this report.

9.2.7 Chilled Water System

See SER Section 9.2.12, "HVAC Normal Cooling Water System," and Section 9.2.13, "HVAC Emergency Cooling Water System."

9.2.8 Makeup Water Preparation System

9.2.8.1 *Introduction*

The makeup water preparation system (MWPS) is a nonsafety-related system that supplies water to the makeup water (purified) (MUWP) system and other systems. The MWPS consists of both mobile and permanently installed water treatment systems. The permanently installed system consists of wells, filters, reverse osmosis (RO) modules, and demineralizers that prepare demineralized water from well water. Much of the MWPS is located in the makeup water preparation (MWP) building, which does not contain any safety-related SSCs. Other parts of the MWPS are located in outdoor areas, including the well water storage tank/basin, the filtered water storage tank, the demineralized water prover tanks, and the demineralized water storage tanks.

9.2.8.2 *Summary of Application*

Section 9.2.8 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.8 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.2.8, the applicant provides the following:

Tier 2 Departures Not Requiring NRC Approval

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

This departure changes the design from a single unit to dual units (STP, Units 3 and 4).

- STP DEP 9.2-2 Makeup Water Preparation System

This departure primarily involves increased flow rates and storage capacities to accommodate two units.

COL License Information Items

ABWR DCD Subsections 9.2.8.5, "Evaluation of Makeup Water System Preparation Performance (Interface Requirements)," and 9.2.8.8, "Tests and Inspections (Interface Requirements)," identify actions for COL applicants to complete. Although these actions are not cross-referenced in DCD Tier 2 Table 1.9-1, "Summary of ABWR Standard Plant COL License Information," STP FSAR Subsections 9.2.8.5 and 9.2.8.8 appropriately identify and address the specified actions as COL license information items.

Site-Specific Information Replacing Conceptual Design Information

- STP CDI – FSAR Subsection 9.2.8.3, "System Description"
- STP CDI – FSAR Subsection 9.2.8.4, "System Operation"

Initial Test Program:

Initial Test Program information is in FSAR Subsection 9.2.8.8, "Tests and Inspections (Interface Requirements)."

ITAAC

Plant-specific ITAAC are referred to in FSAR Subsection 9.2.8.8 and are described in Part 9 of the COLA, Section 3.0 Table 3.0-3, "Makeup Water Preparation (MWP) System."

9.2.8.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

9.2.8.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.8, "Makeup Water (MWP) Preparation System," of the certified ABWR DCD. The staff reviewed Section 9.2.8 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 COL FSAR and the information in the ABWR DCD represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

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[1] 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 3 & 4

This departure changes the design from a single unit to dual units (STP Units 3 and 4).

- STP DEP 9.2-2 Makeup Water Preparation System

This departure primarily involves increased flow rates and storage capacities to accommodate two units.

The applicant's evaluations of the above departures, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that these departures do not require NRC approval. Within the review scope of this section, the staff found it 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.

COL License Information Items

- DCD Tier 2 Subsection 9.2.8.5, "Evaluation of Makeup Water System Preparation Performance (Interface Requirements)," states that "the COL applicant shall analyze the raw water quality and availability and the required makeup water quality and amounts to assure that these requirements can be met. Any deficiencies in either quality or production capability shall be met with mobile water treating systems."

This COL license information item is addressed in FSAR Subsection 9.2.8.5. This information describes to what extent a mobile water-treatment capability is needed to support full-power operation, which is not a regulatory consideration. Consequently, this information was not evaluated by the staff.

- DCD Tier 2 Subsection 9.2.8.8, "Tests and Inspections (Interface Requirements)," states that the COL applicant shall prepare and perform a Preoperational Test Program and other tests in accordance with the requirements of Chapter 14, "Initial Test Program."

This COL license information item is addressed in FSAR Subsection 14.2S.12.1.79, "Makeup Water Preparation Preoperational Test." However, because the MWPS does not perform a safety function and is not important to safety, this information was not evaluated by the staff.

Site-Specific Information Replacing Conceptual Design Information

- STP CDI – FSAR Subsection 9.2.8.3, "System Description"

- STP CDI – FSAR Subsection 9.2.8.4, "System Operation"

In FSAR Subsections 9.2.8.3, "System Description," and 9.2.8.4, "System Operation," ABWR DCD conceptual design information for the MWPS was replaced with site-specific information. The MWPS does not perform a safety function and is not important to safety. The staff's evaluation primarily focuses on confirming that MWPS failures will not adversely impact safety-related SSCs. FSAR Subsection 9.2.8.3.6 states that MWPS failures, including those that result in flooding, will not result in the failure of safety-related SSCs. However, except for the provision to enclose much of the MWPS within the MWP building, which does not contain any

safety-related SSCs, there is no discussion on what other design provisions are necessary to protect safety-related SSCs from MWPS failures that occur outside of the MWP building. For example, there are no descriptions of flood barriers and site-grading requirements that are necessary to prevent water resulting from tank/basin failures from impacting safety-related SSCs. Consequently, the staff was unable to conclude that the requirements specified by GDC 2 are satisfied. Therefore, the staff issued RAI 09.02.04-05, requesting the applicant to fully describe in the FSAR system arrangements and design provisions for protecting safety-related SSCs from MWPS failures.

In its response to RAI 09.02.04-05, dated August 26, 2009 (ML092430133), the applicant indicates that the design basis flood is a failure of the main cooling reservoir embankment and that this event encompasses all other potential flooding events, including any potential flooding due to MWPS failures. As described in FSAR Subsection 3.4.1.1, the penetrations and doors that penetrate the exterior walls of Seismic Category I buildings located below the design-basis flood level are watertight. In addition, the staff verified that the MWPS water storage tank volume is significantly smaller than the failure of the main cooling reservoir embankment as estimated in Table 2.4S.4-5, "MCR Embankment Breach Parameters and Peak Discharge Based on Empirical Equations from Reference 2.4S.4-12d." Therefore the staff found the applicant's response acceptable and RAI 09.02.04-05 is resolved and closed.

Based on the above information, the staff concluded that the MWP system meets the requirements of GDC 2 and the guidance of RG 1.29, Regulatory Position C.2, with regard to the protection of safety-related equipment from natural phenomena.

Initial Test Program:

As discussed above for the COL license information item related to DCD Tier 2 Subsection 9.2.8.5, "Evaluation of Makeup Water System Preparation Performance (Interface Requirements)," the MWPS does not perform a safety function and is not important to safety. Consequently, the Initial Test Program for the MWPS was not evaluated by the staff.

ITAAC:

In order to demonstrate that the interface requirements specified in DCD Tier 1 Section 4.3, "Makeup Water Preparation System," have been met, the applicant establishes a site-specific ITAAC for the MWPS in Part 9 of COLA Section 3, "Site-Specific ITAAC." The description in Section 3 indicates that ITAAC for the MWPS are necessary due to their "safety-related, safety-significant, or risk significant function." The MWPS is a nonsafety-related system and is based on the description in Section 9.2.8 of the FSAR. The MWPS does not perform a safety-significant or risk-significant function. Therefore, the staff issued RAI 09.02.04-06, requesting the applicant to revise Part 9 of COLA Section 3 accordingly.

The ITAAC specified in COLA Part 9 Table 3.0-3, "Makeup Water Preparation System (MWP)," establishes a design requirement for the MWPS to provide a sufficient quantity and quality of makeup water to meet plant demands during normal operation. Because the MWPS is not safety-related and does not perform any functions that are important to safety, establishing an ITAAC to demonstrate the functional capability of the MWPS is not warranted or appropriate. The functional capability of nonsafety-related systems is typically confirmed by the Initial Test Program specified in Chapter 14, "Initial Test Program," of the FSAR. However, in accordance with the requirements specified in 10 CFR 52.47(a)(26) and 10 CFR 52.80(a), ITAAC should be

established to demonstrate that MWPS arrangement and design features that are necessary to ensure that MWPS failures will not impact safety-related SSCs are properly implemented. Therefore, the staff issued RAI 09.02.04-07 requesting the applicant to revise Part 9 of COLA Table 3.0-3, "Makeup Water Preparation (MWP) System," accordingly.

In its revised responses to RAI 29.02.04-06 and RAI 09.02.04-07, dated December 28, 2009 (ML093631615), the applicant provided the site-specific ITAAC established for the MWPS. This response supersedes the previous responses provided on August 20, 2009 (ML092360771).

In its revised response to RAI 09.02.04-06 and RAI 09.02.04-07, the applicant proposed to revise ITAAC in order to more closely align the ITAAC wording with the MWPS interface requirement wording in ABWR DCD Tier 1 Section 4.3. The response states that the site-specific ITAAC established in Part 9 of the COLA for the MWPS was intended to demonstrate that the interface requirements specified in ABWR DCD Tier 1 Section 4.3 are met. Thus, although the MWPS function to provide plant makeup water is not safety-related, important to safety, or risk significant, an ITAAC is retained for the MWPS because ABWR DCD Tier 1 Section 4.3 explicitly discusses the MWPS function as an interface requirement. Therefore, the applicant retained and revised the ITAAC established for the MWPS in Table 3.0-3 of Part 9 of the COLA, Revision 3. The staff determined that the revised ITAAC wording adequately addresses the MWPS interface requirement in ABWR DCD Tier 1 Section 4.3 and that the revised ITAAC are adequate to ensure that STP, Units 3 and 4, will provide demineralized water to the MUWP. The staff has confirmed that Table 3.0-3 in the COLA Part 9, Section 3, Revision 4 was revised as committed in the RAI response. Therefore, RAIs 09.02.04-6 and 09.02.04-07 are resolved and closed.

9.2.8.5 *Post Combined License Activities*

The applicant will satisfy the acceptance criteria in site specific ITAAC (Table 3.0-3, "Makeup Water Preparation (MWP) System ") described in Part 9 of the COLA.

9.2.8.6 *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 the MWPS. 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 Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the MWPS that were incorporated by reference have been resolved.

In addition, the staff compared the additional COL License information and site-specific design information in the application to the relevant NRC regulations. The staff's review concluded that the applicant has provided the required information relating to the MWPS in accordance with the requirements in 10 CFR Part 50, Appendix A, GDC 2, and 10 CFR 52.80(a).

Furthermore, the staff found it 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.

9.2.9 Makeup Water Condensate System

9.2.9.1 *Introduction*

This section of the FSAR addresses the Makeup Water Condensate (MUWC) system which provides condensate quality water for the reactor core isolation cooling (RCIC) pumps, control rod drive (CRD) pumps, high pressure core flooder (HPCF) pumps, suppression pool cleanup (SPCU) pumps, and MUWC transfer pumps. In addition, the MUWC system serves as a receiver for excess water generated by the MWP pumps, CRD system, radioactive waste disposal system, and condensate demineralizer system effluent. Normally information related to the condensate storage facilities is in Section 9.2.6, consistent with the numbering of SRP 9.2.6, "Condensate Storage Facilities." However, descriptive information related to the MUWC system is in Section 9.2.9, "Makeup Water Condensate System," of the Tier 2 ABWR DCD and Section 9.2.9 of the Tier 2 STP COL FSAR. For consistency, the NRC evaluation of the MUWC system is described here in Section 9.2.9 of this SER.

9.2.9.2 *Summary of Application*

Section 9.2.9 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.9 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A with no departures or supplements. However, as explained below, there is a Tier 2 departure that is relevant to the evaluation of the MUWC system.

Tier 2 Departures Not Requiring NRC Approval

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

The ABWR DCD is based on a single-unit site; the STP COL represents a dual-unit project. As noted in Section 9.2.9 of NUREG–1503 and in accordance with SRP Section 9.2.6, an application for a multi-unit facility requires a review of the MUWC system design for compliance with GDC 5, "Sharing of Structures, Systems, and Components," given that the ABWR is designed as a single-unit facility. The applicant addresses the dual-unit configuration by means of this departure.

9.2.9.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the MUWC, and the associated acceptance criteria, are in Section 9.2.6 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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.

9.2.9.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.9 of the certified ABWR DCD. The staff reviewed Section 9.2.9 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 appropriately represents the complete scope

of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring NRC Approval.

As previously discussed, it is necessary to review the design for compliance with GDC 5, given that the application is for a multi-unit facility, whereas the certified ABWR design represents a single unit design.

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

The staff reviewed departure STP DEP 1.1-2, which refers to the dual unit configuration of the plant. In accordance with SRP Section 9.2.6, the staff's review focused on compliance with GDC 5. As described in Section 3.0 of the STP COL "Departures Report," each unit has a separate MUWC system, including a separate condensate storage tank (CST). A common MWP system provides the source of water for each unit's CST. Each CST has sufficient capacity to provide at least 8 hours of makeup inventory during a station blackout. The adequacy of the CST capacity is discussed in Section 9.2.9 of NUREG–1503.

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 was unable to determine whether it is reasonable for this departure not to require prior NRC approval. The STP COL FSAR does not explicitly indicate whether there are any cross-connections between the MUWC systems for each unit. If a cross-connection were to exist, it might be possible for a rupture of components (e.g., tank, piping) in one unit to drain condensate inventory from the other unit. Accordingly, the staff issued RAI 09.02.06-01, requesting the applicant to describe any cross-connections between the separate MUWC systems, and if any cross-connections exist, to explain how it is assured that rupture of components in one unit will not drain condensate inventory from the other unit.

In its response to RAI 09.02.06-1, dated August 20, 2009 (ML092360771), the applicant states that the unit-specific MUWC systems for STP, Units 3 and 4, do not have any cross-connections. The staff concurred with the applicant's confirmation that no cross-connections exist between the MUWC systems of the two units and the unit-specific MUWC systems are independent. The staff therefore found the departure acceptable with regard to the requirements of GDC 5, as it relates to the MUWC system design, and RAI 09.02.06-1 is resolved and closed.

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 found it reasonable that this departure does not require prior NRC

[1] 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.

approval. In addition, the applicant's process for evaluating departures and changes to the DCD is subject to NRC inspections.

9.2.9.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.2.9.6 *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, 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 Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the MUWC system that were incorporated by reference have been resolved.

The staff's review concluded that the application conforms to the requirements of GDC 5 as it relates to the MUWC system design, and found it reasonable that the Tier 2 Departure STP DEP 1.1-2 is characterized as not requiring prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5.

9.2.10 Makeup Water Purified System

9.2.10.1 *Introduction*

This section of the FSAR addresses information related to the ABWR makeup water purified system.

9.2.10.2 *Summary of Application*

Section 9.2.10 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.10 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.2.10, the applicant provides the following:

Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This departure reflects the elimination of the requirement to maintain equipment needed to mitigate a design-basis LOCA hydrogen release.

9.2.10.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the makeup water purified system, and the associated acceptance criteria, are given in Section 9.2.6 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 1 departure. Tier 1 departures require prior NRC approval and are subject to the requirements of 10 CFR Part 52 Appendix A, Section VIII.A.4.

9.2.10.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.10 of the certified ABWR DCD. The staff reviewed Section 9.2.10 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

The applicant included Departure STD DEP T1 2.14-1 in Section 9.2.10. This departure has administrative impacts on Section 9.2.10 (figures, tables). The detailed technical evaluation of this Tier 1 departure is addressed in Section 6.2, "Containment Systems," of this SER.

9.2.10.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.2.10.6 *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, 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 makeup water purified system that were incorporated by reference have been resolved.

9.2.11 Reactor Building Cooling Water System

9.2.11.1 *Introduction*

This section of the FSAR addresses the system that removes heat from plant auxiliaries and transfers it to the UHS through the RSW system. Essential equipment serviced by the RCW system includes RHR, the EDGs, the HVAC emergency water cooling (HEWC) system. FSAR information and reviews associated with the auxiliary cooling water systems are normally located in Section 9.2.2, consistent with the numbering of SRP Section 9.2.2, "Reactor Auxiliary Cooling Water System." However, descriptive information related to the RCW system is in Section 9.2.11, "Reactor Building Cooling Water System," of the Tier 2 ABWR DCD and in Section 9.2.11, "Reactor Building Cooling Water System," of the Tier 2 STP COL FSAR. For

[1] 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.

purposes of consistency, the staff's evaluation of the RCW system is described here in Section 9.2.11 of this SER.

9.2.11.2 *Summary of Application*

Section 9.2.11 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.11 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with the following departures:

Tier 1 Departure

- STD DEP T1 2.14-1 — Hydrogen Recombiner Requirements Elimination

This departure eliminates the flammability control system that was called for in the ABWR DCD.

Tier 2 Departure*

- STD DEP 1.8-1 — Tier 2* Codes, Standards, and Regulatory Guide Edition Changes

This departure updated the references to more current revisions or editions of codes and standards.

Tier 2 Departures Requiring Prior NRC Approval

The following departures affect TS and require prior NRC approval.

- STD DEP 16.3-16 — LCO 3.7.1, Reactor Building Cooling Water (RCW) System, Reactor Service Water (RSW) System, and Ultimate Heat Sink (UHS) - Operating and LCO 3.7.2, RCW/RSW System and Ultimate Heat Sink (UHS) – Shutdown and LCO 3.7.3, RCW/RSW System and UHS Refueling
- STD DEP 16.3-46 — LCO 3.7.2, RCW, RSW, and UHS Applicability

These departures eliminate some LCO items and alter some wording in the TS to be more consistent with other sections.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.2-1 — Reactor Building Cooling Water System

This departure revises the design characteristics of the RCW system and corrects inconsistencies in the system design description in Subsection 9.2.11.2, "Power Generation Design Bases," of the ABWR DCD. This departure also clarifies that all heat exchanger pumps are normally placed in operation, rather than required for shutdown cooling as stated in Subsection 9.2.11.3.2, "Safety Evaluation of Equipment," of the ABWR DCD. The major impact of this departure is an increase in heat removal capacity that results in higher performance margins.

9.2.11.3 *Regulatory Basis*

The regulatory basis for the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the RCW, and the associated acceptance criteria, are in Section 9.2.2, "Reactor Auxiliary Cooling Water System." of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 1, Tier 2* and Tier 2 departures. The Tier 1 and one Tier 2* departure require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.A.4 and Section VIII.B.6, respectively. Tier 2 departures affecting 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 not requiring 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.

In particular, the regulatory basis and review criteria for the departures are specified in Section 9.2.2 of NUREG–0800.

9.2.11.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.11 of the certified ABWR DCD. The staff reviewed Section 9.2.11 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departure

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

The staff reviewed Departure STD DEP T1 2.14-1 which eliminates the flammability control system that was called for in the ABWR DCD. The only impact of this departure on the RCW system is the removal of that system from the heat load required to be serviced by the system. The staff found the proposed departure acceptable in regards to the impact on the RCW system. This departure was also evaluated in Chapter 6, "Engineered Safety Features," of this SER.

[1] 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*

- STD DEP 1.8-1 — Codes, Standards, and Regulatory Guide Edition Changes

The staff reviewed this departure, which updated the references to more current revisions or editions of codes and standards. In FSAR Subsection 9.2.11.1.1, "Safety Design Basis," the reference to IEEE Std-279, "Criteria for Protection Systems for Nuclear Power Generating Stations," is replaced with a reference to IEEE Std-603, "Criteria for Safety Systems for Nuclear Power Generating Stations." This change is a departure from Tier 2* information and thus requires prior NRC review and approval. IEEE Std-279 addresses considerations such as design bases, redundancy, independence, single failures, qualifications, bypasses, status indication, and tests. IEEE Std-603 has since superseded IEEE Std-279. The guidance in IEEE Std-603, as endorsed by RG 1.153, "Criteria for Safety Systems," incorporates the guidance of IEEE Std-279. Therefore, the staff found the proposed departure acceptable.

Tier 2 Departures Requiring Prior NRC Approval

- STD DEP 16.3-16 — LCO 3.7.1, Reactor Building Cooling Water (RCW) System, Reactor Service Water (RSW) System, and Ultimate Heat Sink (UHS) - Operating and LCO 3.7.2, RCW/RSW System and Ultimate Heat Sink (UHS) – Shutdown and LCO 3.7.3, RCW/RSW System and UHS – Refueling

The staff reviewed Departure STD DEP 16.3-16. This departure in part deletes LCO 3.7.1C.2 and LCO 3.7.2B.2 and claims that these items are redundant with other items that are retained. The staff found that eliminating the requirements for Condition C2 may result in an interpretation of the LCO that allows a division to be out of service for SSCs for 21 days (the 7-day period to fix the first disabled unit followed by a new 14-day period to fix the second disabled unit) instead of the 14 days that is specified by Condition C2 in LCO 3.7.1 of the ABWR DCD TS. Therefore, the staff issued RAI 09.02.02-5, requesting the applicant to provide additional information confirming the validity of this departure or to remove the departure.

In its response to RAI 09.02.02-5, dated August 28, 2009 (ML092450155), the applicant cites TS Section 1.3, "Compilation Times," which establishes the Completion Time Convention for the TS. The applicable citation is: "If situations are discovered that require entry into more than one condition at a time within a single LCO (multiple Conditions), the Required Actions for each Condition must be performed within the associated Completion Time." The staff found the citation and the applicant's interpretation applicable and correct. Therefore, RAI 09.02.02-5 is resolved and closed.

- STD DEP 16.3-46 — LCO 3.7.2, RCW, RSW, and UHS Applicability

The staff reviewed Departure STD DEP 16.3-46, which alters the application of LCO 3.7.2 and 3.7.3. Because this departure clarifies the wording of the original TS, the staff found the proposed departure acceptable.

Tier 2 Departure Not Requiring Prior NRC Approval

Although there are no proposed Tier 2 departures requiring NRC review and approval ,the applicant plans to implement a Tier 2 departure that does not require NRC review and approval as permitted by 10 CFR Part 52, Appendix A, Section VIII.B.5.b. This regulation allows the applicant to depart from ABWR DCD Tier 2 information without obtaining prior NRC approval if, among other considerations, the departure does not result in more than a minimal increase in: (1) the likelihood of the occurrence or the consequences of a malfunction of a SSC important to safety, or (2) the consequences of an accident previously evaluated in the plant-specific DCD. However, in order to assure the proper implementation of this requirement, the staff evaluated the following Tier 2 departure:

- STD DEP 9.2-1 Reactor Building Cooling Water System

This departure revises the design characteristics of the RCW system and corrects inconsistencies in the system design description in Subsection 9.2.11.2, "Power Generation Design Bases," of the ABWR DCD. An additional clarification adds that all heat exchanger pumps are normally placed in operation rather than required for shutdown cooling as stated in Subsection 9.2.11.3.2, "Safety Evaluation of Equipment," of the ABWR DCD. The major impact of this departure is an increase in heat removal capacity that results in higher performance margins.

The staff reviewed Departure STD DEP 9.2-1 in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5.b. This departure does not appear to increase the likelihood or consequence of a malfunction or accident that was evaluated in the ABWR DCD within the RCW system. This conclusion results from review against the stated criteria in SRP Section 9.2.2, for compliance with GDCs 2, 4, 5, 44, 45, and 46. The primary impact of this departure on the ability of the RCW system to perform its required heat transfer function as required by GDC 44 is to increase the heat removal capability during the RHR for normal shutdown cooling and in response to a LOCA. This change is accomplished by increasing the capacity of the RCW heat exchangers. The ultimate effect of a higher heat transfer between the components being cooled and the UHS will be a smaller temperature differential. These changes add margin to the system and are not significant to safety because they do not affect the performance requirements of the system.

The staff reviewed the clarification that Departure STD DEP 9.2-1 made to FSAR Subsection 9.2.11.3.2 regarding the use of heat exchanger pumps. The staff found that the revised wording indicating that all heat exchanger pumps are normally placed in operation—rather than required for shutdown cooling—to be acceptable, because only two of the three RCW/RSW system division are needed to meet plant safe shutdown requirements as discussed in FSAR Subsections 9.2.5.7.1 "Thermal Performance" and 9.2.11.2 "System Description."

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

9.2.11.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.2.11.6 *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 relevant information relating to the RCW system and no outstanding information is expected to be addressed in the COL FSAR related to this subsection. 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 RCW system that were incorporated by reference have been resolved.

In addition, the staff compared the information in the application to the relevant NRC regulations and the guidance in Section 9.2.2 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the Tier 1, Tier 2*, and TS departures in accordance with Section 9.2.2 of NUREG–0800, and found it 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.

Based on the results of this evaluation, the staff determined that the STP, Units 3 and 4, COL FSAR is acceptable with respect to the RCW system.

9.2.12 HVAC Normal Cooling Water System (Related to RG 1.206 Section 9.2.2, "Cooling System for Reactor Auxiliaries [Closed Cooling Water System]")

9.2.12.1 *Introduction*

This section of the FSAR addresses the system that provides chilled water to the drywell cooler cooling coils and to other nonsafety-related air conditioners. The HVAC normal cooling water (HNCW) system is not a safety-related system, but it does penetrate the primary containment and does require isolation.

9.2.12.2 *Summary of Application*

Section 9.2.12 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.12 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.2.12, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.2-9 HNCW Cooling Water System

This departure revises the design characteristics of the HNCW system by increasing the return water temperature from 12 °C (53.6 °F) to 14.7 °C (58.5 °F).

- STD DEP 9.2-7 HVAC Normal Cooling Water System

This departure revises inconsistencies in the ABWR DCD and increases capacity and flow rates of the HNCW chiller.

9.2.12.3 *Regulatory Basis*

The regulatory basis for reviewing the information incorporated by reference is in NUREG–1503 and in Supplement 1. In addition, the relevant requirements of the Commission regulations for the HNCW system, and the associated acceptance criteria, are given in Section 9.2.2 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

In particular, the regulatory basis and review criteria for the Tier 2 departures are specified in Section 9.2.2, "Reactor Auxiliary Cooling Water System," of NUREG–0800.

9.2.12.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.12 of the certified ABWR DCD design. The staff reviewed Section 9.2.12 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.2-9 HNCW Cooling Water System
- STD DEP 9.2-7 HVAC Normal Cooling Water System

Section 9.2.12 of the FSAR identifies Tier 2 Departure STD DEP 9.2-9, which is identified as not requiring prior NRC review and approval as permitted by 10 CFR Part 52, Appendix A, Section VIII.B.5.b. The staff's review identified a second departure (STD DEP 9.2-7) in Chapter 3.0, "Departures Not Requiring Prior NRC Approval," of Part 7 of the COLA, which results in modifications to the HNCW system described in ABWR DCD Section 9.2.12. Departure STD DEP 9.2-7 is not referenced in FSAR Section 9.2.12, but Departure STD DEP 9.2-9 of the Departure Report provides a reference to Departure STD DEP 9.2-7, as applicable to the HNCW system.

- Departure STD DEP 9.2-7, "HVAC Normal Cooling Water System," reflects a design change to correct inconsistencies in referenced ABWR DCD Tables 6.2-9, 9.2-6, 9.2-7, and 9.4-1 and Figure 9.2-2 so that the waterside heat removal rate of the nonsafety-

[1] 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.

related HNCW system is greater than or equal to the airside cooling duty heat loads. The capacity and flow rate for each HNCW chiller are also increased to include the revised heat loads. This design change from the ABWR DCD reflects changes to the HNCW system that ensure a sufficient heat removal capability for the revised heat loads.

- Departure STD DEP 9.2-9, "HNCW Cooling Water System," revises the design characteristics of the HNCW system by increasing the return water temperature from 12 °C (53.6 °F) to 14.7 °C (58.5 °F) and by modifying HNCW equipment to reduce equipment, piping, valve sizing and electrical power for better maintainability.

The applicant's evaluations, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5, determined that these departures do not require prior NRC approval. Within the review scope of this section, the staff found it 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.

9.2.12.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.2.12.6 *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 HNCW system that were incorporated by reference have been resolved.

In addition, the HNCW design for STP, Units 3 and 4, includes Departures STD DEP 9.2-7 and STD DEP 9.2-9. The staff found it 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.

9.2.13 HVAC Emergency Cooling Water System (Related to RG 1.206 Section 9.2.2. "Cooling System for Reactor Auxiliaries [Closed Cooling Water System]")

9.2.13.1 *Introduction*

This section of the FSAR addresses the system that provides cooling water to the MCR air conditioners, RB essential electrical room coolers, and control building essential electrical equipment room coolers. This system is required to operate during normal power, reactor shutdown, and after any postulated abnormal reactor conditions including a LOCA.

9.2.13.2 *Summary of Application*

Section 9.2.13 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.13 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.2.17, the applicant provides the following:

COL License Information Item

- COL License Information Item 9.11 HECW System Refrigeration Requirements

This COL License Information Item addresses the applicant's request to provide HVAC Emergency Cooling Water (HECW) system refrigerator requirements after procuring the refrigerators.

9.2.13.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the HECW system, and the associated acceptance criteria, are given in Section 9.2.2 of NUREG–0800.

9.2.13.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.13 of the certified ABWR DCD. The staff reviewed Section 9.2.13 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the HECW.

The staff reviewed the following information in the COL FSAR:

COL License Information Items

- COL License Information Item 9.11 HECW System Refrigeration Requirements

COL License Information Item 9.11 addresses the HECW system refrigerator requirements. The DCD requests the applicant to provide specific information after procuring the refrigerators that addresses COL Information Item 9.11 and includes the following:

1. Means for adjusting refrigerator capacity to chilled water outlet temperature

2. Means for starting and stopping the pump and refrigerator in proper sequence

3. Means for reacting to a loss of electrical power for periods of up to two hours and for the automatic restarting of pumps and refrigerators, under the expected environmental conditions, during SBOs when electrical power is restored

4. Means to minimize the potential for coolant leakage or release into the system or the surrounding equipment environs

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[1] 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.

5. An evaluation of transient effects on starting and stopping or prolonged stoppage of the refrigeration/chiller units; transient effects include items such as high restart circuit drawdowns on safety buses, coolant-oil interactions, degassing needs, coolant gas leakage or release in equipment areas along with flammability threats, and synchronized refrigeration swapping

The staff reviewed the applicant's proposal using the review procedures described in Section 9.2.2 of NUREG–0800.

With regard to items (1), (4), and (5) the applicant commits (COM 9.2-2) to meet the design goal through technical requirements on the procured components. Because the design goals are not listed as an ITAAC design feature, there did not appear to be a mechanism for assuring that these requirements have been met before fuel loading. Therefore, the staff issued RAI 09.02.02-1, RAI 09.02.02-3 and RAI 09.02.02-4, requesting the applicant to justify how items (1), (4) and (5), respectively, have been satisfied.

In its response to RAI 09.02.02-1, dated August 28, 2009 (ML092450155), the applicant refers to RG 1.206 Regulatory Position C.III.4.3, which gives the COL applicant the option of describing in the application the proposed approach for addressing the COL information item in sufficient detail to support the NRC finding. The response also states that closure "can be accomplished by review of the refrigerator procurement documentation, including the procurement specification and certificate of conformance, as part of the NRC's Construction Inspection Program (CIP). The documentation would be available after refrigerator procurement, which is consistent with the COL information item as specified in the DCD." The applicant's response further states that the "schedule for procurement of equipment will be part of the master schedule, which NRC will have access to also through the CIP."

In reviewing the applicant's response to RAI 09.02.02-1, the staff agreed that the RG 1.206, Regulatory Position C.III.4.3 option (4) applies, but the staff did not believe that the applicant provided sufficient information in the FSAR to support a safety finding by the NRC. The staff believed additional detail in the response as to the CIP and the master schedule should be addressed in Section 9.2.13 of the FSAR. Therefore, the resolution of this concern was tracked by issuing RAI 09.02.02-6.

Similar to the RAI 09.02.02-1 response, the applicant's responses to RAI 09.02.02-3 and RAI 09.02.02-4 dated August 28, 2009 (ML092450155) refer to RG 1.206 Regulatory Position C.III.4.3 and did not provide sufficient information in the FSAR to support a safety finding by the NRC. The resolution of these concerns was also tracked by issuing RAI 09.02.02-6.

In its response to RAI 09.02.02-6, dated November 12, 2009 (ML093440180), the applicant initially proposed to address COL Information Item 9.11 by including additional descriptions in Subsection 9.2.17.1, "HECW System Refrigerator Requirements." The proposed revision described an option of procurement documentation review and referenced the CIP and master schedule, as means to verify the COL item is met. However, in its follow up supplemental response dated June 7, 2010 (ML101620285), the applicant instead chose to remove the CIP and master schedule reference, since the FSAR commitment already indicates that technical requirements will be included in procurement documents. The staff reviewed the applicant's response and found it acceptable since FSAR commitment (COM 9.2-2) will ensure that, prior to installation of the equipment, the technical requirements will be provided in procurement

documents. The staff confirmed that the proposed changes were included in Revision 4 of the FSAR, as committed to in the RAI response. Therefore, RAI 09.02.02-6 is resolved and closed.

With regard to item (2), the applicant commits (COM 9.2-2) to meet the design goal by producing detailed design documents that provide for starting and stopping the pump and refrigerator in the proper sequence. ITAAC Items 4, 5, and 6 in Table 2.11.6, "HVAC Emergency Cooling Water System," of the ABWR Tier 1 DCD address this design feature. Because the applicant commits to include this feature in the design and incorporates the ITAAC by reference, the staff found that the applicant has sufficiently addressed this item.

With regard to item (3), the applicant originally stated in Revision 3 of the FSAR that alternate alternating current (AAC) power provides for the automatic restart of pumps and refrigerators. The applicant was relying on the safety evaluation of Subsection 9.2.13.3, "Safety Evaluation," of Tier 2 of the DCD, which outlines the response to power interruption to further address this COL item. This DCD section, however, indicates additional requirements in Subsection 9.2.17.1, "HECW System Refrigerator Requirements," are needed to assure that "provisions will be made to assure prompt and reliable restart of the chiller units."

Also in regard to item (3), the applicant had taken an exception to the DCD COL license information item to provide an AAC design capable of reacting to the loss of electrical power for "periods up to two hours for automatic restarting of pumps and refrigerators, under the expected environmental conditions during station blackout when electrical power is restored." The staff determined the applicant needed to provide additional details to address item the (3) design goal. Therefore, the staff issued RAI 09.02.02-2 requesting the applicant to provide additional technical requirements and RAI 09.02.02-2 also requested the applicant to justify the proposed exception.

In its response to RAI 09.02.02-2, dated August 28, 2009 (ML092450155), the applicant proposed changing STP FSAR Subsection 9.2.17.1 by adding a technical requirement that the pumps and refrigerator units must be capable of automatically restarting after a loss of electrical power for up to two hours under the expected conditions during a SBO. The staff found the applicant's response acceptable because it corrects and resolves the proposed exception. The staff confirmed that the proposed FSAR changes are incorporated in the FSAR Revision 4. Therefore, RAI 09.02.02-2 is resolved and closed.

9.2.13.5 *Post Combined License Activities*

The applicant identifies the following commitment:

- Commitment (COM 9.2-2) - The following actions address COL License Information Item 9.11:

    1. Technical requirements will be provided in the procurement document for the refrigerators to ensure there are provisions for adjusting the refrigerator capacity to chilled water outlet temperature.

    2. Detailed design documents will be provided for starting and stopping the pump and refrigerator on proper sequence.

    3. Technical requirements will be provided in the procurement documents for the pumps and refrigerators to ensure that the design of the pumps and refrigerators

are capable of automatic restart, after a loss of electrical power for up to two (2) hours, under the expected environmental conditions during a SBO when electrical power is restored.

4. Technical requirements in the procurement documents will include national standards for design, fabrication, and testing to minimize the potential for coolant leakage or release into system or surrounding equipment environs.

5. Technical requirements will be provided in the procurement documents for evaluation of transient effects on starting and stopping or prolonged stoppage of the refrigeration/chiller units. These requirements will consider effects such as high restart circuit draw downs on safety buses, coolant-oil interactions, degassing needs, coolant gas leakage, or release in equipment areas along with flammability threats and synchronized refrigeration swapping.

9.2.13.6 *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 the HECW system, 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 HECW system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.2.2 of NUREG–0800. The staff's review concluded that the application has adequately addressed COL license Information Item 9.11 in accordance with the relevant guidance in Section 9.2.2 of NUREG–0800. The staff also found that the applicant has provided adequate information to address the COL license information item 9.11 and demonstrates compliance with NRC regulations.

9.2.14 Turbine Building Cooling Water System

9.2.14.1 *Introduction*

This section of the FSAR addresses the system that provides cooling water for various turbine island auxiliary equipment items. The turbine building cooling water (TBCW) system is a nonsafety-related system.

9.2.14.2 *Summary of Application*

Section 9.2.14 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference, Section 9.2.14 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.2.14, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 9.2-3 Turbine Building Cooling Water System

This departure increases the heat removal capacity of the three TBCW system heat exchangers from 68.7 giga joules per hour (GJ/h) to 114.5 GJ/h (65.1 million British Thermal Units per hour [MBTU/h] to 108.5 MBTU/h) and the flow rates of the three pumps from 3,405 cubic meters per hour (m^3/h) to 4,550 m^3/h (14,993 gallons per minute [gpm] to 20,035 gpm). These changes were made to accommodate larger heat loads due to additional pumps and a larger, nonessential chiller in the turbine building.

9.2.14.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the TBCW system, and the associated acceptance criteria, are in Section 9.2.2 of NUREG–0800.

In particular, the regulatory basis and review criteria that the staff used for the Tier 2 departure described above are specified in Section 9.2.2 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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.

9.2.14.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.14 of the certified ABWR DCD. The staff reviewed Section 9.2.14 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the TBCW.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 9.2-3 Turbine Building Cooling Water System

The applicant states that this departure does not require NRC review and approval, in accordance with the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.5. The staff reviewed Departure STP DEP 9.2-3, which increases the heat removal capacity of each of the three TBCW system heat exchangers from 68.7 GJ/h to 114.5 GJ/h (65.1 MBTU/h to 108.5

[1] 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.

MBTU/h) and the flow rates of each of the three pumps from 3,405 m^3/h to 4,550 m^3/h (14,993 gpm to 20,035 gpm). The TBCW system is not safety related, is not required for a safe shutdown, and provides no safety function used to mitigate the consequences of any accident. In addition, the proposed departure has no impact on the safety analysis of the plant.

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

9.2.14.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.2.14.6 *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 TBCW system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.2.2 of NUREG–0800. The staff's review concluded that the applicant has provided adequate information to satisfy the criteria specified in Section 9.2.2 of NUREG–0800, and found it reasonable that the identified Tier 2 departure is adequately characterized as not requiring prior NRC approval, per 10 CFR Part 52, Appendix A, Section VIII.B.5.

9.2.15 Reactor Service Water System

9.2.15.1 *Introduction*

This section of the FSAR addresses the system that provides cooling water to the RCW system (described in Section 9.2.11, "Reactor Building Cooling Water System," of this SER) for distribution to numerous safety-related and non-safety related loads. The RSW system removes heat from the RCW and transfers it to the UHS (described in Section 9.2.5, "Other Auxiliary Systems," of this SER). The RSW is required to operate at normal power, reactor shutdown, hot standby, and after a postulated LOCA. Under each of these conditions the RSW is required to function both with and without preferred AC power available and with a single active failure. FSAR information and reviews associated with station service water systems are normally located in Section 9.2.1, consistent with the numbering of the SRP Section 9.2.1, "Reactor Service Water System." However, information related to the STP COL RSW system are located in Section 9.2.15, of the Tier 2 STP COL FSAR and referenced to Section 9.2.15, "Reactor Service Water System," of the Tier 2 ABWR DCD. For purposes of consistency, this section (Section 9.2.15) of the SER describes the staff's evaluation of the RSW system.

9.2.15.2 *Summary of Application*

The ABWR DCD includes only those portions of the RSW system in the control building (CB) in the scope of the ABWR Standard Plant. However, as required by 10 CFR Part 52, the DCD provides a conceptual design and interface requirements for those portions of the RSW system considered to be site-specific. In Revision 12 of the FSAR, the COL applicant incorporates by reference Section 9.2.15, "Reactor Service Water System," of the certified ABWR DCD, with several departures from the DCD for those portions of the design within the scope of the ABWR Standard Plant, described in FSAR Subsection 9.2.15.1, "Portions within the Scope of the ABWR Standard Plant." STP COL FSAR Subsection 9.2.15.2, "Portions Outside the Scope of ABWR Standard Plant," provides the supplemental information, including interface requirements, related to the site-specific design of the RSW outside of the CB.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure*

- STD DEP 1.8-1 — Tier 2* Codes, Standards, and Regulatory Guide Edition Changes

This departure updated the references to more current revisions or editions of codes and standards.

Tier 2 Departures Requiring Prior NRC Approval

The following departures affect TS and require prior NRC approval.

- STD DEP 16.3-16 — LCO 3.7.1, Reactor Building Cooling Water (RCW) System, Reactor Service Water (RSW) System, and Ultimate Heat Sink (UHS) - Operating and LCO 3.7.2, RCW/RSW System and Ultimate Heat Sink (UHS) – Shutdown and LCO 3.7.3, RCW/RSW System and UHS- Refueling
- STD DEP 16.3-46 — LCO 3.7.2, RCW, RSW, and UHS Applicability

These departures eliminate some LCO items and alter some wording in the TS for consistency with other sections. The review of the above two TS departures is addressed in Section 9.2.11, "Reactor Building Cooling Water System," of this SER.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.2-5 — Reactor Service Water System

This departure revises the RSW design flow rate specified in the ABWR DCD in order for the site-specific RSW system to accomplish its safety and power generation design basis. This departure is largely the result of Departure STD DEP 9.2-1, reviewed in Section 9.2.11 of this SER, which increases the capacity of the RCW heat exchangers to provide additional heat removal capability and increased margin allowances for fouling and other requirements.

COL License Information Item

- COL License Information Item 9.12 Reactor Service Water System Requirements

In addition, in FSAR Subsection 9.2.17.2, "Reactor Service Water System Requirements," the applicant addressed COL License Information Item 9.12, identified in the DCD Tier 2, Table 1.9-1, "Summary of ABWR Standard Plant COL License Information." Further detail on COL License Information Item 9.12 is in DCD Subsection 9.2.17.2 with the following individual requirements:

- RSW/UHS water testing and visual inspection.
- RSW pump operational rotation.
- RSW biocide treatment.
- Biocide treated potable water for RSW flushing.
- RSW biocide treatment for layup of other systems.
- Emergency procedure guidelines.

Interface Requirements

The applicant provides supplemental information to address RSW interface requirements with the certified design on safety design bases, power generation design bases, safety evaluation, instrumentation and alarms, and tests and inspections.

9.2.15.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the RSW system, and the associated acceptance criteria, are in Section 9.2.1 of NUREG–0800.

In particular, the regulatory basis and review criteria that the staff used for the Tier 2* and Tier 2 departures and COL license information described above are specified in Section 9.2.1 of NUREG–0800. Within the scope of SRP Section 9.2.1, the staff's acceptance of the RSW design is based on meeting the requirements of GDC 2, 4, 5, 44, 45, and 46.

In addition, in accordance with 10 CFR Part 52 Appendix A, Section VIII, the applicant identifies Tier 2* and Tier 2 departures. 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 not requiring 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 of 10 CFR 50.59.

9.2.15.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.15 of the certified ABWR DCD. The staff reviewed Section 9.2.15 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 appropriately represents the complete

scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure*

- STD DEP 1.8-1 — Tier 2* Codes, Standards, and Regulatory Guide Edition Changes

This departure updated the references to more current revisions/editions of codes and standards. In FSAR Subsection 9.2.15.1.1, "Safety Design Basis," the reference to IEEE Std-279, "Criteria for Protection Systems for Nuclear Power Generating Stations," is replaced with a reference to IEEE Std-603, "Criteria for Safety Systems for Nuclear Power Generating Stations." This is a departure from Tier 2* information and thus requires prior NRC review and approval. IEEE Std-279 addresses considerations such as design bases, redundancy, independence, single failures, qualifications, bypasses, status indication, and tests. IEEE Std-603 has since superseded IEEE Std-279. The guidance in IEEE Std-603, as endorsed by RG 1.153, "Criteria for Safety Systems," incorporates the guidance of IEEE Std-279. Therefore, the staff found the proposed departure acceptable.

Tier 2 Departure Not Requiring Prior NRC Approval

Although no Tier 2 departures requiring prior NRC review and approval are proposed, the applicant plans to implement a Tier 2 departure that does not require prior NRC review and approval, as permitted by 10 CFR Part 52, Appendix A, Section VIII.B.5.b. This section of 10 CFR Part 52 contains eight criteria that, if satisfied, allow the applicant to depart from the ABWR DCD Tier 2 information without obtaining prior NRC approval. In order to assure that this requirement is being properly implemented, the staff evaluated the following Tier 2 departure:

- STD DEP 9.2-5 — Reactor Service Water System

The primary reason for this departure is to increase the RSW design flow rate specified in the ABWR DCD, in order for the site-specific RSW system to accomplish its safety and power generation design basis. This departure is largely the result of Departure STD DEP 9.2-1, which is reviewed in Section 9.2.11 of this SER. This departure increases the capacity of the RCW heat exchangers to provide additional heat removal capability and increases margin allowances for fouling and other requirements. Increasing the RSW flow rate increases RSW system pipe sizes, as shown in Tier 2 FSAR Figure 9.2-7, Sheets 1-3, "Reactor Service Water System P&ID," and increases the RSW flow rate per pump, as shown in Tier 2 Table 9.2-13, "Reactor Service Water System (Interface Requirements)." These increases in pipe size and flow rate per pump result in an increased flow to the RCW heat exchangers to accommodate the increased RCW heat removal requirements resulting from Departure 9.2-1.

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[1] 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.

This departure also provides additional site-specific information by adding or revising inservice testing (IST) requirements for several RSW system valves. These IST valve revisions are in Table 3.9-8, "Inservice Testing Safety-Related Pumps and Valves."

This departure also changes the design parameters for the RSW pumps, piping, and valves (Table 9.2-13, "Reactor Service Water System (Interface Requirements)") due to the changes in configuration of the UHS, which is reviewed in Section 9.2.5 of this SER. These design parameters provide specific site information for the RSW system.

The increase in RSW pipe sizes and flow rates could also result in an increase in the amount of flooding in the CB should an RSW pipe fail in the CB. However, the applicant concludes that the existing separation of each RSW division and the design interlocks to trip the RSW pump and isolate the failed RSW piping can mitigate this impact. In addition, safety-design basis Interface Requirement 5 in COL FSAR Subsection 9.2.15.2.1 (reviewed below) requires an analysis of the flood level in the CB in the event of an RSW line break and a single active failure. A corresponding ITAAC requires the acceptance of the flooding calculation and verification by testing. In Section 3.4.1, "Flood Protection," of this SER, the staff evaluates this departure against flooding criteria requirements. In the staff's review of Section 3.4.1, the staff issued RAI 03.04.01-4 requesting the applicant to provide sufficient information to demonstrate that the RSW modifications will not result in more severe internal flooding consequences than previously assumed. The staff's review of the applicant's response to RAI 03.04.01-4, is in Section 3.4.1 of this SER.

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

Interface Requirements

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.15 of the certified ABWR DCD. However, the certified ABWR DCD required the COL applicant to provide site-specific design information for those portions of the RSW system outside of the CB. The DCD also identified a number of interface requirements to be addressed by the COL applicant. FSAR Revision 3, Subsection 9.2.15.2 addresses the site-specific information, including the interface requirements evaluated by the staff (see below).

Safety Design Bases (Interface Requirements)

In Tier 2 Subsection 9.2.15.2.1 of the COL FSAR, seven interface items address requirements from DCD Tier 2, Subsection 9.2.15.2.1, "Safety Design Bases (Interface Requirements)." The seventh item addresses requirements from DCD Tier 1 Section 2.11.9, "Reactor Service Water." The staff's review of each interface item is provided below:

1. In this interface requirement, the Tier 2 DCD required the COL applicant to provide the temperature increase and pressure drop across the RCW heat exchangers, which receive cooling water from the RSW system. In FSAR Revision 2 Subsection 9.2.15.2.1, Item 1, the applicant referenced Table 9.2-4d, "Design Characteristics for Reactor Building Cooling Water System Components," which only provides the heat exchanger design temperature (71 °C [159.8 °F]) and not the required temperature increase.

However, this information (temperature increase) is in Table 9.2-17, "Design Data for Reactor Service Water," so the reference to Table 9.2-4d appeared to be incorrect. Also, the applicant failed to provide the pressure drop across the heat exchangers, but did make a commitment to provide this information in Table 9.2-17 following procurement but before the installation of equipment. The staff issued RAI 09.02.01-4, requesting the applicant to provide the required temperature increase and pressure drop across the RCW heat exchangers cooled by the RSW system.

In its response to RAI 09.02.01-4, dated September 8, 2009 (ML092530407), the applicant stated that the referenced table for the temperature increase in the RSW heat exchanger was incorrect and should be (as stated in the above staff review), Table 9.2-17 rather than Table 9.2-4d. The applicant also provided a markup of Revision 2 of COL FSAR Subsection 9.2.15.2.1, "Safety Design Bases (Interface Requirements)," to include the correct table reference. Additionally, the applicant indicated that the required RCW heat exchanger pressure drop will be available after the award of the RCW heat exchanger procurement and the receipt of the final vendor drawings. The RCW heat exchanger pressure drop data will be available per the Current Design Report Date in Table 1 of RAI 3.09.03-3. The staff found both the proposed revision to Subsection 9.2.15.2.1 and the proposed future inclusion of the RCW heat exchanger pressure drop acceptable. The staff confirmed that the proposed changes have been incorporated in the FSAR, Revision 4. Therefore, RAI 09.02.01-4 is resolved and closed.

The design parameters provided by the applicant and those to be provided in response to RAI 09.02.01-4, will need verification through a site-specific ITAAC item before plant startup. The ABWR DCD, Tier 1 Section 2.11.9, provides the ITAAC within the certified design. The applicant provides additional site-specific ITAAC in Part 9 of the COLA to address site-specific design information. The staff reviewed the site-specific ITAAC in COLA Part 9, Table 3.0-5, "Reactor Service Water." The performance of the RSW system will be validated through ITAAC 3.0-5, Item 3(d).

2. In this interface requirement, the Tier 2 DCD directs the COL applicant to provide the required and available NPSH data for the RSW pumps at the site-specific pump suction locations considering anticipated low water levels. Item 2 in Subsection 9.2.15.2.1 of the COL FSAR states that the available NPSH data referenced to the pump center line is approximately 17 m (55.65 ft) considering all losses. The required NPSH data are not provided, but the applicant made a Commitment (COM 9.2-1) to provide this information in Table 9.2.17 following RSW pump procurement, but before installation. The staff issued RAI 09.02.01-5, requesting the applicant to provide the required NPSH for the RSW pumps.

   In its response to RAI 09.02.01-5, dated September 8, 2009 (ML092530407), the applicant states that the RSW pump procurement documents will specify that for all RSW pump operating modes the NPSH at pump centerline shall be less than the available NPSH. This data will be available after receipt of final vendor drawings and data. No COLA change was proposed in the response to RAI 09.02.01-5, but the applicant committed to including it as part of its response to RAI 03.09.03-3.

   The applicant also stated the response to RAI 09.02.01-5 that the design specifications for the RSW pump will be available per the Current Design Report Date in Table 1, "Risk Significant Components," of RAI 3.09.03-3 for the staff to audit. During a staff audit

conducted from January 18 to 20, 2011 (ML112440665), the staff reviewed the design specification documents for the RSW pumps. Refer to Section 3.9.3 of this SER for a full description and evaluation of the design specification for the RSW pumps.

The staff found the applicant's response to RAI 09.02.01-5, acceptable because the procurement specification will specify that the NPSH for the RSW pump will be less than the available NPSH to ensure that the available NPSH will be adequate for RSW pump operation. The staff also found the proposed commitment (COM 9.2-1) will ensure that prior to installation of the equipment, the pressure drop for the RB cooling water heat exchanger and the NPSH for the RSW pump will be determined. In addition, in its response to RAI 09.02.01-6, dated September 8, 2009 (ML092530407), the applicant includes a site-specific ITAAC item to verify, through tests and verification, the NPSH requirements for the RSW pumps. The proposed NPSH ITAAC is included in a Table 3.0-5 markup of the COLA Part 9. The staff reviewed the proposed site-specific ITACC and found it acceptable because it requires verification through inspection, testing, and analysis that the RSW pump NPSH requirements are met. The staff confirmed that the information has been incorporated into the FSAR, Revision 4. Therefore, RAI 09.02.01-5 and RAI 09.02.01-6 are resolved and closed.

3. In this interface requirement, the Tier 2 DCD directs the COL applicant to provide the location of the RSW pump house. Item 3 in Subsection 9.2.15.2.1 of the COL FSAR states that the STP, Units 3 and 4, RSW pump houses are contiguous with the UHS basins that are located directly south of the RB. The staff found that this information adequately designates the location of the pump house. Site-specific ITAAC Item 1 in Tier 1, Table 3.0-5 will verify the configuration of the RSW pump house.

4. In this interface requirement, the Tier 2 DCD directs the COL applicant to address design features of the site-specific RSW system to meet the requirements in DCD Subsection 9.2.15.1.1(3), approved by the NRC in NUREG–1503. These requirements are: (1) each RSW division shall be mechanically and electrically separated from other divisions; (2) for structures housing RSW components, there shall be inter-divisional boundaries (walls, floors, doors, and penetrations) that have a three-hour fire rating; and (3) each division is protected from flooding, spraying, steam impingement, pipe whip, jet forces, missiles, fire from other divisions, and the effects from the failure of any non-Seismic Category 1 equipment, as required.

   Item 4 in Subsection 9.2.15.2.1, of the COL FSAR provides design information indicating that the site-specific RSW system components meet those specified interface requirements. The staff found this information acceptable.

   The staff found that site-specific ITAAC Items 3a, b, c, and e Table 3.0-5 of Part 9 of the COLA, address the verification of the mechanical and electrical separation requirements, as well as the physical separation by structural boundaries with a three-hour fire rating.

5. In this interface requirement, the Tier 2 DCD directs the COL applicant to ensure by analysis that an RSW pipe break and a single active failure will not result in flooding that exceeds 5.0 m (16.37 ft) in an individual RCW heat exchanger room of the CB.

   Item 5 in Subsection 9.2.15.2.1, of the COL FSAR indicates that a calculation will be performed taking into account the longest distance from the RSW pump house and the

CB, with an RSW line break in any RCW heat exchanger room and an active component failure, to show that the flood level in the CB will not exceed 5.0 m (16.37 ft). The staff also verified that Item 2 in the COLA Part 9, Table 3.0-5 is a site-specific ITAAC that requires accurate sizing of each RSW division, in addition to acceptance of a flood calculation and testing of the RSW water level switches to verify actuation in the event of a pipe break with increasing water levels. Item 7 in Table 3.0-5 tests other components in each division that must actuate upon receipt of a signal indicating flooding in the tested division. The staff found that this interface requirement has been met and the ITAAC exists to verify through analysis and testing the flood control design of the RSW system.

6. In this interface requirement, the Tier 2 DCD directs the COL applicant to provide RSW system low point drains and high point vents. Additionally, all divisions are to be maintained full of water to prevent water hammer when not in service, except during maintenance. Item 6 in Subsection 9.2.15.2.1 of the COL FSAR meets the DCD requirement for low point drains, vents, and maintenance of the system full of water for water hammer prevention. The applicant however did not appear to identify that operating procedures will be prepared and approved for filling, draining, and maintaining the RSW system full of water to prevent the occurrence of a water hammer event. SRP Section 9.2.1, Section III.5 recommends these operating procedures in addition to the design of drains and vents. Therefore, the staff issued RAI 09.02.01-7, requesting the applicant to specify in the FSAR the development and use of specific operating procedures for draining, filling, and operating the RSW full of water, except when undergoing maintenance, to prevent the occurrence of a water hammer event in the system.

   In its response to RAI 09.02.01-7, dated September 8, 2009 (ML092530407), the applicant states that Subsection 13.5.3.4.5, "System Operating Procedures," of the COL FSAR specifies the development and use of operating procedures for filling, draining, and operating the RSW full of water. In order to clarify the use of these operating procedures for the prevention of water hammer events, the applicant proposed a markup of this section of the COL FSAR to show the intent to prevent the occurrence of water hammer. The proposed markup is included in the applicant's response to this RAI. The staff found that the proposed future inclusion of this update to the COL FSAR adequately addresses the concerns raised in this RAI. The staff confirmed that COL FSAR, Revision 4, Subsection 13.5.3.4.5, was revised as committed to in the RAI response. Therefore, RAI 09.02.01-7 is resolved and closed.

7. In this interface requirement, the applicant addresses additional interface items for the RSW beyond what is specified in Tier 2 ABWR DCD Subsection 9.2.15.2.1. The following interface requirements from DCD Tier 1, Section 2.11.9 are first listed in italics and then followed by the staff's evaluation:

   a) Each RSW division is powered by its respective Class IE division. In the RSW system, independence is provided between Class 1E divisions, and between Class 1E divisions and non-Class 1E equipment.

      As stated in the COL FSAR Tier 2, Subsection 9.2.15.2.3, "System Description," each RSW system division is mechanically and electrically separated from other divisions and each division is powered from its respective Class 1E division. The

RSW does not provide cooling to non-safety loads; therefore, there is no non-class 1E equipment in the RSW. The staff found that site-specific ITAAC Items 3 a, 3b, and 3c, in Part 9, Table 3.0-5 of the COLA address verification of the electrical separation requirements of the RSW.

b) RSW System Divisions A and B components have control interfaces with the RSS as required to support RSW operation during RSS design basis conditions.

Subsection 9.2.15.2.5, "Instrumentation and Alarms," describes the RSW system operating logic for design basis conditions. For a LOCA, all standby pumps and standby valves open and blowdown isolation valves close. If a loss of offsite power occurs during the LOCA, the pumps are momentarily stopped until transfer to the standby diesel-generator power is achieved. Site-specific ITAAC Items 4 and 5 of Part 9, Table 3.0-5 of the COLA address testing of these required actions and the control room displays and controls.

c) If required by the elevation relationships between the UHS and the RSW system components in the CB, the RSW system shall have anti-siphon capability to prevent a CB flood after an RSW system break and after the RSW pumps have been stopped.

The COLA in FSAR Subsection 9.2.15.2.1, states that the anti-siphon capability is not required for STP. However, the COLA did not provide sufficient information support this conclusion. Although site elevation data in the DCD and COLA drawings were reviewed, the staff was unable to find sufficient data on these drawings to verify that elevations of the RCW heat exchanger room in the CB and the water levels in the UHS/RSW intake are in a configuration to prevent the siphoning that would lead to a CB flood after an RSW system pipe break. Therefore, the staff issued RAI 09.02.01-8 requesting the applicant to provide a specific basis such as the listing of and evaluation of site elevations or other design features that would lead to the conclusion that anti-siphon capability is not required to prevent a CB flood after an RSW system break and after the RSW pumps have been stopped.

In its response to RAI 09.02.01-8, dated September 8, 2009 (ML092530407), the applicant includes a rationale for not providing anti-siphon capability referencing various sections that form the technical basis for the applicant's decision. FSAR Section 19R4.4, "Control Building," indicates that drainage of the UHS through the RSW to the RSW/RCW rooms is possible as evidenced by the elevation relationships between the UHS/RSW pumps shown in Figures 1.2-35, "UHS Tower Sections," and 1.2-36, "RSW Pumphouse, Tunnel Plans and Sections." Flood level detection, with redundant sensors, provides alarms and an automatic trip of the affected RSW pumps, as well as closure of the associated RSW isolation valves in the event that a pipe break occurs in an RSW division. The original concept in the DCD was for a vertical RSW pump configuration, in which case anti-siphon measures would be appropriate. However, the applicant's design for STP, Units 3 and 4, utilizes horizontal centrifugal pumps below the water surface elevation of the UHS basin, negating the need for anti-siphon measures. The design for potential flood mitigation is further described in the applicant's COL FSAR, Chapter 3, and in Departure STD DEP 19R-1. Upon

review of the applicant's response to this RAI and the referenced design material in the COL FSAR, the staff concurred that anti-siphon measures are not required for the STP design. The staff found the response satisfactory; therefore, RAI 09.02.01-8 is resolved and closed.

d) Tunnel structures used to route RSW system piping to the CB shall be classified as Seismic Category I. Tunnel flooding due to site flood conditions shall be precluded.

The COLA in FSAR Subsection 9.2.15.2.1 states that portions of the RSW system located outside of the CB, including tunnel structures used to route RSW system piping to/from the CB, will be designed for extreme natural phenomena such as earthquakes, tornados, and flooding (GDC 2). The safety evaluation of the piping and structures for RSW is addressed in Section 3.8.4, "Other Seismic Category 1 Structures" of this SER.

Power Generation Design Bases (Interface Requirements)

In Tier 2 Subsection 9.2.15.2.2 of the COL FSAR, four interface items address requirements from DCD Tier 2 Subsection 9.2.15.2.2, "Power Generation Design Bases (Interface Requirements)."

1. In this interface requirement, Tier 2 DCD Subsection 9.2.15.2.2(1) requires the RSW system to be able to function during abnormally high or low water levels, and steps are taken to prevent organic fouling of the system, including trash racks and provisions for biocide treatment. Thermal backwashing will be provided where infestations of microbial growths can occur.

   FSAR Subsection 9.2.15.2.2, provides the site-specific information related to this interface requirement, specifically for operations during abnormally high or low water levels and the use of biocide treatments. However, this section makes no statement concerning the inclusion of trash racks in the design. The staff noted that DCD Subsection 9.2.5.5.2 (7), states that a perforated plate is installed above the intake to prevent the ingestion of large debris. Subsection 9.2.15.2.2 of the COL FSAR should also have included a discussion of this design feature and how operations prevent the occurrence of organic fouling of the system. Therefore, the staff issued RAI 09.02.01-9, requesting the applicant to provide further information addressing DCD power generation interface requirement (1) of Tier 2 DCD Subsection 9.2.15.2.2 concerning design features and activities to prevent organic fouling of the RSW system.

   In its response to RAI 09.02.01-9, dated September 8, 2009 (ML092530407), the applicant provides the technical basis for not including trash racks and thermal backwashing in the design. The applicant also proposed a COLA revision to clarify the design. Because the primary makeup for the RSW/UHS cooling water is from wells and not from a river or other body of water, trash racks are not deemed necessary because well water will not contain debris that could damage the system. Additionally, in lieu of thermal backwashing, chemical treatment of the UHS basin water will be utilized to control microbial growth. The applicant attached a proposed revision to Tier 2 Subsection 9.2.15.2.2(1) to clarify the STP Units 3 and 4 design regarding trash racks and thermal backwashing. The staff found the applicant's response acceptable. . The

staff confirmed that this information has been incorporated in the FSAR, Revision 4. Therefore, RAI 09.02.01-9 is resolved and closed.

2. In this interface requirement, Tier 2 DCD Subsection 9.2.15.2.2(2) requires system components and piping materials to be compatible with site cooling water to minimize corrosion. Adequate corrosion and safety factors are to be used to assure system integrity over the life of the plant. The staff reviewed the COLA and found that the applicant has adequately addressed this interface requirement.

3. In this interface requirement, Tier 2 DCD Subsection 9.2.15.2.2(3) states that heat removal requirements for the RCW system are in Table 9.2-4d. The staff reviewed the COLA and found that the applicant has adequately addressed this interface requirement.

4. In this interface requirement, Tier 2 DCD Subsection 9.2.15.2.2(4) requires that potable water be provided to flush the service water side of the RCW heat exchanges, whenever they are to be put into a wet standby condition. The staff reviewed the COLA and found that the applicant has adequately addressed the provision of potable water, as described in FSAR Subsection 9.2.4.1.3.

Safety Evaluation (Interface Requirements)

FSAR Subsection 9.2.15.2.4 addresses interface requirements from DCD Tier 2 Subsection 9.2.15.2.4, "Safety Evaluation (Interface Requirements)." This interface requirement states that analyses shall show that requirements in Subsections 9.2.15.1.1(3) and 9.2.15.2.1(5) are met. These sections address the following:

- 9.2.15.1.1(3): This requirement is the same as the Safety Basis Interface Requirement (4) in FSAR Subsection 9.2.15.2.1, which the staff analyzes in the Safety Basis Interface Requirement evaluation of this SER section. This interface requirement states that: (1) each RSW division shall be mechanically and electrically separated from other divisions; (2) for structures housing RSW components there shall be interdivisional boundaries (walls, floors, doors, and penetrations) that have a three-hour fire rating; and (3) each division is protected from flooding, spraying, steam impingement, pipe whip, jet forces, missiles, fire from other divisions, and the effect of failure of any non-Seismic Category 1 equipment, as required.

- 9.2.15.2.1(5): Analysis of the RSW pipe break with a single active component failure shows that maximum flooding will not exceed 5.0 m (16.4 ft) in any individual RCW heat exchanger room of the CB. This requirement is the same as the Safety Basis Interface Requirement (5) in FSAR Subsection 9.2.15.2.1, which the staff analyzes in the Safety Basis Interface Requirement evaluation of this SER section.

The staff found that the applicant has adequately addressed both of the above interface requirements in the FSAR Safety Basis Interface Requirements evaluation, including the site-specific ITAAC in Part 9 of the COLA.

Instrumentation and Alarms (Interface Requirements)

FSAR Subsection 9.2.15.2.5 addresses interface requirements from DCD Tier 2 Subsection 9.2.15.2.5, "Instrumentation and Alarms (Interface Requirements)." This interface requirement states that all RSW pumps shall stop and all automatic isolation valves outside of the CB shall

close upon receipt of a high water level signal in the RCW heat exchanger room in the affected division. Additionally, the requirement states that operators will periodically clean strainers to maintain low differential pressures and that high differential pressure is alarmed in the control room. The staff reviewed FSAR Subsection 9.2.15.2.5, and found that the applicant has adequately addressed this interface requirement.

Tests and Inspections (Interface Requirements)

FSAR Subsection 9.2.15.2.6, addresses interface requirements from DCD Tier 2 Subsection 9.2.15.2.6, "Tests and Inspections (Interface Requirements)." This interface requirement states that tests shall assure, under conditions as close as is practical, the performance of the full operating sequence of the RSW system, including bringing the system into operation for a reactor shutdown and for a LOCA. This requirement also includes operation of the applicable portions of the reactor protection system and transfer between normal and standby power sources. The staff reviewed FSAR Subsection 9.2.15.2.6, and found the applicant's commitment to these test requirements. The staff found this commitment acceptable.

COL License Information Item

- COL License Information Item 9.12 Reactor Service Water System Requirements

FSAR Subsection 9.2.17.2 provides the information to address COL License Information Item 9.12, "Reactor Service Water Requirements." The staff reviewed the application to determine the acceptability of this design information. Each of the six provisions of COL License Information Item 9.12 is addressed below:

1. Item 1 provides for periodically analyzing RSW water and substrate and/or periodically inspecting the intake structure for bio fouling and the removal of any accumulations detected. The staff found FSAR Subsection 9.2.17.2(1) acceptable.

2. Item 2 provides for full flow testing of redundant and infrequently used cooling loops. FSAR Subsection 9.2.17.2(2) indicates that there are no infrequently used cooling loops. The RSW pumps are to be rotated so that pumps will be in service at a frequency of no less than 3 months. Pump operations will be equalized over time, with full flow achieved for one pump in each cooling loop during normal operations. FSAR Subsection 9.2.15.2.3, indicates that the operating time of each RSW pump is monitored, allowing the operator to take actions to equalize the run time for pumps in the same division. The staff found that the FSAR adequately addresses this COL license information item.

3. Item 3 provides for continuous biocide treatment of the RSW system. The Tier 2 description of this feature indicates that biocide treatment is implemented using an intermittent injection upstream of the RSW pump. The staff found this information acceptable.

4. Item 4 provides for filling the RSW system cooling loops with biocide-treated water before layup. The staff found the Tier 2 provisions acceptable. The application indicates that the plant-specific provisions are to include biocide-treated potable water for flushing the RSW system cooling loops whenever they are to be put into a wet standby condition. Methods and procedures will be developed for these activities. The staff found that the FSAR adequately addresses this COL license information item.

5. Item 5 provides biocide treatments for other systems, such as fire protection, which use RSW as a source of water. The COLA states that because the RSW does not provide a source of water for any other systems, these provisions are not applicable. The staff found that the FSAR adequately addresses this COL license information item.

6. Item 6 provides an Emergency Procedure Guideline (EPG) to backup the RSW system leak detection instrumentation and automatic actions by manual operator actions that include local and manual valve closures. The application commits (COM 9.2-4) to develop the appropriate EPG before fuel loading to identify the manual operator actions required if a leak is detected and the affected RSW division is automatically tripped and isolated. The staff found this information acceptable.

Under the ABWR DCD TS in Section 16.1.1, "COL Information Required for Plant Specific Technical Specifications," where the detailed design is required to establish the information to be specified in TS, a "[ ]" is noted and the COL applicant is to provide the required information to complete the plant-specific TS. The staff reviewed the DCD TS applicable to the RSW system. The applicable TS sections are LCOs 3.7.1, 3.7.2, 3.7.3, "Reactor Building Cooling Water System and Reactor Service Water and Ultimate Heat Sink for Modes 1, 2 & 3 (LCO 3.7.1), 4 and 5 Shutdown (LCO 3.7.2) and Refueling (LCO 3.7.3)."

In the first two SRs associated with each of these three TS LCOs as noted by a "[ ]," the COL applicant is required to provide SR data on the required water level in the UHS spray pond, as well as the water level in each RSW pump well of the intake structure. The staff found that the COLA includes these data. The UHS water level is required to be ≥ 19.28 m (63.12 ft) and the water level in the RSW pump well is required to be ≥ 0.91 m (2.98 ft). The term "[spray pond]" and "[spray network]" in the DCD was identified for the COLA to clarify in the plant-specific Technical Specifications. The COLA also includes the appropriate terminology as required. The staff determined that the applicant has satisfactorily addressed RSW COL License Information Item 16.1.

During the review of the DCD and COLA TS for each of the applicable RSW LCOs, the staff noted a discrepancy for which the COL applicant does not identify a supplement or departure in the COLA. The TS in the COLA have an additional SR that is not found in the DCD TS. COL TS SRs 3.7.1.4, 3.7.2.4 and 3.7.3.4 state, "Operate each cooling tower cell fan for ≥ 15 minutes" on a 31-day frequency. There did not appear to be an explanation for this additional SR in the COLA, nor was there a supplement or departure in the COLA Departures Report. This concern was addressed in RAI 16-8, which was resolved and closed as discussed in Section 16.4.10.1 of this SER.

Initial Test Program

The staff reviewed the COLA Initial Test Program, Chapter 14.0, against the ABWR DCD Initial Test Program, including COL license information items. The COLA incorporates the Initial Test Program with no departures. There are no COL license information items related to the RSW system.

ITAAC

The staff reviewed the COLA site-specific ITAAC using detailed review guidance and checklists from SRP Section 14.3. This review includes a review of the site-specific ITAAC information in Part 9 Section 3 of the COLA that was not included as part of the DCD. Additionally, the staff's

review included verification that the ITAAC appropriately considered the interface requirements included in the referenced DCD.

The staff's review of DCD Tier 1 and Tier 2 identified interface requirements for the RSW in this section of the report and evaluated the site-specific ITAAC for each requirement. As noted above, RAI 09.02.01-6 requested the applicant to provide the required ITAAC to verify, through an ITAAC test and verification, the NPSH requirements for the RSW pumps. As noted above, this RAI was resolved by the applicant's response to RAI 9.2.15-06.

Using SRP Section 14.3 Appendix D, "ITAAC Checklist Examples for Fluid Systems," the staff evaluated the DCD ITAAC combined with the site-specific ITAAC in COLA Part 9, Table 3.0-5, "Reactor Service Water System," to determine whether the applicant has provided acceptable ITAAC for the design. Other than the one RAI identified above, the staff determined that the ITAAC is sufficient for the RSW.

9.2.15.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.2-3) – Develop appropriate methods for biocide treatment of the layup following equipment procurement and develop applicable procedures before fuel loading.
- Commitment (COM 9.2-4) – Develop the appropriate EPG before fuel loading to identify the operator actions (manual) required if a leak is detected and the affected RSW division is automatically tripped and isolated.
- Demonstrate satisfactory compliance with acceptance criteria in ITAAC Table 3.0-5 for the Reactor Service Water System.

9.2.15.6 *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 RSW system. 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 RSW system that were incorporated by reference have been resolved.

The staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.2.1 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information item in accordance with the relevant guidance in Section 9.2.1 of NUREG–0800, and found it 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. The staff also found that the applicant has provided adequate information to address the COL license information item and demonstrates compliance with NRC regulations.

9.2.16 Turbine Service Water System

9.2.16.1 *Introduction*

This section of the FSAR addresses the nuclear power plant's turbine service water (TSW) system. The TSW system provides cooling water to the turbine cooling water (TCW) system heat exchangers to transfer heat from the TCW system to the power cycle heat sink. The TSW system is required to operate during normal and shutdown conditions. FSAR information and reviews associated with station service water systems are normally located in Section 9.2.1 and are consistent with the numbering in SRP Section 9.2.1, "Station Service Water System." However, information related to the STP COL TSW system is in Section 9.2.16, "Turbine Service Water System," of the Tier 2 STP COL FSAR and references Section 9.2.16, "Turbine Service Water System," of the Tier 2 ABWR DCD. For purposes of consistency, the staff's evaluation of the TSW system is described in this SER section.

9.2.16.2 *Summary of Application*

The ABWR DCD included only those portions of the TSW system in the turbine building that were within the scope of the ABWR standard plant design. However, as required by 10 CFR Part 52, the DCD provided a conceptual design and interface requirements for those portions of the TSW system considered to be site-specific.

Section 9.2.16 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.2.16 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Section 9.2.16, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.2-10 Turbine Service Water System

This departure revises the TSW system design parameters to reflect the site-specific information and design information specific to the conceptual design of those parts of the system outside of the turbine building.

Site Specific Information Replacing Conceptual Design Information

In Subsections 9.2.16.2.3.1, "General Description," through 9.2.16.2.3.3, "System Operation," the applicant provides additional information regarding the description and operation of the TSW system to replace the conceptual design information in the ABWR DCD.

Interface Requirements

The applicant provides supplemental information to address TCW interface requirements with the certified design on safety design bases, power generation design bases, safety evaluation, instrumentation and alarms, and tests and inspections.

9.2.16.3 *Regulatory Basis*

The regulatory basis for the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements for the Commission's regulations and the associated acceptance criteria for reviewing supplemental information are in Section 9.2.1 of NUREG-0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

In particular, the regulatory basis and review criteria that the staff used for the Tier 2 departure described above are in Section 9.2.1 of NUREG–0800.

9.2.16.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.16 of the certified ABWR DCD. The staff reviewed Section 9.2.16 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

In NUREG–1503, the staff reviewed the ABWR TSW system in accordance with SRP Section 9.2.1. Within the scope of SRP Section 9.2.1, the staff's acceptance of the TSW system design is based on meeting the requirements of GDC 2, 4, 5, 44, 45, and 46. In NUREG–1503, the staff concluded that GDC 4, 44, 45, and 46 do not apply because the TSW system is a nonsafety-related system with no connections to safety-related systems. The STP FSAR provides supplemental information (interface requirements and a Tier 2 departure) on the TSW system. This information does not affect the system configuration, or operation. Therefore, the evaluation of the system's compliance with GDC 2 in NUREG–1503, is unaffected and remains valid.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

Although no Tier 2 departures requiring prior NRC review and approval are proposed, the applicant plans to implement a Tier 2 departure that does not require prior NRC review and approval as permitted by 10 CFR Part 52, Appendix A, Section VIII.B.5.b. This section of 10 CFR Part 52 contains eight criteria that if satisfied, allow the applicant to depart from ABWR DCD Tier 2 information without obtaining prior NRC approval. In order to assure that this requirement is being properly implemented, the staff evaluated the Tier 2 departure:

- STD DEP 9.2-10 Turbine Service Water System

This departure revises the TSW system design parameters to reflect the site specific information and design information specific to the design of those parts of the system outside of the turbine building. The changes 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

[1] 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.

drop across the TCW heat exchangers, and the number of TCW discharge lines. The departure also includes a change from the DCD conceptual design by adding a fill line for the circulating water system (CWS) from the TSW pump discharge. In addition the TSW inlet and outlet lines are modified to reflect that these lines come from and go to the main cooling reservoir, respectively. The design parameters affected by this departure are shown in FSAR Table 9.2-16, "Turbine Service Water System (Interface Requirement)," and Figure 9.2-8, "Turbine Building Service Water System."

The TSW system is a nonsafety-related system. As such, there is no impact on any Tier 1, Tier 2*, TS, TS Bases or other safety-related operational requirements. The proposed departure does not affect the design or function of any SSCs important to safety. There is no effect on the likelihood or consequences of any accidents or the likelihood or consequences of malfunctions of any SSC important to safety that was previously evaluated in the DCD. This departure also does not introduce the possibility of any new type of accident. There is no impact on fission product barriers.

The potential for flooding in the turbine building in the event that a TSW system piping failure occurs was evaluated in the DCD review by the staff in NUREG–1503, with a satisfactory finding. Additionally, in an interface requirement, reviewed by the staff (see the discussion below), the COL applicant demonstrates that a break in the TSW line will not result in the flooding of safety related SSCs.

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 found it reasonable that this departure does not require prior NRC approval. In addition, the applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

GDC 5, Sharing of SSCs

NUREG–1503 concludes that for the ABWR, the requirements of GDC 5 for sharing of SSCs do not apply because the ABWR is designed as a single unit plant. NUREG–1503 also states that any application for a multi-unit facility will require a review of the design for compliance with GDC 5. The COLA is for two units at the STP site. Therefore a review of the TSW system against GDC 5 requirements is appropriate. The STP COLA identifies a departure that addresses this issue for the facility: Departure STP DEP 1.1-2, "Dual Units at STP 3 & 4." This departure identifies the shared set of STP systems between the units. The TSW system is not identified as a system that STP, Units 3 and 4, share. Therefore the staff concluded that the site-specific design of the TSW system described in the COLA meets the GDC 5 requirements relative to the sharing of SSCs.

Interface Requirements

As documented in NUREG–1503, the staff reviewed and approved Section 9.2.16, "Turbine Service Water System," of the certified ABWR DCD. However, the DCD required the COL applicant to provide site-specific design information for those portions of the TSW system outside of the turbine building. Also in Subsection 9.2.16.2, "Power Generation Design Bases," the DCD identifies interface requirements to be addressed by the COL applicant in the following subsections:

- 9.2.16.2.2, "Power Generation Design Bases (Interface Requirements)."

- 9.2.16.2.4, “Safety Evaluation (Interface Requirements).”
- 9.2.16.2.5, “Instrumentation and Alarms (Interface Requirements).”
- 9.2.16.2.6, “Tests and Inspections (Interface Requirements).”

Tier 2 Subsection 9.2.16.2 of the STP COL FSAR Revision 3, addresses site-specific information that includes the DCD interface requirements evaluated by the staff (see below).

Power Generation Design Bases (Interface Requirements)

Tier 2 Subsection 9.2.16.2.2, “Power Generation Design Bases (Interface Requirements),” of the COLA addresses five interface requirement items in DCD Tier 2 Subsection 9.2.16.2.2:

1. In this interface requirement the Tier 2 DCD requires the COL applicant to provide the temperature increase and pressure drop across the heat exchangers. The COLA documents the temperature increase as 6.0 °C (10.8 °F) and the pressure drop across the TCW system heat exchangers as 69 kilopascal (kPa) (10 pound per square inch [psi]). The staff found that the applicant has adequately addressed this interface requirement.

2. In this interface requirement the Tier 2 DCD requires the COL applicant to provide the required and available NPSH for the TSW pumps at pump suction locations considering anticipated low water levels. The COL applicant’s response provides an available NPSH at the pump suction locations with a consideration of anticipated low water levels at 99 kPa (14.4 psi). The applicant further indicates that the NPSH for the TSW pumps will be less than the available NPSH for all operating conditions. The staff found that the applicant has adequately addressed this interface requirement.

3. In this interface requirement, DCD Tier 2 required the COL applicant to identify the location of the TSW pump house. The COL applicant’s response indicates that the TSW pump house is located south of the STP power block at the main cooling reservoir in the STP circulating water intake structure. The staff found that the applicant has adequately addressed this interface requirement.

4. In this interface requirement, DCD Tier 2 required the COL applicant to identify heat removal requirements from the TCW system. The staff reviewed Subsection 9.2.14.2, “Component Description,” to verify that the TCW heat removal requirements are provided. The COL applicant identifies three TCW heat exchangers each with a heat removal capacity of 114.5 GJ/h (108.5 MBTU/h) each (connected in parallel). The staff found that the applicant has adequately addressed this interface requirement.

5. In this interface requirement, DCD Tier 2 required the COL applicant to provide TSW system low point drains and high point vents in the design. All TSW system components are required to be maintained full of water to prevent water hammer when not in service except when undergoing maintenance. The COL applicant confirmed that these requirements are met. The staff found that the applicant has adequately addressed this interface requirement.

Subsection 9.2.16.2.2 of FSAR Revision 3 documents that Table 9.2-16, “Turbine Service Water System (Interface Requirement),” of the referenced ABWR DCD was also replaced to reflect

site specific design information for the system, thus satisfying an additional interface requirement in this section.

Safety Evaluation (Interface Requirements)

Tier 2 Subsection 9.2.16.2.4 of the FSAR addresses the interface requirements in DCD Tier 2, Subsection 9.2.16.2.4. This interface requirement states that the COL applicant shall demonstrate that all safety-related SSCs are protected from flooding in the event of a pipeline break in the TSW system. In COL FSAR, Revision 3, Subsection 9.2.16.2.4, the applicant referenced FSAR Subsection 3.4.1.1.2.5, "Evaluation of Turbine Building Flood Events," to demonstrate that a break in the TSW line will not flood safety related SSCs. The staff reviewed FSAR Subsection 3.4.1.1.2.5 and a departure related to the turbine building (Departure STP DEP 1.2-2), which addresses the potential for a flooding in the turbine building resulting from a break in the TSW system piping.

In the COLA Part 7, "Departures Report," for Departure STP DEP 1.2-2, the applicant indicates that the CWS and the TSW systems are the only systems large enough to fill the condenser pit with water. Therefore, only these two systems are required to be addressed by the applicant to show that the turbine building design is adequate to prevent flooding into the adjacent RB and control building. As indicated in the evaluation of Departure STP DEP 1.2-2 in the STP design, TSW system floods are limited by system isolation signals initiated by leak detectors in the TSW system equipment room. The increased area in the turbine building provides an adequate volume for storing the limited flood water from the TSW system to assure that the water level will remain below the access level to the RB and the control building via the service building.

Review of the Tier 2 Subsection 3.4.1.1.2.5 confirms that it is consistent with the COL applicant's evaluation of Departure STP DEP 1.2-2. The TSW system pipe break could result in turbine building flooding below grade. Isolation of the system is accomplished through leak detectors in the TSW system equipment room. In the event that the system isolation fails, there are two other means to prevent the leak from crossing into adjacent safety related buildings. The first is a closed and alarmed door connecting the passage from the turbine building to the service building. The second is the radwaste tunnel seal at both ends of the tunnel to prevent water from entering the tunnel. In the event that a large hydrostatic head could occur in the turbine building, a large non-water tight truck door is at grade to provide a release point for any flood water.

Based on the review of Departure STP DEP 1.2-2, FSAR Subsection 3.4.1.1.2.5, and the multiple means for preventing major flooding in the turbine building, the staff found that the applicant has adequately addressed this interface requirement.

Instrumentation and Alarms (Interface Requirements)

DCD Tier 2 Subsection 9.2.16.2.5, "Instrumentation and Alarms (Interface Requirements)," requires the following provisions to be addressed in the COLA:

1. The TSW pump status shall be indicated in the MCR.

2. The TSW pump trip shall be alarmed and the automatic start of the standby pump shall be annunciated in the control room.

3. An alarm in the control room shall indicate high differential pressure on the duplex filter.

The COL applicant does not provide a corresponding section in the application to address these interface requirements, and the staff could not find this information in any other sections of the COLA. The staff therefore issued RAI 09.02.01-1, requesting the applicant to provide the required interface requirements information to address the TSW system MCR status indications and alarms.

In its response to RAI 09.02.01-1 dated September 8, 2009 (ML092530407), the applicant states that the requested information concerning TSW instrumentation and alarms in the MCR was inadvertently omitted in Revision 2 of the COLA. The applicant thus provided a markup of the Revision 2 COLA to add Subsection 9.2.16.2.5, "Instrumentation and Alarms (Interface Requirements)." The markup includes the MCR TSW pump status, the TSW system trip alarm, an automatic startup annunciation, and the alarm of the high differential pressure across the duplex filters. The staff found that the proposed future inclusion of this update to the COL FSAR adequately addresses the concerns in RAI 09.02.01-1, and therefore this RAI is resolved. The staff confirmed that COL FSAR, Revision 4, Subsection 9.2.16.2.5 was revised as committed to in the RAI response. Accordingly, the staff found that the applicant has adequately addressed this issue. Therefore, RAI 09.02.01-1 is closed

Tests and Inspections (Interface Requirements)

DCD Tier 2, Subsection 9.2.16.2.6, "Tests and Inspections (Interface Requirements)," specifies the following testing and inspection requirements for the TSW system:

1. The major components of the TSW system are to be tested individually before installation and as an integrated system after installation. Preoperational tests are to be performed in accordance with Chapter 14 of the FSAR.

2. TSW system components and instrumentation are to be accessible for examination during plant operation. Periodic inspections are to take place during plant operations for operability and system integrity; the DCD specifies the types of measurements to be taken during periodic rounds.

The COL applicant did not provide a corresponding section in the application to address these interface requirements, and the staff could not find this information in any other sections of the COLA. The staff therefore issued RAI 09.02.01-2, requesting the applicant to provide the required interface requirements information to address the TSW system testing and inspection interface requirements.

In its response to RAI 09.02.01-2 dated September 8, 2009 (ML092530407), the applicant states that the requested information concerning TSW testing and inspections was inadvertently omitted in Revision 2 of the COLA. The applicant thus provided a markup of the Revision 2 COLA to add Subsection 9.2.16.2.6, "Tests and Inspections (Interface Requirements)." The staff found that the proposed markup adequately addresses the TSW preoperational testing requirements, in accordance with DCD Chapter 14 as well as system accessibility and periodic inspections during normal operations. The staff has confirmed that COL FSAR, Revision 4, Subsection 9.2.16.2.6 was revised as committed in the RAI response. Accordingly, the staff finds that the applicant has adequately addressed this issue. Therefore, RAI 09.02.01-2 is resolved and closed.

ITAAC

The staff reviewed the COLA ITAAC using the detailed review guidance and checklists from SRP Section 14.3, "Standard Plant Designs, Initial Test Program - Final Design Approval (FDA)." This review included the site-specific ITAAC information in COLA Part 9 Section 3, "Site-Specific ITAAC," which was not included as part of the DCD. The TSW system is not identified as having additional site-specific ITAAC because the applicant's design indicates that the site-specific portions of the TSW system do not have a safety-related, safety-significant, or risk significant function. However, in the staff's evaluation of the "Safety Evaluation Interface Requirements" for the TSW system, Subsection 3.4.1.1.2.5 of the Tier 2 COLA was reviewed to determine whether a break in the TSW system piping could result in a flood affecting safety-related SSCs. As indicated in the evaluation of the TSW system floods, the design includes system isolation signals from leak detectors in the TSW system equipment room. In the event that the system isolation fails, there are two other means to prevent the leak from crossing into other safety-related buildings. The first is a closed and alarmed door connecting the passage from the turbine building to the service building. The second is the radwaste tunnel seal at both ends of the tunnel to prevent water from entering the tunnel. In the event that a large hydrostatic head could occur in the turbine building, a large non-watertight truck door is at grade to provide a release point for any flood water. The staff viewed these described measures as important design features that require verification through tests and inspections, thus ensuring that safety-related SSCs are protected from potential TSW system pipe breaks and a resulting flood. The staff believed that these design features and automatic logic met the criteria in SRP Section 14.3 for system ITAAC. The staff issued RAI 09.02.01-3, requesting the applicant to provide an ITAAC to verify through tests and inspections that the leak detection instrumentation, system isolation, and other described design features will provide the flood protection for the turbine building that the COLAidentifies.

In its response to RAI 09.02.01-3, dated September 8, 2009 (ML092530407), the applicant states that the description of the design for the turbine building in the ABWR DCD (Tier 1) Section 2.15.11, Turbine Building," already specifies provisions to prevent potential impacts on safety-related SSCs from turbine building flood conditions. These provisions are also included in an existing Tier 1 DCD ITAAC that requires verification of the as-built turbine building configuration. The applicant also states that an additional ITAAC item is not warranted and would not be consistent with NRC provisions on the finality of standard DCs in 10 CFR 52.63. The staff reviewed the applicant's response and found it acceptable. The COL does not warrant an ITAAC because DCD Tier 1 Section 2.15.11 already specifies provisions to prevent potential impacts on safety-related SSCs from turbine building flood conditions. Therefore, RAI 09.02.01-3 is resolved and closed.

9.2.16.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.2.16.6 *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 TSW system. 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 TSW system that were incorporated by reference have been resolved.

In addition, the staff compared the information in the COLA to the relevant NRC regulations and the guidance in Section 9.2.1 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the supplemental information in accordance with Section 9.2.1 of NUREG–0800, and found it 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.

9.3 Process Auxiliaries

9.3.1 Compressed Air System

The safety evaluation of the compressed air system is addressed in Section 9.3.6, "Instrument Air System," of this SER.

9.3.2 Process and Post-Accident Sampling System

9.3.2.1 *Introduction*

This section of the FSAR addresses the design and operation of the process and post-accident sampling system. The process sampling system is designed to collect water and gaseous samples contained in the reactor coolant system and associated auxiliary system process streams during all normal modes of operation. The post-accident sampling system is designed to determine the extent of core degradation following a severe reactor accident.

9.3.2.2 *Summary of Application*

Section 9.3.2 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.3.2 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Section 9.3.2, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 9.3-3 Control Rod Drive System Sampling

This departure removes the requirement to measure water oxygen content and conductivity in the CRD water from the table of water quality instrumentation. The departure accomplishes the same function by measuring these parameters in condensate purification system (CPS) effluent.

- STD DEP Admin

The applicant makes an editorial change to correct an ITAAC number that was incorrectly referenced in the FSAR.

9.3.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is NUREG–1503. In addition, the relevant requirements of the Commission regulations for the process and post-accident sampling system, and the associated acceptance criteria, are in Section 9.3.2 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

9.3.2.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.3.2 of the certified ABWR DCD. The staff reviewed Section 9.3.2 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 9.3-3 Control Rod Drive System Sampling

The staff found this departure acceptable because the CRD water sample line and the reactor water cleanup inlet use the same instrumentation, making it possible to sample the CRD water.

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 found it reasonable that the departure does 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.

- STD DEP Admin

The staff found this departure acceptable because it references the correct ITAAC, and does not affect the technical evaluation of the process and post-accident sampling system documented in Section 9.3.2 of the ABWR FSER.

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 found it reasonable that this departure does not require prior NRC approval.

9.3.2.5 *Post Combined License Activities*

There are no post COL activities related to this section.

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[1] 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.

9.3.2.6 *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, 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 process and post-accident sampling that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.3.2 of NUREG–0800. The staff's review found it 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.

The staff also found that the departures do not affect the conclusion on the process and post-accident sampling system documented in Section 9.3.2 of the ABWR FSER.

9.3.3 Non-Radioactive Drainage System

9.3.3.1 *Introduction*

This section of the FSAR describes STP conformance with design features and considerations that were specified and approved by the NRC for the standard ABWR plant design. The non-radioactive drainage (NRD) system is designed to assure that waste liquids, valve and pump leakoffs and component drains and vents are directed to the proper area for processing.

9.3.3.2 *Summary of Application*

Section 9.3.3 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.3.3 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.3.3, the applicant provides the following:

Site-Specific Supplement

FSAR Subsection 9.3.3.2.3, "System Description," contains the site-specific system information used to replace the ABWR DCD conceptual design information and refers to the FSAR Figure 9.3-12, "Non-Radioactive Drainage System," that shows the site-specific design.

9.3.3.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements for the Commission regulations for the NRD system, and the associated acceptance criteria, are in Section 9.3.3 of NUREG–0800.

9.3.3.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.3.3 of the certified ABWR DCD. The staff reviewed Section 9.3.3 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 appropriately represents the complete scope

of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Site Specific Supplement

The staff reviewed FSAR Subsection 9.3.3.2, "Non-Radioactive Drains (Interface Requirements)," and Subsection 9.3.3.3, "System Description," which specifies the site-specific details regarding the NRD system from the standard ABWR plant buildings to the discharge outfall. These sections include a reference to Figure 9.3-12, that shows the system piping, pumps, valves and tanks that direct the effluent from selected plant buildings to the discharge areas. The staff compared this supplemental information to the requirements of GDC 60 as it relates to providing a means to control the release of radioactive materials in liquid effluent, including anticipated operational occurrences. The certified ABWR DCD states that the NRD system shall provide means for obtaining samples and analyzing them to ensure that no radioactive effluents are discharged. FSAR Figure 9.3-12, shows radiation monitoring at the discharge of the NRD system, before entering the main cooling reservoir through permitted outfall(s). In the event of high radiation levels, the NRD system discharge can be diverted to the radioactive effluent portion of the radwaste system, as shown in FSAR Figure 9.3-12. In addition, FSAR Subsection 9.3.3.2.3 states that means are provided to perform any required tests or analyses required by the discharge permit. However, the provisions for obtaining samples did not appear to be specifically discussed in the FSAR or shown in Figure 9.3-12. The staff issued RAI 09.03.03-4, requesting the applicant to provide a sampling and analysis program and to describe the sampling provisions for the NRD system.

In its response to RAI 09.03.03-4, dated June 12, 2008 (ML081710126), the applicant refers to ABWR DCD Subsection 9.3.3.2.5 and STP FSAR Subsection 9.3.3.2.3 that specify the means to perform any required tests or analyses to meet the requirements of the discharge permit. The staff reviewed the applicant's response to RAI 09.03.03-4, and determined that the applicant's response to RAI 09.03.03-5 evaluated below addresses the concern raised in this RAI. Therefore, RAI 09.03.03-4 is resolved and closed.

The staff issued RAI 09.03.03-5, further requesting the applicant to provide details for a sampling, monitoring, and analysis program for the NRD system to determine the potential for carrying radioactive contamination into the environment. In its response to RAI 09.03.03-5, dated August 28, 2009 (ML092450154), and the supplemental response dated December 28, 2009 (ML093631615), the applicant states, "The program for monitoring and sampling of the non-radioactive waste system, including the determination of batch discharge limits, is in accordance with the Offsite Dose Calculation Manual (ODCM), IEN 80-10, and RG 1.21." FSAR Subsection 13.5.3.4.3, "Radiation Control Procedures," states, "procedures will be developed for handling discharge of effluents and dose calculations for STP units 3 and 4." These procedures will be issued six months before the Preoperational Test Program per FSAR Subsection 13.5.3.3.2, "Maintenance and Other Procedures." Also, sufficient hold up capacity is

[1] 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.

provided by the main cooling reservoir and the 209 million cubic meters (7.35 billion cubic feet) of dilution water, before any site environmental conditions that would release any liquid effluents to the environment, per GDC 60. The staff evaluated the applicant's response and found it acceptable, because it complies with GDC 60. Therefore, RAI 09.03.03-5 is resolved and closed.

9.3.3.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.3.3.6 *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, 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 NRD system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to relevant NRC regulations and the guidance in Section 9.3.3 of NUREG–0800. The staff's review confirmed that the applicant has adequately provided supplemental information satisfying the criteria in Section 9.3.3 of NUREG–0800. The staff determined that the NRD system satisfies all NRC regulatory requirements.

9.3.4 Chemical and Volume Control System

The ABWR does not include this system.

9.3.5 Standby Liquid Control System

This section of the FSAR addresses the standby liquid control system (SLCS). BWR plants include an SLCS that provides backup capability for reactivity control independent of the CRD system.

Section 9.3.5 of the STP, Units 3 and 4, COL FSAR incorporates by reference Section 9.3.5, "Standby Liquid Control System," 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.[1] 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 SLCS have been resolved.

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[1] 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.

9.3.6 Instrument Air System

This section of the FSAR discusses the instrument air system, which provides dry, oil-free, compressed air for valve actuators, for nonsafety-related instrument control functions, and for general instrumentation and valve services outside the containment.

Section 9.3.6 of the STP, Units 3 and 4, COL FSAR incorporates by reference Section 9.3.6, "Instrument Air System," 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.[1] 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 instrument air system have been resolved.

9.3.7 Service Air System

9.3.7.1 *Introduction*

This section of the FSAR discusses the service air system (SAS), which provides a continuous supply of service air for general plant use and serves as a backup to the instrument air system on an as-needed basis.

9.3.7.2 *Summary of Application*

Section 9.3.7 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.3.7 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Section 9.3.7, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.3-2 Breathing Air System

This departure adds a stand-alone breathing air system to the SAS.

9.3.7.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the SAS, and the associated acceptance criteria, are in Section 9.3.1 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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.

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[1] 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.

9.3.7.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.3.7 of the certified ABWR DCD. The staff reviewed Section 9.3.7 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 COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.3.2 Breathing Air System

The staff reviewed STD DEP 9.3.2, which adds a stand-alone breathing air system to the SAS.

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

ITAAC

COLA Part 9 Table 3.0-12, "Breathing Air System" provides an ITAAC. The ITAAC requires the design to have one locked closed isolation valve inside and one locked closed isolation valve outside containment, and to ensure that the results of the pressure test of the ASME Code components of the Breathing Air (BA) system conform to the requirements in ASME Code Section III. The staff evaluated this information in Section 14.3, "Test Procedures," of this SER.

9.3.7.5 *Post Combined License Activities*

The applicant identifies site specific ITAAC described in COLA Part 9 Table 3.0-12, "Breathing Air System."

9.3.7.6 *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, 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 SAS that were incorporated by reference have been resolved.

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[1] 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.

In addition, the staff compared the additional information in the COLA to relevant NRC regulations and the guidance in Section 9.3.1 of NUREG–0800. The staff's review found it 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.

Therefore, the staff's review confirmed that the applicant has adequately addressed the relevant information relating to the SAS.

9.3.8 Radioactive Drain Transfer System

9.3.8.1 *Introduction*

This section of the FSAR describes the ability of the radioactive drain transfer system (DTS) to ensure that waste liquids, valve and pump leakoffs, and component drains and vents are directed to the proper area for processing.

9.3.8.2 *Summary of Application*

Section 9.3.8 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.3.8 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Sections 9.3.8 and 9.3.12, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.3-1 Radwaste Drain Materials

This departure replaces carbon steel piping in the radwaste collection system with stainless steel piping. In addition, the applicant provides the following in Subsection 9.3.8.2.3, "Component Description":

> Drain system components are as follows:
>
> 1. Collection Piping —In all areas of potential radioactivity contamination, the collection system piping for the liquid system is of stainless steel for embedded and chemical drainage and for suspended drainage. Offsets in the piping are provided, where necessary, for radiation shielding. In general, the fabrication and installation of the piping provide for a uniform slope that causes gravity to flow to the appropriate sump. During construction, equipment drain piping is terminated not less than 5 cm above the finished floor or drain receiver at each location where the discharge from equipment is to be collected. The connections to the individual equipment are made after the equipment is installed in its proper location.

COL License Information Item

- COL License Information Item 9.15 Radioactive Drain Transfer System

This COL license information item addresses the COL license information item in ABWR DCD Subsection 9.3.12.4, "Radioactive Drain Transfer System," which directs the COL applicant to provide Piping and instrumentation diagram (P&IDs) for the radioactive DTS.

9.3.8.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the radioactive drain transfer system, and the associated acceptance criteria, are in Section 9.3.3 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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.

9.3.8.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.3.8 of the certified ABWR DCD. The staff reviewed Section 9.3.8 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 COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

The following Tier 2 departure not requiring prior NRC approval identified by the applicant in this section may also be evaluated in other sections of this SER. For more information, refer to COLA Part 7, Section 5.0, "Tables and Indexes," for a listing of all FSAR sections affected by this departure.

- STD DEP 9.3-1 Radwaste Drain Materials

This departure replaces carbon steel piping in the radwaste collection system with stainless steel piping. The staff found Departure STD DEP 9.3-1 to be acceptable because in a corrosive environment such as the radioactive DTS, the properties of stainless steel are better than those of carbon steel.

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

COL License Information Item

- COL License Information Item 9.15 Radioactive Drain Transfer System

FSAR Subsection 9.3.12.4, "Radioactive Drain Transfer System," refers to COL License Information Item 9.15, which addresses the COL license information item in ABWR DCD Subsection 9.3.12.4. To address this COL license information item, the applicant provided P&IDs (FSAR Figure 9.3-11, "Piping and Instrumentation Diagram, Radioactive Drain Transfer," Sheets 1 through 22). The P&IDs include relevant piping, valves, sumps, and sump pumps required to ensure that the radioactive DTS can accommodate excessive water accumulation and that flooding is prevented in accordance with the plant's design. Upon reviewing these P&IDs, the staff was unable to verify that DTS meets the criteria in GDC 2 as it relates to the capability of safety-related portions of the system to withstand the effects of natural phenomena, because the piping qualification and seismic classification could not be read due to the low resolution and quality of the P&IDs. In addition, the staff was unable to confirm from the drawings whether motor-operated valve (MOV) 006 and MOV 007 in Sheet 1 of FSAR Figure 9.3-11 are containment isolation valves, or to determine their safety class and quality group according to the notes in the P&IDs.

ABWR DCD Tier 2 Subsection 9.3.8.1.1, "Safety Design Bases," states that the radioactive drain transfer collection piping shall be non-nuclear safety class and Quality Group D, with the exception of the containment penetrations and piping in the drywell, which should be Seismic Category I and Quality Group B.

In Part 1 of RAI 09.03.03-1, the staff asked the applicant to clarify whether MOV 006 and MOV 007 in Sheet 1 of FSAR Revision 1, Figure 9.3 11, are containment isolation valves.

In its response to Part 1 of RAI 09.03.03-1, dated June 12, 2008 (ML081710126), the applicant states that the valves numbered as MOV 0006 and MOV 0007 in Sheet 1 of Figure 9.3.11 are containment isolation valves. Sheet 5 of Figure 9.3.11, in the current FSAR revision incorrectly shows the containment isolation valves as ball valves (numbered 0057 and 0065). The applicant agreed to correct Sheet 5 in the next FSAR revision to show that both valves are motor-operated isolation valves.

In Part 2 of RAI 09.03.03-1, the staff indicated that given the low quality/resolution of the drawings, the staff was unable to verify the designations of Seismic Category 1 and Quality Group B portions of the system. In addition, the staff noted inconsistencies between FSAR Revision 2 Figure 9.3-11 and ABWR DCD Tier 2 Figure 1.7-1, "Piping and Instrumentation Diagram Symbols." For example, the piping identification format does not follow the convention described in Note 10 in Figure 1.7-1. Also, in Sheets 13, 15, and 17 of Figure 9.3-11, the symbols for some check valves are inconsistent with those of Note 6 in Figure 1.7-1.

In its response to Part 2 of RAI 09.03.03-1, dated June 12, 2008 (ML081710126), the applicant stated that the FSAR would be revised to provide P&IDs with a higher resolution and legible symbols that will be consistent with ABWR DCD Figure 1.7-1.

The staff reviewed the applicant's RAI response and determined that the applicant has provided sufficient information to satisfy GDC 2 criteria, as it relates to the capability of the safety-related system portions of the radioactive DTS to withstand the effects of natural phenomena. Therefore, RAI 09.03.03-1 is resolved.

Upon review of Revision 4 of the FSAR, the staff noted that Sheets 12 and 13 of Figure 9.3-11 were deleted. Therefore, the applicant provided a RAI 09.03.03-1, supplemental response dated January 5, 2011 (ML110070123), clarifying that the drains shown on Sheets 12 and 13 were inputs to the non-radioactive drain transfer system and that Figure 9.3-11 is for the radioactive drain transfer system. The staff reviewed this response and Figure 9.3-11 and concurs with the applicant's assessment and finds the deletion of the sheets from Figure 9.3-11 to be appropriate and acceptable. The staff verified that the proposed markups have been included in the FSAR. Therefore, RAI 09.03.03-1 is resolved and closed.

Upon reviewing Revision 2 of the FSAR, the staff was unable to confirm that the radioactive DTS meets the GDC 4 criteria. To meet GDC 4, the applicant needs to demonstrate the capability of important safety equipment to withstand the effects of and to be compatible with the environmental conditions (e.g., flooding) of normal operation, maintenance, testing, and postulated accidents. The FSAR needs to demonstrate that the radioactive DTS is capable of mitigating flood conditions that could adversely affect SSCs important to safety. In ABWR DCD Tier 2 Subsection 9.3.8.1.1, "Safety Design Bases," Item 5(a) states that backflow check valves should be included in the emergency core cooling system (ECCS) equipment room sumps. Item 5(b) states that floor drain piping in each divisional area of the ECCS pump rooms and in the control building shall be arranged so that flooding or backflow in one quadrant will not adversely affect other quadrants. However, the staff was unable to locate the ECCS equipment room sumps and associated check valves for each individual ECCS pump room in FSAR Figure 9.3-11. The staff issued RAI 09.03.03-2, requesting the applicant to provide P&IDs showing the check valves and sumps for each ECCS equipment room.

In its response to RAI 09.03.03-2, dated June 12, 2008 (ML081710126), the applicant states that the drains from ECCS equipment rooms A, B, and C are collected in the individual high conductivity waste (HCW) sumps located in each room. The sumps are HCW Sump 4A on Sheet 6 of Figure 9.3-11 and 4B and 4C on Sheet 7 of Figure 9.3-11. The sump pump is actuated on a high-water level signal to prevent flooding. The suction line of each of the relevant sump pumps has a check valve to prevent backflow. The check valve is located in the HCW sump in the individual ECCS equipment room. The applicant also stated that Figure 9.3-11, would be revised accordingly in the next FSAR revision.

After reviewing the applicant's response, the staff determined that the applicant has provided sufficient information to satisfy GDC 4, as it relates to the capability of the system to withstand the effects of environmental conditions by preventing flooding that could adversely affect safety-related SSCs. Therefore, RAI 09.03.03-2 is resolved. The staff has confirmed that the proposed markups have been incorporated in the FSAR Revision 4. Therefore, RAI 09.03.03-2 is closed.

9.3.8.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.3.8.6 *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 the radioactive DTS. 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 radioactive DTS that were incorporated by reference have been resolved.

In addition, the staff compared the additional in the COLA to the relevant NRC regulations and the relevant guidance in Section 9.3.3 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information item, and found it 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.

9.3.9 Hydrogen Water Chemistry System

9.3.9.1 *Introduction*

This section of the FSAR addresses information related to the hydrogen water chemistry system (HWCS).

9.3.9.2 *Summary of Application*

Section 9.3.9 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.3.9 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.3.9, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

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

The applicant states that both hydrogen and oxygen supply systems will be site-dependent, and makes an editorial deletion to clarify the meaning of the sentence, in Subsection 9.3.9.2, "System Description," of the COL FSAR.

9.3.9.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. There is no regulatory guidance in NUREG–0800 that directly applies to the HWCS review.

The applicable industry requirements for the HWCS that are endorsed by the NRC are as follows:

- Electric Power Research Institute (EPRI), "BWR Hydrogen Water Chemistry Guidelines," EPRI Report NP-4947-SR.
- EPRI, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations," EPRI Report NP-5283-SR-A.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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.

9.3.9.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.3.9 of the certified ABWR DCD. The staff reviewed Section 9.3.9 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

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

The HWCS is composed of hydrogen and oxygen supply systems that inject hydrogen into the feedwater and oxygen into the offgas. Several monitoring systems track the effectiveness of the HWCS. The ABWR DCD requires the HWCS to utilize the guidance in the EPRI NP-4947-SR Report, which provides guidelines for operating the HWCS and for safely storing and handling hydrogen. Although the HWCS is nonsafety-related, given the potential for hydrogen combustion or detonation, the ABWR DCD requires that the handling of hydrogen should be safe, reliable, and consistent with the requirements for using hydrogen gas. The ABWR DCD requires HWCS installations to include the capability of storing and handling hydrogen in accordance with the guidelines in the EPRI NP-5283-SR-A Report.

Departure STD DEP 1.1-2 identifies the set of STP systems that the units share. In its departure the applicant states that both hydrogen and oxygen supply systems will be site-dependent, and the applicant makes an editorial deletion to clarify the meaning of the sentence, in Subsection 9.3.9.2 of the COL FSAR. 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. The staff reviewed the Departures Report regarding this departure and Section 9.3.9 of the COL FSAR. The staff notes that the applicant did not indicate whether the HWCS will be used. The staff was unable to determine whether it is reasonable for this departure not to require prior NRC approval. Therefore, the staff issued RAI 01.10, requesting the applicant to confirm whether the HWCS will be utilized. In its response to RAI 01.10, dated August 12, 2009 (ML092260197), the applicant states that the HWCS will be installed at STP, Units 3 and 4. Therefore, RAI 01.10 is resolved and closed. Within the review scope of this section, the staff found it reasonable that the departure does not require prior NRC approval. The applicant's

[1] 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.

process for evaluating departures and other changes to the certified ABWR DCD is subject to NRC inspections.

9.3.9.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.3.9.6 *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, 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 Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the HWCS that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to relevant NRC regulations and the guidance in the industry standard (EPRI NP-4947-SR and NP-5283-SR-A). The staff's review concluded that the applicant has provide adequate information in accordance with the EPRI standards, and found it 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.

9.3.10 Oxygen Injection System

The Oxygen Injection System (OIS) is designed to add sufficient oxygen (20 to 50 parts per billion [ppb]) for reducing corrosion and reducing the release of corrosion products into the condensate and feedwater systems. The EPRI NP-5283-SR-A Report includes guidance for the design, operation, maintenance, surveillance, and testing of the oxygen storage facility. The ABWR DCD requires every OIS installation to meet this guidance.

Section 9.3.10 of the STP, Units 3 and 4, COL FSAR, Revision 11, incorporates by reference Section 9.3.10, "Oxygen Injection System," 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.[1] 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 OIS have been resolved.

9.3.11 Zinc Injection System

This section of the FSAR addresses the zinc injection system (ZIS).

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[1] 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.

9.3.11.1 *Summary of Application*

Section 9.3.11 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.3.11 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements.

9.3.11.2 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. There is no regulatory guidance in the NUREG–0800 that directly applies to the ZIS review.

9.3.11.3 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.3.11 of the certified ABWR DCD. The staff reviewed Section 9.3.11 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

Controlling the build-up of radiation in reactor systems is a concern in BWR plants. Laboratory testing and plant experience have shown that the presence of trace amounts of soluble zinc in reactor water reduces cobalt-60 (^{60}Co) build-up in the corrosion films on primary system piping and components.

Provisions in the ABWR DCD permit the installation of a system for adding a zinc solution to the feedwater, but it wasn't clear in the COL FSAR whether the ZIS will be installed. Therefore, the staff issued RAI 01.11, requesting the applicant to clarify and confirm whether the ZIS will be utilized. In its response to RAI 01.11, dated August 12, 2009 (ML092260197), the applicant clarifies that the ZIS will not be installed. Instead, the applicant will install the piping connections necessary to connect a ZIS in case operational experience in STP, Units 3 and 4, indicates that injecting zinc will be beneficial. The staff found the applicant's response to RAI 01.11, to be acceptable.

9.3.11.4 *Post Combined License Activities*

There are no post COL activities related to this section.

9.3.11.5 *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

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[1] 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.

52.63(a)(5) and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the ZIS that were incorporated by reference have been resolved.

9.4 Air-Conditioning, Heating, Cooling, and Ventilation Systems

9.4.1 Control Building HVAC (Related to RG 1.206, Chapter C.I.9.4.1, "Control Room Area Ventilation System")

9.4.1.1 *Introduction*

The control building HVAC system is divided into two separate systems that include: (1) one HVAC system for the main control area envelope within two floors, and (2) one HVAC system for safety-related electrical and RCW heat exchange equipment.

9.4.1.2 *Summary of Application*

Section 9.4.1 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.4.1 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in Section 9.4.1, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.4-2 Control Building HVAC System

This standard departure changes the design of the smoke removal mode of operation of the control building HVAC system, as described in FSAR Subsections 6.4.4.2, "Smoke and Toxic Gas Protection," 9.4.1.1.4, "Safety Evaluation," and 9.5.1.1.6, "Instrumentation Application." This change adds a main air supply duct bypass line around the control room Air Conditioning Unit (ACU). When the recirculation damper is closed and the damper in the bypass duct around the ACU is opened, the air exhaust and supply are balanced. This balance means that the smoke is exhausted and is therefore not transported to other areas of the control building.

- STD DEP 9.4-6 Control Building HVAC System

This departure describes a proposed design change to install one flow switch on the discharge side of each of the four fans in the two redundant emergency filtration units (EFUs). As a result, a two-out-of-two logic signal is required to automatically initiate a switchover to the standby division.

- STD DEP 9.4-7 Control Building HVAC System

This standard departure modifies the design of the control building annex HVAC system to accommodate the relocation of motor generator (MG) sets from the control building to the control building annex. This modification changes the control building annex HVAC design to provide appropriate ventilation, filtering, cooling, and heating of the MG set rooms in the control building annex.

9.4.1.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the control building HVAC and the associated acceptance criteria are in Section 9.4.1 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

9.4.1.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.4.1 of the certified ABWR DCD. The staff reviewed Section 9.4.1 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.4-2 Control Building HVAC System
- STD DEP 9.4-6 Control Building HVAC System
- STD DEP 9.4-7 Control Building HVAC System

The applicant's evaluation, in accordance with Section VIII.B.5 of 10 CFR Part 52, Appendix A, determined that these departures do not require prior NRC approval. The staff reviewed the Departures Report regarding these departures, and was unable to determine whether it is reasonable for these departures to not require prior NRC approval. Therefore, the staff issued RAI 09.04.01-1, requesting the applicant to address potential contamination issues in the HVAC systems in order to meet the objectives of 10 CFR 20.1406. The staff also asked the applicant about the FSAR provisions for monitoring, collecting, and controlling any contaminated condensate and gaseous effluents that may form at the coolers or be carried through all of the underground HVAC ducts and piping. In its response to RAI 09.04.01-1, dated September 8, 2009 (ML092530407), the applicant states that the ABWR design directs condensate from the cooling coils of the ventilation systems that are expected to be contaminated to floor drains associated with the radioactive drain system. For STP, Units 3 and 4, the condensate drain from the control room area HVAC system cooling coils is non-contaminated and is directed to the non-radioactive drain system. There are no underground HVAC ducts or piping in STP,

[1] 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.

Units 3 and 4. Both the radioactive and non-radioactive drain systems feature monitored effluent streams to meet 10 CFR 20.1406, in accordance with RG 4.21. The staff found this response acceptable, and therefore, RAI 09.04.01-1 is resolved and closed.

Based on the additional information in the applicant's response, the staff found it reasonable that the 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.

9.4.1.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.4.1.6 *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 control building HVAC system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to relevant NRC regulations and the guidance in Section 9.4.1 of NUREG–0800. The staff's review found it 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.

9.4.2 Spent Fuel Pool Area HVAC System (Related to RG 1.206, Section 9.4.2, "Spent Fuel Pool Area Ventilation System")

Section 9.4.2 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 9.4.2, "Spent Fuel Pool Area HVAC System," of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. Section 9.4.2 of the ABWR DCD states that the spent fuel pool area HVAC system is part of the RB secondary containment HVAC system described in Subsection 9.4.5.1. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] 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 spent fuel pool area HVAC system have been resolved.

9.4.3 Auxiliary Area HVAC System (Related to RG 1.206, Section C.I.9.4.3, "Auxiliary and Radwaste Area Ventilation System")

Section 9.4.3 of the STP Units 3 and 4 COL FSAR Revision 12 incorporates by reference Section 9.4.3, "Auxiliary Area HVAC System," of the certified ABWR DCD Revision 4,

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[1] 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.

referenced in 10 CFR Part 52, Appendix A, with no departures or supplements. Section 9.4.3 of the ABWR DCD states that the auxiliary area HVAC system is part of the RB secondary containment HVAC system described in Subsection 9.4.5.1. The staff reviewed the application and checked the referenced DCD to ensure that no issue relating to this section remains for review.[1] 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 auxiliary area HVAC system have been resolved.

9.4.4 Turbine Island HVAC System (Related to RG 1.206, Section C.I.9.4.4, "Turbine Building Area Ventilation System")

9.4.4.1 *Introduction*

The turbine island HVAC system consists of the turbine building HVAC system and the electrical building HVAC system.

9.4.4.2 *Summary of Application*

Section 9.4.4 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.4.4 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Section 9.4.4, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.4-4 Turbine Island HVAC System

This standard departure revises the design of the turbine island HVAC system cooling/heating load and flow rate to accommodate the changes in the turbine building general arrangement and in the systems located in the turbine building. Local chilled-water unit coolers and electric unit heaters are installed in high-load areas as a result of the cooling/heating load recalculation for the revised turbine building general arrangement and offgas system requirements.

This departure also changes the turbine island HVAC subsystem name in Section 9.4 from "Electrical Building (E/B) HVAC System" to "Turbine Building Electrical Equipment Areas (EEA) HVAC System." This name change signifies a nonradioactive-controlled area of the turbine building where nonsafety-related electrical equipment is installed. The turbine building HVAC system and the turbine building electrical equipment areas (EEAs) HVAC system do not serve or support any safety function and have no safety design bases.

- STD DEP 9.4-9 Turbine Building HVAC System

This standard departure revises the turbine building HVAC design room temperature limits, system air flow, equipment layout, and main heating coil. The minimum air temperature in the turbine building is reduced from 15 °C to 10 °C (59 °F to 50 °F); and the maximum air

[1] 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.

temperatures in the moisture separator compartment and steam tunnel area are increased from 49 °C to 60 °C (120.2 °F to 140 °F). The departure changes the turbine building HVAC system from a recirculating air flow to a once-through supply of filtered and tempered air, thus minimizing contamination/exposure in controlled areas of the turbine building during all modes of normal plant operation. The departure redesigns this system to direct airflow from areas of low-potential radioactivity to areas of high-potential radioactivity, with independent ventilation to the EEAs. The turbine building HVAC main heating coil is changed from a hot-water coil to an electric-heater coil. Also, the ABWR DCD certified the location of the turbine building HVAC equipment rooms on two floors, whereas this departure locates those rooms on three floors.

9.4.4.3 *Regulatory Basis*

The regulatory basis for the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission's regulations for the turbine island HVAC system, and the associated acceptance criteria, are in Section 9.4.4 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

9.4.4.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.4.4 of the certified ABWR DCD. The staff reviewed Section 9.4.4 of the STP, Units 3 and 4, COL FSAR and checked the ABWR DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the turbine island HVAC system.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 9.4-9 Turbine Building HVAC System

Departure STD DEP 9.4-9 modifies the turbine building HVAC design from a recirculating air flow system to a once-through system supplying filtered and tempered air, in order to minimize contamination/exposure for controlled areas inside the turbine building during all modes of normal plant operation. The departure also increases the maximum air temperature in the moisture separator compartments and the steam tunnel area from 49 °C (120.2 °F) to 60 °C (140 °F). In the Departures Report (Part 7 of the COLA), there is no discussion of the potential impact of this departure on the operational dose limits for the general public, radiation monitoring, heat stress, and equipment qualification. Therefore, the staff conducted an audit of

[1] 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 applicant's screening process to determine whether the applicant has performed an adequate evaluation to meet the requirements in 10 CFR Part 52, Appendix A, Section VIII.B.5.b. The staff's audit findings included the following:

- The applicant needs to furnish an analysis demonstrating that changing the recirculating HVAC system to a once-through system will not result in an increase in the operational dose to individual members of the public and will meet the 10 CFR Part 20 dose limits. The main concern is that the proposed once-through system may increase the operational dose to the public by enhancing the release of radionuclides from the turbine building and reducing their residence time inside the building to decay.

Even though the flow rates of the individual air streams from various areas inside the turbine building are measured, the overall flow rate of the combined air stream through the plant stack is not measured but is computed. The applicant needs to develop provisions for measuring the overall air flow rate through the plant stack in order to reduce the uncertainties involved in monitoring the overall radiation due to unaccounted-for air flows, such as from the building's air infiltration.

- The applicant should commit to furnish a heat stress analysis for the operator's possible entry into the two 60 °C (140 °F) MSR (Moisture Separator Reheater) areas inside the turbine building. The analysis should also account for the high level of radiation expected in the area.

The staff issued RAI 09.04.04-1, requesting the applicant to address these issues. In its response to RAI 09.04.04-1, dated March 17, 2010 (ML100770388), the applicant states that changing the recirculating HVAC system to a once-through system is an option that is allowed in the certified ABWR DCD and will not affect any safety-related equipment or functions. The proposed revisions in FSAR Subsections 9.4.4.1.1, "Safety Design Bases," 9.4.4.1.2, "Power Generation Design Bases," and 9.4.4.2.1, "T/B HVAC General Description," are to clarify that the recirculation option is not adopted in the STP design. Regarding the question on measuring the overall air flow rate through the plant stack to reduce the uncertainties in monitoring the effluents, the RAI response refers to FSAR Subsection 11.5.2.2.4, "Plant Stack Discharge Radiation Monitoring," which commits to the guidance in ANSI N13.1 to sample airborne radioactive materials. FSAR Subsection 11.2.5.1, which addresses COL License Information Item 11.1, also states that STP, Units 3 and 4, comply with the guidelines in ANSI 13.1, "Sampling And Monitoring Releases Of Airborne Radioactive Substances From The Stacks And Ducts Of Nuclear Facilities"; RG 1.21, Revision 1, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants"; and RG 4.15, Revision 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment." The RAI response states that the determination of the plant stack release rate using the isokinetic sampling system will not rely on flow measurement inputs from individual waste streams entering the stack. The RAI response also states that the final configuration of the stack flow instruments associated with the isokinetic sampling system will be established during detailed design. The staff found the responses to the question on plant stack releases acceptable because following the guidance in ANSI N13.1, and in RG 1.21 and RG 4.15 will ensure flow rates are being monitored to ensure radiation release can be accurately measured.

In RAI 09.04.04-1, the staff requested the applicant to address equipment qualification and habitability issues in the MSR because Departure STD DEP 9.4-9 raises the MSR compartments air temperature upper design limit from 49 °C to 60 °C (120.2 °F to 140 °F). In its response to RAI 09.04.04-1, dated March 17, 2010,, the applicant states that the purpose of changing the temperature limit in COL FSAR Subsection 9.4.4.1.2 is to be consistent with Table 3I-6 in DCD Tier 2 Appendix 3I. The RAI response also states that the DCD does not describe safety-related equipment or instrumentation in the MSR compartments, which precludes the need for any operator action in this area during accident scenarios. The staff confirmed that the normal operating conditions in the main steam stop valve area described in Table 3I-6, "Thermodynamic Environment Conditions Inside Turbine Building Plant Normal Operating Conditions," of Appendix 3I of the DCD does have a maximum temperature limit of 60° C (140 °F), and there is no discussion of any safety equipment in the MSR compartment. Therefore, the responses to the issue of elevated temperature discussed in Departure STD DEP 9.4-9 are acceptable. The staff concluded that the applicant has addressed all the staff's concerns regarding Departure STD DEP 9.4-9, and the responses to RAI 09.04.04-1 are acceptable. Therefore, RAI 09.04.04-1 is resolved and closed.

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

- STD DEP 9.4-4 Turbine Island HVAC System

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

9.4.4.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.4.4.6 *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 relevant 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 turbine island HVAC system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to relevant NRC regulations and the guidance in Section 9.4.4 of NUREG–0800. The staff found it 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 conclusion, the applicant has provided sufficient information to satisfy Section 9.4.4 of NUREG–0800.

9.4.5 Reactor Building HVAC System (Related to RG 1.206 Chapter C.I.9.4.5, "Engineered Safety Feature Ventilation System")

9.4.5.1 *Introduction*

The safety-related and nonsafety-related equipment areas of the RB are served by the RB HVAC system. This system is designed to provide an environment with a controlled temperature to ensure the comfort and safety of plant personnel and the integrity of equipment and components. The RB HVAC system comprises the following subsystems:

- RB Secondary Containment HVAC System.
- RB Safety-Related Equipment HVAC System.
- RB Nonsafety-Related Equipment HVAC System.
- RB Safety-Related Electrical Equipment HVAC System.
- RB Safety-Related DG HVAC System.
- RB Primary Containment Supply/Exhaust System.
- RB Main Steam Tunnel HVAC System.
- RB Reactor Internal Pump Adjustable Speed Drive (ASD) HVAC System.

9.4.5.2 *Summary of Application*

Section 9.4.5 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.4.5 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.4.5, the applicant provides the following:

Tier 1 Departures

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This standard departure eliminates the hydrogen recombiner requirements of the certified ABWR design. As a result, the ABWR flammability control system (FCS), which consists of two redundant hydrogen recombiners, is eliminated and its support systems are modified or eliminated. The departure is based on 10 CFR 50.44, "Combustible gas control for nuclear power reactors," which was amended after the issuance of the DC for the ABWR. The amended 10 CFR 50.44 eliminates the requirements for hydrogen control systems to mitigate a design-basis LOCA hydrogen release. Consequently, the containment hydrogen and oxygen monitoring instrumentation is reclassified as nonsafety-related and is eliminated in the mitigation of a design-basis LOCA.

- STD DEP T1 2.15-2 RBSRDG HVAC

This standard departure revises the maximum temperature limit in the RB safety-related DG (RBSRDG) engine room from 50 °C (122 °F) to 60 °C (140 °F) during DG operation. This revision is needed because the DG engine room temperature can exceed 50 °C (122 °F) when

160,000 m^3/h (1569.5 cubic feet per second [ft^3/s]) design outdoor air flow passes through the DG engine room at 46.1 °C (115 °F) (Tier 1 Section 5, "Site Parameters") ambient summer design temperature and picks up the heat rejected from the DG.

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 9.4-8 Reactor Building HVAC

This departure proposed three changes to the Tier 2 drawings to make them consistent with the corresponding Tier 1 depictions:

- Adding tornado dampers to the inlet and exhaust sections on the CB HVAC flow (Tier 2 Figure 9.4-1, "Control Building HVAC").
- Rearranging the inlet air handling fans and equipment and adding tornado dampers to the inlet section on the secondary containment HVAC system (Tier 2 Figure 9.4-3, "Secondary Containment HVAC System").
- Adding tornado dampers to the inlet and exhaust sections and removing the fire dampers from the RB safety-related electrical equipment HVAC system (Tier 2 Figure 9.4-4, "R/B Safety Related Electrical Equipment HVAC System").

This departure also changes the site-specific outdoor air design temperature limits in the ABWR DCD to the local 1 percent exceedance values for both summer and winter conditions.

9.4.5.3 *Regulatory Basis*

The regulatory basis for the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the RB HVAC system, and the associated acceptance criteria, are in Section 9.4.5 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, "the applicant identifies Tier 1 and Tier 2 departures. Tier 1 departures require prior NRC approval and are subject to the requirements specified in 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2 departures not requiring 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.

9.4.5.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.4.5 of the certified ABWR DCD. The staff reviewed Section 9.4.5 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 appropriately represents the complete scope of information relating to this review topic.[1]. The staff's review confirmed that the information in

[1] 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 application and the information incorporated by reference address the relevant information related to the RB HVAC system.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departures

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

This Tier 1 departure eliminates the hydrogen recombiner from the ABWR design. The staff reviewed this proposed standard departure with respect to Commission rules and regulations. With this departure, the design complies with the revisions to 10 CFR 50.44 made after the issuance of the DC for the ABWR. The staff's evaluation of the ability of the ABWR design to meet the requirements of 10 CFR 50.44 is in Section 6.2.5 of this SER. As this is a standard departure applicable to all COL applicants referencing the ABWR DCD, no loss of standardization will result from the departure. The staff determined that the standard departure is consistent with Commission rules and regulations and has no adverse impact on public health and safety.

- STD DEP T1 2.15-2 RBSRDG HVAC

The applicant's evaluation determined that the proposed revision in this departure of the maximum temperature limit for the RB safety-related DG engine room—from 50 °C (122 °F) to 60 °C (140 °F) during the DG operation—does not affect the DG HVAC system or any safety-related equipment in the DG engine rooms.

Because an increase in temperature from 50 °C (122 °F) to 60 °C (140 °F) could have an impact on the environmental qualification of safety-related electrical equipment, the staff issued RAI 08.03.01-12 and RAI 08.03.01-14 requesting the applicant to clarify the potential impact of increasing the maximum temperature limit during DG operation on: (1) DG performance; (2) cable ampacity; (3) mild environment equipment qualification; and (4) operation of other equipment in the room, if any. The applicant's responses to RAI 08.03.01-12 (ML092050077) and RAI 08.03.01-14 (ML093170204) state that because the generator is specified and procured to the 60 °C temperature requirement, there will be no impact to DG performance. In addition, safety-related equipment in the DG room will be qualified to the guidance in ABWR DCD Tier 2, Section 3.11.2, "Qualification Tests and Analyses", and the qualification of the equipment will include consideration of the environment conditions in the DG room. Staff accepted these responses and these RAIs are closed and resolved and Section 8.3, "Onsite Power Systems," of the SER will document this conclusion.

The resolution of issues regarding the operator's safe entry into the DG room's high-temperature environment was resolved through the issuance of RAI 09.04.05-1. In its response to RAI 09.04.05-1, dated May 3, 2010 (ML101260118), the applicant states that the DGs are designed to automatically start and load without operator action, and the accident analysis does not credit operator actions to recover a DG that fails to start or run. There are no safety functions in the DG room that are required to be performed by the operators. Local DG control panels are located outside and above the rooms containing the diesel engines. No monitoring inside the DG room is mandatory and may be deferred if the room temperatures are excessive. Routine technical specification testing requiring loaded DGs can be scheduled to avoid extreme daytime peak temperatures. In addition, the development of Emergency Operating Procedures (EOP) under Subsection 13.5.3.2 for STP, Units 3 and 4, considers the lessons-learned

described in NUREG–1358, "Lessons Learned from the Special Inspection Program for Emergency Operating Procedures." This NUREG report states that an adequate analysis should be performed to assess the feasibility of performing actions in areas of high temperatures during emergency situations. Such a situation-specific heat stress exposure analysis for the operators' safe entry into the DG room would be performed in accordance with the Occupational Safety and Health Administration (OSHA) guidelines and industrial safety and hygiene practices. The staff found this response acceptable, and therefore, RAI 09.04.05-1 is resolved and closed.

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 9.4-8 Reactor Building HVAC

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

9.4.5.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.4.5.6 *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 relevant information relating to the RB HVAC system, and no outstanding information is expected related to this COL FSAR 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 RB HVAC system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.4.5 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the Tier 1 departures in accordance with Section 9.4.5 of NUREG–0800, and found it reasonable that the identified Tier 2 departure is characterized as not requiring prior NRC approval per 10 CFR 52, Appendix A, Section VIII.B.5.

9.4.6 Radwaste Building HVAC Systems (Related to RG 1.206 Section C.I.9.4.3, "Auxiliary and Radwaste Area Ventilation System")

9.4.6.1 *Introduction*

The radwaste building HVAC system is designed to provide an environment with controlled temperature and airflow patterns, which will ensure both the comfort and safety of plant personnel and the integrity of equipment and components. A positive static pressure, with respect to the balance of the building and the atmosphere is maintained in the radwaste control room. The radwaste building HVAC system has no safety-related function, as defined in Section 3.2. The failure of the system does not compromise any safety-related system or component and does not prevent a safe reactor shutdown. There are provisions incorporated to

minimize the release of radioactive substances into the atmosphere and to prevent operator exposure.

9.4.6.2 *Summary of Application*

Section 9.4.6 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.4.6 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.4.6, the applicant provides the following:

Tier 1 Departures

- STP DEP T1 5.0-1 Site Parameters

This site-specific departure proposed two changes to the design of the radwaste building HVAC system certified in the referenced ABWR DCD:

- The discussion of the summer and winter indoor design temperature conditions for the redesigned (STP) radwaste building HVAC system is relocated to the bulleted items under Departure STD DEP 9.4-5 in FSAR Subsection 9.4.6.1.2.

- The applicant revises the outdoor summer design dry-bulb temperature from the DCD maximum of 46 °C (114.8 °F) to 32.8 °C (91 °F) dry bulb and 26.3 °C (79.3 °F) wet bulb based on the one percent annual exceedance value (coincident). In addition, the applicant uses as its winter design condition the one percent exceedance value for the STP site of 2.1 °C (35.8 °F) rather than the ABWR winter design temperature of -40 °C (-40 °F). These one percent exceedance values represent a condition where the outdoor temperatures exceed these values one percent of the time. This temperature change is also incorporated in Departure STP DEP 9.4-8 for the RB HVAC system but is addressed here in this SER subsection. The standard Departure STD DEP 9.4-5 is proposed to redesign the radwaste building HVAC system to the STP site-specific, one percent exceedance outdoor ambient temperatures.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.4-5 Radwaste Building Ventilation

This standard departure demarcates another clean zone within the balance of the radwaste building consisting of a clean electrical equipment room, an HVAC equipment room, an air filtration equipment room, an elevator machine room, and a radwaste building entrance. This departure modifies the radwaste building HVAC system design by adding a dedicated HVAC system for the additional clean zone, which is completely separate from the one used for the radwaste control room. This design change also enhances the operation control of the exhaust air system by automatically routing the exhaust air through the filtration equipment upon detection of airborne radioactivity in the exhaust airflow, which will reduce the replacement frequency of the filters.

The departure also modifies the radwaste building HVAC system description in the FSAR to be consistent with Figure 9.4-10, “Radwaste Building HVAC,” (which depicts the system) and eliminates the HVAC equipment supporting the radwaste incinerator, which is deleted. The description of the control room systems operation is also clarified to demonstrate proper control

room boundary pressurization. All of these changes are based on calculations and general arrangements and temperatures.

COL License Information Item

- COL License Information Item 9.17 Radwaste Building HVAC System

This COL license information item provides detailed equipment lists and system flow rates in FSAR Table 9.4-6a, "Radwaste Building Control Room Air Conditioning Unit," through Table 9.4-6m, "Radwaste Process Areas Air Exhaust Filtration Units."

9.4.6.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the radwaste building HVAC system, and the associated acceptance criteria, are in Section 9.4.3 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 1 and Tier 2 departures. Tier 1 departures require prior NRC approval and are subject to the requirements specified in 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2 departures not requiring 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 reviewing the COL license information item is in Section 9.4.3 of NUREG–0800.

9.4.6.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.4.6 of the certified ABWR DCD. The staff reviewed Section 9.4.6 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the radwaste building HVAC system.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departure

- STP DEP T1 5.0-1 Site Parameters

This Tier 1 departure identifies STP site characteristics (flood level, humidity and temperature, and shear wave velocity) that are not bounded by the Tier 1 site parameters described in Tier 1 Chapter 5 of the ABWR DCD. In addition, for the nonsafety-related radwaste building HVAC system, the applicant uses as its winter design condition the one percent exceedance value for

[1] 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 STP site rather than the ABWR winter design temperature. Therefore, in subsection 9.4.6.1.2, "Power Generation Design Bases," of the FSAR, the applicant replaced the summer and winter outdoor and indoor design temperatures of the referenced ABWR DCD with the STP site summer wet and dry bulb (coincident) temperatures and winter temperature as the design conditions for the radwaste building HVAC system.

Based on the information in FSAR Subsection 9.4.6.1.2 and the Departures Report (Part 7 of the COLA), the staff was not able to determine whether the applicant's conclusions were acceptable. Therefore, the staff issued RAI 09.04.03-1, requesting the applicant to clarify the proposed revision of the outdoor design temperatures in Departure STP DEP T1 5.0-1, and the removal of the indoor design temperatures described in ABWR DCD Subsection 9.4.6.1.2. In its response to RAI 09.04.03-1, dated September 8, 2009 (ML092530407), the applicant points out that the departure from the temperature parameters identified in this Tier 1 Departure was addressed in Tier 2 Departure STD DEP 9.4-5.

The applicant proposed Departure STD DEP 9.4-5 to redesign the radwaste building HVAC system. In the response to RAI 09.04.03-1, the applicant addresses the indoor temperature question by stating that the description of the radwaste building indoor temperatures in ABWR DCD Subsection 9.4.6.1.2 has been relocated to the bulleted items under Departure STD DEP 9.4-5.

As described in COL FSAR Subsection 9.4.6.1.2, the HVAC system design is based on STP site-specific outdoor ambient temperatures provided in Tier 1 Departure STP DEP 5.0-1, which states, in part:

> The Radwaste Building HVAC systems have been redesigned using STP site-specific ambient temperatures and the revised HVAC design is compliant with STP 3 & 4 Characteristics.

The RAI response proposed to add Note [8] to Table 5.0, "ABWR Site Parameters", in COL FSAR Part 2, Tier 1, stating that nonsafety-related HVAC systems are designed based on the temperatures described in Departure STD DEP 5.0-1. Because the radwaste building HVAC system is nonsafety-related, using 1 percent outdoor exceedance temperatures to design nonsafety-related HVAC systems is acceptable because it represents a condition that the duration of outdoor temperatures exceeding these values is short (one percent of the time). Any temperature swing in these short time periods will have no safety impact because there is no safety-related functions associated with the operation of the radwaste systems. In addition, the design approach is in accordance with standard industry practice. The staff found this response acceptable because the HVAC system is nonsafety-related, there is no concern with equipment qualification, and the occasional temperature spike (one percent exceedance) would have no impact on habitability and safety operation. The proposed FSAR changes had been implemented in Revision 3 of the FSAR. Therefore, RAI 09.04.03-1 is resolved and closed. The STP site characteristics identified in Departure STP DEP T1 5.0-1 have been appropriately incorporated in the design of the radwaste building HVAC system.

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.4-5 Radwaste Building Ventilation

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

this section, the staff found it reasonable that the 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.

COL License Information Item

- COL License Information Item 9.17 Radwaste Building HVAC System

Per COL License Information Item 9.17 in ABWR DCD Revision 4, the applicant has provided site-specific equipment lists and system flow rates to conform to RG 1.140, Revision 2 "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants," for the radwaste building HVAC system in Subsection 9.4.6.2 of the STP, Units 3 and 4, COL FSAR. The staff finds this acceptable because the information provided conforms to RG 1.140.

9.4.6.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.4.6.6 *Conclusion*

The staff's finding related to information incorporated by reference is in NUREG–1503. The staff reviewed the application and checked the ABWR DCD. The staff's review confirmed that the applicant has addressed the relevant information, and no outstanding information is expected to be addressed in the COL FSAR related to this subsection. 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 radwaste building HVAC system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to relevant NRC regulations and the guidance in Section 9.4.3 of NUREG–0800. The staff's review concluded that the applicant has provided adequate information to address the COL license information item and the Tier 1 departure in accordance with the relevant guidance in Section 9.4.3 of NUREG–0800, and found it 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. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

9.4.7 Diesel Generator Area Ventilation System

The DG building ventilation system is part of the RB ventilation system, which is reviewed in Section 9.4.5 of this SER.

9.4.8 Service Building HVAC System (Related to RG 1.206, Section C.I.9.4.3, "Auxiliary and Radwaste Area Ventilation System")

9.4.8.1 *Introduction*

This system serves all areas within the service building including locker rooms; men and women's changing rooms; the laundry room, lunchroom, and instrument repair room; HVAC equipment rooms; and the technical support center (TSC). This system operates during all

normal station conditions. The service building HVAC system consists of two subsystems: the clean area HVAC system and the controlled area HVAC system.

9.4.8.2 *Summary of Application*

Section 9.4.8 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.4.8 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.4.8, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 9.4-1 Service Building HVAC System

This site-specific departure modifies the design of the service building HVAC system. The departure revises the outdoor air inlet monitoring instrumentation design by removing the provisions for toxic gas monitors and the TSC alarm for high toxic gas concentration. The toxic gas monitors and the TSC alarm were deleted from the design based on the site-specific evaluation of the onsite and offsite mobile and stationary sources of toxic gases and in accordance with RG 1.78, Revision 1 "Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," as described in FSAR Section 2.2S.

- STP DEP 9.4-3 Service Building HVAC System

This standard departure revises the service building HVAC system design by deleting the two subsystems and consolidating them into a single HVAC system that supplies air to both the clean area and the controlled area. This change also makes it possible to operate the service building HVAC system using power from the combustion turbine generator, which can be manually loaded by the operator during a loss of offsite power conditions. This departure allows the TSC and operations support center (OSC) to be habitable under accident conditions.

COL License Information Item

- COL License Information Item 9.16 Service Building HVAC System

Details in this COL license information item include the P&ID, system flow rates, an equipment list, toxic gas protection requirements, and a description of radiation monitors at the supply air inlet (if any) for the service building HVAC system, including the TSC and OSC.

9.4.8.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the service building HVAC system, and the associated acceptance criteria, are in Section 9.4.3 of NUREG–0800.

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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 reviewing the COL license information items is in SRP Section 9.4.3.

9.4.8.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.4.8 of the certified ABWR DCD. The staff reviewed Section 9.4.8 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 COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the relevant information related to the service building HVAC system.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

- STP DEP 9.4-1 Service Building HVAC System

This site-specific departure revises the outside inlet air monitoring instrumentation design by removing the provisions for toxic gas monitors and the Technical Support Center (TSC) alarm for high toxic gas concentration This is based on the site-specific evaluation of on-site and off-site mobile and stationary sources of toxic gases described in FSAR Subsection 2.2S in accordance with RG 1.78.

In FSAR Section 6.4, COL License Information Item 6.8, "Toxic Gases," (in Subsection 6.4.7.1), the applicant concludes that "Instrumentation to detect and alarm a hazardous chemical release in the STP 3 & 4 vicinity and to isolate the main control area envelope from such releases is not required based on analyses in Subsection 2.2S.3…." The staff did not have sufficient information to reach the same conclusion. Therefore, in the review of Section 6.4 of this application, the staff performed a detailed review of the applicant's site-specific supplement that addresses COL License Information Item 6.8. The details of the staff's confirmatory calculations and audit are documented in Section 6.4 of this SER. The staff issued RAI 06.04-2, to request the applicant's analyses of the onsite and offsite mobile and stationary sources of toxic gases to justify the removal of the service building HVAC system toxic gas monitors and the TSC alarms. This has been resolved and closed in Chapter 6.4 of this SER. The staff concluded that no hazardous chemicals with quantities exceeding the immediate danger to life and health (IDLH) criteria of RG 1.78 were identified, and there is no toxic gas threat to the control room.

The applicant's evaluation, in accordance with Section VIII.B.5 of 10 CFR Part 52, Appendix A, determined 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.

- STD DEP 9.4-3 Service Building HVAC System

The service building HVAC system in the ABWR DCD contains two subsystems: the clean area HVAC system and the controlled area HVAC system. This standard departure combines the

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[1] 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.

two subsystems into one. The STP service building HVAC system supplies air to both the clean and the controlled areas.

In Revision 4 of the FSAR, the applicant increased the service building HVAC system charcoal filters efficiency from 95 percent to 99 percent in Departure STD DEP 9.4-3. The staff reviewed the increase in the charcoal-bed thickness of the emergency filter train from 5.1 centimeters (cm) (2 inches [in.]) to 10.2 cm (4 in.) and other design changes described in this departure. Their impact on the TSC radiological design and ABWR DCD Tier 1 ITAAC Item 4 in Table 2.15.5m for the service building HVAC system emergency filtration unit efficiency was thoroughly assessed. In this regard, the staff issued several RAIs and conducted two audits of the TSC radiological design and dose analysis in 2010 and 2011. Increasing the HVAC filter thickness, and thus its efficiency, ensures that the acceptance criterion in ITAAC Table 2.15.5m, Item 4, is met. Details of these activities are documented in Section 15.6 of this SER. The staff concluded that the changes proposed by the applicant in the service building HVAC system are improvements and found it reasonable that the departure does not require prior NRC approval.

The applicant's evaluation, in accordance with Section VIII.B.5 of 10 CFR Part 52, Appendix A, determined 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.

COL License Information Item

- COL License Information Item 9.16 Service Building HVAC System

The staff reviewed COL License Information Item 9.16, which is included under Section 9.4.10 of the STP, Units 3 and 4, COL FSAR.

To satisfy COL License Information Item 9.16 in ABWR DCD Revision 4, the COL applicant provides FSAR Figure 9.4-11, which depicts the service building HVAC system P&ID. Radiation monitors at the supply air inlet are shown in Figure 9.4-11, "Service Building HVAC P&ID (Sheets 1 and 2)," and are discussed in FSAR Subsection 9.4.8.2 (7c). Flow rates and component capacities are listed in FSAR Tables 9.4-3, "HVAC Flow Rates," 9.4-4h, "HVAC System Component Descriptions—Non-Safety-Related Filters," 9.4-7a, "Service Building HVAC System Component Descriptions Non-Safety Related Heating/Cooling Coils," and 9.4-7b "Service Building HVAC System Component Descriptions Non-Safety Related Fans."

In FSAR Subsection 9.4.10.1, "Service Building HVAC System," the applicant states that no hazardous chemicals with quantities exceeding the criteria of RG 1.78 have been identified as discussed in Section 2.2S.3 "Evaluation of Potential Accidents." Therefore, there is no instrumentation to detect and alarm a hazardous chemical release in the STP, Units 3 and 4, vicinity and to isolate the service building clean area from such releases. The applicant also states that the service building clean area emergency filter unit complies with all applicable provisions of RG 1.140, Revision 2, Section C.

The staff's review of the applicant's proposal for radiation monitoring is addressed in SER Section 6.4, and the applicant's screening of hazardous materials is evaluated in SER Section 2.2S, "Nearby Industrial, Transportation, and Military Facilities." Based on these reviews and the information provided in Chapter 9.4, "Air-Conditioning, Heating, Cooling, and Ventilation Systems," described above, staff found the information provided is sufficient to satisfy COL License Information Item 9.16.

9.4.8.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.4.8.6 *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 the service building HVAC system, and no outstanding is expected to be addressed in the COL FSAR related to this section. Pursuant to 10 CFR 52.63(a)(5) and Part 52 Appendix A Section VI.B.1, all nuclear safety issues relating to the drywell cooling system have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.4.3 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed COL License Information Item 9.16 in accordance with the relevant guidance in Section 9.4.3 of NUREG–0800, and found it 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. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

9.4.9 Drywell Cooling System

Section 9.4.9 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.4.9, "Drywell Cooling System," 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.[1] 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 drywell cooling system have been resolved.

9.5 <u>Other Auxiliary Systems</u>

9.5.1 Fire Protection System (Related to RG 1.206, Section C.I.9.5.1, "Fire Protection Program")

9.5.1.1 *Introduction*

This section of the FSAR addresses how the Fire Protection Program provides assurance, through a defense-in-depth philosophy, that the following NRC fire protection objectives are satisfied:

- To prevent fires from starting.

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[1] 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.

- To detect rapidly, control, and extinguish promptly those fires that do occur.
- To provide protection for SSCs important to safety so that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant.

In addition, fire protection systems must be designed to assure that their failure (or inadvertent operation) does not significantly impair the safety capability of the SSCs important to safety to perform their safety functions.

9.5.1.2 *Summary of Application*

Section 9.5.1 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.1 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. The COL FSAR also incorporates by reference Appendices 9A and 9B of the certified ABWR DCD. Section 9.5.1 and Appendix 9A of the COL FSAR also incorporate by reference Section 9.5.1 and Appendix 9A of the certified STP Nuclear Operating Company "Design Control Document ABWR STP Aircraft Impact Assessment Amendment Revision 3" (AIA Amendment), referenced in 10 CFR Part 52, Appendix A. In addition, the applicant includes a new Appendix 9E in the FSAR, which covers certain administrative controls and procedures to address COL License Information Item 9.35.

The applicant identifies and addresses the following Fire Protection Program-related departures from the ABWR certified design:

Tier 1 Departure

- STP DEP T1 3.4.1 Safety-Related I&C Architecture

This departure addresses design changes to the safety-related instrumentation and control (I&C) architecture and design.

Tier 2 Departures Not Requiring Prior NRC Approval

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

This departure addresses issues of applying the single unit ABWR certified design to a two unit plant, which can affect systems such as the supply of fire water.

- STP DEP 1.2-2 Turbine Building

This departure addresses design changes to the turbine building.

- STD DEP 9.2-2 Makeup Water Preparation System

This departure addresses design changes to the makeup water preparation system.

- STD DEP 9.4-2 Control Building HVAC System

This departure addresses design changes to the HVAC system in the control building.

- STD DEP 9.4-8 Reactor Building HVAC

This departure addresses design changes to the HVAC system in the RB.

- STD DEP 9.5-7 Fire Protection – House Boiler Area of the Turbine Building

This departure addresses design changes to the house boiler area of the turbine building.

- STD DEP 10.2-4 Bulk Hydrogen Storage

This departure addresses design changes to the bulk hydrogen storage.

The applicant addresses the following COL license information items as identified in the ABWR certified design:

COL License Information Items

- COL License Information Item 9.19 Use of Communication Systems in Emergencies

This COL license information item addresses the procedures for the emergency use of plant communication systems. (COM 9.5-4).

- COL License Information Item 9.20 Maintenance and Testing Procedures for Communication Equipment

This COL license information item addresses the procedures for maintaining and testing plant communication systems. (COM 9.5-5).

- COL License Information Item 9.21 Use of Portable Hand Light in Emergency

This COL license information item addresses the use of portable hand lights during emergencies.

- COL License Information Item 9.24 High Energy Penetration Seals

This COL license information item addresses the fire rating for penetration seals.

- COL License Information Item 9.26 Applicant Fire Protection Program

This COL license information item addresses the inclusion of specific equipment and areas within the plant's Fire Protection Program.

- COL License Information Item 9.27 HVAC Pressure Calculations

This COL license information item addresses the smoke control features of HVAC systems. (COM 9.5-10 and COM 9.5-17).

- COL License Information Item 9.28 Plant Security Systems Criteria

This COL license information item addresses the evaluation of adverse impacts from the plant security system on operations and emergencies. (COM 9.5-16).

- COL License Information Item 9.31 Portable and Fixed Emergency Communication Systems

This COL license information item addresses the design of the telephone system, portable radio communication system, microwave system interface, public addressing (PA) paging/alarm system, maintenance jack system, refueling communication system, operator communication panel console, and special service telephone lines.

- COL License Information Item 9.32 Identification of Chemicals

This COL license information item addresses liquid insulated transformers and the location of hazardous process chemicals. (COM 9.5-12, and COM 9.5-13).

- COL License Information Item 9.34 Sound-Powered Telephone Units

This COL license information item addresses the provision of sound powered telephones. (COM 9.5-15).

- COL License Information Item 9.35 Fire-Related Administrative Controls

This COL license information item addresses fire protection administrative controls.

Operational Program

- Operational Program #8 Plant Fire Protection Program

This operational program addresses the Plant Fire Protection Program.

9.5.1.3 *Regulatory Basis*

The regulatory basis for the information incorporated by reference is in NUREG–1503 and NUREG–1948. In addition, the relevant requirements of the Commission regulations for the fire protection system, and the associated acceptance criteria, are in Section 9.5.1 of NUREG–0800. The Fire Protection Program follows the guidance of Branch Technical Position (BTP) Chemical Engineering Branch (CMEB) 9.5-1, Revision 2, "Guidelines for Fire Protection for Nuclear Power Plants," as incorporated by reference in the DCD. However, RG 1.189, Revision 1 "Fire Protection for Nuclear Power Plant," is followed for those items discussed in the STP COLA. There is one exception; the applicant follows RG 1.189, Revision 2, as it pertains to single and multiple spurious actuations.

COL License Information Items 9.19, 9.20, 9.21, 9.24, 9.26, 9.27, 9.28, 9.31, 9.32, 9.34, and 9.35; Operational Program #8; and interface requirements in DCD Tier 1 Section 2.12.16 are reviewed based on the regulations in 10 CFR Part 50. The SRP acceptance criteria are based on meeting the relevant requirements of 10 CFR 50.48; 10 CFR 50.71(e); 10 CFR Part 50 GDCs 3, 5, 19, and 23; 10 CFR Part 52; and 10 CFR 52.80(a).

In addition, in accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies a Tier 1 departure and Tier 2 departures. Tier 1 departures require prior NRC approval and are subject to the requirements specified in 10 CFR Part 52, Appendix A, Section VIII.A.4. Tier 2 departures not requiring prior NRC approval are subject to the requirements in 10 CFR Part 52, Appendix A, Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59.

9.5.1.4 *Technical Evaluation*

As documented in NUREG–1503 and NUREG–1948, the staff reviewed and approved Section 9.5.1 of the certified ABWR DCD and AIA Amendment. The staff reviewed Section 9.5.1 and Appendices 9A, 9B and 9E of the STP, Units 3 and 4, COL FSAR Revision 10, and checked the referenced ABWR DCD Revision 4, and AIA Amendment Revision 3 to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD and AIA Amendment appropriately represents the complete scope of information relating to this review topic.[1] 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 system.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departures

- STP DEP T1 3.4.1 — Safety-Related I&C (instrumentation and control) Architecture

This departure addresses the:

- Elimination of obsolete data communication technology by replacing a single common Essential Multiplexer System with separate, independent system level data communication capabilities for each division;
- Elimination of unnecessary inadvertent actuation prevention logic and equipment;
- Clarification of digital controls nomenclature and systems such as the definition of several I&C systems, and the replacement of terminology associated with "module", "unit", or "system" with "function";
- Final selection of platforms, which changed the implementation architecture including the use of configurable logic devices for the (Neutron Monitoring System and the Reactor Trip & Isolation System in lieu of microprocessors;
- Testing and surveillance changes for Safety System Logic & Control (i.e., all logic and control systems associated with safety-related control systems), which were revised to be consistent with the characteristics of the design platforms;
- Modification to TS 3.0 to reflect the above changes; and
- Elimination of a duplicate set of non-safety related Video Display Units.

This departure affects the following fire protection system subsections:

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[1] 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.

- Subsection 9.5.1.1.2, “Divisional Separation,” was modified to replace “multiplexed over fiber optic cables so” with “communicated such”. This terminology change presents no adverse impact on the fire protection system or program.

- Subsection 9.5.1.1.4, “Combustible Loading,” was modified to replace “multiplexing” with “transmitting” or “Data communication,” as appropriate. This terminology change presents no adverse impact on the fire protection system or program.

- In Subsection 9.5.1.1.7, “Spurious Control Actions,” the applicant:

  - replaced “multiplexed” with “communicated”;

  - replaced “two channel operation of the multiplex system” with “redundant fiber optic design”;

  - replaced “The possibility of two spurious signals matching is essentially zero” with “The probability of spurious messages occurring on each of the redundant links that both pass the communication diagnostics and that also match between the two redundant links is essentially zero”; and

  - replaced the description of the multiplexing, dual channel system and of how the multiplexing signals are verified with a generic new system description which will utilize redundant fiber optic links and diagnostics to verify signal validity. The redundant messages received must also match each other for component actuation to occur.

The staff reviewed this departure within the review scope of fire protection system and program. Nomenclature changes and clarifications do not change the physical design or function. The replacement of the older multiplexing technology with newer redundant fiber optic technology that will be separate and independent per division maintains or decreases the chance of fire-induced spurious actuations. The use of configurable logic devices in lieu of microprocessors has no impact on the fire protection system or program. The staff finds that none of the departure elements described above have an adverse impact on the fire protection program because the departure has no impact or provides an enhancement from the certified ABWR DCD design. The staff finds that this departure satisfactorily maintains the guidance of RG 1.189, Revision 1 and, therefore, is acceptable within the review scope of this section.

Tier 2 Departures Not Requiring Prior NRC Approval

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

This departure addresses the issues related to applying the single unit ABWR certified design to a two unit plant, including effects on systems such as the fire protection water supply system. The applicant has designed a single fire protection pump house and two storage tanks to serve as the fire protection systems for both STP, Units 3 and 4.

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 found it reasonable that the 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.

- STP DEP 1.2-2 Turbine Building

This departure addresses the design changes associated with the turbine building. The changes include a different turbine generator, a different power generation heat sink, and the replacement of the medium voltage system with a dual voltage system in the turbine building. The turbine building will house safety-related equipment, including the condensate pump motor trip circuit breakers and instrumentation associated with the reactor protection system.

The turbine building is a nonsafety-related structure located adjacent to the control building. With the exception of instrumentation associated with the reactor protection system and the safety-related condensate pump motor trip circuit breakers, there are no safety-related equipment in the turbine building. The turbine building is also a non-Seismic Category I building, but is designed to withstand the SSE to avoid jeopardizing adjacent Seismic Category I buildings.

This departure resulted in changes to portions of the fire hazards analysis related to the turbine building in Appendix 9A.4.3. The turbine building is provided with standpipes, hose reels, and portable extinguishers throughout the building. In addition, automatic sprinkler systems are provided throughout the turbine building except in higher hazard areas that are protected as described below:

> Deluge foam-water sprinkler systems are provided in the combustion turbine generator areas, hydrogen seal oil unit room, turbine lube oil storage tank room, EHC hydraulic control unit room, lube oil conditioning area and the lube oil reservoir area.

These design changes do not result in any increase in the frequency of a malfunction of an SSC important to safety.

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 found it reasonable that the 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.

- STD DEP 9.2-2 Makeup Water Preparation System

This departure addresses design changes that increase the flow and storage capacities of the MWP system, a system that is not important to safety. The MWP system can provide makeup water to the fire protection system as needed. The MWP system does not need to address the fire protection water supply storage guidance of RG 1.189, Revision 1, because conformance with this guidance is provided by the fire protection system, including the fire water storage tanks. The fire water storage tanks provide the required primary water supply for the fire protection system. In addition, this design change adds demineralized water prover tanks and sulfuric acid chemical feed tanks to reduce fouling and scaling in the reverse osmosis filter membranes. In the event that the MWP system is used to provide temporary makeup water to the fire protection system, these tanks will provide an acceptable level of quality water.

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 found it reasonable that the 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.

- STD DEP 9.4-2 Control Building HVAC System

This departure addresses the standard design changes to the smoke removal mode of the HVAC system in the control building. The change adds that when the recirculation damper is closed, “the damper in the bypass duct around the air handling unit is opened”. The change also clarifies that “both” exhaust fans are operated in conjunction with the supply fan for smoke removal. FSAR Section 6.4.2, Subsection 9.4.1.1.4, and Subsection 9.5.1.1.6 describe the air supply bypass line and fire damper arrangement. This arrangement is required to satisfy an air balance during the smoke removal mode and to ensure that smoke does not migrate to other areas of the control building. This design change will still meet the applicable National Fire Protection Association (NFPA) codes and the guidance of RG 1.189, Revision 1. The applicant commits to not increasing adverse consequences for SSCs important to safety with this design change.

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 found it reasonable that the 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.

- STD DEP 9.4-8 Reactor Building HVAC

This departure addresses the standard design change to replace the inlet and exhaust fire dampers with tornado dampers in the RB. There are no identified outdoor fire hazards in the vicinity of the intake or exhaust.

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 found it reasonable that the 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.

- STD DEP 9.5-7 Fire Protection – House Boiler Area of the Turbine Building

This departure changes an oil-heated boiler to an electrically heated house boiler. This boiler is not important to safety and is located in the turbine building away from any SSCs important to safety. This change will reduce the combustible loading by removing the fuel oil. In addition, this change will eliminate the potential open-flame ignition source associated with the oil-heated house boiler.

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 found it reasonable that the 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.

- STD DEP 10.2-4 Bulk Hydrogen Storage

This departure only changes the storage location of the bulk hydrogen from a location near the turbine building to a location away from the power block buildings. This departure reduces any potential damage to the power block by increasing the distance between the power block buildings and the bulk hydrogen storage.

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 found it reasonable that the 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.

COL License Information Items

- COL License Information Item 9.19 Use of Communication System in Emergencies

Specific information required to address COL License Information Item 9.19, includes the procedures for using the plant communication systems in emergencies, including from the RSS in the event of a MCR fire. These procedures will be developed before fuel load to be consistent with the plant operating procedure development plan in Section 13.5. Because the detailed designs and procedures for the communication systems are not complete at this time, the applicant commits (COM 9.5-4) to develop the above procedures in accordance with Section 13.5, "Plant Procedures." This commitment is acceptable under the guidance in RG 1.189, Revision 1, Regulatory Position C.4.1.7.

- COL License Information Item 9.20 Maintenance and Testing Procedures for Communication Equipment

Specific information required to address COL License Information Item 9.20, includes procedures for maintaining and testing the plant communication systems that will be developed before the fuel load. These procedures will be developed to be consistent with the plant operating procedure development plan in Section 13.5. Because the detailed designs and procedures for the communication systems are not complete at this time, the applicant commits (COM 9.5-5) to develop the above procedures in accordance with Section 13.5. This commitment is acceptable under the guidance in RG 1.189, Revision 1, Regulatory Position C.4.1.7.

- COL License Information Item 9.21 Use of Portable Hand Light in Emergency

Specific information required to address COL License Information Item 9.21 includes the following information to verify that the following BTP CMEB 9.5-1 Positions C.5.g(1) and C.5.g(2), (RG 1.189, Revision 1, Regulatory Position C.4.1.6) information is provided:

Suitable fixed and portable emergency lighting devices are available as follows:

1. Fixed self-contained lighting consisting of fluorescent or sealed-beam units with individual eight-hour minimum battery power supplies are provided in areas that must be manned for safe shutdown and for access and egress routes to and from all fire areas. Safe shutdown areas include those required to be manned if the control room must be evacuated.

2. Suitable sealed-beam battery-powered portable hand lights are available for emergency use by the fire brigade and other operations personnel required to achieve a safe shutdown of the plant.

- COL License Information Item 9.24 Fire Rating for Penetration Seals

Specific information required to address COL License Information Item 9.24, includes design data verifying that the applicant will provide three-hour, fire-rated penetration seals tested and assembled in accordance with a nationally recognized laboratory for all high-energy piping. For those situations where this will not be the case, STP will provide a substitute adequate to withstand the hazards associated with the area, based on an equivalency engineering evaluation established by a qualified fire protection engineer. Fire endurance and performance qualification testing of the products, assembly or portions thereof may be performed to support the equivalency engineering evaluation. Equivalency will be determined by a qualified fire protection engineer utilizing such codes as the ASTM E 814 "Standard Test Method for Fire Tests of Penetrations Firestop Systems," and NFPA 251 "Standard Methods of Tests of Fire Resistance of Building Construction and Materials." This provision is acceptable under the guidance in RG 1.189, Revision 1, Regulatory Position C.4.2.1.5.

- COL License Information Item 9.26 Applicant Fire Protection Program

Specific information required to address COL License Information Item 9.26, includes the following areas that are outside of the ABWR Standard Plant design scope for the Fire Protection Program, but which are included in the applicant's Fire Protection Program: main transformer, equipment entry lock and large component entrance building, fire protection pump house, and the ultimate heat sink.

- Main transformer

Outdoor oil-filled main transformers have oil spill confinement features or drainage away from the buildings. Transformers are located at least 15.24 m (50 ft) from the building, or building walls within 15.24 m (50 ft) of oil-filled transformers have no openings and have a fire resistance rating of at least three hours. Oil-filled transformers are also protected by a fixed deluge water spray system in accordance with NFPA 15, "Water Spray Fixed Systems for Fire Protection."

- Equipment entry lock and large component entrance building

The equipment entry lock or large component entrance building is a three-hour fire resistant structure adjacent to, but independent from the RB. The airlock door between the equipment entry lock and the RB is airtight and fire resistant. The large Component entrance building is protected by fire detection and alarms to annunciate a fire condition at the MCR. Administrative controls will be implemented for access control, to assure that in-situ combustible loading is negligible, that transient combustibles are reduced, and to prevent potential ignition sources.

- Fire protection pump house

The fire protection pump house is located remotely from any structures onsite. The electric motor-driven fire pump is separated by a three-hour fire barrier from the diesel engine-driven fire pump. The fire protection pump house is protected by a fire detection and alarm system that annunciates in the MCR and has automatic water sprinklers. Fire pump installation and post

installation periodic inspections and testing comply with Regulatory Position 3.2.2 in RG 1.189, Revision 1 and applicable NFPA Standards.

- Ultimate Heat Sink (UHS)

The UHS consists of three redundant trains of counter flow mechanically-induced draft cooling towers. The cooling towers are located with a significant physical separation distance from any structures onsite. Fire protection of the UHS is in accordance with NFPA 214, "Standard for Water-Cooling Towers." The RSW pump house is provided with area fire detection in accordance with NFPA 72, "National Fire Alarm Code," with manual fire protection provided by portable fire extinguishers located and installed per NFPA 10, "Standard for Portable Fire Extinguishers." Additional manual fire fighting protection is also provided by area yard hydrants located and installed per NFPA 24, "Standard for the Installation of Private Fire Service Mains and Their Appurtenances."

Applicable fire protection program elements for the main transformer, equipment entry lock, fire protection pump house and UHS conform to Regulatory Position C.7 in RG 1.189, Revision 1.

Therefore, these elements of the applicant's Fire Protection Program comport with SRP Section 9.5.1 and RG 1.189. The Fire Protection Program is described in Appendix 9E of the STP, Unit 3 and 4, COL FSAR. See COL License Information Item 35, below, for review of the administrative control elements of the applicant's Fire Protection Program.

The ability to bring the plant to a safe shutdown condition following a complete fire burnout of a fire area/division, without the need for recovery is described in Appendix 9E, Section 9E.8.2. The applicant states that a principal feature of the ABWR design approach to fire protection is providing three complete divisions of safety-related cooling systems with only one division located in any single fire area. Complete burnout of any fire area without recovery will not prevent safe shutdown of the plant; therefore, complete burnout of a fire area can be tolerated. Divisional separation is not practical in the case of the inerted containment. Also, all divisions are present in the control room and this cannot be avoided. It is the purpose of the remote shutdown panel to provide redundant control of the safe shutdown function from outside the control room. This meets the guidance of RG 1.189, Revision 1 and SECY 90-016.

- COL License Information Item 9.27 HVAC Pressure Calculations

The STP, Units 3 and 4, HVAC systems (DCD Tier 2 Subsection 9.5.1.1.6) are designed for a dual purpose of HVAC and smoke control. Specific information required to address COL License Information Item 9.27 includes pressure calculation guidance, commitments, and preoperational testing acceptance criteria of the smoke control mode of the HVAC systems that confirm the following smoke control features:

1. Venting of fire areas to prevent the undue buildup of pressure due to a fire via the HVAC system in the smoke removal mode. (This does not apply to the turbine building HVAC system which is described in Section 9.4.4.).

2. Pressure control across the fire barriers to assure that any leakage goes into the fire area experiencing the fire, in accordance with NFPA 92A.

3. Pressure control and purge air supply to prevent the backflow of smoke and hot gases when fire barrier doors are kept open and accessible for manual fire suppression activities.

4. Augmented and directed clean air supply to provide a clean air path to the fire area for fire suppression personnel.

5. Smoke control by the HVAC system external to the fire area experiencing the fire.

6. Removing smoke and heat from the fire using exhaust fans and operating supply fans to provide clean, cool air via the HVAC system in the smoke removal mode.

The applicant will utilize Underwriters Laboratories (UL)-listed fire-dampers and smoke-dampers listed under UL 555 and UL 555S, respectively.

Because the detailed design of the HVAC system is not complete at this time, the applicant commits (COM 9.5-10) to confirm the above DCD-listed features with calculations and testing before fuel loading. Refer to the discussion below on RAI 09.05.01-10, for further information. This commitment is acceptable under the guidance in RG 1.189, Revision 1, Regulatory Position C.4.1.4 and C.8.

ABWR DCD Subsection 9.5.1.1.6 states under COL License Information Item 9.27, that the COL applicant shall provide “pressure calculations” for each smoke control HVAC system and that preoperational testing of the smoke removal mode will be performed to confirm capability. However, STP FSAR Subsection 9.5.13.10 only committed to developing a procedure for the pre-operational test prior to fuel load. In RAI 09.05.01-10, the staff requested the applicant to update the FSAR to include a description of how these pressure values will be calculated and a description of the initial tests to be conducted to confirm capability. In its response to RAI 09.05.01-10, dated October 29, 2009 (ML093430301), the applicant provided an FSAR markup in which the applicant commits to using NFPA 92A for the proper design and testing of the smoke removal mode of the HVAC system. The staff found the information in this RAI response acceptable under the guidance of RG 1.189, Revision 1. The staff verified that the applicant included in the FSAR Subsection 9.5.13.10 Revision 4, the use of Appendix A of NFPA 92A to determine required differential pressure values and the use of NFPA 92A Chapter 4 for the pre-operational testing and acceptance criteria. These are also captured by the applicant under Commitment (COM 9.5 10) and Commitment (COM 9.5 17). Therefore, RAI 09.05.01-10 is resolved and closed.

- COL License Information Item 9.28 Plant Security Systems Criteria

Specific information required to address COL License Information Item 9.28, includes an evaluation to ensure that the plant security system design does not create the potential for adverse impacts on plant operations, testing, and maintenance and that communications coverage with security alarm stations is accomplished as a component of the in-process engineering design effort and specification development for the plant security systems. This evaluation will include the issuance of vital area keys to those operations personnel relied upon for unrestricted plant access for emergency local operations, including access by members of the fire brigade. Communications coverage from all areas of the nuclear island to the central and secondary alarm stations will be evaluated and, to the extent practical, will be provided (COM 9.5-16). This commitment is acceptable under the guidance in RG 1.189, Revision 1, Regulatory Positions C.4.1.2.3, C.4.1.7, and C.4.2.1.2.

- COL License Information Item 9.31 Portable and Fixed Emergency Communication Systems

Specific information required to address COL License Information Item 9.31, includes the design and testing of features of the portable radio communications system and the fixed emergency communications system. The communication systems are designed in such a way that at any given moment, adequate onsite and offsite portable and fixed communication means are available for both normal and emergency conditions. This design includes uses related to fire emergencies that will be available in fire areas described in the FSAR. The communication systems include the following systems, special equipment, and communication lines:

1. Telephone System.

2. Portable Radio Communications System.

3. Microwave System Interface.

4. PA Paging/Alarm System.

5. Maintenance Jack System (DC/Sound-Powered).

6. Refueling Communications System.

7. Operator Communications Panel (OCP) Consoles.

8. Special Service Telephone Lines.

This provision is acceptable under the guidance of BTP CMEB 9.5-1 Positions C.5.g(3) and (4) (RG 1.189, Revision 1, Regulatory Position C.4.1.7).

In RAI 09.05.01-3, the staff requested the applicant to provide a communication design appropriate for use by the fire brigade in accordance with RG 1.189, Revision 1, Regulatory Position C.4.1.7. In its response to RAI 09.05.01-3, dated August 12, 2009, (ML092260197), the applicant stated that the STP, Units 3 and 4, communications systems described in FSAR Subsection 9.5.13.14 will be designed to meet the guidance in Regulatory Positions C.5g(3) and (4) of BTP SPLB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants (formerly BTP CMEB 9.5-1)." Regulatory Positions C.5g(3) and (4) are repeated in RG 1.189, Revision 1, Regulatory Positions C.4.1.7a. and b. The two-way radio system will be designed and installed with a sufficient number of repeaters/antennas to ensure that direct portable radio communication with the control room is possible from at least one location in each fire area identified in the final as-built fire hazards analysis. A dedicated radio communications channel will be available for fire brigade purposes. Essential communication system components, including fixed repeaters, power cables, and antenna will be protected from exposure to fire damage. In the event of direct fire damage to a repeater or antenna, a talk-around channel is provided on control base stations, mobile units, and hand-held portables. This allows limited direct unit-to-unit communication between control bases, mobile units, and portables that would permit, for example, personnel fighting a fire in an area that had lost direct communication with the control room to relay information to the control room via personnel outside of, but adjacent to, the affected fire area. Personnel outside of any affected fire area will always be in direct portable communication with the control room. The staff found the response to RAI 09.05.01-3, acceptable under the guidance of RG 1.189, Revision 1.

Communication system planning and design have not yet progressed to a point where specific locations of telephone/maintenance stations/handsets have been determined. At a minimum, fire areas with safe shutdown equipment will be provided with a fixed telephone and all fire areas will have at least one sound-powered phone jack. The staff found this acceptable under the guidance of RG 1.189, Revision 1. The applicant committed to revise COL FSAR Subsection 9.5.13.14 to reflect the STP, Units 3 and 4, telephone system design. The staff verified that the applicant included this change in FSAR Subsection 9.5.13.14, Revision 4. Therefore, RAI 09.05.01-3 is resolved and closed.

- COL License Information Item 9.32 Identification of Chemicals

Specific information required to address COL License Information Item 9.32 includes protective features for liquid-insulated transformers and identification of the types and locations of hazardous chemicals. The fire prevention procedures for the STP, Units 3 and 4, reactor and control buildings allow small quantities of chemicals to be stored in listed or approved containers for immediate use only. Because the detailed design, locations, and procurement of chemicals are not complete at this time, the applicant commits (COM 9.5-13) that the type and location of those materials will be identified and incorporated into the final fire hazards analysis before fuel load. This approach is acceptable under the guidance in RG 1.189, Revision 1, Regulatory Position C.1.2, C.2.1.1, and C.2.2.

- COL License Information Item 9.34 Sound-Powered Telephone Units

Specific information required to address COL License Information Item 9.34 includes providing sound-powered telephone units before fuel load, for use in conjunction with the system described in Subsection 9.5.2.2.2 of the ABWR DCD (COM 9.5-15). This commitment is acceptable under the guidance in RG 1.189, Revision 1, Regulatory Position C.4.1.7.

- COL License Information Item 9.35 Fire-Related Administrative Controls

The applicant provides specific information in FSAR Appendix 9E to address this COL license information item including, but not limited to, the following:

1. Fire Protection Program concepts.

2. Qualification, organization, and responsibilities of fire protection engineering personnel, fire brigade members, and maintenance and testing personnel for fire protection systems.

3. Instruction, training, and drills provided to fire brigade members, fire watch members, and offsite firefighting resources.

4. QA with respect to fire protection system components, installation, maintenance, and operation.

5. Control of combustible materials such as combustible/flammable liquids and gases, fire retardant treated wood, plastic materials, dry ion exchange resins, transient materials, and general housekeeping.

6. Control of Ignition sources such as open-flame and hot-work permits and cutting and welding operations, open flames, and temporary heating devices.

7. Fire protection system maintenance and impairments, fire protection for plant modifications, and compensatory measures.

8. Manual firefighting capabilities, such as staffing, equipment, procedures and pre-fire plans, instruction, training, drills, equipment, and offsite firefighting resources.

9. Safe-shutdown capability, including operator manual actions, and alternative shutdown procedures.

10. Special fire hazard areas, such as wildfires, and flammable gas storage.

11. Fire protection for new reactors, including enhanced fire protection criteria for new reactors.

The staff found that FSAR Appendix 9E, in conjunction with the information provided in Section 9.5.1, is acceptable because it provides the necessary specific information for fire-related administrative controls required by the ABWR DCD, and is in accordance with the guidance of RG 1.189, Revision 1.

Operational Program

- Operational Program #8 Plant Fire Protection Program

Specific information that the applicant is required to address in the Fire Protection Operational Program includes a comprehensive description of the overall Fire Protection Program and verification that the program meets the requirements of 10 CFR 50.48. The staff reviewed the COL license information items and the departures within the scope of Section 9.5.1 Appendix 9A, Appendix 9B, and Appendix 9E of the STP, Units 3 and 4, FSAR, which address many of the required elements of the fire protection program. The staff determined that the applicant has provided adequate information to meet the applicable regulations and guidance, and the information provided in responses to the COL license information items is therefore acceptable. Within the review scope of this section, the staff finds it reasonable that the information provided in the Tier 2 departures does not require prior NRC approval.

Within the review scope of this section, the staff found that the Tier 1 departure complies with NRC regulations. The remaining portions of the plant fire protection program are addressed through the RAIs and post-combined license activities discussed below.

Requests for Additional Information

In the staff's evaluation of the Plant Fire Protection Program, the staff issued RAIs 09.05.01-1 through 09.05.01-11, and the applicant responded to these RAIs in letters dated August 12, 2009, (ML092260197), October 29, 2009 (ML093430301), January 13, 2010, (ML100141737), April 5, 2010 (ML100980065), and May 27, 2010, (ML101530167). The following is a discussion of the RAIs.

- RAI 09.05.01-1 Smoke Effects

In RAI 09.05.01-1, the staff asked the applicant to evaluate the potential for adverse effects of smoke on the electrical design and to include effects on the digital equipment. In its response to RAI 09.05.01-1, dated August 12, 2009 (ML092260197), the applicant explained that the ABWR

design will not allow smoke to migrate from the fire area of origin to any of the other divisions, thus preserving at least one division for a safe shutdown. The applicant claims that effects from smoke on equipment within the fire area of origin are handled the same as effects from a fire. Effectively, the smoke effects analysis will be bounded by the analysis for fire effects. The staff found the applicant's response to this RAI acceptable concerning adverse smoke effects on the safe shutdown of SSCs. Therefore, RAI 09.05.01-1 is closed.

- RAI 09.05.01-1 and RAI 09.05.01-8 Spurious Actuations and Final Safe-Shutdown Analysis Methodology

RAI 09.05.01-1 addressed spurious actuations and Departure STD DEP T1 3.4.1 from the certified ABWR digital I&C system design, where the applicant will be using a digital system other than the de-multiplexer type described in the ABWR DCD. As a result of the knowledge gained by the nuclear industry and the NRC since the ABWR design was certified, the staff identified specific additional information needed to perform the ABWR/STP safety evaluation concerning design resolutions for fire-induced spurious actuations that could lead to adverse effects on safety-related or important-to-safety SSCs. More specifically, design resolutions for cables other than fiber optics should address potential single and multiple spurious actuations, adverse smoke effects on digital equipment, and direct electrical shorts that could bypass digital equipment. In its response to RAI 09.05.01-1, dated August 12, 2009 (ML092260197), the applicant states that Departure STD DEP T1 3.4-1 will not change the design basis behind the ABWR's spurious actuation assumption. Because of this the applicant stated that there will be no change to the fire protection design criteria and no change in the potential for spurious actuations. The staff found the applicant's response concerning Departure STD DEP T1 3.4-1 acceptable. The ABWR DCD and the STP FSAR present an acceptable design basis for the fiber optic cables. The staff agreed that the use of fiber optics for control and instrumentation has an extremely low potential for spurious actuations, either single or multiple. Concerning spurious actuations for other types of cables, the applicant collectively claimed finality for spurious actuations without specifically stating that multiple spurious actuations are considered for the other types of cables (e.g., hardwires, power cables, etc.). The applicant also claimed, based on the ABWR DCD, that "there is no unacceptable failure that can occur due to fire induced failures within a division. This is independent of timing." The staff found the applicant's response to RAI 09.05.01-1, dated August 12, 2009 (ML0922600197), incomplete and therefore unacceptable. In accordance with RG 1.189, Revision 2, the staff requested the applicant to commit to analyze multiple spurious actuations using an acceptable methodology for the analysis of single and multiple spurious actuations, and to provide additional clarification and verification that the other types of cables will be included in the analysis. Subsequently, the applicant provided additional information in its response to RAI 09.05.01-8, Revision 2, dated April 5, 2010 (ML100980065). In this response the applicant provided an FSAR markup page stating:

> The evaluation of single and multiple spurious operations that could adversely impact post-fire safe shutdown will be performed in a manner that is consistent with the methodology of NEI 00–01, Revision 2 as modified by the guidance of RG 1.189 Revision 2 as it applies to Single and Multiple Spurious Operation Analysis.

The staff found the applicant's revised response to RAI 09.05.01-8, Revision 2, acceptable because the applicant commits to evaluating multiple spurious actuations in its fire hazards analysis, and is in accordance with RG 1.189. The use of Nuclear Energy Institute (NEI) 00–01

Revision 2, “Guidance for Post-Fire Safe Shutdown Circuit Analysis”; and RG 1.189, Revision 2 will also ensure that cables other than the fiber optic cables will be analyzed for multiple spurious actuations. The staff verified that the applicant included this change in FSAR Subsection 9.5.1.1.7, Revision 4. Therefore, RAI 09.05.01-1 is closed.

RAI 09.05.01-8 also addressed details of the Final Safe-Shutdown Analysis. Based on the ABWR plant layout and design in which redundant portions of safety-related systems are located in different fire areas, the ABWR design has taken an exclusionary approach in the DCD fire hazard analysis. Each fire area is characterized by the inclusion of safety-related equipment and the safety division assignment of the equipment. This approach assumes that all equipment within a given area is damaged by fire but does not necessarily identify and address the potential spurious operation of the equipment. Additionally, where equipment assigned to one safety division is located within an area assigned to a different safety division, the failure of that equipment is also considered and deemed acceptable, as described in DCD Section 9A.2.5, “Core Cooling System”; and in Table 9A.5-2, “Typical Electrical Equipment Connection Block Diagrams of Special Cases.” This approach is consistent with NEI 00–01, Revision 2. In RAI 09.05.01-8, the staff requested the applicant to also include a detailed post-fire safe-shutdown circuit analysis performed and documented using a methodology similar to that described in NEI 00-01. The applicant responded to RAI 09.05.01-8, in a letter dated October 29, 2009 (ML093430301), and supplemented that response on January 13, 2010 (ML100141737), and on April 5, 2010 (ML100980065).

In its response to RAI 09.05.01-8, dated April 5, 2010, the applicant provided a FSAR markup page stating:

> The evaluation of single and multiple spurious operations that could adversely impact post-fire safe shutdown will be performed in a manner that is consistent with the methodology of NEI 00-01, Revision 2 as modified by the guidance of RG 1.189 Revision 2 as it applies to Single and Multiple Spurious Operation Analysis.

The staff found the applicant’s revised response dated April 5, 2010, acceptable because the applicant commits to evaluate the post-fire safe-shutdown analysis using a method consistent with NEI 00-01, Revision 2 and is in accordance with RG 1.189, Revision 2. NEI 00-01, Revision 2, provides acceptable guidance and a methodology for the hardwire portions of the design. However, NEI 00-01, Revision 2, does not specifically cover digital systems that are also part of the STP design.

The STP design contains digital I&C components that are mostly located in the Control Room Complex (Fire Area FC4910), as described in FSAR Chapter 7 and Appendix 9A. The system is composed of four electrical divisions (1, 2, 3, and 4) and three safety trains (1, 2, and 3). Each electrical division is paired with its corresponding safety train (e.g., Division 1 and Train 1, Division 2 and Train 2, etc.) except for Division 4, because there is no safety train 4. In Appendix 9A, Section 9A.4.2.4.1 states that panels for Divisions 1 and 3 are located in Room 497. Divisions 2 and 4 are located in Room 495. These rooms are separated from each other by Room 496, which contains the main OCPs (see also DCD Figure 9A.4-15). The panels in Rooms 495 and 497 contain the ESFs logic and control system, including the digital trip functions (DTFs) and safety logic functions (SLFs). There are four DTFs, one for each electrical division, and three SLFs, one for each safety train. Fiber optic cables exchange data within the MCR envelope as well as from the panels in Rooms 495 and 497 to the local remote digital logic

controllers (RDLCs), which are located outside of the MCR fire area. The safety-related RDLCs are divisionally separated within their own fire areas. Each RDLC contains a digital input but a hardwire output. The NEI 00–01 analysis performed on these hardwire outputs will bound their respective digital inputs.

In case of fires in the MCR, the MCR will be abandoned after the operators actuate a reactor trip and the transfer switch. The operators will then complete and maintain a safe shutdown via the remote shutdown station. The spurious actuation analysis is based on the MCR abandonment, the transfer switch, and the remote shutdown station. This analysis is consistent with the guidance in RG 1.189, Revision 2. However, if there is a fire in the Control Room Complex, there is additional assurance that one division will remain free of fire damage. These include: (1) the physical divisional separation of the DTFs and SLFs to Rooms 495 or 497; (2) the safety-related RDLCs that can affect a safe shutdown are all in the same divisionally separated switchgear rooms (thus any spurious signal in the MCR would be accounted for in the NEI 00–01 switchgear room analyses); (3) the electrical independence separation follows the guidance in RG 1.75 that endorses IEEE Std 384; and (4) coping strategies, such as having a continually occupied space with trained operators using various procedures (e.g., off-normal, etc.). These layers of protection provide reasonable assurance if fire damage occurs before the transfer switch is actuated.

The revised FSAR also highlights portions of the digital I&C architecture related to preventing a spurious actuation signal. FSAR Subsection 9.5.1.1.7, indicates that digital signals to the local RDLCs are sent via fiber optic cables. These signals are verified as valid signals via diagnostics, and the redundant signal sent on a separate point-to-point fiber optic cable must match each other in order for the RDLC to proceed with each signal.

The staff found the applicant's response acceptable because the applicant commits to evaluate the post-fire safe-shutdown analysis using a method that is consistent with NEI 00–01, Revision 2, and RG 1.189, Revision 2. Based on the above discussion, the staff finds reasonable assurance that any spurious signal or signals initiated by a fire within the digital or hardwire portion of a safe-shutdown train will not cause a spurious actuation that will adversely impact the ability to achieve and maintain a safe shutdown. The staff verified that the applicant included this change in FSAR Subsection 9.5.1.1.7, Revision 4. Therefore, RAI 09.05.01-8 is closed.

In its response to RAI 09.05.01-8, dated October 29, 2009, the applicant also commits to update the fire hazards analysis to include the as-built information and as-built safe shutdown analysis. The applicant considers the fire hazards analysis as an element of the fire protection program to be completed and implemented per FSAR Subsection 9E.8.6, "Fire Protection Program Implementation Schedule." The staff found the applicant's response acceptable because the applicant commits to updating the fire hazards analysis that includes the safe shutdown analysis based on as-built information. The staff verified that the applicant included this change in FSAR Subsection 9.5.1.1.7, Revision 4. Therefore, RAI 09.05.01-8 is closed.

- RAI 09.05.01-2 Fire Water Supply

In RAI 09.05.01-2, the staff requested the applicant to clarify several details concerning the fire water supply design and maintenance. In its response to RAI 09.05.01-2, dated August 12, 2009 (ML092260197), the applicant provided the following clarifications:

1. Consistent with ABWR DCD (Tier 1) Subsection 2.15.6 and DCD and FSAR (Tier 2) Subsection 9.5.1.3.5, a total of two dedicated fire protection water supply storage tanks will be provided and shared between STP, Units 3 and 4. The capability exists to use the fire protection water supply as a diverse alternative supply for the alternating current (ac) independent water addition system mode of the RHR system for reactor vessel injection or drywell sprays. However, the use of the fire protection water supply for this purpose would only be necessary in an unlikely and extreme event in which other redundant normal and alternate sources of reactor vessel cooling or drywell spray were required but not available. For normal operating and postulated accident conditions, use of the fire protection water supply for the ac-independent water addition system mode of the RHR system is not required and is not relied upon to ensure public health and safety. This is consistent with the guidance in RG 1.189, Revision 1.

2. The applicant's detailed design has not yet progressed to a point where the required specific capacity of the two fire protection water supply storage tanks can be determined. However, each of the two fire protection water supply storage tanks for STP, Units 3 and 4, will have a minimum capacity of 1,140 m^3 (300,000 gallons). One of these tanks will hold a minimum reserve of 456 m^3 (120,000 gallons) for use by the seismic-qualified fire suppression systems for the reactor and control buildings. This is consistent with the guidance in RG 1.189, Revision 1.

3. The design basis for the capacity of each fire protection water storage tank is the maximum anticipated flow rate for a period of two hours but not less than 1140 m^3 (300,000 gallons). The maximum anticipated flow rate is conservatively based on 1893 liters/min (500 gpm) for manual hose streams plus the largest design demand of any sprinkler or deluge system as determined in accordance with NFPA 13, "Standard for the Installation of Sprinkler Systems," or NFPA 15, "Standard for Water Spray Fixed Systems for Fire Protection."

   As required in ABWR DCD (Tier 2), Subsection 9.5.1.3.5, the design basis for the capacity of the passively reserved 456 m^3 (120,000 gallons) fire protection water supply is the flow rate for two manual hose streams for a period of two hours. The 456 m^3 (120,000 gallons) capacity bounds the water volume that would be pumped in two hours by the diesel driven pump and motor-driven pump, each supplying this design-basis minimum flow of 1893 liters/min (500 gpm). As required in ABWR DCD (Tier 1), Subsection 2.15.6, both the diesel- driven pump and motor-driven pump each independently supply a minimum flow of 1893 liters/min (500 gpm) at a pressure greater than 448.2 kPa (65 psi) at the most hydraulically remote hose connection in either the reactor or control building. This is consistent with the guidance in RG 1.189, Revision 1.

4. The normal water supply to the fire protection water storage tanks is filtered. Consistent with NFPA 13, "Standard for the Installation of Sprinkler Systems," Sections 15.1.5 and A15.1.5 (Annex A), the intention is to treat the fire protection water as necessary using an approved biocide. However, in the unlikely event that the normal water supply is unavailable or not capable of meeting flow rate demands, an alternate flow path will be available to supply unfiltered groundwater to the fire protection water storage tanks directly from the main well water header. This is consistent with the guidance in RG 1.189, Revision 1. The applicant stated that Subsection 9.2.8.2 of the COL FSAR would be revised to state that the normal water supply to the fire protection system from the fire protection water storage tanks is filtered water. The staff verified that the applicant

included this change in FSAR Subsection 9.2.8.2, Revision 4. Therefore, RAI 09.05.01-2 is closed.

5. The available water supply pumping capacity is considerably greater than the 2,366 liters/min (625 gpm) required to fill either fire protection water supply tank in eight hours or less. This is consistent with the guidance in RG 1.189, Revision 1.

6. The applicant does not intend to construct STP, Units 3 and 4, with the fire protection water supply cross-connected with that of STP, Units 1 and 2. In the event that the cross-connection and sharing of the two systems is pursued in the future, an engineering evaluation will be necessary to ensure an adequate isolation capability between the two systems. This evaluation also will also address potential impacts of the proposed cross-connection on the functional performance of both systems (including potential system degradation issues) to ensure that the change will not have an adverse impact on the respective fire protection water supplies. This is consistent with the guidance in RG 1.189, Revision 1.

7. STP, Units 3 and 4, fire protection system hose threads and other appropriate threaded connections (hydrants, standpipes, fire department connections, etc.) will be compatible with the equipment used by the local offsite fire departments by using National Hose thread, also known as National Standard Thread (NST). This thread is also the same thread used in STP, Units 1 and 2. This is consistent with the guidance in RG 1.189, Revision 1.

8. The fire protection system and component maintenance will be in accordance with applicable NFPA codes. This is consistent with the guidance in RG 1.189, Revision 1.

The staff found the applicant's responses to all of the questions in RAI 09.05.01-2 regarding the fire water supply acceptable under the guidance in RG 1.189, Revision 1. Therefore, RAI 09.05.01-2 is resolved and closed.

- RAI 09.05.01-4 Multi-Unit Fire Brigades

In RAI 09.05.01-4, the staff requested the applicant to clarify whether the STP, Units 3 and 4, applicant plans to have one fire brigade for all four units (STP, Units 1 and 2, are existing nuclear units) or two fire brigades, one for STP, Units 1 and 2, and another for STP, Units 3 and 4. The applicant was also asked to address whether the existing STP, Units 1 and 2, are of a different design than the proposed new STP, Units 3 and 4, and how the different fire protection systems, as well as different safe shutdown equipment and procedures, would impact the fire brigade regarding training, personnel, equipment, strategies and procedures. FSAR Subsection 13.1.2.3 states that a single fire brigade consisting of at least five personnel will be shared among the four STP units. However, in its response to RAI 09.05.01-4, dated August 12, 2009 (ML092260197), the applicant allows for the possibility of using two separate fire brigades – one for the existing units and another for the new units. The guidance in RG 1.189, Revision 1, allows for a single fire brigade for multi-unit sites as well as multiple brigades per site.

FSAR Subsection 13.1.1.1.3, "Technical Support for Operations," states that each fire brigade shift will have one fire brigade leader plus two other members with safe shutdown systems training. In addition, the applicant stated that the fire brigade duties for STP, Units 1 and 2, will not preclude the ability to fully implement fire brigade duties for STP, Units 3 and 4. It is acceptable for the applicant to have one fire brigade shift serving both designs (i.e., all four

units). The brigade leader and at least two brigade members should have sufficient training in or knowledge of plant systems to understand the effects of fire and fire suppressants on safe-shutdown capability for STP, Units 1 and 2, per RG 1.189, Revision 1. In addition, the brigade leader and at least two brigade members should have sufficient training in or knowledge of plant systems to understand the effects of fire and fire suppressants on safe-shutdown capability for STP, Units 3 and 4, per RG 1.189, Revision 1. The staff found it acceptable for members of the fire brigade to possess the knowledge and training required for both designs. Therefore, RAI 09.05.01-4 is resolved and closed.

- RAI 09.05.01-5 Operator Manual Actions

In RAI 09.05.01-5, the staff requested the applicant to clarify whether, and provide a description regarding, any operator manual actions outside of the MCR will be credited for post-fire safe shutdown operations. In its response to RAI 09.05.01-5, dated August 12, 2009 (ML092260197), the applicant states that there are no operator manual actions currently credited for a post-fire safe shutdown. However, the applicant has deferred a final determination of whether operator manual actions will be required for any fire scenarios to the final as-built fire hazards analysis. The applicant did not clarify in the response dated August 12, 2009, or in the FSAR the guidance that will be used to examine and implement any operator manual actions. In its letter dated April 5, 2010 (ML100980065), the applicant provided a supplemental response including FSAR markup in which the applicant commits to identifying operator manual actions not previously identified in the DCD in accordance with RG 1.189, Revision 1. In addition the applicant commits to utilizing the guidance provided in NUREG–1852 to demonstrate that the operator manual actions are feasible and reliable. The staff thus found this response acceptable in accordance with RG 1.189, Revision 1. The staff verified that the applicant included this change in FSAR Subsection 9E.5.3, Revision 4. Therefore, RAI 09.05.01-5 is resolved and closed.

- RAI 09.05.01-6 Biodiesel

In RAI 09.05.01-6, the staff requested the applicant clarify whether the use of alternative fuels, such as biodiesel, is anticipated for the diesel engine driven fire pump. If so, the RAI asked the applicant to describe the provisions for determining the possible effects on the diesel engine and the measures to be taken to ensure continued operation of the system. In its response to RAI 09.05.01-6, dated August 12, 2009 (ML092260197), the applicant clarifies that the use of alternative fuels is not planned or anticipated and no FSAR revision is required for this response. The staff found the information in this RAI response acceptable under the guidance of RG 1.189, Revision 1, and Information Notice 2009-02, “Biodiesel in Fuel Oil Could Adversely Impact Diesel Engine Performance,” because alternative fuels will not be used. Therefore, RAI 09.05.01-6 is resolved and closed.

- RAI 09.05.01-7 Editorial

The staff issued RAI 09.05.01-7, requesting that the applicant make an editorial correction in FSAR Section 9.5.1 that refers to Appendix “9ES” instead of “9E.” In its response to RAI 09.05.01-7, dated August 12, 2009 (ML092260197), the applicant clarifies that Appendix 9E is the correct appendix label. The staff found the correction acceptable and consistent with the FSAR. The applicant has included this change referencing Appendix 9E and not 9ES in FSAR Subsection 9.5.1, Revision 4. Therefore, RAI 09.05.01-7 is resolved and closed.

- RAI 09.05.01-9 and RAI 09.05.01-11 Change Process License Condition

In RAI 09.05.01-9, the staff requested the applicant to provide information on the change process for the Fire Protection Program in STP FSAR Subsection 9E.1.8. In its response to RAI 09.05.01-9, dated October 29, 2009 (ML093430301), the applicant provided an FSAR markup in which it deleted the license condition for Fire Protection Program changes/code deviations. The staff found this response unacceptable because the applicant did not provide a change process license condition for the Fire Protection Program. The staff issued RAI 09.05.01-11, requesting the applicant to provide the change process license condition for the FPP. In its response to RAI 09.05.01-11 dated May 27, 2010 (ML101530167), the applicant provided its FSAR markup in which the applicant commits to evaluate changes to the STP, Units 3 and 4, Fire Protection Program in accordance with 10 CFR 52.98(c). The staff finds this change process evaluation approach acceptable under the guidance of RG 1.189, Revision 1. The staff verified that the applicant included this change in FSAR Subsection 9E.1.8, Revision 4, and therefore, RAIs 09.05.01-9 and 09.05.01-11, are resolved and closed.

9.5.1.5 *Post Combined License Activities*

The post-COL activities are identified in the preceding COL license information items, RAI response letters, and Section 13.4, "Milestone Implementation," of the COL FSAR.

ABWR DCD Tier 1 Table 2-3-16, Item 9 commits the applicant to provide an as-built review of the final fire hazards analysis. A post-fire safe-shutdown analysis will be performed based on final plant cable routing and equipment arrangement. This analysis will include verification that purchased components required for post-fire safe shutdown are not impacted by indirect effects of fire such as smoke migration from one fire area to another. The post-fire safe-shutdown analysis will include an evaluation of single and multiple spurious operations that could adversely impact post-fire safe shutdown that is performed in a manner that is consistent with the methodology of NEI 00–01, Revision 2 as modified by the guidance of RG 1.189 Revision 2 as it applies to single and multiple spurious operation analysis.

ABWR DCD Tier 1, Section 2.15.6 commits the applicant to inspecting and testing the as-built fire protection systems. Inspections to be performed include the MCR alarms and displays for the fire protection systems, the fire detection and alarm systems including the power supplies, the foam-water extinguishing systems, basic fire protection system configurations, and the Fire Hazards Report. Tests to be performed include operational tests of the fire detection and alarm systems for all fire areas, verification of the minimum water supply flow of 1893 l/min (500 gpm) and pressure of 448.2 kPa (65 psi) for the reactor and control buildings, and verification of the rated flow and pressure of the fire water supply pumps. Analyses to be performed include the as-built fire protection system seismic analyses.

ABWR DCD Tier 2, Subsection 14.2.12.1.48, commits the applicant to numerous preoperational tests of the fire protection system.

- Commitments (COM 9.5-1 and COM 9.5-2) – Subsection 9.5.1.5 of the STP, Unit 3 and 4, FSAR addresses site specific inspection and testing requirements for both startup and post-startup of the fire protection system. A final plan for implementation of the fire protection system Preoperational and Post-operational Inspection and Testing Program, based on the as-procured and as-installed fire protection systems and components, including the fixed and portable emergency lighting and the fixed and portable

communication systems, will be available prior to commencement of construction. The plan includes documented instructions, procedures or drawings that prescribe inspections and tests that govern the installed fire protection systems. The scope of items for inspection includes fire protection system equipment and active and passive components such as fire barriers, fire dampers, fire doors, and fire-rated penetration seals (COM 9.5-1). Preoperational and post-operational inspections and tests will comply with the applicable NFPA codes and standards (COM 9.5-2).

- Commitment (COM 9.5-4) – Develop before fuel loading the plant communication procedures to be used during emergencies, including procedures from the remote shutdown station.

- Commitment (COM 9.5-10) – Confirm before fuel loading the required HVAC design criteria and pressure calculations.

- Commitment (COM 9.5-12) – Provide for those fire areas using liquid-insulated transformers features that prevent the insulating liquid from becoming an unacceptable health hazard to workers.

- Commitment (COM 9.5-13) – Identify before fuel loading the type and locations of chemicals and other consumables in the final fire hazards analysis.

- Commitment (COM 9.5-17) – Perform before fuel loading the preoperational testing to verify the smoke removal performance of HVAC systems.

STP FSAR Table 13.4S-1, "Operational Programs Required by NRC Regulation and Program Implementation," commits the applicant to the Fire Protection Program (Item 8) implementation milestones, which are those Fire Protection Program elements required for receiving fuel and the remaining Fire Protection Program elements required for fuel loading. RG 1.206, C.IV.4.1 states that the fire protection program, as an operational program, will use license condition(s) to ensure the implementation of said operational program. These respective milestones fall under License Conditions, 1-4 and 1-6, described in subsection 1.5S.5.6 of this safety evaluation report. Therefore, pursuant to 10 CFR Part 52, License Conditions 1-4 and 1-6 are also applicable in accordance with RG 1.206, C.IV.4.1.

STP Commitment 07-13926-1: HVAC differential pressures for smoke removal will be determined per NFPA 92A Appendix A.

STP Commitment 07-13934-1: Preoperational testing will be determined per NFPA 92A, Chapter 4 to confirm the capability of the smoke control mode of the HVAC systems.

9.5.1.6 *Conclusion*

The staff's finding related to information incorporated by reference is in NUREG–1503 and NUREG–1948. The staff reviewed the COL FSAR application up to and including Revision 10, and checked the referenced DCD and AIA Amendment. The staff's review confirmed that the applicant has addressed the required information relating to the fire protection program, including the fire protection system, 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 program that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.1 of NUREG–0800. The staff's review concluded that applicant has adequately addressed the Fire Protection Program (including the COL license information items described in Subsection 9.5.13.9 of the FSAR), and the Tier 1 departure in accordance with the relevant guidance in Section 9.5.1 of NUREG–0800. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations. Furthermore, the staff found it 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.

9.5.2 Communication Systems

9.5.2.1 *Introduction*

This section of the FSAR addresses the communication systems used in intraplant and plant-to-offsite communications during normal operation, transients, fire, accidents, off-normal phenomena, and security-related events except for the interface with the offsite emergency communication systems, which is addressed in Part 5, "Emergency Plan," of the COLA.

9.5.2.2 *Summary of Application*

Section 9.5.2 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.2 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.5.2, the applicant provides the following:

Tier 2 Departure Not Requiring NRC Approval

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

The referenced ABWR DCD is based on a single unit site. However, STP, Units 3 and 4, are a dual unit project on an existing site. Some supporting systems described in the certified DCD are single systems that will be used to support two or more units. The systems shared by STP, Units 3 and 4, include the fire protection water supply system, common nonsafety-related communication systems, the makeup water preparation, the hydrogen gas storage facility, a common plant grounding grid, and the potable water system. In addition, STP, Units 3 and 4, share the main cooling reservoir with existing STP, Units 1 and 2.

COL License Information Items

- COL License Information Item 9.19 Use of Communication System in Emergencies

This COL license information item addresses the use of communication systems in emergencies (FSAR Subsection 9.5.13.2, "Use of Communication System in Emergencies"). The applicant commits (COM 9.5-4) to develop "procedure(s) for maintenance and testing of the plant communication systems" before fuel loading.

- COL License Information Item 9.20 Maintenance and Testing Procedure for Communication Equipment

This COL license information item addresses maintenance and testing procedures for communications equipment (FSAR Subsection 9.5.13.3, "Maintenance and Testing Procedure

for Communication Equipment"). The applicant commits (COM 9.5-5) to develop "procedure(s) for maintenance and testing of the plant communication systems" before fuel loading.

- COL License Information Item 9.28 Plant Security Systems Criteria

This COL license information item addresses communication requirements for the plant security systems (FSAR Subsection 9.5.13.11, "Plant Security Systems Criteria").

- COL License Information Item 9.31 Portable and Fixed Emergency Communication Systems

This COL license information item addresses the portable and fixed emergency communications systems (FSAR Subsection 9.5.13.14, "Portable and Fixed Emergency Communication Systems").

- COL License Information Item 9.34 Sound-Powered Telephone Units

This COL license information item addresses the sound-powered telephone units (FSAR Subsection 9.5.13.17, "Sound-Powered Telephone Units"). The applicant commits (COM 9.5-15) to provide the "sound-powered telephone units" before fuel loading.

Interface Requirement

Subsection 9.5.2.6.3, "System Operation," of the ABWR DCD requires the COL applicant to specify the design and power supply requirements for portable and fixed emergency communication systems, which are discussed in FSAR Subsection 9.5.2.6.3.

The applicant provides information in FSAR Section 13.3, "Emergency Planning," and refers to COLA Part 5, "Emergency Plan," which addresses the ABWR DCD Tier 1 Section 2.12.16, interface requirement for the offsite emergency communications system.

9.5.2.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the communications systems, and the associated acceptance criteria, are in Section 9.5.2 of NUREG–0800; 10 CFR Part 50, Appendix E, Section IV.E(9); 10 CFR 50.47(a)(8); 10 CFR 73.45(g)(4)(i); 10 CFR 73.46(f); 10 CFR 73.55(e); 10 CFR 73.55(f); and 10 CFR 52.80(a).

In accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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.

9.5.2.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.2 of the certified ABWR DCD. The staff reviewed Section 9.5.2 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The communication systems of this section relate to voice communication capability. Data communications are reviewed in SER Chapter 7.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring NRC Approval

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

The referenced ABWR DCD is based on a single unit site. The applicant provides a plant-wide, nonsafety-related communication system for multi-unit sites at the same location as described in Departure STP DEP 1.1-2. The sharing of common nonsafety-related communication systems among multiple units on the site does not have any impact on any Tier 1, Tier 2*, Tier 2, TS and TS bases, or operational requirements.

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 found it reasonable that the 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.

COL License Information Items

- COL License Information Item 9.19 Use of Communication System in Emergencies

In FSAR Subsection 9.5.13.2, "Use of Communication System in Emergencies," the applicant commits (COM 9.5-4) to develop procedure(s) before fuel loading for use of the plant communication system in emergencies, including from the RSS in the event of a MCR fire. These procedures will be developed consistent with the plant operating procedure development plan in FSAR Section 13.5.

Based on the above discussion, the staff found the applicant's approach to resolving this COL license information item acceptable.

- COL License Information Item 9.20 Maintenance and Testing Procedures for Communications Equipment

In FSAR Subsection 9.5.13.3, "Maintenance and Testing Procedure for Communication Equipment," the applicant commits (COM 9.5-5) to provide maintenance and testing procedures

[1] 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.

for the communications equipment before fuel loading. The procedures will be created consistent with the plant operating procedure development plan in FSAR Section 13.5.

Based on the above discussion, the staff found the applicant's approach to resolving this COL license information item acceptable.

- COL License Information Item 9.28 Plant Security System Criteria

Specific information from the applicant in FSAR Subsection 9.5.13.11 that addresses COL License Information Item 9.28 includes the following:

The design of the security system includes an evaluation of its impact on plant operation, testing, and maintenance. This evaluation assures that the security restrictions for access to equipment and plant regions are compatible with required operator actions during all operating and emergency modes of operation (i.e., loss of offsite power, access for fire protection, health physics, maintenance, testing, and local operator).

In addition, this evaluation assures that:

1. There is a limited number of areas within the Nuclear Island, such as high radiation areas or inside the inerted primary containment, where communication is not possible. The applicant commits (COM 9.5-16) to evaluate the communications coverage from all areas of the nuclear island to the central and secondary alarm stations.

2. Portable security radios will not interfere with plant monitoring equipment.

3. Minimum isolation zone and protected area illumination capabilities cannot be defeated by sabotage actions outside of the protected area.

4. Electromagnetic interference (EMI) from plant equipment startups or power transfers will not create nuisance alarms or trip security access control systems. ITAAC Item 12.d (other microprocessor-based, software controlled systems or equipment) in Table 3.4 of the ABWR DCD Tier 1 has been assigned to address the EMI issue.

Based on the above discussion, the staff found the applicant's approach to resolving this COL license information item acceptable.

- COL License Information Item 9.31 Portable and Fixed Emergency Communications Systems

Specific information from the applicant in FSAR Subsection 9.5.13.14, "Portable and Fixed Emergency Communication Systems," that address COL License Information Item 9.31 includes information to verify that BTP CMEB 9.5-1, Positions C.5.g(3) and C.5.g(4) are met. The proposed site-specific portable and fixed emergency communication systems include the following systems, special equipment, and communication lines:

- Telephone system.

- Portable radio communications system.

- Microwave system interface.

- PA paging/alarm system.
- Maintenance jack system (direct current [dc]/sound-powered).
- Refueling communication system.
- OCP consoles.
- Special service telephone lines.
- Satellite telephone.

The staff finds that the site-specific portable and fixed emergency communication systems are designed so that at any time, there are adequate onsite and offsite portable and fixed emergency communication systems available for both normal and emergency conditions.

Design and Power Supply Requirements for Portable and Fixed Emergency Communication Systems: The specific information from the applicant in FSAR Subsection 9.5.2.6.3 addresses the COL license information on design and power supply requirements for portable and fixed emergency communication systems. The staff reviewed the applicant's information and found it acceptable.

Power Supplies for Power-Actuated Paging Communication Systems: Figure 9.5-2, "Outline - Telephonic Communication System for Single Unit of STP 3 or 4," of FSAR shows that both power supplies for the power-actuated paging communication systems are for normal use. According to Section IV.E(9) of Appendix E to 10 CFR Part 50, a backup power source is required for communication systems. The staff issued RAI 09.05.02-1, requesting the applicant to provide the information on backup power. In its response to RAI 09.05.02-1 (ML091540278), the applicant stated that the communication system backup power supply shown in Figure 9.5-2 was inadvertently mislabeled in COLA Revision 2. The applicant provided a proposed markup of Figure 9.5-2 to correct the labeling of the backup power supply feed. Additionally, the applicant indicated that the proposed markup is the same as Figure 9.5-2 of the DCD (with STP DEP 1.1-2, Dual Units at STP, Units 3 and 4, incorporated). The staff reviewed the revised Figure 9.5-2 and found it acceptable because the proposed figure does not differ from the approved design in the ABWR DC. The staff verified that the proposed markup have been incorporated in the FSAR Revision 4. Therefore, RAI 09.05.02-1 is resolved and closed.

For the reasons given above, the staff found that the applicant has adequately addressed COL License Information Item 9.31, and that the portable and fixed emergency communication systems are acceptable.

- COL License Information Item 9.34 Sound Powered Telephone Units

In FSAR Subsection 9.5.13.17, "Sound-Powered Telephone Units," the applicant commits (COM 9.5-15) to provide before fuel loading sound-powered telephone units to be used in conjunction with the sound-powered telephone system described in ABWR DCD Subsection 9.5.2.2.2, "Sound-Powered Telephone System for Plant Maintenance and Repair."

Based on the above discussion, the staff found the applicant's approach to resolving this COL license information item acceptable

Interface Requirement

The applicant provides specific information in COLA Part 5 to address the interface requirement in ABWR DCD Tier 1 Section 2.12.16 for offsite emergency communications. In addition, Section 13.3C.6 provides details on offsite emergency communication. See Section 13.3C.6 of the SER for the evaluation of emergency communication.

9.5.2.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.5-4) – Develop procedure(s) prior to fuel load for use of the plant communication system in emergencies including from RSS in the event of a MCR fire. These procedures will be developed consistent with the plant operating procedure development plan in FSAR Section 13.5.

- Commitment (COM 9.5-5) – Develop maintenance and testing procedures for the communications equipment prior to fuel load. The procedures will be created consistent with the plant operating procedure development plan in FSAR Section 13.5.

- Commitment (COM 9.5-15) – Provide before fuel loading sound-powered telephone units to be used in conjunction with the sound-powered telephone system described in the ABWR DCD Subsection 9.5.2.2.2.

- Commitment (COM 9.5-16) – Evaluate the communications coverage from all areas of the nuclear island to the central alarm stations and secondary alarm stations.

9.5.2.6 *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, 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 communication systems that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.2 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed COL license information items 9.19, 9.20, 9.28, 9.31, and 9.34 in accordance with the relevant guidance in Section 9.5.2 of NUREG–0800, and found it 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. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

9.5.3 Lighting and Servicing Power Supply System

9.5.3.1 *Introduction*

This section of the FSAR addresses plant lighting, which is comprised of four independent lighting systems: (1) normal AC lighting system, (2) standby AC lighting system, (3) emergency

dc lighting system, and (4) guide lamp lighting systems. The normal AC lighting system is non-Class 1E. The other three lighting systems are comprised of Class 1E (guide lamps only), associated circuits, and non-Class 1E subsystems.

9.5.3.2 *Summary of Application*

Section 9.5.3 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.3 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.5.3, the applicant provides the following:

Tier 2 Departures Not Requiring NRC Approval

- STD DEP 9.5-4 Lighting and Servicing Power Supply System

This departure changes mercury lamps to high-pressure sodium (HPS) wherever mercury lamps are being used.

- STD DEP Admin

This departure corrects a referenced subsection number.

Supplemental Information

The applicant provides the following supplemental information detailing a description of the lighting and servicing power supply system at STP, Units 3 and 4:

- Lighting and Servicing Power Supply System

The applicant, in Section 9.5.3, provides supplemental information regarding emergency lighting and the emergency lighting distribution system.

- General Design Bases

The applicant, in Subsection 9.5.3.1.1, provides supplemental information regarding lighting fixtures, control switches for lighting fixtures, and high-efficiency electronic ballasts.

- Normal (Non-Class 1E) Lighting

The applicant, in Subsection 9.5.3.2.1, provides supplemental information regarding yard lighting.

9.5.3.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503.

NUREG–0800, Section 9.5.3 states that there is no GDC or RG that directly applies to the performance requirements for the lighting system. However, the plant's lighting system is used to support accident mitigation (e.g., Fire Protection Program) as well as safety-related maintenance and operating activities, and must have the capability to: (1) provide adequate lighting during all plant operating conditions; (2) provide adequate emergency lighting during all plant operating conditions including fire, transient, and accident conditions; and (3) address the effect of the loss of all ac power (i.e., during a SBO) on the emergency lighting system.

Additionally, the staff followed the guidance of Illuminating Engineering Society of North America (IESNA) Lighting Handbook, as related to systems design for illumination levels recommended for industrial facilities.

In addition, in accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies Tier 2 departures. Tier 2 departures not requiring 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.

9.5.3.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.3 of the certified ABWR DCD. The staff reviewed Section 9.5.3 of the STP, Units 3 and 4, COL FSAR and checked the reference DCD to ensure that the combination of the information in the COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring NRC Approval

- STD DEP 9.5-4 Lighting and Servicing Power Supply System

In Section 9.5.3, the applicant addresses the plant lighting and servicing power supply system and provides the following information regarding the STP departure from the ABWR DCD:

> Plant AC lighting systems are generally of the fluorescent type, with High-Pressure Sodium (HPS) lamps (or equivalent) provided for high ceiling. Incandescent lamps are used for DC lighting systems and above the reactor, and fuel pool.

The staff reviewed the departure described above and determined that the departure pertains to a change from mercury lamps in the ABWR DCD to high-pressure sodium lamps. The staff's review also observed that the applicant has deleted the DCD reference to mercury lamps, indicating that these lamps are "Not Used," in Subsection 9.5.3.1.1(-5), "General Design Bases," Subsection 9.5.3.1.2(1), "Safety-Related Design Bases," and Subsection 9.5.3.2, "System Description." Additionally, in Subsection 9.5.3.1.1, the applicant has deleted the reference to mercury lamps.

The staff's review of FSAR Subsection 9.5.3.1.1, "General Design Bases," noted that the subsection numbering was modified with respect to the DCD. For instance, Subsections (4) (-5) and (5) (-3) (-2) corresponding to DCD Subsections (4)(l) and (5)(a)(ii), respectively, do not agree. Therefore, the staff issued RAI 09.05.03-1, requesting the applicant to clarify these

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[1] 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.

discrepancies. In its response to RAI 09.05.03-1, dated August 12, 2009 (ML092260197), the applicant stated that the discrepancies are typographical errors that would be corrected. The staff found the applicant's response acceptable, and RAI 09.05.03-1, is resolved. The staff confirmed that the FSAR was revised to reflect the corrected typographical errors. Therefore, RAI 09.05.03-1 is resolved and closed.

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

- STD DEP Admin

In Subsection 9.5.3.3, "Inspection and Testing Requirements," the applicant addresses testing and inspecting emergency lighting:

> Since the normal standby and emergency lighting circuits are energized and maintained continuously, they require no periodic testing. However, periodic inspection and bulb replacement will be performed (Subsection 8.3.4.25). The guide lamps are capable of being tested and will be inspected and tested periodically to ensure operability of lights and switching circuits.

The applicant corrected the referenced subsection number in the ABWR DCD from "8.3.4.2.5" to "8.3.4.25."

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, etc.). Administrative departures do not affect the presentation of any design discussion or the qualification of any design margin.

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 found it reasonable that this departure does not require prior NRC approval.

Supplemental Information

- Lighting and Servicing Power System

In Section 9.5.3, the applicant provides the following site-specific supplemental information regarding emergency lighting:

> Emergency lighting comprised of emergency DC lighting and guide lamp lighting system is provided throughout the plant as necessary to support fire suppression actions and safe-shutdown operations, including access and egress pathways to safe-shutdown areas during a fire event.
>
> The emergency lighting power distribution system contains protective devices necessary to preclude a fire in one area from causing a loss of emergency lighting in any unaffected area required for safe-shutdown operations.

The staff's review of the applicant's supplemental information regarding emergency lighting found that the additional design features are acceptable because they enable adequate emergency lighting during all plant operating conditions including fire, transient, and accident conditions.

- General Design Bases

In Subsection 9.5.3.1.1, "General Design Bases," the applicant addressed the Nuclear Island lighting systems and provided the following plant-specific supplemental information:

> (s) Control switches for lighting fixtures inside the drywell or containment are installed both inside and outside of the drywell/containment.

In Subsection 9.5.3.1.1, "General Design Bases," the applicant addressed lighting fixtures and provided the following plant-specific supplemental information:

> (o) High-efficiency electronic ballasts are not used in a high radiation environment.
>
> (p) Lighting fixtures for yard lighting are 1000 W HPS lamps mounted on 100-foot (30.48 meter) lighting poles with retractable/lowering devices.
>
> The NRC staff's review of the applicant's supplemental information in this subsection found that this supplemental information is acceptable because the plant design meets the lighting design criteria specified in the IESNA's Lighting Handbook.

- Normal (non-Class 1E) Lighting

In Subsection 9.5.3.2.1, "Normal (non-Class 1E) Lighting," the applicant provides the following site-specific supplemental information pertaining to yard lighting:

> Yard lighting is supplied at 480V from non-Class 1E sources. If this power is not available, power for the yard lighting will be automatically provided from the non-Class 1E Combustion Turbine Generator (CTG).

The staff reviewed the applicant's supplemental information regarding Non-Class 1E power source for yard lighting and found that additional design features enhance the function of subject equipment and are therefore acceptable.

9.5.3.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.5.3.6 *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 application has addressed the relevant information relating to the lighting and servicing power supply system. No outstanding information is expected to be addressed in the COL FSAR related to this subsection. 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 lighting and servicing power supply system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.3 of NUREG–0800, and industry standards. The staff's review concluded that the design of the lighting system for STP, Units 3 and 4, is accordance with Section 9.5.3 of NUREG–0800 and industry standards, and found it 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. The staff also concluded that the lighting system is in accordance with the lighting levels recommended in NUREG–0700, which is based on the IESNA Lighting Handbook. Therefore, the staff concluded that the lighting and servicing power supply system is in accordance with NRC requirements.

9.5.4 Diesel Generator Fuel Oil Storage and Transfer System

9.5.4.1 *Introduction*

This section of the FSAR addresses the fuel oil storage and transfer system for the diesel engines that provide emergency onsite power. This system includes all piping up to the connection to the engine interface, fuel oil storage tanks, fuel oil transfer pumps, day tanks, and the tank storage vaults. In addition, this section discusses the quality and the quantity of fuel oil stored onsite and the availability and procurement of additional fuel from offsite sources.

9.5.4.2 *Summary of Application*

Section 9.5.4 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.4 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in the COL FSAR the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STP DEP 9.5-6 — Diesel Generator Fuel Oil Storage and Transfer System

This is a site-specific departure that introduces several design changes in the ABWR DCD. The applicant classifies this departure as not requiring prior NRC review and approval, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5.

COL License Information Items

- COL License Information Item 9.22 — Vendor Specific Design of Diesel Generator Auxiliaries

This COL license information item is related to ABWR DCD Subsection 9.5.4.2 and requires the applicant to update the STP FSAR to include as-built design information.

- COL License Information Item 9.30 — Diesel Fuel Refueling Procedures

This COL license information item is related to ABWR DCD Subsection 9.5.4.2 and requires the applicant to establish procedures for ensuring that the day tank is full before refilling the storage tank.

The ABWR DCD describes a single unit plant. Although this STP application is for a two unit plant, there is no sharing of DG functions between the two new STP reactor units. Each EDG is supported by an independent train that stores and supplies fuel for its respective diesel engine. There are no cross-ties among any of the six trains provided for the two STP reactor units, and each train is powered from an independent Class 1E power supply fed from the associated EDG. The failure of any one train will not cause a failure of any of the other EDGs on the site.

9.5.4.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the DG fuel oil storage and transfer system, and the associated acceptance criteria, are in Section 9.5.4 of NUREG-0800.

In particular, the regulatory basis and review criteria that the staff used for COL License Information Items 9.22 and 9.30 and the Tier 2 departure described above, as they relate to the protection of the SSCs important to safety, are specified in SRP Section 9.5.4. The staff's review of the application is also based on 10 CFR Part 50, Appendix A, GDC 5. Although the ABWR DCD is based on a single-reactor unit plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG fuel oil storage and transfer system does not affect the compliance of STP, Units 3 and 4, to GDC 5.

In addition, in accordance with 10 CFR Part 52, Appendix A, Section VIII, "the applicant identifies one Tier 2 departure that does not require prior staff approval. This departure is 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.

9.5.4.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.4 of the certified ABWR DCD. The staff reviewed Section 9.5.4 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Although the ABWR DCD is based on a single-reactor unit plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG fuel oil storage and transfer system does not affect the compliance of STP, Units 3 and 4, with GDC 5.

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[1] 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 9.5-6 — Diesel Generator Fuel Oil Storage and Transfer System

The staff reviewed STP DEP 9.5-6, which modifies the basic design of the DG fuel oil storage and transfer system in the following ways:

1. The storage tank vent line is extended to an elevation that exceeds the local maximum flood level.

2. The fuel oil storage tanks are located in underground concrete vaults with bottom gravity drain and stick gauge access. The fuel oil piping is routed underground in concrete tunnels from the storage tanks to the RB, thus removing the requirement for cathodic protection for any directly buried components.

3. Locked closed isolation valves are added to the storage tank sample and fill lines.

4. As a result of the local flood level at STP, Units 3 and 4, the fuel oil transfer pumps are relocated to the inside of the seven-day storage tanks.

5. A gravity drain is provided at the bottom of each storage tank to periodically remove water accumulation and sediment from the tanks. The suction of the fuel oil transfer pumps is elevated two to three inches above the tank's low points to allow space for water to settle below the pump suction.

The applicant states that these design changes are considered necessary because of the potential flood level at STP, Units 3 and 4. The applicant declares that this departure does not require prior NRC review and approval because the changes comply with the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.5.

The applicant addresses compliance with GDC 5 in COL FSAR Subsection 3.1.2.1.5.2, "Evaluation Against Criterion 5." This section of the COL does not identify any sharing of the DG among the reactor units at the site, including the structures in which the system is located.

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 found it reasonable that this departure does not require prior NRC approval. In addition, the applicant's process for evaluating departures and changes to the DCD is subject to NRC inspections.

COL License Information Items

- COL License Information Item 9.22 — Vendor Specific Design of Diesel Generator Auxiliaries

The staff reviewed COL License Information Item 9.22, in STP FSAR Subsection 9.5.13.5. Information provided by the applicant to address COL License Information Item 9.22 indicates that the applicant has committed (COM 9.5-6) to update the STP FSAR to provide specific as-built information about the DG fuel oil storage and transfer system. The staff finds this

acceptable since the applicant has committed to provide as-built information regarding DG fuel oil storage and transfer system, as requested in the ABWR DCD.

- COL License Information Item 9.30 Diesel Fuel Refueling Procedures

The staff reviewed COL License Information Item 9.30 in STP FSAR Subsection 9.5.13.13. Information provided by the applicant to address COL License Information Item 9.30 indicates that the COL applicant has committed (COM 9.5-11) to develop procedures for verifying that the day tank is full before refilling the fuel oil storage tank. These procedures will be provided before fuel loading but following the procurement of affected equipment. The applicant states that this procedure "will reduce the possibility of sediment obstruction of fuel lines and harmful impacts on the DG operation."

The development and availability of this procedure for use by operations personnel is a post-COL activity. The staff finds this acceptable since the applicant has committed to provide information regarding diesel fuel refueling procedures, as requested in the ABWR DCD.

Technical Specification Considerations

The staff reviewed the TS for site-specific supplements applicable to the DGs in Chapter 16 of the COL FSAR. TS 3.8.3 was reviewed for its relevance to the DG fuel oil storage and transfer system. The application incorporates the ABWR DCD section by reference with one departure, Departure STD DEP 16.3-51, which modifies the DG operating condition for starting air receiver pressure but does not affect the fuel oil storage and transfer system. However, Revision 3 to the STP FSAR adds specific values for applying operating conditions. In the case of the fuel oil system, LCO 3.8.3-A allows a depleted DG fuel oil inventory condition between 380,000 liters (100,385 gallons) and 350,000 liters (92,460 gallons) for a period of 48 hours before requiring the DG to be declared inoperable. The applicant states that this condition provides a remaining capacity of more than six days of continuous operation under a full load, and the 48-hour period is considered a sufficient amount of time to complete the restoration of the required volume.

SR 3.8.3.1 requires verification that the fuel oil inventory for each DG is greater than 380,000 liters (100,385 gallons) on a 31-day frequency. The applicant states that this requirement ensures that each DG has a sufficient fuel oil inventory to support at least seven days of a full load operation.

SR 3.8.3.3 lists the specific American Society for Testing and Materials (ASTM) standards for performing the series of tests to determine that the new fuel oil is the correct grade, and it is not contaminated. The specified standards are ASTM D4057–06, D975–09, D4176–04e1, D1552–08, D2622–08, and D2276–06.

The staff evaluated the implications of these departures from the ABWR DCD TS. The staff determined that because these changes do not involve changes to the design of the fuel oil system and do not change the allowed LCO completion times or surveillance frequencies, the findings documented in NUREG–1503, regarding whether the system design meets the requirements of GDC 2, 4, 5, and 17 have not been affected and are thus maintained.

Therefore, the staff concluded that these departures from the ABWR DCD TS are acceptable.

ITAAC Considerations

The EDG system ITAAC requirements specified in Tier 1 Section 2.12.13 of the ABWR DCD are incorporated by reference in the STP FSAR.

Initial Plant Test Program

The DG preoperational tests specified in Tier 2 Subsection 14.2.12.1.45.3 of the ABWR DCD are incorporated by reference in the STP FSAR.

9.5.4.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.5-6) – Update the FSAR to provide specific as-built information about the DG fuel oil storage and transfer system, in accordance with COL License Information Item 9.22 in DCD Subsection 9.5.13.5.

- Commitment (COM 9.5-11) – Develop procedures for verifying that the day tank is full before refilling the fuel oil storage tank, in accordance with COL License Information Item 9.30 in DCD Subsection 9.5.13.13.

9.5.4.6 *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, 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 DG fuel oil storage and transfer system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.4 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information items in accordance with the relevant guidance in Section 9.5.4 of NUREG–0800. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

The staff determined that the DG fuel oil storage and transfer system design is acceptable and complies with regulations, as stated in the GDC of Appendix A to 10 CFR Part 50. This conclusion is based on the staff's technical evaluation that determined that the system meets the criteria in GDC 2, 4, 5, and 17; 10 CFR 52.47(b)(1); and NUREG/CR–0660. The staff also found it 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.

The staff also determined that the applicant has adequately addressed the TS, ITAAC, interface requirements, and Initial Test Program considerations related to this area of review.

9.5.5 Diesel Generator Jacket Cooling Water System

9.5.5.1 *Introduction*

This section of the FSAR addresses how the emergency diesel engine cooling water system (EDECWS) provides cooling water to the station emergency diesel engines. The review covers EDECWS portions housed within their respective diesel engine compartments receiving heat from components that are essential for the proper operation of the diesel engines and additional parts of the system transferring the heat to a heat sink. The system includes all valves, heat exchangers, pumps, and piping up to the engine interface.

9.5.5.2 *Summary of Application*

Section 9.5.5 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.5 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Sections 9.5.5 and 9.5.13, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

- STD DEP 9.5-1 Diesel Generator Jacket Cooling Water System

This departure addresses the changes to the regulatory conformance basis for inspection and testing guidance from RG 1.108, which was withdrawn in 1993, and replaced by RG 1.9, Revision 3, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants," which addresses the qualifications, preoperational, and periodic testing of DGs. The applicant classifies this departure as not requiring prior NRC review and approval, in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5.

COL License Information Item

- COL License Information Item 9.23 Diesel Generator Jacket Cooling System Design Flow and Heat Removal Requirements

This COL license information item is related to DCD Subsection 9.5.5.2. It addresses the requirement for the applicant to update the STP FSAR to provide design flow and heat removal capabilities of the as-built DG cooling water system. The applicant commits (COM 9.5-7) to update the FSAR in accordance with 10 CFR 50.71(e) to provide as-built information on the design and heat removal requirements for the DG cooling water system.

The ABWR DCD describes a single-unit plant. Although this STP COLA is for a two-unit plant, there is no sharing of DG functions between the two new STP reactor units. Each emergency diesel is supported by an independent train that provides cooling for its respective diesel engine. There are no cross-ties among any of the six trains provided for the two STP reactor units, and each train is powered from an independent Class 1E power supply fed from the associated EDG. The failure of any one train will not cause a failure of any of the other redundant EDGs.

9.5.5.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the emergency diesel engine cooling water system, and the associated acceptance criteria, are in Section 9.5.5 of NUREG–0800."

In particular, the regulatory basis and review criteria that the staff used for COL License Information Item 9.23 and the Tier 2 departure described above, as they relate to the protection of the SSCs important to safety are specified in SRP Section 9.5.5.

The staff's review of the application is also based on 10 CFR Part 50, Appendix A, GDC 5. Although the ABWR DCD is based on a single reactor plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG jacket cooling water system does not affect the compliance of STP, Units 3 and 4, with GDC 5.

In addition, in accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior Commission approval. This departure is 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.

9.5.5.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.5 of the certified ABWR DCD. The staff reviewed Section 9.5.5 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Although the ABWR DCD is based on a single-reactor unit plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG jacket cooling water system does not affect the compliance of STP, Units 3 and 4, with GDC 5.

Tier 2 Departure Not Requiring Prior NRC Approval

The applicant determined that the following DCD Tier 2 departure does not require NRC review and approval in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5 requirements.

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[1] 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 9.5-1 Diesel Generator Jacket Cooling Water System

The staff reviewed Departure STD DEP 9.5-1, which updated the reference to NRC guidance for inspection and testing by deleting the reference to an obsolete RG and replacing it with a more up-to-date RG. Section 3 of the Departures Report indicates that this departure was determined not to require NRC approval in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5. Departure STP DEP 9.5-1 deletes the reference to RG 1.108, which was withdrawn in August 1993, and specifies that scheduled inspection and testing of equipment is performed in accordance with RG 1.9, as part of the overall engine performance checks. The applicant incorporates by reference Table 1.8-20 of the certified ABWR DCD that specifies Revision 3 of RG 1.9. RG 1.9, Revision 3, includes updated guidance and references the IEEE standard 387-1984. There is no change to any design or function of an SSC important to safety as a result of this departure from the certified ABWR design. Therefore, this change is acceptable to the staff with respect to the review criteria established in SRP Section 9.5.5. Within the review scope of this section, the staff found it reasonable that this departure does not require prior NRC approval with respect to the DG jacket cooling water system. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

The STP FSAR addresses compliance with GDC 5 in Subsection 3.1.2.1.5.2, "Evaluation Against Criterion 5." This section of the STP FSAR does not identify any sharing of the DG system among reactor units at the site, including the structures in which the system is located.

COL License Information Item

- COL License Information Item 9.23 Diesel Generator Jacket Cooling Water System Design Flow and Heat Removal Requirements

The staff reviewed COL License Information Item 9.23 in FSAR Subsection 9.5.13.6, "Diesel Generator Cooling Water System Design Flow and Heat Removal Requirements." The applicant's information that addresses COL License Information Item 9.23 indicates that the COL applicant has committed to update the STP FSAR to provide specific as-built information about the DGs (COM 9.5-7). The following as-built information related to the DG jacket cooling water system will be provided in the update to STP FSAR in accordance with 10 CFR 50.71(e):

- Design flow and heat removal requirements and heat removal capacities for all coolers and heat exchangers in the system.
- The type of cooling water circulating pumps and motive sources (i.e., motor-driven or others).
- NPSH of the cooling water circulating pumps.
- Type of temperature sensors (the "Amot" brand or an equivalent type of temperature sensing element recommended in NUREG/CR–0660, page V-17, Item 4).
- The capacity of the expansion tank.
- Cooling water loss estimates.

The incorporation of this proposed revision in the STP FSAR is a post COL activity. The staff finds this acceptable since the applicant has committed to provide as-built information regarding DG cooling water system, as requested in the ABWR DCD.

Technical Specification Considerations

The staff reviewed the TS applicable to the DGs in Chapter 16, "Technical Specifications," of the application. TS 3.8.3 was reviewed for its relevance to the DG jacket cooling water system. No specific LCOs or SRs directly related to the DG jacket cooling water system are provided. However, as stated in Tier 2 Subsection 9.5.5.1 of the ABWR DCD, the diesel engine will be capable of operating at full load without secondary cooling for an amount of time in excess of the time needed to restore the secondary cooling water systems following a loss of preferred power. Thus, no LCOs or SRs are required.

ITAAC Considerations

The EDG system ITAAC requirements specified in Tier 1 Section 2.12.13 of the ABWR DCD are incorporated by reference in the STP FSAR.

Initial Plant Test Program

The DG preoperational tests specified in Tier 2 Subsection 14.2.12.1.45.3 of the ABWR DCD are incorporated by reference in the STP FSAR.

9.5.5.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.5-7) – Update the STP FSAR to provide specific as-built information about the DG jacket cooling water system in accordance with COL License Information Item 9.23 in DCD Subsection 9.5.13.6.

- Test and Inspection – Perform inspections and tests of the system equipment in accordance with RG 1.9 and COL FSAR Subsection 9.5.5.4.

9.5.5.6 *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 this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.5 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information items in accordance with the relevant guidance in Section 9.5.5 of NUREG–0800. The staff also found that the applicant has provided adequate information to address the COL license information items and demonstrate compliance with NRC regulations.

The staff determined that the DG jacket cooling water system design is acceptable and complies with the regulations as stated in the GDC of Appendix A to 10 CFR Part 50. This conclusion is based on the staff's technical evaluation determining that the system meets GDC 2, 4, 5, 17, 44, 45, and 46; 10 CFR 52.47(b)(1); and NUREG/CR–0660.

Furthermore, the staff determined that that the applicant has adequately addressed the TS, ITAAC, interface requirements, and Initial Test Program considerations related to this area of review, and staff found it reasonable that Tier 2 Departure STP DEP 9.5-1 is characterized as not requiring prior NRC approval in accordance with 10 CFR Part 52, Appendix A, Section VIII.B.5.

9.5.6 Diesel Generator Starting Air System

9.5.6.1 *Introduction*

This section of the FSAR addresses how the EDG starting system covers system features necessary for reliable EDG starting following a loss of offsite power. The review includes the system air compressors, air dryers, air receivers, devices to crank the diesel engine, valves, piping up to the connection to the engine interface, filters, and ancillary I&C systems.

9.5.6.2 *Summary of Application*

Section 9.5.6 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.6 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.5.13, the applicant provides the following:

COL License Information Items

- COL License Information Item 9.22 Vendor Specific Design of Diesel Generator Auxiliaries

This COL license information item requires the applicant to update the STP FSAR to provide as-built DG starting air system design information.

- COL License Information Item 9.25 Diesel Generator Requirements

This COL license information item directs the applicant to review the vendor-specific design for dust-tight protection of relays and contactors.

The ABWR DCD describes a single-unit plant. Although this STP application is for a two-unit plant, there is no sharing of DG functions between the two new STP reactor units. Each emergency diesel is supported by an independent train that provides starting air for its respective diesel engine. There are no cross-ties among any of the six trains provided for the two STP reactor units, and each train is powered from an independent Class 1E power supply fed from the associated EDG. The failure of any one train will not cause a failure of any of the other redundant EDGs.

9.5.6.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the DG starting air system, and the associated acceptance criteria, are in Section 9.5.6 of NUREG-0800.

In particular, the regulatory basis and review criteria that the staff used for COL License Information Items 9.22 and 9.25 described above, as they relate to the protection of the SSCs important to safety, are specified in SRP Section 9.5.6, "Emergency Diesel Engine Starting System."

The staff's review of the application is also based on 10 CFR Part 50, Appendix A, GDC 5. Although the ABWR DCD is based on a single reactor unit plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG starting air system does not affect the compliance of STP, Units 3 and 4, to GDC 5.

9.5.6.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.6 of the certified ABWR DCD. The staff reviewed Section 9.5.6 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 appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

Although the ABWR DCD is based on a single-reactor unit plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG starting air system does not affect the compliance of STP, Units 3 and 4, with GDC 5.

COL License Information Items

- COL License Information Item 9.22 Vendor Specific Design of Diesel Generator Auxiliaries

The staff reviewed COL License Information Item 9.22, in STP FSAR Subsection 9.5.13.5, "Vendor Specific Design of Diesel Generator Auxiliaries." Information provided by the applicant to address COL License Information Item 9.22 indicated that the COL applicant has committed (COM 9.5-6) to update the STP FSAR to provide specific as-built information about the DG starting air system. The following as-built information will be provided in the updated STP FSAR in accordance with 10 CFR 50.71(e):

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[1] 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.

- A description of engine cranking devices for the starting air system.
- Duration of a cranking cycle and number of engine revolutions per start attempt.
- Volume and design pressure of air receivers sufficient for five start cycles per receiver.
- Air compressor size and discharge flow required to recharge the system in 30 minutes or less.

The incorporation of this proposed revision in the STP FSAR is a post-COL activity (COM 9.5-6). The staff finds this acceptable since the applicant has committed to provide as-built information regarding DG starting system, as requested in the ABWR DCD.

NUREG–0800 Section 9.5.6, SRP Acceptance Criteria Item 4.F, states that "starting air should be dried to a dew point of not more than 10 °C (50 °F) when installed in a normally controlled 21 °C (70 °F) environment; otherwise, the starting air dew point should be controlled to at least 5.5 °C (10 °F) less than the lowest expected ambient temperature." As indicated in ABWR DCD Section 9.5.6.2 and shown on DCD Drawing 9.5-8, the starting air system is provided with an air dryer to control the dew point of the starting air, and ensure clean, dry air to the air receiver tank. The dryer will be capable of controlling the dew point as recommended by the diesel engine manufacturer. The dryer will also be equipped with pre- and after-filters to remove oil, waste, dust and any pipe scale from the air stream. The staff finds this reasonable since the applicant design will control the dew point as recommended by the diesel engine manufacturer.

- COL License Information Item 9.25 Diesel Generator Requirements

The staff reviewed COL License Information Item 9.25 in STP FSAR Subsection 9.5.13.8. The applicant's information addressing COL License Information Item 9.25 indicates that the COL applicant has committed (COM 9.5-9) to review the vendor-specific design of the DG starting air system to assure that the design meets the recommendations for dust-tight enclosures for all relays and contactors as follows:

> The vendor-specific design for the starting air system will be reviewed to assure that it meets NUREG/CR–0660 Recommendations 2.a and 2.b, that all contactors and relays will have dust–tight, enclosed contacts of the bifurcated type manufactured by Struthers-Dunn or an equivalent type, and that all contactors and relays for the DG equipment will be enclosed in dust-tight steel cabinets with fully gasketed doors and other openings.

In addition, in Subsection 9.5.13.8, as part of the Commitment (COM 9.5-9), the applicant will maintain the floors of the DG rooms free of dust in accordance with NUREG/CR–0660, Recommendations 2.d and 5. The staff finds this acceptable since the applicant has committed to provide dust and dirt control in accordance with NUREG/CR-0660 guidance.

The STP COL FSAR addresses compliance with GDC 5 in Subsection 3.1.2.1.5.2, "Evaluation Against Criterion 5." This section of the application does not identify any sharing of the EDGs among reactor units at the site, including the structures in which the system is located.

Technical Specification Considerations

The staff reviewed the TS applicable to the DGs in Chapter 16 of the application. TS Section 3.8.3 was reviewed for relevance to the DG starting air system. The application incorporates the ABWR DCD section by reference with one departure, Departure STD DEP 16.3-51, which modifies the DG operating condition for starting air receiver pressure and requires the pressure in at least one (not both) of the starting air receivers to be within specified limits. The stated basis for this departure is that as long as one of the air receivers for each DG has the capacity for five successive start attempts without recharging, the DG starting system for that unit satisfies the operability requirements.

The applicant states that this departure is a change to the wording of the generic TS and does not change the intent, nor is it associated with a design change. However, because the departure changes the TS it requires prior NRC approval. Otherwise, it would normally meet the definition of an administrative departure. The applicant further states that this departure complies with the requirements in Section VIII.C.4 of Appendix A to 10 CFR Part 52.

The staff evaluated the implications of this departure from the generic TS. The staff determined that because the departure does not involve changes to the design of the starting system, the findings documented in the ABWR FSER (NUREG–1503) regarding whether the system design meets the requirements of GDC 2, 4, and 5 have not been affected and are thus maintained.

The staff then considered six specific SRP acceptance criteria listed in Section II of SRP 9.5.6 for meeting the requirements of GDC 17. Item B specifies that each DG should have a dedicated air start system consisting of a compressor, an air dryer, *one or more* air receivers (emphasis added), piping, lines and valves, and devices to crank the engine. Departure STD DEP 16.3-51 does not change the redundancies in the basic system design, thus this feature is not impacted. Item C specifies that the air starting system should be capable of cranking a cold diesel engine five times without recharging the receiver(s). In addition, each cranking cycle should (i) be approximately three seconds in duration, (ii) consist of two or three engine revolutions, or (iii) meet the air start requirements provided by the engine manufacturer. As described in Subsection 9.5.6.1 of the ABWR DCD, and incorporated by reference in the STP FSAR, each starting air subsystem is capable of performing five consecutive starts of the engine, thus meeting its required safety function. Therefore, the staff found that this departure from the generic TS is acceptable.

In Revision 3 of STP FSAR Section B 3.8.3, under the sub-heading “Actions, E.1,” reference is made to “starting air receiver pressure < [3,000] MPaG.” Similarly, in the next sentence the units specified for the lower pressure limit are also given as MPaG. These large pressure values conflict with TS for air receiver pressure limits provided in LCO 3.8.3; namely, [3,000] kPaG and [2,700] kPaG. Therefore, the staff issued RAI 09.05.06-1, requesting the applicant to revise the STP FSAR to correctly identify the pressure values associated with the starting air receivers. In its response to RAI 09.05.06-1, dated August 20, 2009 (ML092360771), the applicant notes that the MPaG units should be kPaG and that this correction would be made in the next revision to the STP FSAR. The staff confirmed that the FSAR was revised to reflect the corrected typographical errors. Therefore, RAI 09.05.06-1 is resolved and closed.

ITAAC Considerations

The EDG system ITAAC requirements specified in Tier 1 Section 2.12.13 of the ABWR DCD are incorporated by reference in the STP FSAR.

Initial Plant Test Program

The DG preoperational tests specified in Tier 2 Subsection 14.2.12.1.45.3, "Electrical Power Distribution System Preoperational Test," of the ABWR DCD are incorporated by reference in the STP FSAR.

9.5.6.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.5-6) – Update the STP FSAR to provide specific as-built information about the EDG in accordance with COL Information Item 9.22 in DCD Subsection 9.5.13.5.

- Commitment (COM 9.5-9) – Review the vendor-specific design of the DG starting air system to ensure it conforms with Recommendations 2.a and 2.b of NUREG/CR–0660 for dust-tight enclosures for all relays and contactors. In addition, Recommendations 2.d and 5 of NUREG/CR–0660 for control of dust in the DG rooms will be adhered to.

9.5.6.6 *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 relating to the DG starting air system, 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 Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the DG starting air system that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.6 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information items in accordance with the relevant guidance in Section 9.5.6 of NUREG–0800. The staffs determined that the DG starting air system design is acceptable and complies with regulations as stated in the GDC of Appendix A to 10 CFR Part 50. This conclusion is based on the technical evaluation that the system meets GDC 2, 4, and 17; 10 CFR 52.47(b)(1); and NUREG/CR–0660. The staff determined that the applicant has adequately addressed the TS, ITAAC, interface requirements, and Initial Test Program considerations related to this area of review.

9.5.7 Diesel Generator Lubrication System

9.5.7.1 *Introduction*

This section of the FSAR addresses how the emergency diesel engine lubrication system provides essential lubrication to emergency diesel engine components. The review includes

system piping, pumps, components, and auxiliary equipment essential for system operation up to the engine interface.

9.5.7.2 *Summary of Application*

Section 9.5.7 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.7 of the certified ABWR DCD, Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.5.13, the applicant provides the following:

COL License Information Item

- COL License Information Item 9.22 Vendor Specific Design of Diesel Generator Auxiliaries

This COL license information item is related to ABWR DCD Subsection 9.5.7.2. It directs the applicant to update the STP FSAR to provide as-built design information.

The ABWR DCD describes a single-unit plant. Although this STP COLA is for a two-unit plant, there is no sharing of DG functions between the two new STP reactor units. Each emergency diesel is supported by an independent train that provides lubrication for its respective diesel engine. There are no cross-ties among any of the six trains provided for the two STP reactor units, and each train is powered from an independent Class 1E power supply fed from the associated EDG. The failure of any one train will not cause a failure of any of the other redundant EDGs.

9.5.7.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the DG lubrication system, and the associated acceptance criteria, are in Section 9.5.7 of NUREG–0800. The staff's review of the application is also based on 10 CFR Part 50, Appendix A, GDC 5.

9.5.7.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.7 of the certified ABWR DCD. The staff reviewed Section 9.5.7 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 COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

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[1] 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.

Although the ABWR DCD is based on a single-reactor unit plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG lubrication system does not affect the compliance of STP, Units 3 and 4, with GDC 5.

COL License Information Item

- COL License Information Item 9.22 Vendor Specific Design of Diesel Generator Auxiliaries

The staff reviewed COL License Information Item 9.22 in STP FSAR Subsection 9.5.13.5. The applicant's information addressing COL License Information Item 9.22 indicates that the COL applicant has committed (COM 9.5-6) to update the STP FSAR to provide specific as-built information about the DG lubrication system. The following as-built information related to the DG lubrication system will be included in the updated STP FSAR, in accordance with 10 CFR 50.71(e):

- Lubricating oil pump flows.
- System operating pressure.
- Temperature differentials.
- Cooling system heat removal capabilities.
- Electric heater characteristics.

The incorporation of this proposed revision in the STP FSAR is a post COL activity. The staff finds this acceptable since the applicant has committed to provide as-built information regarding DG lubrication system, as requested in the ABWR DCD.

The applicant addresses compliance with GDC 5 in FSAR Subsection 3.1.2.1.5.2, "Evaluation Against Criterion 5." The applicant does not identify any sharing of the EDGs among reactor units at the site, including the structures in which the system is located.

Technical Specification Considerations

The staff reviewed the TS applicable to the DG in Chapter 16 of the application. TS Section 3.8.3 was reviewed for relevance to the DG lubrication system. The application incorporates by reference the ABWR DCD section with one departure, Departure STD DEP 16.3-51, which modifies the DG operating condition for starting air receiver pressure but does not affect the lubrication system. However, Revision 3 to the STP FSAR adds specific values for applying operating conditions. In the case of the lubrication system, LCO 3.8.3-B allows a depleted DG lube oil inventory condition between 7,300 liters (1,929 gallons) and 6,700 liters (1,770 gallons) for a period of 48 hours before requiring the DG to be declared inoperable. The applicant states that this condition provides a minimum remaining capacity of more than 6 days of continuous operation under a full load, and the 48-hour period is considered a sufficient amount of time to complete a restoration of the required volume.

SR 3.8.3.2 requires verification that the lubricating oil inventory for each DG is greater than 7,300 liters (1,929 gallons) on a 31-day frequency. The applicant states that this requirement

ensures that each DG has a sufficient lubricating oil inventory to support at least seven days of a full load operation.

The staff evaluated the implications of these departures from the ABWR DCD TS. The staff determined that because the departures do not involve changes to the design of the lubrication system, the findings documented in the NUREG–1503 regarding whether the system design meets the requirements in GDC 2, 4, 5 and 17 are not affected and are thus maintained.

NUREG–0800, Section 9.5.7, SRP Acceptance Criteria Item 4.H specifies that the onsite lubricating oil storage capacity for each DG is sufficient for 7 days of operation following any design-basis event and a continuous loss of offsite power. The incorporation of specific volumes as part of the TS is intended to ensure that the lubricating oil system is capable of allowing the DG to operate continuously under a full load for a period of at least seven days. Therefore, the staff found that this departure from the ABWR DCD TS is acceptable.

ITAAC Considerations

The EDG system ITAAC requirements as specified in Tier 1 Section 2.12.13 of the ABWR DCD, are incorporated by reference in the STP FSAR.

Initial Plant Test Program

The DG preoperational tests specified in Tier 2 Subsection 14.2.12.1.45.3 of the ABWR DCD are incorporated by reference in the STP FSAR.

9.5.7.5 *Post Combined License Activities*

The applicant identifies the following commitment:

- Commitment (COM 9.5-6) – Update the STP FSAR to provide specific as-built information in accordance with COL License Information Item 9.22 in DCD Subsection 9.5.13.5.

9.5.7.6 *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, 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 this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.7 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information items in accordance with the relevant guidance in Section 9.5.7 of NUREG–0800. The staff determined that the DG lubrication system design is acceptable and complies with regulations as stated in the GDC in Appendix A to 10 CFR Part 50. This conclusion is based on the staff's technical evaluation that determined that the system meets GDC 2, 4, 5, and 17; 10 CFR 52.47(b)(1); and NUREG/CR–0660.

The staff also determined that the applicant has adequately addressed the TS, ITAAC, interface requirements, and Initial Test Program considerations related to this area of review.

9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

9.5.8.1 *Introduction*

This section of the FSAR addresses how the diesel engine combustion air intake and exhaust system supplies combustion air of reliable quality to the diesel engines and exhausts combustion products from the diesel engines to the atmosphere. The system is reviewed from the outside air intake to the combustion air supply lines connected to the diesel engine interface and from the exhaust connections at the diesel engine interface to the discharge point outside the building.

9.5.8.2 *Summary of Application*

Section 9.5.8 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.8 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 9.5.13, the applicant provides the following:

COL License Information Items

- COL License Information Item 9.18 Contamination of Diesel Generator Combustion Air Intake

This COL license information item is related to ABWR DCD Subsection 9.5.8.1. It requires the applicant to take measures to limit contaminating materials from the plant site that may be accessible to the DG air intakes.

- COL License Information Item 9.22 Vendor Specific Design of Diesel Generator Auxiliaries

This COL license information item is related to ABWR DCD Subsection 9.5.8.2. It requires the applicant to update the STP FSAR to provide as-built design information.

The ABWR DCD describes a single-unit plant. Although this STP application is for a two-unit plant, there is no sharing of DG functions between the two new STP reactor units. Each emergency diesel is supported by an independent train that provides combustion air intake and exhaust for its respective diesel engine. There are no cross-ties among any of the six trains provided for the two STP reactor units, and each train is powered from an independent Class 1E power supply fed from the associated EDG. The failure of any one train will not cause a failure of any of the other redundant EDGs.

9.5.8.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG–1503. In addition, the relevant requirements of the Commission regulations for the DG combustion air intake and exhaust system, and the associated acceptance criteria, are in Section 9.5.8 of NUREG–0800.

In particular, the regulatory basis and review criteria that the staff used for COL license information items 9.18 and 9.22, as they relate to the protection of the SSCs important to safety, are specified in SRP Section 9.5.8.

The staff's review of the application is also based on 10 CFR Part 50, Appendix A, GDC 5, . Although the ABWR DCD is based on a single-reactor unit plant, Departure STP DEP 1.1-2 describes systems and facilities that are shared between STP, Units 3 and 4. Because the EDGs are not cross-tied between the two units, the DG combustion air intake and exhaust system does not affect the compliance of STP, Units 3 and 4, with GDC 5.

9.5.8.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.8 of the certified ABWR DCD. The staff reviewed Section 9.5.8 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 COL FSAR and the information in the ABWR DCD appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to this section.

The staff reviewed the following information in the COL FSAR:

COL License Information Items

- COL License Information Item 9.18 Contamination of Diesel Generator Combustion Air Intake

The staff reviewed COL License Information Item 9.18, in STP FSAR Subsection 9.5.13.1. The applicant's information addressing COL License Information Item 9.18 indicates that the COL applicant has committed (COM 9.5-3) to take measures before and subsequent to testing the DGs to restrict contaminating substances from the STP site that may be available to the DG air intakes.

The staff finds this acceptable since the applicant has committed to taking measures to avoid contamination of the DG air intakes.

- COL License Information Item 9.22 Vendor Specific Design of Diesel Generator Auxiliaries

The staff reviewed COL License Information Item 9.22, in STP FSAR Subsection 9.5.13.5. The applicant's information addressing COL License Information Item 9.22 indicates that the COL applicant has committed (COM 9.5-6) to update the STP FSAR to provide specific as-built information. The following as-built information will be included in the updated FSAR, in accordance with 10 CFR 50.71(e):

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[1] 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.

- Selection of a combustion air flow capacity sufficient to ensure complete combustion.

The incorporation of this proposed revision in the STP FSAR is a post-COL activity. The staff finds this acceptable since the applicant has committed to provide as-built information regarding DG combustion air intake and exhaust system, as requested in the ABWR DCD.

The applicant addresses compliance with GDC 5 in FSAR Subsection 3.1.2.1.5.2, "Evaluation Against Criterion 5." The applicant does not identify any sharing of the emergency DGs among reactor units at the site, including the structures in which the system is located.

Technical Specification Considerations

The staff reviewed the TS applicable to the DGs in Chapter 16 of the application. The staff also reviewed TS 3.8.3 for its relevance to the DG combustion air intake and exhaust system. There are no specific LCOs or SRs directly related to the DG combustion air intake and exhaust system.

ITAAC Considerations

The EDG system ITAAC requirements specified in Tier 1 Section 2.12.13 of the ABWR DCD are incorporated by reference in the STP FSAR.

Initial Plant Test Program

The DG preoperational tests specified in Tier 2 Subsection 14.2.12.1.45.3 of the ABWR DCD are incorporated by reference in the STP FSAR.

9.5.8.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 9.5-3) – Update the STP FSAR to describe the means for ensuring and verifying that measures for limiting contaminating materials from the plant site that may be accessible to the DG air intakes are completed before and subsequent to DG testing in accordance with COL License Information Item 9.18 in ABWR DCD Subsection 9.5.13.1.

- Commitment (COM 9.5-6) – Update the STP FSAR to provide specific as-built information about the DG combustion air intake and exhaust system in accordance with COL License Information Item 9.22 in ABWR DCD Subsection 9.5.13.5.

9.5.8.6 *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, 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 this section that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations and the guidance in Section 9.5.8 of NUREG–0800. The staff's review concluded that the applicant has adequately addressed the COL license information items in accordance with the relevant guidance in Section 9.5.8 of NUREG–0800. The staff determined that the DG combustion air intake and exhaust system design is acceptable and complies with regulations as stated in the GDC of Appendix A to 10 CFR Part 50. This conclusion is based on the staff's technical evaluation that determined that the system meets GDC 2, 4, 5, and 17; 10 CFR 52.47(b)(1); and NUREG/CR–0660.

The staff also found that the applicant has adequately addressed the TS, ITAAC, interface requirements, and Initial Test Program considerations related to this area of review.

9.5.9 Suppression Pool Cleanup System

This section of the FSAR addresses information related to the ABWR Suppression Pool Cleanup System.

Section 9.5.9 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.9, "Suppression Pool Cleanup System," 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.[1] 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 suppression pool cleanup system have been resolved.

9.5.10 Motor Generator Set

See SER Section 8.3.1, "AC Power System."

9.5.11 Combustion Turbine/Generator

See SER Section 8.4S, "Station Blackout."

9.5.12 Drywell Flooder

9.5.12.1 *Introduction*

The function of the lower drywell flooder (LDF) system is to flood the lower drywell with water from the suppression pool in the unlikely event of a severe accident where the core melts and causes a subsequent vessel failure.

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[1] 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.

9.5.12.2 *Summary of Application*

Section 9.5.12 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 9.5.12 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in COL FSAR Section 9.5.12, the applicant provides the following:

Tier 2 Departure Not Requiring Prior NRC Approval

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

The applicant proposed the following Tier 2 departure from the ABWR DCD. The flooder system is comprised of ten piping lines. Each line originates in one of the ten vertical pipes that are part of the drywell to wetwell connecting vent system. The vents are arranged symmetrically around the perimeter of the lower drywell. The flow through each flooder line will be initiated by melting a temperature-sensitive fusible plug (or fusible link) that, in turn, triggers the fusible plug valve to fully open and remain open.

Supplemental Information

The applicant provides the following supplemental information describing the LDF system at STP, Units 3 and 4.

General Design Bases

In Subsection 9.5.12.1, the applicant provides supplemental information regarding air temperature in the drywell air space and discusses flow distribution.

System Description

In Subsection 9.5.12.2, the applicant clarifies how the system operates, including the incorporation of the Tier 2 departure design changes.

9.5.12.3 *Regulatory Basis*

The regulatory basis of the information incorporated by reference is in NUREG-1503. There is no regulatory guidance or requirements in the NUREG–0800, in the GDC in 10 CFR Part 50, Appendix A, or in the RGs that directly apply to the performance requirements for the LDF system.

In addition, in accordance with 10 CFR Part 52, Appendix A, Section VIII, the applicant identifies one Tier 2 departure that does not require prior NRC approval. This departure is 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.

9.5.12.4 *Technical Evaluation*

As documented in NUREG–1503, the staff reviewed and approved Section 9.5.12 of the certified ABWR DCD. The staff reviewed Section 9.5.12 of the STP, Units 3 and 4, COL FSAR

and checked the referenced ABWR DCD to ensure that the combination of the ABWR DCD and the information in the COL FSAR appropriately represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and the information incorporated by reference address the required information relating to the drywell flooder.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departure Not Requiring Prior NRC Approval

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

The staff reviewed Departure STD DEP 9.5-2, included in Section 9.5-2 of the STP, Units 3 and 4, COL FSAR and Part 7, "Departures Report," of the COLA. The text changes do not reflect any changes to the design concept, but instead allow for greater flexibility in implementing the design. In particular, a temperature-sensitive fusible plug (or fusible link) would be melted after molten core debris had entered the lower drywell, thus enabling the fusible plug valve to open and to remain open. The staff agreed that this concept would enable water to enter the lower drywell and cover the core debris. There was a concern, however, that the containment liner failure may not be averted for 24 hours after core damage, even with water on top of the debris. Accordingly, in Chapter 19, "Response to Severe Accident Policy Statement," the staff issued RAI 19-1 and RAI 19-28, requesting the applicant to submit the results of the Modular Accident Analysis Program calculations that show containment liner integrity during this period for the more likely severe accident scenarios. The staff's confirmatory assessment was completed using MELCOR 1.8.6 and verified that the containment liner would remain intact for 24 hours. Therefore, as discussed in Section 19E.4, "Technical Evaluation," of this SER, RAI 19-1 and RAI 19-28, are resolved and closed.

Supplemental Information

The supplemental information in Subsections 9.5.12.1 and 9.5.12.2 provides additional insights related to LDF operation and is reviewed under Departure STD DEP 9.5-2.

9.5.12.5 *Post Combined License Activities*

There are no post COL activities related to this section.

9.5.12.6 *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 LDF system 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

[1] 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.

safety issues relating to the drywell flooder that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the COLA to the relevant NRC regulations. The staff's review found it 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. The staff concluded that the application is in compliance with NRC regulations.