8.0 ELECTRIC POWER

The electric power system is the source of power for station auxiliaries during normal operation and for the reactor protection system and engineered safety features (ESF) during abnormal and accident conditions. This chapter provides information on the functional adequacy of the offsite power systems and safety-related onsite electric power systems, as applicable to the South Texas Project (STP), Units 3 and 4, Advanced Boiling-Water Reactor (ABWR) design. This chapter ensures that these systems have adequate redundancy, independence, and testability in conformance with the current criteria established by the U.S. Nuclear Regulatory Commission (NRC).

8.1 <u>Electrical Power – Introduction</u>

8.1.1 Introduction

Final Safety Analysis Report (FSAR) Section 8.1 provides (1) a brief description of the transmission grid and its interconnection to the nuclear unit and other grid interconnections, (2) a description of those onsite alternating current (ac) and direct current (dc) loads that are added to the certified ABWR design, and (3) a selective description of the functions provided by these loads.

This section also includes a regulatory requirement applicability matrix that lists all design bases, criteria, regulatory guides (RGs), standards, and other documents to be implemented in the design of the electrical systems that are beyond the scope of the design certification. The review under this section is coordinated closely with the reviews described in Sections 8.2, “Offsite Power System,” 8.3.1, “AC Power System,” 8.3.2,”DC Power System,” 8.4S, “Station Blackout,” and Appendix 8A, “Miscellaneous Electrical Systems.”

8.1.2 Summary of Application

Section 8.1 of the STP, Units 3 and 4, Combined License (COL) FSAR Revision 12 incorporates by reference Section 8.1 of the certified ABWR design control document (DCD) Tier 2, 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.” In addition, in FSAR Section 8.1, the applicant provides the following:

<u>*Tier 1 Departures*</u>

- STD DEP T1 2.4-2 Feedwater Line Break Mitigation

This departure provides supplemental information on the addition of medium voltage, safety-related circuit breakers for the feedwater line break (FWLB) mitigation.

- STD DEP T1 2.12-2 I&C Power Divisions

This departure identifies the addition of a fourth-division, safety-related 120 volts ac (Vac) instrumentation and control (I&C) power system.

Tier 2 Departures*

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

The definition of "safety-related" that this departure uses is based on the Institute of Electrical and Electronics Engineers (IEEE) Standard (Std) 603–1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations." Tier 2* is defined in 10 CFR Part 52, Appendix A.

Tier 2 Departures Requiring Prior NRC Approval

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

This departure identifies a change in the medium voltage distribution system that affects the FSAR in the offsite electric power system, the onsite ac power distribution system, and safety loads.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 1.1-2 — Dual Units at STP 3 & 4 (Table 8.1-1)

This departure addresses the STP inclusion of General Design Criterion (GDC) 5, "Sharing of structures, systems, and components", Regulatory Guide (RG) 1.81, Revision 1, "Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants," with the associated IEEE standards.

- STD DEP 9.5-1 — Diesel Generator Jacket Cooling Water System (Table 8.1-1)

In this departure, RG 1.108 "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants," is superseded by RG 1.9, Revision 3, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants," and IEEE Std 387, "IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations." Therefore, RG 1.108 is not used.

COL License Information Item

- COL License Information Item 8.1 — Diesel Generator Reliability

The applicant provides supplemental information to address COL License Information Item 8.1 in Subsection 8.1.4.1, referencing the use of recommendations in NUREG/CR–0660, "Enhancement of Onsite Emergency Diesel Generator Reliability," to develop procedures that improve the performance and reliability of emergency diesel generators (EDGs) (COM 8.1-1).

Supplemental Information

The applicant supplements Section 8.1.1, "Offsite Transmission Network," with additional information described in Section 8.2.3, "Interface Requirements," regarding the interface requirements between the offsite transmission network and STP, Units 3 and 4.

8.1.3 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,” (July 1994) (Final Safety Evaluation Report (FSER) related to the ABWR DCD).

In addition, the relevant requirements of the Commission regulations for Section 8.1, “Electric Power – Introduction,” and the associated acceptance criteria, are in Section 8.1 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 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 Tier 1, Tier 2*, 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 require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.B.6. Tier 2 Departures affecting technical specifications (TS) are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.C.4.

Specifically, the regulatory bases for accepting the departures, the COL license information items, and the supplements are established as follows:

Tier 1 Departures

Departure STD DEP T1 2.4-2 is subject to the guidance of RG 1.75, Revision 3, “Criteria for Independence of Electrical Safety Systems.”

Departure STD DEP T1 2.12-2 is subject to the requirements of GDC 17, “Electric power systems,” and the guidance of RG 1.75 and RG 1.32, Revision 3 “Criteria for Power Systems for Nuclear Power Plants.”

Tier 2 Departures*

Departure STD DEP 1.8-1 is subject to the guidance of IEEE Std 603–1991.

Tier 2 Departures Requiring Prior NRC Approval

Departure STD DEP 8.3-1 is subject to the requirements of GDC 17 and the guidance of RG 1.206, “Combined License Application for Nuclear Power Plants, (LWR Edition).”

Tier 2 Departures Not Requiring Prior NRC Approval

Tier 2 departures are subject to the requirements of Section VIII.B.5, which are similar to the requirements in 10 CFR 50.59, “Changes, Tests and Experiments.”

COL License Information Items

COL License Information Item 8.1 is subject to the guidelines of NUREG/CR–0660 regarding the development and implementation of plant-specific operating procedures and the training of personnel to enhance the reliability of the onsite EDGs.

Supplemental Information

Subsection 8.1.1, "Offsite Transmission Network," is subject to the requirements of GDC 17.

8.1.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Section 8.1 of the certified ABWR DCD. The staff reviewed Section 8.1 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 relevant information related to this section.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departures

The following Tier 1 departures identified by the applicant in this section require prior NRC approval and the full scope of their technical impact may be evaluated in the other sections of this safety evaluation report (SER) accordingly. For more information, refer to COL application (COLA) Part 07, Section 5.0 for a listing of all FSAR sections affected by these Tier 1 departures.

- STD DEP T1 2.4-2 Feedwater Line Break Mitigation

This departure addresses the STP use of safety-related 13.8 kilovolts (kV) breakers on nonsafety-related 13.8 kV switchgear buses to trip condensate pumps in case of a feedwater pipe break. The NRC staff's review of this departure resulted in two requests for additional information (RAIs) (see Section 8.3.1). These RAIs request clarifications pertaining to the application of RG 1.75 to the feedwater supply breakers and to the design of the breakers themselves. Refer to Subsection 8.3.1.4 of this SER for the evaluation of this departure.

- STD DEP T1 2.12-2 I&C Power Divisions

This departure addresses the STP use of four Class 1E 120 Vac instrument power system buses rather than the three buses specified in the ABWR DCD. The NRC staff's review of this departure resulted in one RAI (see Section 8.3.1). This RAI requests the applicant to address the difference in logic philosophy between the DCD and STP designs and the impact of a temporary loss of all ac at the station. Refer to Subsection 8.3.1.4 of this SER for the evaluation of this departure.

Tier 2 Departures*

The following Tier 2* departure identified by the applicant in this section require prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this

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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

SER. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 2* departure.

- STD DEP 1.8-1 — Tier 2* Codes, Standard and Regulatory Guide Edition changes

This departure clarifies the definition of “safety-related” and corrects its applicability to IEEE Std 603–1991 rather than to IEEE Std 279–1971, “Criteria for Protection Systems for Nuclear Power Generating Stations.” The NRC staff reviewed this departure and found that the FSAR change is reasonable in that IEEE Std 279–1971 is superseded by IEEE Std 603–1991.

FSAR Section 8.1 Table 8.1-1 does not include the following RGs:

- RG 1.160, Revision 3, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants”;

- RG 1.180, Revision 1, “Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems”;

- RG 1.182, “Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants”; and

- RG 1.204. “Guideline for Lightning Protection at Nuclear Power Plants.”

The NRC staff issued RAI 08.01-1 requesting the applicant to discuss the applicability of these RGs to the STP design. In its response to RAI 08.01-1, dated May 18, 2009 (Agencywide Documents Access and Management System [ADAMS] Accession Number, ML091410060), the applicant notes that the RGs that are applicable to the ABWR design are in ABWR DCD Tier 2, Table 1.8-20, “NRC Regulatory Guides Applicable to ABWR.” In particular, the applicant provides the following clarifications:

a. Because RG 1.160 is not listed in ABWR DCD Tier 2, Table 8.1-1, there is no departure from this portion of the certified design and therefore, no change is required. The applicant also states that RG 1.160 is applicable to the plant-specific Maintenance Rule Program.

b. RG 1.182 is applicable to the plant-specific Maintenance Rule Program.

c. RG 1.180 relates to I&C platform departures and it is not applicable to the electrical power system. Therefore, no changes to FSAR Table 8.1-1 are required for this item.

d. Because RG 1.204, “Guidelines for Lightning Protection of Nuclear Power Plants,” is also added to FSAR Section 8A.1.2, “Analysis,” in the COLA, Revision 2, the RG will also be added to FSAR Table 8.1-1. The staff confirmed that this change is incorporated in Revision 3 of the FSAR.

The staff found Items a, b, and d acceptable because the applicant will conform with RGs 1.160, 1.182 and 1.204, respectively. However, the staff does not agree with the applicant’s position regarding Item c (above). Solid state and digital components are being used in many safety-related systems, including the electric power system. Electromagnetic interference (EMI), radio-frequency interference (RFI), and power surges are identified as environmental conditions that can affect the performance of safety-related electrical equipment. GDC 4, "Environmental and dynamic effects design bases," requires that structures, systems, and components (SSCs) important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operations, maintenance, testing, and postulated accidents including loss-of-coolant accidents (LOCAs). Such environmental effects could result in the common cause/common mode failure of independent and redundant systems and components. The staff issued RAI 08.01-2, requesting the applicant to discuss whether solid state and digital devices are being used in safety-related portions of the STP electric power system. If such devices are being used, the RAI requests the applicant to discuss how the GDC 4 requirements will be met for safety-related equipment regarding the EMI, the RFI, and power surges. In its response to RAI 08.01-2, dated December 7, 2009 (ML093440181), the applicant states that STP electrical power system will use solid state and digital devices in safety-related and nonsafety-related systems. The applicant further states that the GDC 4 requirements relative to EMI/RFI and power surges as environmental conditions are addressed in FSAR Subsection 8.2.2.1(2) and Section 7A, "Design Response to Appendix B, ABWR LRB Instrumentation and Controls." On the basis of this information, the staff found that the GDC 4 requirements relative to EMI/RFI and power surges for solid state and digital devices are consistent with the ABWR DCD requirements. Therefore, this RAI is resolved.

Tier 2 Departure Requiring Prior Approval

The following Tier 2 departure identified by the applicant in this section require prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 2 departure.

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

This departure addresses the changes to the offsite and onsite ac electric power systems and the addition of two ESF support systems to the list of safety loads.

Regarding the offsite system, the STP design uses two reserve auxiliary transformers (RATs) rather than the one RAT cited in the DCD. Additionally, the voltages supplied by the two secondary windings of each unit auxiliary transformer (UAT) and the RATs are 13.8 kV and 4.16 kV, respectively, rather than the 6.9 kV and 6.9 kV used in the DCD. Lastly, the capacity of the combustion turbine generator (CTG) is increased from 9 megawatts electrical (MWe) to 20 MWe. An interconnection is provided between STP, Units 3 and 4, so that the STP, Unit 3 CTG can supply power to STP, Unit 4 and vice versa.

Regarding the onsite power system, the departures identified in Section 8.1 of the STP FSAR relate to the changes in the voltage output of the transformers and the various medium voltage buses. Specifically, the STP FSAR specifies 13.8 kV for the power generation (PG) buses and 4.16 kV for the Class 1E buses and the plant investment protection (PIP) buses.

The NRC staff reviewed this departure and found that the description of the STP FSAR departures from the ABWR DCD indicates that the explanation above is sufficient for an evaluation of the offsite and onsite power systems. This review generated several RAIs that are included as part of SER reviews in Sections 8.2, 8.3, "Onsite Power Systems," and 8.4S. These RAIs address various aspects of the offsite and onsite electric power systems. Refer to

Sections 8.2.4, and 8.4S.4 and Subsections, 8.3.1.4, and 8.3.2.4 of this SER for the evaluation of this departure.

Tier 2 Departures Not Requiring Prior NRC Approval

The following Tier 2 departures not requiring prior NRC approval identified by the applicant in this section may also be evaluated in other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by these departures.

- STD DEP 1.1-2 — Dual Units at STP 3 & 4 (Table 8.1-1)

This departure addresses the inclusion of GDC 5, in the list of GDC that are applicable to the STP, Units 3 and 4. Additionally, this item addresses the inclusion of RG 1.81, "Shares Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants," in the list of RGs that are applicable to the STP. 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 NRC 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 9.5-1 — Diesel Generator Jacket Cooling Water System (Table 8.1-1)

This departure addresses the STP exclusion of RG 1.108 from the list of RGs applicable to the STP, Units 3 and 4. RG 1.108 was withdrawn by the NRC with the issuance of RG 1.9, Revision 3. 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 NRC staff found it reasonable that this departure does not require prior NRC approval. The applicant's process for evaluating departures and other changes to the DCD is subject to NRC inspections.

COL License Information Item

- COL License Information Item 8.1 — Diesel Generator Reliability

The applicant indicates that as part of Commitment (COM 8.1-1) the procedure(s) to monitor onsite EDG performance will be in accordance with NUREG/CR–0660 and will be developed before fuel loading.

The NRC staff reviewed the COL license information in Subsection 8.1.4.1 of the STP, Units 3 and 4, COL FSAR related to the development of procedures to monitor the performance of the onsite EDGs. The staff found that the applicant's use of NUREG/CR–0660 for the development of these procedures is appropriate. Additionally, the applicant indicates that the procedures will be developed before fuel loading. The staff found the schedule for the development of the procedures as well as their scope reasonable.

Supplemental Information

Offsite Transmission Network

The NRC staff reviewed the supplemental information related to the offsite transmission network in Section 8.1.1 of the STP, Units 3 and 4, COL FSAR and found that the information is sufficient for an evaluation of the utility power grid system. The staff also found that the supplemental information related to the offsite transmission network is consistent with the requirements of GDC 17.

8.1.5 Post Combined License Activities

The applicant identifies the following commitment:

- Commitment (COM 8.1-1) – Develop plant procedures consistent with the guidance of NUREG/CR–0660 to monitor the performance of the onsite EDGs before fuel loading.

8.1.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG–1503. The NRC 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 "Electric Power- Introduction" 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 8.1 of NUREG-0800. The staff's review concluded that the applicant has adequately addressed COL License Information Item 8.1, the Tier 1 and Tier 2*departures, and the supplemental information in accordance with Section 8.1 of NUREG–0800 and 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.

8.2 Offsite Power System

8.2.1 Introduction

This section of the FSAR provides descriptive information, analyses, and referenced documents including electrical single-line diagrams; electrical schematics; logic diagrams; tables; and physical arrangement drawings for the offsite power system. The offsite power system is referred to in industry standards and RGs as the "preferred power system." It includes two or more physically independent circuits capable of operating independently of the onsite standby power sources and encompasses the grid, transmission lines (overhead or underground), transmission line towers, transformers, switchyard components and control systems, switchyard battery systems, the main generator, generator circuit breakers, disconnect switches, and other switchyard equipment such as capacitor banks and volt amperes reactive compensators that supply electric power to safety-related and other equipment.

The interface of the preferred power supply with an alternate ac (AAC) power source for a safe shutdown in the event of a station blackout (SBO) (non-design-basis accident) is also addressed with respect to its adequacy and its independence from the offsite and onsite power systems. The AAC source for the ABWR standard plant is a CTG. The design, operation, and performance of the AAC power source are addressed in Section 8.4S, “Station Blackout (SBO),” of this SER.

8.2.2 Summary of Application

Section 8.2 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 8.2 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 8.2, the applicant provides the following:

Tier 2 Departure Requiring Prior NRC Approval

- STD DEP 8.3-1 — Plant Medium Voltage Electrical System Design (Table 8.2-1)

This departure addresses the STP departure from the DCD standard design in various areas of the offsite electric power system.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 1.1-2 — Dual Units at STP 3 & 4 (Table 8.2-1)

This departure addresses the applicability of GDC 5 and RG 1.81 to the STP-specific design.

- STD DEP 8.2-1 — Electrical Equipment Numbering (Figure 8.2-1)

In Figure 8.2-1, this departure shows the physical location of major electrical equipment applicable to the STP and the interconnections of power among such equipment.

- STD DEP Admin

The applicant provides editorial changes in FSAR Subsections 8.2.1.1, 8.2.1.2, and 8.2.1.3. The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced DCD (i.e., misspellings, incorrect references, table headings, etc.).

COL License Information Items

- COL License Information Item 8.2 — Periodic Testing of Offsite Equipment

The applicant provides supplemental information in Subsection 8.2.4.1 regarding the development of procedures to periodically test the offsite power systems and components. (COM 8.2-1).

- COL License Information Item 8.3 Procedures When a Reserve or Unit Auxiliary Transformer Is Out of Service

The applicant provides supplemental information in Subsection 8.2.4.2 that indicates the applicability of the TS whenever one of the UATs is inoperable or both of the RATs are inoperable.

- COL License Information Item 8.4 Offsite Power Systems Design Bases

The applicant provides supplemental information in Subsection 8.2.4.3 identifying that the interface requirements in Section 8.2.3 pertaining to offsite power systems have been adopted as the design bases for STP, Units 3 and 4.

- COL License Information Item 8.5 Offsite Power Systems Scope Split

The applicant provides supplemental information in Subsection 8.2.4.4 stating that the interface requirements in Section 8.2.3, which pertain to the offsite power systems scope split, have been adopted as the design bases for STP, Units 3 and 4.

- COL License Information Item 8.6 Capacity of Auxiliary Transformers

The applicant provides supplemental information in Subsection 8.2.4.5 indicating the procedures to assure that the ratings of the UATs and the RATs are not exceeded under any operating mode. (COM 8.2-2).

Supplemental Information

The applicant provides the following supplemental information describing the offsite power system for STP, Units 3 and 4, to address the information requested by RG 1.206. This supplemental information replaces the conceptual design information in Section 8.2.5, "Conceptual Design," of the referenced DCD.

Transmission Lines

In Subsection 8.2.1.2.1, the applicant provides detailed supplemental information regarding the transmission network connecting the STP, Units 3 and 4, to the Electric Reliability Council of Texas (ERCOT) grid. This subsection also includes some design details of the transmission lines and operating experience information with these lines. A general arrangement of the transmission lines is depicted in Figure 8.2-2, "345 kV General Arrangement," including the new 345 kV switchyard for STP, Units 3 and 4, the existing 345 kV switchyard at STP, Units 1 and 2, and the lines connecting the two switchyards. The applicant also includes Figure 8.2-5, "345 kV Transmission Configuration Map," which shows the 345 kV transmission configuration map.

Switchyard Description

In Subsection 8.2.1.2.2, the applicant describes the STP, Units 3 and 4, switchyard arrangement. This subsection includes details pertaining to breaker ratings, switchyard equipment protection, service power to the switchyard, and control power for equipment protection and control. A single-line diagram depicts the STP, Units 3 and 4, switchyard and the switchyard arrangement in Figures 8.2-3, "345 kV Switchyard Single Line Diagram," and 8.2-4, "345 kV Switchyard Arrangement," respectively.

Main Power, Unit Auxiliary and Reserve Auxiliary Transformers

Subsections 8.2.1.2.3 and 8.2.1.2.4 provide details about the main power transformer (MPT), the UATs, and the RATs that provide normal preferred and reserve preferred power to the station.

Failure Modes and Effects Analysis

In Subsection 8.2.2.2, the applicant describes the failure modes and effects analysis pertaining to the offsite power system of STP, Units 3 and 4. The description addresses various switchyard and transmission components, their failure modes, and their impact on the system and the plant.

Grid Analysis

In Subsection 8.2.2.3, the applicant addresses the availability and reliability of the grid system. The discussion describes the studies that were undertaken to ensure the capability of the system to supply the offsite power required for starting, operating, and safely shutting down the plant.

Interface Requirements

In Section 8.2.3, the applicant references various FSAR subsections that describe the STP, Units 3 and 4, interface requirements for the offsite power system.

Conceptual Design

In Section 8.2.5, the applicant references various FSAR subsections that describe the STP, Units 3 and 4, site-specific offsite power system.

8.2.3 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 offsite power system, and associated acceptance criteria, are in Section 8.2 of NUREG–0800.

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 Tier 2 departures. Tier 2 departures affecting TS are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.C.4.

Specifically, the regulatory bases for accepting the Tier 2 departures, the COL license information items, and the supplements are established as follows:

Tier 2 Departures Requiring Prior NRC Approval

Departure STD DEP 8.3-1 affects the TS and is subject to the requirements of GDC 17 and the guidance of RG 1.206.

Tier 2 Departures Not Requiring Prior NRC Approval

Tier 2 departures are subject to the requirements of Section VIII.B.5 of 10 CFR Part 52, Appendix A, which are similar to the requirements in 10 CFR 50.59.

COL License Information Items

- COL License Information Item 8.2 is subject to the requirements of GDC 18, "Inspection and testing of electric power and protection systems," and the guidelines of RG 1.32, Revision 3, and RG 1.118, Revision 3, "Periodic Testing of Electric Power and Protection Systems."
- COL License Information Item 8.3 is subject to the requirements of GDC 17.
- COL License Information Items 8.4 and 8.5 are subject to the guidelines of RG 1.206.
- COL License Information Item 8.6 is subject to the requirements of GDC 17.

Supplemental Information

- Subsection 8.2.1.2.1, "Transmission Network," is subject to the requirements of GDC 17.
- Subsection 8.2.1.2.2, "Switchyard Description," is subject to the requirements of GDC 17.
- Subsections 8.2.1.2.3 and 8.2.1.2.4, "Main Power, Unit Auxiliary and Reserve Auxiliary Transformers," are subject to the requirements of GDC 17.
- Subsection 8.2.2.2, "Failure Modes and Effects Analysis," is subject to the guidelines of RG 1.206.
- Subsection 8.2.2.3, "Grid Analysis," is subject to the requirements of GDC 17 and the guidelines of RG 1.32, RG 1.206, Branch Technical Position (BTP) 8-3 "Stability of Offsite Power Systems," BTP 8-6 "Adequacy of Station Electric Distribution System Voltages,", and 10 CFR 50.65, "Maintenance Rule."
- Section 8.2.3, "Interface Requirements," is subject to the requirements of GDC 17 and the guidance of RG 1.206.
- Section 8.2.5, "Conceptual Design," is subject to the requirements of GDC 17 and the guidance of RG 1.206.

8.2.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Section 8.2 of the certified ABWR DCD. The staff reviewed Section 8.2 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 Requiring Prior NRC Approval

The following Tier 2 departure identified by the applicant in this section require prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this SER. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 2 departure.

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

This departure clarifies that the STP design uses two RATs rather than the one RAT indicated in the ABWR DCD. Additionally, the applicant addresses the interconnection changes resulting from the use of transformers with dual-voltage secondary windings.

In addition, in Subsection 8.2.1.2, the applicant addresses the STP departure from the ABWR DCD regarding the transformers by providing the following details regarding those transformers:

> There are three Unit Auxiliary Transformers (UATs), which are designated the normal preferred offsite source. UATs A and B are rated at 82.5/110 MVA [Mega Volt Ampere] oil natural air natural/oil natural air forced (ONAN/ONAF). UATs A and B each have primary windings at the main generator voltage and two secondary windings, one at 13.8 kV and one at 4.16 kV. UAT C is rated at 22.5/30 MVA (ONAN/ONAF). UAT C has primary winding at the main generator voltage and a single secondary winding at 4.16 kV. All three UATs use automatic tap changers to improve voltage regulation on the plant medium voltage buses. The UATs are designed with significant capacity margin during normal operation because the transformers operate near their ONAN ratings.
>
> UAT A supports 13.8 kV Power Generation (PG) buses A1 and C1 and 4.16 kV PIP bus A2 and Class 1E 4.16 kV bus A3. UAT B supports PG buses B1 and D1 and PIP bus B2 and Class 1E bus B3. UAT C supports PIP bus C2 and Class 1E bus C3.
>
> There are two Reserve Auxiliary Transformers (RATs), either of which can be used as the alternate preferred offsite source. RATs A and B are each rated at approximately 82.5/110 MVA (ONAN/ONAF). RATs A and B each have primary windings at the switchyard voltage and two secondary windings, one at 13.8 kV and one at 4.16 kV. RATs A and B use automatic tap changers to improve voltage regulation on the plant medium voltage buses. The RATs are designed with significant capacity margin during normal operation because the transformers operate near their ONAN ratings. RAT A is designed to be capable

[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.

> of supporting PG buses A1 and C1, which are normally supported by UAT A, via an intermediate 13.8 kV bus designated as CTG 2.
>
> The 4.16 kV winding of RAT A can be aligned to support any of the three PIP buses (A2, B2, and C2) and any of the three Class 1E buses (A3, B3, and C3) and has the capacity to support all three Class 1E buses. RAT A is not normally aligned to support any PG, PIP, or Class 1E bus. RAT B is designed to be capable of supporting PG buses B1 and D1, which are normally supported by UAT B, via an intermediate 13.8 kV bus designated as CTG 1. The 4.16 kV winding of RAT B can be aligned to support any of the three PIP buses and any of the three Class 1E buses and has the capacity to support all three Class 1E buses.

Subsection 8.2.1.2 also includes supplemental information regarding the site-specific offsite power system, in accordance with RG 1.206, and addresses the conformance of the STP design to GDC 17. There is a pictorial description of the offsite system in Figures 8.2-1 through 8.2-6 that includes the transmission network.

The NRC staff reviewed Subsection 8.2.1.2 and the associated figures and determined that FSAR Figure 8.3-1, "Electrical Power Distribution System SLD (Sheets 1- 4)," does not identify the ratings of all bus duct sections. The staff issued RAI 08.02-17 requesting the applicant to specify the bus duct section ratings and to provide the data required to confirm the capability of each section to carry maximum full load currents. In its response to RAI 08.02-17, dated May 18, 2009 (ML091410060), the applicant states that the ratings are not yet known because the detailed design of the plant is still incomplete. Those ratings will be added when the design is complete. Because the analysis of the as-built electric power distribution system (EPDS) will be performed to determine the bus duct ratings, this analysis will be verified as part of the EPDS Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) to ensure that the as-built bus duct has an adequate rating. The staff found the applicant's response acceptable, and this RAI is resolved.

Subsection 8.2.1.2 provides the symmetrical and asymmetrical interrupting ratings of the main generator circuit breaker. The staff's review noted that these values are different from those specified in the DCD. The staff issued RAI 08.02-1 requesting the applicant to identify the maximum fault available from the main generator and main step-up transformers and to provide supporting information showing that the breaker interrupting ratings are consistent with the available fault from the system. In its response to RAI 08.02-1, dated May 18, 2009, the applicant states that based on the IEEE Std C37.013–1997, "Standard for AC High Voltage Generator Circuit Breakers Rated on a Symmetrical Current Basis", methodology and the site-specific impedance values, the maximum fault available from the main generator or from the main step-up transformer is less than the generator circuit breaker capability values identified in the FSAR. The applicant also states that the application of a generator circuit breaker requires vendor-specific considerations that will be addressed during the procurement process. The staff found that the use of the IEEE Std C 37.013–1997 methodology to determine the interrupting capability of the main generator circuit breaker is consistent with the guidance of SRP Section 8.2, Appendix A. The staff therefore found the applicant's response acceptable, and this RAI is resolved.

The staff also observed that the 4.16 kV winding of the RAT could be aligned to support any of the three PIP buses and all three Class 1E buses. Therefore, the staff issued RAI 08.02-2 requesting the applicant to discuss the interlocks provided to prevent the closure of all six breakers and the potential overload of the transformers. Additionally, because the design includes a tie breaker that allows the interconnection of the 13.8 kV windings of the RATs through intermediate buses CTG1 and CTG2, the staff issued RAI 08.02-3 requesting the applicant to discuss the interlocks provided between the main, tie, and feeder breakers to prevent overloading the transformer windings. In its response to RAI 08.02-2 and RAI 08.02-3, dated May 18, 2009, the applicant states that procedures assuring that the ONAF ratings of the UATs or the RATs are not exceeded under any operating mode will be developed before fuel loading to be consistent with the plant operating procedure development plan in Section 13.5, "Plant Procedures." Because an analysis of the as-built EPDS will be performed to determine the ratings of the UATs or the RATs, this analysis will be verified as part of the EPDS ITAAC to ensure that the as-built ratings of the UATs or the RATs are adequate. The staff found the applicant's response acceptable, and this RAI is therefore resolved.

In Subsection 8.2.1.3, the applicant addresses the STP departure from the ABWR DCD regarding separation and provides the following details relating to this area:

> The location of the main power transformer, unit auxiliary transformers, and reserve auxiliary transformers are shown on Figure 8.2-1. The reserve auxiliary transformers are separated from the main power and unit auxiliary transformers by minimum distance of 15.24 meters (m), or by barriers.
>
> Reference is made to Figures 8.3-1 for the single line diagrams showing the method of feeding the loads. The circuits associated with the alternate offsite circuit from the reserve auxiliary transformers to the Class 1E buses are separated by walls or floors, or by at least 15.24 m, from the main and unit auxiliary transformers. The circuits associated with the normal preferred offsite circuit from the unit auxiliary transformers to the Class 1E buses are separated by walls or floors, or by at least 15.24 m, from the reserve auxiliary transformers. Separation of the normal preferred and alternate preferred circuits is accomplished by floors and walls over their routes through the Turbine, Control and Reactor Buildings except within the switchgear rooms where they are routed to opposite ends of the same switchgear lineups. Either reserve auxiliary transformer may be used to satisfy requirements as the alternate preferred power supply. Separation between the two reserve auxiliary transformers is not sufficient to allow each to be considered an independent offsite power supply.

Additionally, the applicant provides a description of the CTG as follows:

> A combustion turbine generator (CTG) supplies standby power to the non-Class 1E buses which supply the non-Class 1E plant investment protection (PIP) loads. It is a 20 MW (minimum) rated self-contained unit which is capable of operation without external auxiliary systems. Although it is located on the site, it is treated as an additional offsite source in that it supplies power to multiple load groups. In addition, manually controlled breakers provide the capability of connecting the combustion turbine generator to any of the Class 1E buses if all other AC power sources are lost. In this way, the CTG provides a second "offsite" power source to any Class 1E bus being fed from the reserve auxiliary transformers while the associated unit auxiliary transformer is out of service.

The staff's review of FSAR Subsection 8.2.1.3 and the associated figures determined that the RATs are separated from the main power and from the UATs by distance or by barriers. Also, the separation between the two RATs is not sufficient to allow each to be considered an independent offsite power supply. As a result of this observation, the staff issued RAI 08.02-4 requesting the applicant to clarify the FSAR statement and to provide additional details regarding the separation provided by the design, including the type and size of the barriers that will be used and how these barriers will meet the separation criteria. In its response to RAI 08.02-4, dated May 18, 2009 (ML091410060), the applicant states that although the detailed design is not complete, a decision was made to maintain a separation between the two RATs and the three UATs either by distance or barriers, and the RATs will be separated from the UATs by a distance of at least 15.24 m (50 feet [ft]). The applicant also states that FSAR Tier 2, Subsection 8.2.1.3 will be revised to remove the statement "…or by barrier." The staff found the response acceptable and noted that FSAR Revision 3 has incorporated this change. This RAI is therefore resolved.

The staff concluded that the departure discussed above is consistent with the requirements of GDC 17 and guidance of RG 1.206 and is therefore acceptable.

Tier 2 Departures Not Requiring Prior NRC Approval

The following Tier 2 departures not requiring prior NRC approval identified by the applicant in this section may also be evaluated in other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by these departures.

- STD DEP 1.1-2 — Dual Units at STP 3 & 4 (Table 8.2-1)

This departure addresses the applicability of GDC 5 and RG 1.81 to the site-specific design. Specifically, the applicant states in Table 8.2-1 that the STP, Units 3 and 4, plant is a dual ABWR plant, but there is no sharing of preferred power supplies between the units. Additionally, Subsection 8.2.2.1 states that:

> STP 3 & 4 is a dual-unit station. STP 3 & 4 receive offsite power from a common 345 kV switchyard through normal and alternate preferred power transmission lines and circuits in accordance with GDC 17. The Failure Modes and Effects Analysis (FMEA) discussed in Section 8.2.2.2 concludes that there are no single failures which can prevent the offsite power system from performing its function to maintain the anticipated operational containment integrity and other vital functions in the event of a postulated accident. The ability to perform an orderly shutdown and cooldown of the other unit in the event of an accident is not significantly impaired and it is concluded that GDC 5 and RG 1.81 are met.

- STD DEP 8.2-1 — Electrical Equipment Numbering (Figure 8.2-1)

In this departure, Figure 8.2-1 shows the physical location of major electrical equipment applicable to the STP and the interconnections of power among the equipment. The departure itself is described in Subsection 8.2.1.3, "Separation." The departure involves the entrance of the alternate preferred power feed into the reactor building from the Division I rather than the Division II side of the building.

The applicant's evaluation, 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 NRC 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.

- STP DEP Admin

The applicant provides editorial changes in FSAR Subsections 8.2.1.1, 8.2.1.2, and 8.2.1.3. In FSAR Subsection 8.2.1.1 the applicant deletes a reference to DCD Section 8.2.5 for conceptual design information. This information has been replaced by supplemental information reviewed accordingly in this SER. In FSAR Subsection 8.2.1.2, the applicant removes a reference to DCD Subsection 8.2.3(10) for interface requirements which no longer exists. In FSAR Subsection 8.2.1.3, the applicant removes references to DCD Subsections 8.2.3 Items (13) and (15) which no longer exist.

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.

COL License Information Items

- COL License Information Item 8.2 Periodic Testing of Offsite Equipment

In Subsection 8.2.4.1, the applicant discusses the maintenance and testing of offsite equipment and provides the following supplemental information:

> Offsite power systems are designed to test periodically: (1) the operability and functional performance of the components of the offsite power systems, such as onsite power sources, relays, switches, circuit breakers, and buses, and (2) the operability of the systems as a whole and, under conditions as close to design as practical, the full operational sequence that brings the systems into operation, including operation of applicable portions of the protection system, and the transfer of power among the nuclear power unit, the offsite power system and the onsite power system. Procedures will be developed prior to fuel load to include periodic testing and/or verification of the following items 1-9. These will be established to be consistent with the requirements of GDC 18 and the plant operating procedure development plan in Section 13.5. (COM 8.2-1).

Regarding the procedures to be developed, the applicant states that the procedures will provide the following:

(1) Verification that the normal offsite power circuit is energized and connected to the appropriate Class 1E distribution system division and that the alternate offsite power circuit is energized at least once every 12 hours.

(2) Maintenance, calibration, and functional testing of the instrumentation, control, and protection systems, equipment, and components associated with the normal and alternate offsite preferred circuits. Calibration of the

instrumentation and the functional tests include tolerances for relays and meters so that minimum operable voltages for offsite power will not be exceeded, based on the design of the system. Functional test will be performed on transformers with load tap equipment, including the controller. The test procedures include expected effects on the distribution system and equipment during the test.

(3) That the required Class 1E and non-Class 1E loads can be powered from their designated preferred power supply within the capacity and capability margins specified in Tier 2 for the offsite system circuits.

(4) Functional testing of undervoltage schemes to detect the loss of the offsite preferred power supply.

(5) Preferred power supplies switching.

(6) Assurance that surveillances for the batteries and chargers meet accepted industry standards for their design load profiles and recharge times.

(7) Maintenance and functional testing of the generator breaker.

(8) Isolated and non-segregated phase bus ducts are inspected and maintained so that they are clear of debris, fluids, and other undesirable materials and that terminals and insulators are also inspected, cleaned, and tightened, as necessary.

(9) Potential and power transformer testing, ground grid testing, arrester testing, and circuit breaker timing tests will be performed periodically in accordance with applicable industry standards or industry accepted practice.

The testing and inspection intervals will be established and maintained according to the guidelines of IEEE-338, Section 6.5, as appropriate for non-Class 1E systems (i.e., Items (4) and (7) of Section 6.5.1 are not applicable), except as specifically noted above.

The NRC staff reviewed the site-specific supplemental information included in FSAR Subsection 8.2.4.1 related to the development of procedures for the periodic testing of the offsite systems and components. The staff issued RAI 08.02-16 requesting the applicant to discuss the type and interval of routine inspections of the offsite system such as (but not limited to) structures, network lines, transformers, circuit breakers, substation equipment, batteries, potential transformers, the ground grid, and lightning arresters. The staff also requested the applicant to discuss the industry standards that will be followed for monitoring, maintaining, and testing the switchyard protection system. In its response to RAI 08.02-16, dated May 18, 2009 (ML091410060), the applicant addresses and provides details pertaining to inspection activities of the switchyard and its components. Additionally, the applicant identifies the standards and guidelines that will be used for maintenance activities. The applicant, however, does not provide any information on battery discharge testing, relay testing, circuit breaker timing testing, potential and power transformer testing, ground grid testing, and arrester testing. Therefore, the staff issued supplemental RAI 08.02-21 requesting the applicant to address these tests along with the periodicity for the tests. In its response to RAI 08.02-21, dated October 29, 2009 (ML093430299), the applicant states that COL FSAR Subsection 8.2.4.1 will be modified to clarify that the testing requirements for the above items will be in accordance with the applicable industry codes and standards and they will be performed at the intervals required by the standards or industry accepted practices. The staff found the proposed FSAR revisions is consistent with the requirements of GDC 18 and the guidelines of RG 1.118 and, are therefore acceptable. RAI 08.02-21 is resolved. The staff confirmed that the proposed FSAR changes are incorporated in the FSAR Revision 4. Therefore, RAIs 08.02-16 and 08.02-21 are closed.

- COL License Information Item 8.3 Procedures When a Reserve or Unit Auxiliary Transformer Is Out of Service

In FSAR Subsection 8.2.4.2, the applicant states that the TS limit plant operations whenever one of the UATs is inoperable or when both of the RATs are inoperable. The STP design differs from the ABWR DCD design in that the STP uses two RATs rather than one RAT. The NRC staff issued RAI 08.02-19 requesting the applicant to explain whether the plant operating procedure will include any restrictions on plant operations when one RAT is out of service. In its response to RAI 08.02-19, dated July 22, 2009 (ML092050077), the applicant clarifies that plant procedures will be provided to assure that the RAT loading does not exceed the transformer ONAN rating, and appropriate plant operating procedures will restrict plant operations when both RATs are out of service. However, plant operations will not be limited when only one RAT is out of service. The staff found the applicant’s response acceptable because two offsite power sources will be available to the safety-related buses when one RAT is inoperable. COL License Information Item 8.3 is consistent with the requirements of GDC 17 and is therefore acceptable. This issue is resolved.

- COL License Information Item 8.4 Offsite Power Systems Design Bases

The NRC staff reviewed the COL license information item in Subsection 8.2.4.3 of the STP, Units 3 and 4, COL FSAR, which pertains to the adoption of the interface requirements in Section 8.2.3 as the design bases for STP, Units 3 and 4, offsite power systems. The applicant provides the ITAAC to address offsite power system interface requirements as the site-specific ITAAC listed in Part 9 of COLA Table 3.0-2, “Offsite Power System,” which are consistent with the recommendations of RG 1.206 and are therefore acceptable.

- COL License Information Item 8.5 Offsite Power Systems Scope Split

The NRC staff reviewed the COL license information item in Subsection 8.2.4.4 of the STP Units 3 and 4, COL FSAR pertaining to the adoption of the interface requirements in Section 8.2.3 as the design bases for the STP Units 3 and 4, offsite power systems scope split. The applicant provides the ITAAC to address offsite power system interface requirements as the site-specific ITAAC listed in Part 9 of COLA Table 3.0-2, which are consistent with the recommendations of RG 1.206 and are hence acceptable.

- COL License Information Item 8.6 Capacity of Auxiliary Transformers

The NRC staff reviewed the COL license information item in Subsection 8.2.4.5 of the STP Units 3 and 4, COL FSAR regarding the commitment to develop procedures to assure that the capacity of the auxiliary transformers is not exceeded under all modes of operation (COM

8.2-2). Because an analysis of as-built EPDS will be performed to determine the ratings of the UATs or the RATs, this analysis will be verified as part of the EPDS ITAAC to ensure that the as-built ratings of the transformers are adequate. COL License Information Item 8.6 is consistent with the requirements of GDC 17 and is therefore acceptable.

Supplemental Information

Transmission Lines

In Subsection 8.2.1.2.1, the applicant provides detailed information regarding the transmission network connecting the STP, Units 3 and 4, to the ERCOT grid. Specifically, the applicant states (in part):

> Six 345 kV transmission circuits rated from 896 MVA to 1793 MVA (Reference 8.2-3) connect the STP 3 & 4 switchyard to the (ERCOT) grid, as shown on Figure 8.2-6. These six 345 kV circuits provide the source of AC power to the 345 kV switchyard. The 345 kV transmission circuits terminate at six points as follows: at Velasco 345 kV Substation (CenterPoint Energy); at Hillje 345 kV Switchyard (CenterPoint Energy); at Elm Creek 345 kV Switchyard (City of Public Service Board of San Antonio (CPS); at White Point 345 kV Substation (AEP Texas Central Company (TCC); at the STP 1 & 2 switchyard via a tie-line with a series reactor (TCC); and at Blessing 345 kV Substation autotransformer (TCC). The Blessing 345 kV autotransformer is connected to the TCC's Blessing 138 kV Substation.
>
> The STP 3 & 4 transmission lines utilize the existing (from STP 1 & 2) corridor and rights-of way for interconnects to the existing transmission grid. The description of the transmission system components for both existing and new structures fully describes and qualifies the use of this system within the present boundaries of the existing corridors.
>
> The 345 kV transmission circuits are routed on rights-of-way as described above except for the distance from the rights-of-way to the STP 3 & 4 switchyard on the STP Electric Generating Station (STPEGS) plant property. In this small section, the 345 kV structures are arranged as depicted in Figure 8.2-2. The location of transmission circuits within this small section has been analyzed and failure of a tower due to failure of an adjacent tower has been determined not to adversely impact plant offsite power supply.

Subsection 8.2.1.2.1 also includes some details of the transmission lines design and information based on experience with these lines. Figure 8.2-2 depicts a general arrangement of the transmission lines, including the new 345 kV switchyard for STP, Units 3 and 4, the existing 345 kV switchyard for STP, Units 1 and 2, and the lines connecting the two switchyards. The applicant also provides Figure 8.2-5, which depicts the 345 kV transmission configuration map.

The NRC staff reviewed FSAR Subsection 8.2.1.2.1 and associated figures pertaining to the design and susceptibility of the transmission lines. As a result of the review, the staff issued three RAIs. RAI 08.02-5 requested the applicant to identify the basic insulation level (BIL) specified for the 345 kV transmission lines, the switchyards, and the substations listed in this subsection and to provide a comparison of the BILs that are utilized for other transmission lines in the general area for existing and proposed 345 kV transmission lines. Additionally, the staff requested the applicant to describe design features such as surge protection devices, grounding, and lightning protection for the switchyard and transmission lines, and to indicate how these systems will be periodically maintained and tested to assure their functionality. In its response to RAI 08.02-5, dated May 18, 2009 (ML091410060), the applicant states that the BIL for the 345 kV substation and equipment, including circuit breakers, is 1,300 kV. Additionally, for each transmission line the applicant provides the minimum critical flash-over (CFO) design of the insulators. This CFO ranges between 1,700 kV and 2,065 kV. Regarding lightning protection, the applicant indicates that the transmission lines use two overhead shield wires grounded at each structure. To protect circuit breakers and other substation equipment, metal oxide varistor surge arresters are installed at each transmission line's entrance to a substation or switchyard. Additionally, the applicant states that the standard design for the surge arresters is the maximum continuous operating voltage of 209 kV, and circuit breakers are tested to withstand a 1,680 kV chopped wave. Regarding grounding, the switchyard will be designed with a buried ground grid, sized according to the maximum available fault current and the soil resistivity. The switchyard will also be designed with an overhead shield wire to dissipate lightning strikes without damaging substation equipment. Transmission service providers (TSPs) have periodic inspection programs for the transmission lines and rights of way to identify any issues that may impact functionality. All transmission lines undergo an aerial inspection at least once per year, and non-wood structures in coastal areas undergo a comprehensive inspection at least once every five years. The 345 kV substations and switchyards undergo a monthly site inspection and walkthrough, as well as an annual predictive maintenance inspection that includes a thermographic inspection. The staff found that the design, inspection, and testing of the switchyard equipment are adequate and will assure that the offsite power system performs its function. This RAI is therefore resolved.

The review of FSAR Figure 8.2-2 indicates that the existing DOW 27 line runs underground between the switchyards for STP, Units 1 and 2, and STP, Units 3 and 4. Because underground cables are susceptible to moisture, the staff issued RAI 08.02-6 requesting the applicant to identify cable design features and/or in situ programs that will be implemented to avoid or arrest the degradation of the cable insulation from the effects of moisture. In its response to RAI 08.02-6, dated May 18, 2009 (ML091410060), the applicant states that the line consists of parallel cross-linked polyethylene cables with metallic (either lead or copper) sheaths installed in duct banks. The applicant also states that because metallic-sheathed cables are designed for continuous submergence, cable degradation from the effects of moisture will be avoided and in situ testing of the cable installation is not necessary.

The staff found the applicant's response acceptable because the DOW 27 line is only one of several transmission lines supporting the STP, Units 3 and 4, switchyard. Also, the cables are reasonably protected against potential moisture in the underground trench, and their failure will not adversely impact equipment important to safety. This RAI is therefore resolved.

In FSAR Table 8.2-3, "Transmission Line Historical Data on Outages Due to Circuit Breaker Actuations STP Units 1 & 2," the applicant identifies the historical failure of the transmission line associated with STP, Units 1 and 2. This table shows that a large majority of failure incidents were either unknown (166) or weather-related (147). The staff issued RAI 08.02-7 requesting the applicant to discuss how these incidents are being used in the design of the new switchyard and transmission lines. In its response to RAI 08.02-7, dated May 18, 2009 (ML091410060), the applicant clarifies that a portion of the 166 unknown and 147 weather-related transmission line incidents were instantaneous circuit breaker trips, where the fault was cleared and the line was brought back into service instantaneously. In the remaining cases, the circuit breaker cleared the fault and was locked out, which required the TSP to bring the line back into service. Table 8.2-3 will be revised to provide a breakdown of the incidents showing whether the breaker had re-closed instantaneously or locked out. The applicant also clarifies that the historical transmission line incidents will not affect the new switchyard's design. The staff confirmed that FSAR Revision 3 incorporates this change.

The staff reviewed revised Table 8.2-3 and noted that of the 525 circuit breaker actuations experienced by the STP, Units 1 and 2, switchyard during a period of 26 years, 269 resulted in circuit breaker lockouts. Of the 269 lockouts, 193 were either related to unknown causes (63) or to weather (94) and insulator flash-over (36). An almost equal amount of events (175) from the same causes resulted in an instantaneous re-closure of the circuit breakers that could have resulted in lockouts. Because these and other events included in the revised table are potentially related to switchyard and line maintenance, the staff is concerned about the reliability of the offsite power system. The staff issued supplemental RAI 08.02-22 requesting the applicant to indicate whether: (1) the events in Table 8.2-3 ever resulted in multiple line failures during the period of observation; (2) multiple line failures have ever occurred when the instantaneous breaker reclosures resulted in breaker lockouts; (3) STP, Units 1 and 2, ever experienced a loss of offsite power or a partial loss-of-offsite power (LOOP); (4) any corrective actions were taken as a result of the events in Table 8.2-3; and (5) a similar reoccurrence was experienced after completing these corrective actions. In its response to RAI 08.02-22, dated November 18, 2009 (ML093270046), the applicant states that STP, Units 1 and 2, have never experienced either a LOOP or a partial loss of offsite power due to a transmission line or switchyard event. Additionally, the transmission companies responsible for the Hill Country and Skyline transmission lines recognized the large number of outages and, in 2004, replaced the circuits' ceramic insulators with polymer insulators. This change resulted in a greatly increased reliability through the remainder of the period of observation. Also, in 2007, an additional substation (Elm Creek) was installed between the STP switchyard and the Hill Country and Skyline substations, which shortened the transmission line length by about 30 miles (48.28 Kilometers (Km)) and reduced its exposure to faults. The staff found the applicant has adequately addressed this issue and RAI 08.02-22 is therefore resolved and closed.

Switchyard Description

Subsection 8.2.1.2.2, provides the following description for the STP, Units 3 and 4, switchyard arrangement:

> The STP 3 & 4 345 kV switchyard is sized and configured to accommodate the output of both units. The location of this switchyard is on the STP site approximately 650 feet north of STP 3 & 4. The switchyard layout and location are shown on Figures 8.2-2, 8.2-4 and 8.2-6. As indicated on Figure 8.2-3, a breaker and-a-half scheme is incorporated in the design of the 345 kV switchyard.

This subsection also includes the following details pertaining to breaker ratings:

> The switchyard bus has a 63 kA fault duty design. Circuit breakers and disconnect switches are sized and designed in accordance with ANSI Standard C37.06 [-1987] "AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and related Required Capabilities" ([DCD] Reference 8.2-1). All circuit breakers are equipped with dual trip coils. The

345 kV circuit breakers in the switchyard are rated according to the following criteria:

- Circuit breaker continuous current ratings are chosen such that no single contingency in the switchyard (e.g., a breaker being out for maintenance) will result in a load exceeding 100 percent of the nameplate continuous current rating of the breaker.

- Interrupting duties are specified such that no fault occurring on the system, operating in steady-state conditions will exceed the breaker's nameplate interrupting capability.

- Momentary ratings are specified such that no fault occurring on the system, operating in steady-state conditions will exceed the breaker's nameplate momentary rating.

- Voltage ratings are specified to be greater than the maximum expected operating voltage.

All 345 kV breakers have a minimum symmetrical interrupting capability of 63,000 amperes. The Onsite Electrical System is designed for a future maximum switchyard short circuit contribution of 37 giga volt ampere (GVA).

Regarding switchyard electrical equipment protection, the applicant states that:

Electrical protection of circuits from the STP 3 & 4 switchyard uses a primary and secondary relaying scheme. The current input for the protective relaying schemes come from separate sets of circuit breaker bushing current transformers. Also, the control power for all primary and secondary relaying schemes is supplied from separate 345 kV switchyard 125 VDC systems. These schemes are used for the following:

- The scheme is used on each of the six 345 kV transmission circuits from the STPEGS 345 kV switchyard to the ERCOT grid. The potential input for the primary and secondary transmission circuit relaying systems is supplied from fused branch circuits originating from a set of coupling capacitor potential devices connected to the associated transmission circuit.

- The switchyard buses use a primary and backup scheme. The zone of protection of each 345 kV bus includes all the 345 kV circuit breakers adjacent to the protected bus.

- Line protection for the main power transformers and reserve auxiliary transformers use primary and backup schemes.

In addition to the above described STP 3 & 4 345 kV switchyard relaying systems, each of the 345 kV circuit breakers has an associated circuit breaker failure relaying system. The primary and secondary relaying systems of the STP 3 & 4 345 kV switchyard are connected to separate trip circuits in each 345 kV circuit breaker.

Lastly, regarding the service power for switchyard and control power for equipment protection and control, the applicant states the following:

- For the two 125 VDC batteries located in the STPEGS 345 kV switchyard control house, each battery has its own battery charger. Each battery charger is connected to separate 480 VAC distribution panel boards also located in the control house. The 345 kV switchyard 125 VDC systems are entirely independent of the unit non-Class 1E and unit Class 1E battery systems.

- The STP 3 & 4 345 kV switchyard 480VAC and 120/240VAC station service system consists of two 4.16 kV/480 VAC load center transformers, a 480 VAC double-ended load center, two 480VAC distribution panel boards, a 480/120-240VAC transformer bank and two 120/240 VAC distribution panel boards. The 4.16kV/480VAC load center transformers are supplied by two 4.16 kV non-Class 1E feeders, one from each unit, and each are provided with a backup power feed from the CTG.

- The control cables for the switchyard breakers are routed through three parallel, independent cable trenches. The two outer trenches carry the primary relaying and control for all breakers. The center trench carries the secondary (or backup) relaying and control for all breakers. Cables are routed from each breaker to the respective trenches in such a fashion as to maintain separation between primary and secondary circuits.

In FSAR Subsection 8.2.1.2.2, the applicant describes the criteria used to specify the continuous current rating, interrupting rating, momentary rating, and voltage rating for the switchyard circuit breakers. However, the applicant provides no values for these ratings. The NRC staff issued RAI 08.02-8 requesting the applicant to provide each rating and to indicate why those ratings are adequate for their particular application. Additionally, the staff requested the applicant to indicate the applicable ratings for the disconnect switches. In its response to RAI 08.02-8, dated May 18, 2009 (ML091410060), the applicant states that the ratings for the circuit breaker and the disconnect switches are based on the interconnection study (Reference 8.2-3, of the COL FSAR Section 8.2) that was performed for the addition of STP, Units 3 and 4, at the STP site. The study conducted both continuous and short-circuit scenarios for various configurations and contingencies. Regarding the requested ratings, the applicant states that the interrupting rating of the circuit breakers is 63,000 amps; the voltage rating is 362 kV; and the momentary rating is 82,000 amps. The continuous ratings of the circuit breakers and disconnect switches are 4,000 amps. The staff found that the continuous rating of 2,424 MVA ($\sqrt{3}$ x 350 x 4,000/1,000) is well above the main generator rating of 1,610 MVA and is therefore acceptable. This RAI is resolved.

FSAR Subsection 8.2.1.2.2, describes the protection provided for the switchyard and its components and indicates that the switchyard uses a primary and secondary relay scheme. For the MPTs and RATs, the protection scheme includes primary and backup protection. The staff issued RAI 08.02-9 requesting the applicant to provide specific details regarding the protection devices and schemes used for the switchyard and its components, including the UATs. Additionally, the staff requested the applicant to indicate whether the protection schemes address lessons learned from the event described in Information Notice 2005-15, “Three-Unit

Trip and Loss of Offsite Power at Palo Verde Nuclear Generating Station." In its response to RAI 08.02-9, dated May 18, 2009 (ML091410060), the applicant provides additional clarifications and states that specific details regarding protective devices are not available, because the detailed design for switchyard protective relaying is not complete. Regarding lessons learned from the Palo Verde event, the applicant clarifies the protection scheme used at the STP site. The applicant states that the offsite power circuit and the switchyard relay scheme use primary and backup protection features. Each circuit breaker is equipped with dual trip coils. Each protection circuit supplying a trip signal is connected to a separate trip coil, and there is a physical separation between the cabling for primary and backup protection circuits.

The 345 kV switchyard breakers use dual trip coils, dual control power, and redundant primary and secondary relay schemes that limit the possibility of an event similar to the Palo Verde event. The staff found the response acceptable, and this issue is resolved.

The staff issued RAI 08.02-10 requesting the applicant to indicate who is responsible for coordinating, setting, monitoring, maintaining, and testing all protective relays for the switchyard and its components. The staff also asked the applicant to discuss the associated review and approval requirements by the STP and/or the grid reliability organization. In its response to RAI 08.02-10, dated May 18, 2009 (ML091410060), the applicant states that because Texas is a deregulated electricity market, an Interconnection Agreement is required between a Generation Owner, a Generation Operator, and the TSPs. The applicant also indicates that an Interconnection Agreement between STP and the TSPs specifies that the TSPs will be responsible for coordinating, setting, monitoring, maintaining, and testing the protective relays for the switchyard and its components. The TSPs will be required to notify STP of all maintenance and testing activities in the switchyard. However, STP approval will be required for any design changes to the switchyard. The staff found the applicant's response acceptable, and RAI 08.02-10 is resolved.

FSAR Subsection 8.2.1.2.2, states that the control cables for the switchyard breakers are routed through three parallel independent cable trenches. The staff issued RAI 08.02-11 requesting the applicant to describe the cable design features and the monitoring program that will be implemented to avoid or arrest the degradation of cable insulation from the effects of moisture. In its response to RAI 08.02-11, dated May 18, 2009 (ML091410060), the applicant states that the switchyard control cables at the STP are routed into a concrete modular trench with drain holes in the bottom and trench covers at grade to facilitate cable installation. The applicant also states that at the STP site, the water table is about 1.83 m (6 ft) below grade and the switchyard elevation is increased by at least a foot above grade to facilitate runoff during heavy rainfalls. Additionally, the trenches will be mounted on 15 to 20 centimeters (cm) (6 to 8 inches in.) of crushed stone with a top layer of 5 to 7.6 cm (2 to 3 in.) of sand to facilitate the leveling of the trench and to further improve the natural drainage of a potential water accumulation in the trench. Lastly, the applicant indicates that the cables used at STP are designed for wet/dry environments and should not be challenged because they will not be continuously submerged. However, this response does not meet the intent of Generic Letter (GL) 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," to describe inspection, testing, and monitoring programs to detect the degradation of inaccessible or underground power cables that support equipment and other systems that are within the scope of 10 CFR 50.65 (the Maintenance Rule). The staff issued RAI 08.02-23 asking the applicant to indicate whether there are any plans to implement a program for testing and inspecting inaccessible or underground power, control, and instrumentation cables; to indicate the frequency of the tests and inspections; or to justify not developing such a program.

In its supplement response to RAI 08.02-23, dated April 1, 2010 (ML100980067), the applicant states that the COL applicant will meet the intent of GL 2007-01, for onsite safety- and nonsafety-related power cables covered by the maintenance rule by monitoring and/or testing cables that are installed below grade and potentially subjected to submergence. The applicant adds that low-voltage power, control, and instrumentation cables are not included in the STP, Unit 3 and 4, monitoring and/or testing programs. The staff found this response inconsistent with the requirements of 10 CFR 50.65(a)(1) which state:

> Each holder of an operating license for a nuclear plant … shall monitor the performance or condition of structures, systems, or components … in a manner sufficient to provide reasonable assurance that such structures, systems, and components … are capable of fulfilling their intended functions.

Additionally, NUREG–0800, Section 8.2, Review Procedures Item 1.L, states, “Operating experience has shown that undetected degradation of underground electric cables … could result in multiple equipment failures. Underground or inaccessible power and control cable runs that are susceptible to protracted exposure to wetted environments or submergence … [should be] reviewed.” Guidance on the selection of electric cable condition monitoring can be found in Sections 3, “Commonly Used Cables CM Techniques,” and 4.5, “Selection of CM Techniques,” of NUREG/CR–7000, “Essential Elements of an Electric Cable Condition Monitoring Program.”

Regarding testing, the applicant states that the testing of power cables (e.g., 13.8 kV, 4.16 kV and 480 V cables) will be performed using dc megger as part of routine preventive and corrective maintenance activities associated with the end device. The staff found the applicant’s response inadequate because the dc megger test alone is not sufficient to identify incipient cable degradation that can lead to a cable failure during plant operations, thereby causing challenges to safety systems and systems important to safety. The megger test is not as sensitive to insulation degradation as are other tests. Electric Power Research Institute (EPRI) studies of cable testing and condition monitoring support the use of other tests in addition to the megger test to detect incipient degradation in cables. Therefore, the staff believes that a combination of megger and other state-of-the-art tests is needed for cable conditions monitoring program. In addition, the staff considers the megger test including the end device an unacceptable method for cable conditions monitoring program, because the test results would be masked by the conditions of the end device insulation rather than revealing the condition of the cable insulation itself.

Regarding monitoring, the applicant adds that monitoring includes inspecting the manholes for water levels above the lowest layer of cable, confirming sump pump functionality and manhole covers are properly sealed, and, if required, seal the manholes to prevent or minimize water ingression. The cables will be tested every five years when the equipment is taken out of service.

Therefore, the staff issued RAI 08.02-24, requesting that the applicant revise its response to RAI 08.02-23, Supplement 1, and provide an appropriate condition monitoring program for detecting incipient degradation in cables based on the industry (EPRI, IEEE and nuclear entities including regulatory bodies) recommended practices or provide justification for supporting its position.

In its revised response to RAI 08.02-24, dated July 15, 2010 (ML102010030), the applicant states that medium voltage power cables, 480 Vac, 120 Vac and 125/250 Volts of direct current

(Vdc) power cables, control cables and instrumentation cables which are underground and which support equipment covered by the maintenance rule are tested and monitored. The applicant adds that FSAR Section 8.3.3, "General Onsite Power System Information," will be revised as follows:

> 8.3.3.2.1S Testing of Power, Control, and Instrumentation cables
>
> Medium voltage power cables, 480 Vac, 120 Vac and 125/250 Vdc power cables, control cables and instrumentation cables which are underground and which support equipment covered by the Maintenance Rule are monitored and the results trended using techniques and at a frequency determined appropriate for the application based on a review of industry best practices.
>
> 8.3.3.9S Monitoring of Manholes
>
> Manholes are provided with high water level alarms. Where appropriate, sump pumps are provided. Additionally, manholes are inspected every year to ensure water levels are below the lowest layer of cables, to confirm sump pump and alarm functionality, and to ensure proper seating of manhole covers. If warranted, manhole covers will be sealed to minimize water ingression.

Based on the above, the staff found that the applicant's condition monitoring program for underground or inaccessible cables satisfies the recommendations of GL 2007-01, and guidance of NUREG/CR–7000 and NUREG–0800, Section 8.2, Review Procedures Item 1.L. Therefore, RAI 08.02-24 is resolved. The staff confirmed that these changes are incorporated in the FSAR Revision 4. Therefore, RAI 08.02-24 is closed.

In its response to RAI 02.03.02-7, dated April 14, 2009 (ML091070289), the applicant states, regarding salt deposition on electrical equipment, that the STP, Unit 4, transformers are considered bounding for electrical equipment and transmission lines because, based on their location, they receive the greatest amount of salt deposition. The applicant further states that the design of the transformer considers the effect of salt deposition. Because operating experience shows that insulator failures will likely occur due to salt deposits, the staff issued RAI 08.02-18, requesting the applicant to discuss the counter measures that will be taken to prevent insulator and bushing failures on offsite power system equipment due to salt deposits. The staff referenced IEEE Std C57.19.100–1995, "IEEE Guide for Application of Power Apparatus Bushings," for counter measures that can be implemented to insure that the salt deposits do not degrade the bushings. In its response to RAI 08.02-18, dated July 22, 2009 (ML092050077), the applicant states that to prevent insulator and bushing failure on offsite power system equipment due to salt deposition, bushings and insulators for offsite power equipment will be designed for heavy contamination areas. The applicant also states that in accordance with IEEE Std C57.19.100–1995, STP will use bushings designed for heavy contamination with a minimum creep distance of 44 mm/kV (1.73 in./kV). STP will provide a permanent coating on ceramic bushings and ceramic insulators for offsite power equipment up to the switchyard. The applicant further states that FSAR Subsection 8.2.1.2 will be revised to include a minimum creep distance of 44 mm/kV (1.73 in./kV) and a permanent coating on ceramic bushings and ceramic insulators. The staff found the applicant's response acceptable, and this issue is resolved. The staff confirmed that these changes are incorporated in the FSAR Revision 4. Therefore, RAIs 08.03.02-7 and 08.02-18 are closed.

Main Power, Unit Auxiliary and Reserve Auxiliary Transformers

Subsections 8.2.1.2.3 and 8.2.1.2.4 provide details about the MPT, the UATs, and the RATs, which provide normal preferred and reserve preferred power to the station. Specifically, the applicant states that:

- The MPT consists of three normally energized single phase transformers with an additional installed spare. Provisions are made to permit connecting and energizing the spare transformer following a failure of one of the normally energized transformers.

- The calculated rated conditions for the MPT(s) are approximately 1612 MVA with a nominal voltage of approximately 26 kV and with taps at 105%, 102.5%, 100%, 97.5%, and 95% of 362.25 kV. The MPTs are each individually rated at approximately 537.5 MVA. MPT and high voltage circuits have sufficient impedance to limit the primary side maximum available fault current contribution from the system to that required by the main generator output circuit breaker.

- The offsite transmission circuits from the transmission network through and including the main step-up power and reserve auxiliary transformers are designed and constructed to withstand the mechanical and thermal stresses from the worst case faults.

- The offsite transmission circuits from the transmission network through and including the main step-up power and reserve auxiliary transformers are sized to supply their load requirements during all design operating modes of their respective Class 1E divisions and non-Class 1E load groups.

- The impedances of the unit auxiliary and reserve auxiliary transformers are compatible with the interrupting capability of the plant's circuit interrupting devices.

- The main step-up power and reserve auxiliary transformers are provided with separate oil collection pits and drains to safe disposal area, and are provided with fire protection deluge systems as specified in Section 9A.4.6.

- Each transformer has primary and backup protective devices. DC power to the primary and backup devices is supplied from separate non-Class 1E DC sources.

The NRC staff reviewed the details regarding the above transformers. The staff observed that FSAR Subsection 8.2.1.2.4, “Unit Auxiliary Transformers,” does not address these transformers. Instead, the subsection appears to be a continuation of Subsection 8.2.1.2.3. Therefore, the staff issued RAI 08.02-12 requesting the applicant to verify the content of the two subsections and to make the appropriate changes. In its response to RAI 08.02-12, dated May 18, 2009 (ML091410060), the applicant states that Subsection 8.2.1.2.4 is a continuation of Subsection 8.2.1.2.3 and the inclusion of the heading “8.2.1.2.4 Unit Auxiliary Transformers” is an error. The applicant will revise Subsection 8.2.1.2.3 and delete the heading. The staff found this revision acceptable and confirmed that FSAR Revision 3 incorporates this change. This RAI is therefore resolved.

Based on the above discussion, the staff found that the information provided by the applicant on the MPTs, UATs, and RATs is consistent with the requirements of GDC 17.

Failure Modes and Effects Analysis

In Subsection 8.2.2.2, the applicant describes the failure modes and effects analysis pertaining to the offsite power system for STP, Units 3 and 4. The description addresses various switchyard and transmission components, their failure modes, and the impact of a failure on the system and on the plant. Specifically, the applicant's evaluation addresses transmission line towers, transmission line conductors, the 345 kV switchyard, circuit breakers, disconnect switches, MPTs, and RATs. The applicant's conclusions regarding each area of review are provided below:

1) Transmission Line Towers

   Failure of any one tower due to structural failure can at most disrupt and cause a loss of power distribution to only those circuits on the tower. The spacing of the towers between adjacent power circuits is designed to account for the collapse of any one tower. Therefore, one of the preferred sources of power remains available for this failure mode in order to maintain the containment integrity and other vital functions in the event of a postulated accident(s).

2) Transmission Line Conductors

   Failure of a line conductor would cause the loss of one preferred source of power but not more than one. Therefore, a minimum of one preferred sources of power remains available for this failure mode in order to maintain the containment integrity and other vital functions in the event of a postulated accident(s).

3) 345 kV Switchyard

   Regarding the switchyard, the applicant states (in part):

   - Equipment continuous current ratings are chosen such that no single contingency in the switchyard can result in current exceeding 100 percent of the continuous current rating of the equipment.

   - Interrupting duties are specified such that no faults occurring on the system exceed the equipment rating.

   - Momentary ratings are specified such that no fault occurring on the system exceeds the equipment momentary rating

- Voltage ratings are specified to be greater than the maximum expected operating voltage.

- The breaker-and-a-half switchyard arrangement allows that any faulted transmission line into the switchyard can be isolated without affecting any other transmission line and that either bus can be isolated without interruption of any transmission line or other bus.

- A primary and secondary relaying system is included on each of the six 345 kV transmission circuits from the STP 3 & 4 345 kV switchyard to the ERCOT grid. All breakers are equipped with dual trip coils and each protection circuit which supplies a trip signal is connected to a separate trip coil.

- Instrumentation and control circuits of the main power offsite circuit are separated from the instrumentation and control circuits for the reserve power circuit.

- Spurious relay operation within the switchyard that trips associated protection system will not impact any primary or backup system.

Therefore, a minimum of one preferred source of power remains available for this failure mode.

4) Circuit Breakers

Regarding the circuit breakers, the applicant states:

- Circuit breaker continuous current ratings are chosen such that no single contingency in the switchyard will result in a load exceeding 100 percent of the nameplate continuous current rating of the breaker.

- Interrupting duties are specified such that no fault occurring on the system will exceed the breaker's nameplate interrupting capability.

- Any circuit breaker can be isolated for maintenance or inspection without interruption of any transmission line or bus.

- A fault in a tie breaker or failure of the breaker to trip for a line or generator fault results only in the loss of its two adjacent circuits.

- A fault in a bus side breaker or failure of the breaker to trip for a line or generator fault results only in the loss of the adjacent circuits and the adjacent bus.

5) Disconnect Switches

All 345 kV disconnect switches have a momentary rating higher than the available short circuit level. A failure of the disconnect switch results only in the loss of its two adjacent circuits. Therefore, a minimum of one preferred source of power remains available for this failure mode.

6) Main Power Transformers

A primary and secondary relay system precludes any failure interruption of power to the plant as a result of a lost or damaged MPT(s). Failure of any MPT will require a transfer of power to the standby RATs. Each RAT has a rating equal to or greater than that of a UAT and the capability to supply all Engineered Safety Feature buses in a Unit.

7) Reserve Auxiliary Transformers

Failure of any transformer will result in a manual transfer of the sources of power for the 13.8kV plant generation buses, plant investment protection buses and ESF buses and will be initiated by the operator from the control room.

Based on the above reviews, the applicant concludes that there are no single failures that can prevent the offsite power system from performing its function. The NRC staff's evaluation of the applicant's failure modes and effects analysis found that the scope and method of the reviews are consistent with the guidance of RG 1.206. The staff also found the applicant's reviews and conclusions reasonable.

The staff reviewed the applicant's failure modes, effects analysis, and conclusions. The staff accepted the applicant's determination that there are no single failures that can prevent the STP offsite power system from performing its function to provide power to STP, Units 3 and 4.

Grid Analysis and Availability

In Subsection 8.2.2.3, the applicant addresses the availability and reliability of the grid system. The applicant describes the studies that were undertaken to ensure the capability of the system to supply the offsite power required for starting, operating, and safely shutting down the plant. Specifically, the applicant indicates that:

1) An interconnection study was performed by the transmission companies for steady state short circuit and stability analysis. These steady state analyses, demonstrate that the loss of any double-circuit 345 kV transmission line, the loss of any two 345 kV transmission circuits, or the loss of all circuits on any single independent right-of-way do not endanger the supply of offsite power required for starting, operation, and safe shutdown of STP Units 3 and 4.

2) Additionally, a short circuit analysis performed as part of the interconnection study determined that the calculated maximum short circuit level at the STP Unit 3 and 4 switchyard is less than the equipment short circuit criteria rating.

3) Stability studies were undertaken to evaluate the dynamic stability performance of both the proposed expansion and the existing STP power plants during transmission disturbances. The simulation results indicate stable operation of the existing STP Units 1 and 2 and STP Units 3 and 4 for all second level transmission line contingency conditions. Additionally that the stability of the grid is fully maintained when considering the loss of the largest generation source, STP Units 3 and 4, based on the interconnection study.

The applicant also states that ERCOT uses a real-time contingency analysis to determine the condition of the grid for a multitude of single contingencies. During periods of instability or when the analyzed switchyard voltages are lower than the allowed limit, the transmission operator will notify STP, Units 3 and 4.

Regarding grid availability, ERCOT conducts joint studies by testing the adequacy of the bulk power system. The studies include steady-state load flow, transient stability, and loss-of-load probability (generation planning). The load flow and transient stability cases are designed to test the ERCOT bulk power planning criteria for reliability. The results of these studies and the outage data demonstrate that offsite power for a safe shutdown of the electrical system is highly reliable, and no improvement in the line outage rate is experienced.

Regarding the grid analysis, in FSAR Subsection 8.2.2.2.3, the applicant indicates that the evaluation performed under various line outages shows that a stable operation exists for all STP units under all second-level transmission line contingency conditions. The NRC staff, however, observed that the applicant's evaluation does not appear to address the simultaneous loss of multiple units. Therefore, the staff issued RAI 08.02-13 requesting the applicant to address the impact of such events on the ability of the offsite power system to supply power to the safety loads for STP, Units 3 and 4. In its response to RAI 08.02-13, dated May 18, 2009 (ML091410060), the applicant states that as part of the interconnection study performed for the addition of STP, Units 3 and 4, at the STP site (Reference 8.2-3, COLA Part 2, Tier 2, FSAR Section 8.2), a simultaneous loss of both STP, Units 3 and 4, was analyzed. Subsection 8.2.2.3 addresses the loss of both units and the stability of the ERCOT grid. The applicant also states that STP, Units 3 and 4, will have five transmission lines with an additional 345 kV transmission line between the STP, Units 3 and 4, switchyard and the STP, Units 1 and 2, switchyard. Because each remote transmission line terminates at a switchyard with multiple transmission lines, the design allows for alternate power flow paths if an STP transmission line should trip. The staff found the response acceptable, and this RAI is resolved and closed.

Regarding the grid availability study, the staff issued RAI 08.02-14 requesting the applicant to discuss whether the study addresses load increases during the next five to ten years, whether maximum winter and/or summer loads are appropriately accounted for, and the frequency for updating the study. In its response to RAI 08.02-14, dated May 18, 2009 (ML091410060), the applicant clarifies that the grid availability study discussed in FSAR Subsection 8.2.2.3 addresses the 2012 (five-year) generation dispatches provided by ERCOT. This study uses ERCOT's 2012 summer loading cases. The applicant also indicates that the Interconnection Agreement between STP and the TSPs will require the TSPs to provide STP with an annual voltage study of the STP, Units 3 and 4, substation. This study will analyze grid stability and voltage for every year up to five years out from when the study is completed. The subject study will use the summer peak load conditions in order to determine the expected lowest grid voltage. The staff found the applicant's response acceptable, and this RAI is resolved and closed.

The staff's review of the applicant's discussions regarding grid analysis resulted in generating RAI 08.02-15. In this RAI the staff requested the applicant to discuss: (1) the responsibilities of the Independent System Operator (ISO) and the STP organizations to assure the switchyard and transmission system operation and maintenance; (2) communication protocols between STP Plant Operations and the ISO regarding switchyard and plant-related events; (3) the extent to which maintenance and modifications to the switchyard and substation will be reviewed, controlled, and approved through the STP process (i.e., 10 CFR 50.65); (4) the communication that will be established between the plant and grid operators regarding grid reliability evaluations before performing "grid-risk-sensitive" maintenance activities which could increase risk under existing or imminent degraded grid reliability conditions; and (5) the controls and alarm/indication for switchyard components that are available in the STP, Units 3 and 4, control rooms.

In its to RAI 08.02-15, dated May 18, 2009 (ML091410060), the applicant states that agreements will be put in place to establish the interfaces between the grid operators and STP operations and that ERCOT uses protocols, operating guides, and procedures for operation of the ERCOT grid which will support the offsite power requirements for STP. Additionally, the applicant states that the STP will have a formal interconnection agreement with the TSP which will require notification to STP before and during maintenance activities and before removing transmission lines from service and for STP to review and concur with proposed changes to the switchyard. The staff, however, observed that the applicant's response failed to address communication between STP and TSP regarding risk-sensitive plant maintenance activities, such as removal of an EDG from service. Therefore, the staff generated supplemental RAI 08.02-20 requesting that the applicant address this area of communication. Additionally, the staff requested that the applicant discuss whether a quantitative or qualitative grid reliability evaluation will be performed at STP, Units 3 and 4, as part of the maintenance risk assessment required by 10 CFR 50.65(a)(4) before performing grid-risk-sensitive maintenance activities in the switchyard.

In its response to RAI 08.02-20, dated October 29, 2009 (ML093430299), the applicant provides clarifications indicating that the communication protocols between STP and TSP adequately address risk-sensitive plant maintenance. Regarding grid reliability evaluations as part of grid risk-sensitive maintenance activities in the switchyard, the applicant states that the evaluations required by the maintenance risk assessment regulations —10 CFR 50.65(a)(4)— are performed consistent with the guidance provided by Nuclear Energy Institute 07–02, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52," Revision 3 (ML072700564). The applicant refers to the STP, Units 1 and 2, response to Items 5 and 6 of GL 2006-02, "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power," dated March 30, 2006 (ML060940432). In the STP, Units 1 and 2, response to NRC Question 5A, the applicant indicated that the evaluations would be quantitative. The staff found that the applicant's response is consistent with the requirements of 10 CFR 50.65(a)(4) and the guidance of RG 1.182. Therefore, RAI 08.02-20 is closed.

Interface Requirements

In Section 8.2.3, the applicant addresses interface requirements and states:

The following site specific supplements address the interface requirements for this subsection. STP 3 & 4 Offsite Power System meets the design bases as referenced below:

1) For a description of independent offsite transmission circuits, refer to Subsection 8.2.1.2.

2) For voltage variations of the offsite transmission network during steady state operation, refer to Subsection 8.2.1.2.1.

3) For normal steady state frequency of the offsite transmission network, refer to Subsection 8.2.1.2.1.

4) For sizing of the offsite transmission circuits from the transmission network through and including the main step-up power and reserve auxiliary transformers, refer to Subsections 8.2.1.2, 8.2.1.2.1, 8.2.1.2.2 and 8.2.1.2.3.

5) For the impedance of the main step-up power, and reserve auxiliary transformers and the interrupting capability of the plant's circuit interrupting devices, refer to Subsections 8.2.1.2.3.

6) For independence of offsite transmission power, instrumentation, and control circuits and their compatibility with the portion of the offsite transmission power, instrumentation, and control circuits within the ABWR Standard Plant scope, refer to Subsections 8.2.1.2, 8.2.1.2.1, 8.2.1.2.2 and 8.2.2.2.2.3 and Figure 8.2-1.

7) For compatibility of instrumentation and control system loads with the capacity and capability design requirements of DC systems within the ABWR Standard Plant scope, refer to Subsections 8.2.1.2, 8.2.1.2.2 and 8.3.2.

The staff reviewed Section 8.2.3 of the STP, Units 3 and 4, COL FSAR pertaining to the adoption of the interface requirements as design bases for the STP, Units 3 and 4, offsite power systems. The applicant provided ITAAC to address offsite power system interface requirements as site-specific ITAAC listed in Part 9 of COLA Table 3.0-2, which is consistent with the requirements of GDC 17 and the recommendations of RG 1.206 and, hence, acceptable.

Conceptual Design

In Section 8.2.5, the applicant states the following:

> The conceptual design information in this section is replaced with the following site-specific supplement.
>
> For the site-specific design of the STP Units 3 and 4 offsite power system, refer to Subsections 8.2.1.2 and 8.2.1.3 and Section 8.2.3.

The NRC staff reviewed the referenced subsections. The staff found that the applicant has adequately addressed the conceptual design. The staff's discussion of particular aspects of the conceptual design is in the evaluation of Subsections 8.2.1.2 and 8.2.1.3 and Section 8.2.3.

8.2.5 Post Combined License Activities

The applicant identifies the following commitments:

- Commitment (COM 8.2-1) – Develop procedures for the periodic testing of offsite power system equipment.
- Commitment (COM 8.2-2) – Develop procedures to assure that the as-built ratings of the unit auxiliary or RAT are not exceeded under all modes of operation.
- Site-specific ITAAC (Table 3.0-2) closure – Provide the details of Interface requirements for the portions of the electrical power distribution system that are not part of the certified design for the NRC staff to review.

8.2.6 Conclusion

The NRC staff's finding related to information incorporated by reference is in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information related to offsite power 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), "Finality of standard design certifications," and 10 CFR Part 52, Appendix A, Section VI.B.1, all nuclear safety issues relating to the offsite power 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 8.2 of NUREG-0800. The staff's review concluded that the applicant has adequately addressed the Tier 2 departure requiring NRC approval, the COL license information items, and the supplemental information in accordance with Section 8.2 of NUREG–0800 and 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.

8.2S NRC Bulletin 2012-01: Design Vulnerability in Electric Power System

8.2S.1 Introduction

On July 27, 2012, the NRC staff issued Bulletin (BL) 2012-01, "Design Vulnerability in Electric Power System," (ML12074A115) to all holders of operating licenses and combined licenses for nuclear power reactors; except those who have permanently ceased operation and have certified that the fuel has been removed from the reactor vessel. BL 2012-01 requested information about the facilities' electric power system designs in light of a recent operating experience that involved the loss of one of the three phases of the offsite power circuit (single-phase open circuit condition) at Byron Station, Unit 2. The staff is assessing the information provided in response to BL 2012-01 to verify compliance with applicable regulations and to determine whether further regulatory action is warranted.

This section provides the staff's evaluation of the design information in the STP, Units 3 and 4, application that addresses the vulnerability identified in BL 2012-01 to ensure that the STP, Units 3 and 4, application is in compliance with the requirements specified in GDC 17 and 10 CFR 50.55a(h)(3). Bulletin 2012-01 is discussed in Sections 8.2.1 and 8.3.1 of the STP, Units 3 and 4, FSAR.

8.2S.2 Summary of Application

The applicant provided supplemental information to evaluate the postulated loss of one or more of the three phases of the offsite power circuit at STP, Units 3 and 4. The staff requested information regarding the STP electric power system design in RAI 08.02-25 dated November 5, 2012 (ML12307A265); and RAI 08.02-26 dated November 21, 2013 (ML13325A905); which requested the applicant to address the design vulnerability identified in BL 2012-01 for STP, Units 3 and 4, in accordance with GDC 17 and 10 CFR 50.55a(h)(3). The applicant responded to RAI 08.02-25 and RAI 08.02-26 in several responses (see Section 8.2S.4 of this SER). The latest response dated July 24, 2014 (ML14210A054), included proposed revisions to FSAR Subsections 8.2.1.2.4 and 8.3.1.

The staff's evaluation of Departure STD DEP 8.3-1, "Plant Medium Voltage Electrical System Design," as it pertains to the selection of 4.16 kV as the voltage level for the safety-related buses, is in Sections 8.2 and 8.3 of this SER.

8.2S.3 Regulatory Basis

The following regulatory requirements provide the regulatory basis for the staff's review. These requirements encompass the components that will detect and generate an alarm at the onset of a loss of a phase event on the high side of the transformer (STP FSAR Subsection 8.2.1.2.4) and the components that will respond to the loss of a phase event.

- 10 CFR Part 50, Appendix A, GDC 17, as it relates to the preferred power system (i.e., the offsite electrical power system): (1) capacity and capability to permit functioning of SSCs important to safety; (2) provisions to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit or loss of power from the onsite electric power supplies; (3) physical independence; and (4) availability.

- 10 CFR 50.55a(h)(3), on the design criteria for protection systems.

The staff's review of the application's compliance with these requirements was informed by BL 2012-01, on the loss of one or more of the three phases of the offsite power circuit.

8.2S.4 Technical Evaluation

This section provides the staff's evaluation of the applicant's response to RAI 08.02-25 and RAI 08.02-26 dated July 24, 2014, as it relates to the design vulnerability identified in BL 2012-01.

GDC 17 requires that "…[a]n onsite electric power system and an offsite electric power system shall be provided to permit functioning of structures, systems, and components important to safety. The safety function for each system (assuming the other system is not functioning) shall be to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents." 10 CFR 50.55a(h)(3) states, among other things, that design certification and COL applications under 10 CFR Part 52 that are filed on or after May 13, 1999, must meet the requirements for safety systems in IEEE Std 603–1991 and in the correction sheet dated January 30, 1995.[1] Therefore, the STP electric power system (both the offsite and onsite ac and dc power systems) must meet the above requirements and address the design vulnerability identified in BL 2012-01, so as to permit the functioning of SSCs important to safety. The staff determined that at the onset of a loss of one or more phases, the active reactor designs should provide the following:

1. The detection of an offsite power system open phase circuit condition, both with and without a high-impedance ground fault condition on the high voltage side of the MPT under all loading and operating configurations.

2. Alarm in the Main Control Room (MCR).

3. A mitigation/response to the event.

These three elements would satisfy the design requirements needed to address this issue. In addition, implementation would be adequately addressed by providing an ITAAC to verify that the detection/alarm scheme is working properly. Also, the TS should provide surveillance requirements (SRs) for the mitigation scheme. Furthermore, the procedures and the training for the detection/alarm/mitigation scheme should provide assurance that the electrical power system will address the loss of one or more of the three phases of the offsite power circuit during the life of the plant. These steps would ensure that with adequate capacity and capability, the ac power would be available to safety-related equipment to meet the intended safety functions in accordance with GDC 17 requirements.

The staff issued RAI 08.02-25 and RAI 08.02-26 to verify that the COL applicant had addressed the design vulnerability identified in BL 2012-01, in accordance with GDC 17 and 10 CFR 50.55a(h)(3). The applicant responded to these RAIs in several submittals dated January 3, 2013 (ML13008A237); September 4, 2013 (ML13256A154); May 15, 2014 (ML14142A377); June 25, 2014 (ML14181A028); and July 24, 2014 (ML14210A054). In its responses to RAI 08.02-25 and RAI 08.02-26, dated May 15, 2014 (ML14142A377); and July 24, 2014 (ML14210A504); the applicant proposed to change COL FSAR Subsections 8.2.1.2.4 and 8.3.1, which outline the applicant's approach to resolving the open phase condition issue identified in BL 2012-01. On June 2, 2014, the staff performed an audit to verify that the May 15, 2014, responses to these RAIs were supported by the analysis and by other documentation developed by the COL applicant. The staff's findings were documented in the "Final Audit Report, Analysis and Calculations in Support of the Resolution of Bulletin 2012-01" dated August 29, 2014 (ML14220A349). On June 17 – 18, 2014, the staff performed an audit to verify that the May 15, 2014, responses to these RAIs were supported by the risk assessment and by other documentation developed by the COL applicant. The staff's findings were documented in the "Final Audit Report, Open Phase Risk Analysis in Support of the Resolution of Bulletin 2012-01" dated August 13, 2014 (ML14217A053).

[1] Although the ABWR was certified in 1997, the STP applicant took a departure to use IEEE Std 603–1991 and the correction sheet dated January 30, 1995.

In RAI 08.02-25, the staff asked the applicant to provide information regarding the protection scheme design for safety-related buses to detect and automatically respond to a single-phase open circuit condition or high-impedance ground fault condition on credited offsite power circuits. The staff also asked the applicant to clarify whether the safety buses and/or buses important to safety were powered from offsite power sources and to describe the plant's operating procedures, including off-normal operating procedures that specifically call for verification of the voltages on all three phases of the Class 1E buses.

The staff evaluated several submittals from the applicant in response to this RAI. In its response dated July 24, 2014 (ML14210A054), the applicant described the open phase protection approach for STP, Units 3 and 4. The applicant stated that the overall protection scheme for open phase conditions includes the detection of and alarm for open phases on the high voltage side of the MPT and the two RATs (RAT-A and RAT-B), in addition to the automatic protective actuation of a negative sequence voltage on any of the three Class 1E 4.16 kV buses.

To address the detection of and alarm for open phases on the high voltage side of the MPT and RATs, the applicant proposed the following markup to STP FSAR Subsection 8.2.1.2.4, "Monitoring of Main Power and Reserve Auxiliary Transformers":

> NRC Bulletin 2012-01 discusses the possibility that an open phase condition, with or without accompanying ground faults, located on the high-voltage side of a transformer connecting a GDC 17 offsite power circuit to the plant electrical system could, result in a degraded condition in the onsite power system (see Reference 8.2-7). To address this issue, protection of the Class 1E busses is provided as described in Subsection 8.3.1, and monitoring of the normal and alternate preferred power supply feeds through the MPT and RATs is provided as described below.
>
> All three phases of the MPT and RATs are monitored by specific transformer relays for open phase, and ground faults in any combination of one or more phases. The specific relays initiate alarms in the Main Control Room when an open phase or ground fault is detected. If required, operators will complete manual actions to address the alarms. Testing of the monitoring system is performed per Subsection 8.2.4.1 of this chapter to verify proper functionality.
>
> Maintenance and testing procedures, including calibration and troubleshooting procedures, associated with the monitoring system are in accordance with Subsection 13.5. Control room operator and maintenance technician training associated with the operation and maintenance of the monitoring system is in accordance Subsection 13.2.

The staff finds that the applicant's detection scheme for open phase conditions is acceptable because all three phases of the MPT and the RATs are monitored for open phases and ground faults. Furthermore, alarms in the MCR alert operators to an open phase condition, which the staff finds acceptable because this meets the staff's position on active reactor designs for open phase circuit conditions, as described above.

The automatic protective actuation of a negative sequence voltage on any of the three Class 1E 4.16 kV buses involves the opening of the breakers to these buses that then creates an undervoltage (UV) condition. The UV signal will start the EDGs before any of the Class 1E loads experience degraded conditions exceeding those for which the equipment is qualified.

To address the automatic protective actuation of a negative sequence voltage on any of the three Class 1E 4.16 kV buses, the applicant proposed the following markup to STP FSAR Section 8.3.1, "AC Power Systems":

> NRC Bulletin 2012-01 discusses the possibility that an open phase condition, with or without accompanying ground faults, located on the high-voltage side of a transformer connecting a GDC 17 offsite power circuit to the plant electrical system could, result in a degraded condition in the onsite power system (see Reference 8.2-7). To address this issue, monitoring of the normal and alternate preferred power supply feeds through the MPT and RATs is provided as described in Subsection 8.2.1.2.4 and the Class 1E busses are provided with negative sequence voltage relays to ensure that the motors on the 1E busses are not subjected to unbalanced currents and voltages as described below.
>
> Each of the Divisional Class 1E 4.16kV busses, has 3 negative sequence voltage relays configured such that a two-out-of-three trip state will initiate circuitry for transferring power from the offsite power supply to the onsite diesel generator after a time delay. Each negative sequence relay monitors all three bus phases using the bus instrument potential transformers. Should negative sequence voltage that would adversely affect the motors be present on a 4.16kV bus, the two-out-of-three logic will automatically actuate (see Subsection (10) of 8.3.1.1.7.).

Furthermore, in FSAR Subsection 8.3.1.1.6.3, "Bus Protection," the applicant adds the negative sequence voltage protection to the bus protection mechanisms for STP, Units 3 and 4:

> Bus protection is as follows:
>
> (1) Medium voltage bus incoming circuits have inverse time over-current, ground fault, bus differential, under-voltage, *and negative sequence voltage protection*. (emphasis added to identify new language).

Also, in FSAR Subsection 8.3.1.1.7, "Load Shedding and Sequencing on Class 1E Busses," the applicant provided the following description of the "Negative Sequence Voltage Protection:"

> (10) Negative Sequence Voltage — For protection of the Division I, II and III electrical equipment against the effects of an unbalanced power supply, the Class 1E 4.16 kV divisional busses are monitored for negative sequence voltage. If the bus negative sequence voltage increases to the setpoint, and after a time delay (to prevent triggering by transients), the respective feeder breakers trip open. The opening of the feeder breakers de-energizes the bus causing the undervoltage relays to actuate. The actuation of the undervoltage relays results in a start signal being sent to the diesel generator before any of the Class 1E loads experience degraded conditions exceeding those for which the equipment is qualified. The expected nominal setpoint is 4.5% (design limit is 5%) and the expected nominal time delay is 2.5 seconds (design limit is 3 seconds). Final setpoints are determined in accordance with the Setpoint

> Control Program. The time delay setting is defined to provide appropriate motor protection. This assures such loads will restart when the diesel generator assumes the degraded bus and sequences its loads. If the bus voltage recovers within the time delay period, the protective timer will automatically reset. Should a LOCA occur during the time delay, the feeder breaker with the negative sequence voltage will be tripped instantly. Subsequent bus transfer will be as described above. The negative sequence voltage relay output circuitry is separate from the output circuitry for the degraded grid and undervoltage relays in each of the Class 1E 4.16kV switchgear. At the feeder breakers, the contacts for the negative sequence, degraded voltage, and undervoltage are connected in parallel to the trip coils of each feeder breaker.

The applicant stated that the expected nominal negative sequence voltage setpoint is 4.5 percent (with a design limit of 5 percent), and the expected nominal time delay is 2.5 seconds (with a design limit of 3 seconds). The time delay is selected to be both short enough to ensure that motors do not trip on overcurrent should a running motor stall or tries to start, and long enough to prevent inadvertent actuations due to normal bus disturbances. If the negative sequence voltage remains above the expected nominal setpoint on 2 out of 3 sensors for 2.5 seconds, actuation occurs. These expected values are nominal and were selected based on industry practices similar to those used in developing the UV relay setpoints. In determining the instrument uncertainty, the square root of the sum of the squares statistical method was used to combine the errors on each device. The applicant also stated that once the final design is complete and the negative sequence relays are procured, the final setpoint calculation for these relays will be performed in accordance with the previously approved methodology for STP, Units 3 and 4, which is the Setpoint Calculation Methodology (see Section 16.5 of this SER) that will be controlled by the Setpoint Control Program. Before the initial fuel loading, a reconciliation of this setpoint study—which includes the setpoints for the negative sequence relays—against the final design for the plant will be performed as required by the ABWR ITAAC (Section 3.4, "Instrumentation and Control;" Item 13 of Table 3.4, "Instrumentation and Control," ABWR DCD, Revision 4). The staff finds this acceptable because the nominal negative sequence relay setpoints can identify open phase circuit conditions and can actuate to protect the loads on the Class 1E buses, as shown in the simulations and analyses documented in the RAI 08.02-25 response dated July 24, 2014. Furthermore, the staff also finds this response acceptable because the applicant will finalize the setpoint values, which will be verified according to the ABWR ITAAC.

In regard to the power source of the safety buses, in its response to RAI 08.02-25, dated July 24, 2014, the applicant noted that the Class 1E 4.16 kV safety buses at STP, Units 3 and 4, are normally powered by offsite power sources during at-power conditions. The applicant also stated that two of the Class 1E 4.16 kV buses are supplied with power from the main generator through the UATs. The third Class 1E 4.16 kV bus is supplied from RAT-B; RAT-A is normally unloaded and in a standby mode. The applicant also clarified that an open phase detection and alarm system is provided for all three transformers (MPT, RAT-A, and RAT-B) that are connected to the offsite grid. The applicant has thus provided: (1) the detection of an offsite power system in an open phase circuit condition, with and without a high-impedance ground fault condition on the high voltage side of the MPT and RATs under all loading and operating configurations; and (2) an alarm for an open phase condition in the MCR. The staff finds this response acceptable because it meets the staff's position on active reactor designs for open phase circuit conditions, as it pertains to the detection and alarm components in the BL 2012-01.

In its response to RAI 08.02-25, dated July 24, 2014, the applicant also addressed the plant's operating procedures. This response included off-normal operating procedures that specifically call for verification of the voltages in all three phases of the Class 1E safety buses. As referenced in FSAR Subsection 8.2.1.2.4, the applicant stated that the control room operator and maintenance technician training associated with the operation and maintenance of the monitoring system will be developed in accordance with FSAR Subsection 13.2, "Training." The applicant further stated that the maintenance and testing procedures, including calibration and troubleshooting procedures, associated with the monitoring system will be developed in accordance with FSAR Subsection 13.5, "Plant Procedures." The staff finds this response acceptable because training will be developed for the operation and maintenance of the monitoring system to detect an offsite power system open phase circuit condition. Furthermore, the maintenance and testing procedures to be developed for the monitoring system will include calibration and troubleshooting procedures to ensure that the monitoring system functions as expected.

The applicant has thus: (1) provided information on the protection scheme design for safety-related buses to detect, generate an alarm for, and automatically respond to a single-phase open circuit condition or a high-impedance ground fault condition on credited offsite power circuits; (2) clarified whether the safety buses and/or buses important to safety were powered from offsite power sources; and (3) addressed the plant's operating procedures, including off-normal operating procedures that specifically call for verification of the voltages on all three phases of the Class 1E safety buses. The staff therefore finds that the applicant has addressed GDC 17 as it pertains to the provisions for minimizing the probability of losing electric power to the safety-related buses. The staff confirmed that the proposed FSAR changes are incorporated into FSAR Revision 11. Therefore, RAI 08.02-25 is resolved and closed.

To clarify the revised response to RAI 08.02-25, dated September 4, 2013 (ML13256A154), the staff issued RAI 08.02-26, requesting that the applicant's technical solution address the design vulnerability described in BL 2012-01. The staff evaluated several submittals from the applicant in response to RAI 08.02-26. The staff's evaluation below is based on the applicant's latest response dated July 24, 2014 (ML14210A054).

The applicant initially stated that in the scenario where a single-phase open circuit event was on the grid side of the MPT, the feed from the MPT and from each UAT does not affect the safety-related or nonsafety-related loads. Item 1 in RAI 08.02-26, requested the applicant to provide an analysis showing that none of the safety-related or nonsafety-related loads will exceed their current ratings and cause physical damage to motor windings or other inductive elements. Specifically, RAI 08.02-26 asked the applicant to: (1) provide an analysis showing that none of the safety-related or nonsafety-related loads will exceed their current ratings and cause physical damage to motor windings and other inductive elements; (2) clarify how the phase angle change, as well as the presence of negative sequence currents, will be detected to preclude damage on inductive loads; (3) provide an evaluation and an analysis showing that sensitive instrumentation and control and protection circuits dependent on ac power quality are not adversely impacted by an unbalanced power system; and (4) provide supporting documentation from equipment vendors validating the capability of their equipment to function with current and voltage variations addressed in the above first three items.

After several RAI response submittals, the applicant agreed to provide a solution to address the design vulnerability described in BL 2012-01 and not rely on the increased capacity of the MPT. By revising the design to include negative sequence relays, the applicant obviated the concerns expressed in Parts 3 and 4 of RAI 08.02-26 because they were premised on the absence of a negative sequence relay. In its response to RAI 08.02-26, dated July 24, 2014, the applicant stated that negative sequence voltage relays on each Class 1E 4.16 kV bus will actuate in the presence of an unbalanced voltage if the relay setpoint and time delay are exceeded. The setpoint and time delay of the Class 1E negative sequence voltage relays are specifically designed to preclude damage to motor windings and other inductive elements. The applicant has thus addressed the staff's concern described in BL 2012-01 in regard to the provision of a technical solution that would prevent the safety-related or nonsafety-related loads from exceeding their current ratings, which would cause physical damage to motor windings and other inductive elements. The staff therefore finds that RAI 08.02-26, Item 1, Parts 1 and 2 are resolved.

Also, the staff conducted an audit on June 2, 2014, which is documented in the "Final Audit Report, Analysis and Calculations in Support of the Resolution of Bulletin 2012-01" dated August 29, 2014 (ML14220A349). During the audit, the staff observed several at-power scenarios and offline scenario simulations performed by the applicant using the Electrical Transient Analysis Program. These simulations were performed to demonstrate that the negative sequence voltage relays will protect the Class 1E 4.16 kV buses and thus ensure their availability in all plant modes. In summary, for the at-power scenarios with the generator online, an open phase on the high side of the MPT or a RAT that is feeding a Class 1E 4.16 kV bus will result in an actuation of the negative sequence voltage relays on the bus that is being fed; and a transfer of the bus or buses to the EDG. For scenarios where the generator is offline and is backfeeding offsite via the MPT, an open phase on the high side of the MPT will not result in an actuation because the negative sequence voltages on all three Class 1E 4.16 kV buses remain less than the setpoint. The detection and alarm scheme will thus indicate to the operators that an open phase condition exists, and the operators will follow the procedures to disconnect the faulted power source from the plant's distribution system. Following this manual action, the safety bus will be transferred to another power source. If the open phase occurs on RAT-A or RAT-B while feeding a Class 1E 4.16 kV bus, actuation will occur on the Class 1E 4.16 kV bus. The Class 1E 4.16 kV buses fed by the MPT are not significantly affected. The staff finds this acceptable because the loss of one or more phases results in the actuation of the negative sequence relay on the 4.16 kV buses, which thus protect the safety equipment by separating it from the power source with the open phase. In addition, the staff finds the applicant's design acceptable because in the case where an open phase condition exists but does not result in an actuation of the negative sequence relay, the detection and alarm scheme provides an indication of the open phase condition. The operators then follow the procedures to disconnect from the power source with the open phase. Therefore Item 1 of RAI 08.02-26 is resolved.

Item 2 in RAI 08.02-26, requested the applicant to provide a technical solution that would detect the phase angle and the unbalanced currents on the secondary side of the transformer. The RAI specifically asked the applicant to: (a) provide a means of detecting a loss of phase given the assumptions stated in the applicant's initial design solution to BL 2012-01, because the degraded voltage relays will be incapable of detecting the loss of phase as a function of the phase angle; (b) provide an ITAAC that demonstrates with testing the selected means of protection that will actuate and withstand the higher currents during a loss of phase condition; (c) provide a TS SR that will provide assurance that protective measures for a loss of phase condition are reliable and functional and are able to preclude damage to safety-related equipment; and (d) provide details on any tests that will be performed on the plant's electrical system to validate the analytical results for a loss of phase on the high voltage side of transformers and the successful operation of a worst case plant loading for an extended duration without adverse effects.

After several discussions and RAI response submittals, and based on the applicant's latest response dated July 24, 2014, the applicant agreed to provide a solution to address the design vulnerability described in BL 2012-01. As described above, the solution would detect the loss of phase as a function of the phase angle. Therefore, Part a of Item 2 in RAI 08.02-26 is resolved.

In regard to Part b of Item 2 in RAI 08.02-26, the applicant provided an ITAAC to verify the functionality of the detection and alarm components installed on the high side of the MPT. The staff did not request an additional ITAAC for the automatic actuation components residing on the safety-related bus, because there is an ITAAC to reconcile the setpoint analysis against the final design for the plant that includes the setpoints for the negative sequence relays—as described above. In addition, SRs have been placed in the TS to address this feature (SR 3.3.1.4.1; SR 3.3.1.4.2; SR 3.3.1.4.3; SR 3.3.1.4.4; SR 3.3.1.4.5; and SR 3.3.1.4.6). The ITAAC that will verify the functionality of the detection and alarm components installed on the high side of the MPT will be located in STP FSAR Tier 1, Table 3.0-29, "Detection and Protection of Open Phase Events on the Main Power and Reserve Auxiliary Transformers." The design commitment of the first ITAAC includes verifying the continuous monitoring of the power feeds on the high voltage side of the MPT and RATs during an open phase (a) with no transformer high-side ground, (b) with a transformer high-side ground between the open phase and the transformer, or (c) with two transformer high-side open phases (simultaneously). The design commitment of the second ITAAC includes verifying that the monitoring system provides a MCR alarm during an open phase (a) with no transformer high-side ground, (b) with a transformer high-side ground between the open phase and the transformer, or (c) with two transformer high-side open phases (simultaneously). The inspections, tests, and analyses include a test of the as-built monitoring system using simulated signals to demonstrate that at the designated relay setpoints, the MPT and RATs generate an alarm in the MCR. The acceptance criteria are satisfied when using simulated signals at the designated relay setpoints in any combination of the three phases, the as-built MPT and RATs initiate an alarm in the MCR. The staff concludes that the applicant has included an ITAAC to verify that the detection and alarm components installed on the high side of the MPT will function as designed, and that this addresses the detection and alarm guidance in BL 2012-01. Thus, the staff finds that Part b of Item 2 in RAI 08.02-26 is resolved.

In regard to Part c of Item 2 in RAI 08.02-26, the applicant provided TS SRs and the protective measures for a loss of phase condition. In its response to RAI 08.02-26, dated July 24, 2014, the applicant proposed modifying the ESF actuation instrumentation system in order to add a new instrumentation function to monitor the three Class 1E 4.16 kV buses for a negative sequence voltage. This function will isolate from the offsite power any bus that exceeds the negative sequence voltage setpoint for a specified time period (i.e., the time delay has elapsed). This isolation will result in an automatic transfer to the bus's EDG on the UV signal. The Class 1E negative sequence voltage relays on the Class 1E 4.16 kV buses will be used to protect safety-related motor loads from heat damage resulting from a voltage imbalance and the resulting negative sequence currents. In its response o RAI 08.02-26, dated July 24, 2014, (ML14210A054), the applicant also proposed additions to the limiting condition of operation (LCO) and bases for plant-specific TS (PTS) 3.3.1.4 as supplemental information.

Chapter 16, “Technical Specifications,” of this SER include these added TS requirements to address the design vulnerability identified in BL 2012-01. These TS requirements are evaluated in Subsection 16.4.6.4, “3.3.1.4 ESF Actuation Instrumentation,” of this SER. In summary, the evaluation in Subsection 16.4.6.4 concludes that the actuation settings and time delay for the negative sequence voltage function will be established and maintained in accordance with the Setpoint Control Program specifications. The revised PTS 3.3.1.4 and bases are acceptable as they pertain to the protective measures for a loss of phase condition. The staff confirmed that the proposed FSAR changes are incorporated into FSAR Revision 11. Therefore, Part c of Item 2 in RAI 08.02-26 is resolved.

In regard to Part d of Item 2 in RAI 08.02-26, in its response to RAI 08.02-26, dated July 24, 2014, the applicant stated that because the STP, Units 3 and 4, design will include an open phase detection and control room alarm scheme and an automatic protective actuation for unbalanced voltages on the Class 1E 4.16 kV buses, there will be no extended duration of operation with an open phase condition. The staff finds that the applicant’s solution to the design vulnerability described in BL 2012-01 is acceptable. The vulnerability involves the detection and alarm design on the high side of the MPT, as well as the automatic actuation on the safety-related bus that would preclude an extended duration of an open phase condition. Therefore, Part d of Item 2 in RAI 08.02-26 is resolved.

Item 3 in RAI 08.02-26 requested the applicant to provide the applicant’s and/or the grid operator's evaluation to show that the availability and reliability of the offsite power system (in both capacity and capability) are maintained, in accordance with transmission system protocols and GDC 17 requirements, if no plant design changes are planned to automatically detect and isolate the open phase condition (degraded offsite power sources) and transfer the important-to-safety buses to alternate power sources. After several discussions and RAI response submittals, the applicant agreed to provide a solution to address the design vulnerability described in the BL 2012-01 involving the detection and alarm components on the high side of the MPT; as well as the automatic actuation on the safety-related bus. As discussed above, the staff evaluated the design vulnerability solution and found it acceptable. Therefore, Item 3 in RAI 08.02-26 is resolved.

Item 4 in RAI 08.02-26 requested the applicant to provide sufficient analyses in FSAR Sections 8.2 and 8.3 and in the ITAAC information (COLA Part 9 in Section 3.0, “Site-Specific ITAAC”) in accordance with 10 CFR 52.79, “Contents of applications; technical information in final safety analysis report;” 10 CFR 52.80, “Contents of applications; additional technical information;” 10 CFR 50.55a(h)(3), and 10 CFR Part 50, Appendix A, GDC 17, regarding the offsite power circuit and onsite electrical power distribution system to provide adequate capacity and capability in view of the design vulnerability identified in BL 2012-01. The staff requested the applicant to include, at a minimum, design and analyses and ITAAC information to automatically detect and take protective actions against a single-phase open phase condition, both with and without a high-impedance ground condition on the high voltage side of a transformer connecting the credited GDC 17 offsite power circuits to the transmission system (high voltage side of the MPT and RATs). In its response to RAI 08.02-26, dated July 24, 2014 (ML14210A054), the applicant agreed to provide a solution to address the design vulnerability described in BL 2012-01—which involves the detection and alarm components on the high side of the MPT—as well as the automatic actuation on the safety-related bus. The applicant provided this solution, including FSAR markups, as part of the RAI response. The staff evaluated this information, as discussed above, and found it acceptable. Therefore, Item 4 in RAI 08.02-26 is resolved.

Item 5 in RAI 08.02-26 requested the applicant to provide a license condition to reflect the applicant's previous statement in regard to an evaluation of the Nuclear Strategic Issues Advisory Committee (NSIAC) initiatives to ensure that the STP, Units 3 and 4, design and procedures remain consistent with industry-accepted practices. The staff also requested the applicant to provide TS in terms of the LCO and SRs. In its response to RAI 08.02-26, dated July 24, 2014, the applicant stated that STP, Units 3 and 4, will continue to follow the development of industry guidance for open phase conditions. But because of the additional detection, alarm, protective actuation, and TS information—in addition to an ITAAC in response to BL 2012-01 for open phase conditions—the applicant does not believe that a license condition is warranted. Since the applicant has elected to provide a solution to the design vulnerability in BL 2012-01 as evaluated above, and the staff has deemed that the solution is adequate, the staff does not require a license condition to adopt the NSIAC's solution. Therefore, Item 5 in RAI 08.02-26 is resolved.

Item 6 in RAI 08.02-26 requested the applicant to address the Forsmark Operating Experience regarding the loss of the two phases both with and without a high-impedance ground condition, on the high voltage side of a transformer connecting the credited GDC 17 offsite power circuits to the transmission high voltage side of the MPT and RATs. In its response to RAI 08.02-26, dated July 24, 2014, the applicant stated that the open phase detection and alarm design will be capable of detecting and alarming one or more open phases on the high voltage side of the MPT and both RATs with or without a high-impedance ground condition. The applicant also stated that the negative sequence voltage relays on each Class 1E 4.16 kV bus would be capable of providing their protective functions based on the negative sequence voltages detected on the buses. The applicant considered the scenario for the loss of two phases in the development of the detection, alarm, and automatic actuation protective scheme, which complies with the design criteria for protection systems in 10 CFR 50.55a(h)(3). Therefore, the staff finds the applicant's response acceptable, and Item 6 of RAI 08.02-26 is resolved.

Based on the information discussed above, the staff finds that the STP, Units 3 and 4, design complies with the requirements set forth in GDC 17 for the offsite power and onsite electrical power systems and adequately addresses the situation described in BL 2012-01. The offsite circuits are monitored and alarmed in the MCR to detect open phase conditions. In addition, the negative sequence voltage relays protect safety-related equipment in the Class 1E 4.16 kV divisional buses against the effects of an unbalanced power supply by opening the feeder breaker. This will result in a UV signal that will start the EDG before any of the Class 1E loads experience degraded conditions exceeding those for which the equipment is qualified. The applicant has provided an adequate monitoring, alarm, and detection system for an open phase condition that satisfies the concerns of the staff. The staff confirmed that the proposed FSAR changes are incorporated into FSAR Revision 11. Therefore, RAI 08.02-26 is resolved and closed.

As set forth above, the staff reviewed the technical solution that provides the features for monitoring, alarming, and automatically protecting safety-related equipment in the Class 1E 4.16 kV divisional buses against the effects of an unbalanced power supply. Based on the information discussed above, the staff concludes that the STP, Units 3 and 4, design meets the requirements in GDC 17 as it relates to the offsite electrical power system regarding: (1) the capacity and capability to permit the functioning of SSCs important to safety; (2) provisions to minimize the probability of losing electric power from any of the remaining supplies, as a result of or coincident with the loss of power generated by the nuclear power unit or a loss of power from the onsite electric power supplies; (3) physical independence; and (4) availability. The staff also finds that the STP, Units 3 and 4, design satisfies 10 CFR 50.55a(h)(3), as it pertains to the design criteria for protection systems; and as it adequately addresses the issued identified in BL 2012-01 related to the loss of one or more of the three phases of the offsite power circuit.

Consideration of Risk

In its response to RAI 08.02-25 and RAI 08.02-26, dated May 15, 2014 (ML14142A377), the applicant provided a probabilistic risk assessment (PRA) to determine the conditional core damage probability (CCDP) and core damage frequency (CDF) for an open phase condition described in BL 2012-01. The applicant based the assessment on the PRA model described in FSAR Chapter 19, "Response to Severe Accident Policy Statement." The assessment referenced a report that documented an open phase risk analysis. The response described three cases considered in the risk analysis document, including the CCDP and CDF results of the analysis. In addition, the response listed the key design features that contributed to the low risk results. The response concluded that adding the negative sequence relays has a very low impact on the plant's base PRA.

The staff audited the referenced risk analysis on June 17 – 18, 2014, to gain a better understanding of the analysis underlying the RAI response and to confirm the staff's understanding of the response. The staff provided the COL applicant with a list of areas that were not addressed in the risk analysis, which were documented in the audit report dated August 13, 2014 (ML14217A047). The staff proposed the following two options to the COL applicant to resolve the staff's questions related to the risk analysis discussed in RAI 08.02-25 and RAI 08.02-26, which are relative to the proposed design for mitigating a loss of phase condition. These options are: (1) to continue addressing the staff's detailed questions on the risk assessment report, or (2) to revise the applicant's submittal to provide a qualitative discussion of the risks associated with the proposed design.

In its response to RAI 08.02-25 and RAI 08.02-26, dated July 24, 2014 (ML14210A054), the applicant provided a detailed qualitative evaluation that discussed the frequency of an open phase condition; how the plant would respond during such a condition; and the mitigating systems that would remain available during an open phase condition. The applicant also discussed the impact of installing the negative sequence relays by providing information supporting the anticipated high reliability of the relays and how the applicant will maintain the high reliability of the relays. The applicant further stated that the negative sequence voltage relays will be procured as Class 1E devices and are included in the TS, the Design-Reliability Assurance Program (D-RAP), and the Maintenance Rule Program to ensure that the relays will remain reliable throughout the life of the plant. Furthermore, the applicant concluded that the addition of the negative sequence relays would not significantly impact plant risk.

The qualitative discussion of risk in the applicant's response dated July 24, 2014, is summarized as follows. The STP, Units 3 and 4, TS require two qualified offsite circuits between the offsite transmission network and the onsite Class 1E distribution system to be operable at all times, with one of the two sources required to be the MPT. The third Class 1E 4.16 kV bus is normally supplied by the RAT-B. RAT-A is connected to the offsite grid in a standby mode and can be readily aligned from the MCR to supply all three of the Class 1E 4.16 kV buses. If an open phase condition were to occur on the MPT, and the Division I and II Class 1E 4.16 kV bus motors were damaged, the Division III Class 1E 4.16 kV bus supplied by RAT- B and the reactor core isolation cooling (RCIC) system would be unaffected. In this scenario, core cooling could be provided by RCIC; the high-pressure core flooder (HPCF) system; or the residual heat removal (RHR) low-pressure [core] flooder (LPFL) mode system. If the open phase occurred on RAT-B, Divisions I and II, the RCIC would be unaffected. In this scenario, core cooling could be provided by HPCF; two trains of RHR (LPFL mode); or the RCIC system. The STP, Units 3 and 4, design also includes a CTG that can supply any two of the three Class 1E 4.16 kV buses. Furthermore, the ac-independent water addition system would be available to provide core cooling even if all three of the Class 1E 4.16 kV buses were lost. The RHR or the passive containment vent called the containment overpressure protection system assures that containment cooling and containment pressure control are maintained.

Based on the applicant's responses to RAI 08.02-25 and RAI 08.02-26 and on the applicant's qualitative discussion of the risks, the staff finds that the addition of the negative sequence relays to the STP, Units 3 and 4, design does not change the results or insights of the ABWR DCD PRA for the following reasons:

1. The applicant showed that the relays are included in the TS and in programs such as the D-RAP and the Maintenance Rule Program, which provides reasonable assurance that the relays will perform with high reliability;

2. Even if the relays fail to perform properly such that two of three Class 1E 4.16 kV buses suffer damage, the plant design includes multiple redundant and diverse means of achieving core cooling that would remain available and capable of performing this safety function.

8.2S.5 Post Combined License Activities

The applicant identifies the following ITAAC:

- Demonstrate satisfactory compliance with acceptance criteria in ITAAC Table 3.0-29, "Detection and Protection of Open Phase Events on the Main Power and Reserve Auxiliary Transformers," for the open phase detection and alarm components installed on the high side of the MPT.

8.2S.6 Conclusion

The staff reviewed the applicant's responses to the NRC's request for information addressing the design vulnerability identified in NRC BL 2012-01. The staff's review confirmed that the applicant has adequately addressed the required information relating to BL 2012-01, and no outstanding information is expected to be addressed in the COL FSAR related to this section.

The staff finds that the technical solution described above is appropriate to assure that the application adequately addresses the issue identified in BL 2012-01 regarding the postulated loss of one or more of the three phases of the offsite power circuit, and accordingly meets the requirements specified in GDC 17 and 10 CFR 50.55a(h)(3).

8.3 <u>Onsite Power Systems</u>

8.3.1 AC Power System

8.3.1.1 *Introduction*

This section of the FSAR provides descriptions, analyses, and referenced documents that include electrical single-line diagrams; electrical schematics; logic diagrams; tables; and physical arrangement drawings for the onsite ac power systems. The onsite ac power systems include those standby power sources, distribution systems, and auxiliary support systems that supply power to safety-related equipment or equipment important to safety for all normal operating and accident conditions.

The nonsafety-related portions are described only in sufficient detail to permit an understanding of their interactions with the safety-related portions. The nonsafety-related equipment discussed in this subsection is the reactor internal pump (RIP) motor-generator (MG) set in Section 9.5.10, "Motor-Generator Set," of the COL FSAR.

8.3.1.2 *Summary of Application*

Section 8.3.1 and Section 9.5.10 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Section 8.3.1 and Section 9.5.10 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Sections 8.3.1 and 9.5.10, the applicant provides the following:

<u>Tier 1 Departures</u>

- STD DEP T1 2.4-2 — Feedwater Line Break Mitigation (Figure 8.3-1)

This departure provides supplemental information on the addition of medium voltage, safety-related circuit breakers for the FWLB mitigation.

- STD DEP T1 2.12-2 — I&C Power Divisions

This departure identifies the addition of the fourth division of the safety-related 120 Vac instrument power system.

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

This departure eliminates the need for the flammability control system. The effect of this departure is noted in FSAR Table 8.3-1, "D/G Load Table—LOCA + LOPP"; Table 8.3-3, "Notes for Tables 8.3-1 and 8.3-2"; and Table 8.3-4, "D/G Load Sequence Diagram Major Loads."

<u>Tier 2 Departures Requiring Prior NRC Approval</u>

The following Tier 2 departures affect TS.

- STD DEP 6.2-2 — Containment Analysis

This departure updates the containment analysis for the ABWR DCD, as it relates to the design of the condensate pump trip circuit. This departure is evaluated in Chapter 6 of this SER.

- STD DEP 8.3-1 Plant Medium Voltage Electrical System Design (Figure 8.3-1)

This departure addresses the STP onsite ac electrical system design as it relates to the UATs, the RATs, EDG and CTG rating, the voltage level of Class 1E and non-Class 1E medium voltage buses, load shedding and load sequencing of Class 1E buses, and the arrangement of Class 1E equipment.

- STD DEP 8.3-3 Electrical Site Specific Power and Other Changes

The implementation of STD DEP 8.3-1 resulted in site-specific changes to accommodate a new arrangement of the electrical loads. The changes include a EDG and CTG sizing, as referenced in FSAR Table 8.3-1 and Figure 8.3-1.

Tier 2 Departures Not Requiring Prior NRC Approval

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

This departure addresses the applicability of GDC 5 and RG 1.81 to the STP-specific design.

- STD DEP 9.5-1 Diesel Generator Jacket Cooling Water System

This departure pertains to the deletion of RG 1.108 from the list of RGs used at the STP.

- STD DEP 9.5-3 System Description - Reactor Internal Pump Motor-Generator Sets

This departure modifies a description of the electrical system design relating to the MG Sets and the interfaces between these and the RIPs.

- STD DEP 10.2-1 Turbine Design (Figure 8.3-1)

This departure identifies the plant-specific electric power system design, as shown in FSAR Figure 8.3-1.

- STD DEP Admin

The applicant provides editorial changes in FSAR Subsections 8.3.1.1.5 and 8.3.1.1.8. The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced DCD (i.e., misspellings, incorrect references, table headings, etc.).

COL License Information Items

- COL License Information Item 8.8 Diesel Generator Design Details

The applicant provides supplemental information to address COL License Information Item 8.8. The applicant commits (COM 8.3-1) to prepare EDGs procurement documents that will identify their performance requirements and to the development of procedures that will demonstrate their performance capability, in accordance with RG 1.9.

- COL License Information Item 8.10 Protective Devices for Electrical Penetration Assemblies

The applicant provides supplemental information to address COL License Information Item 8.10. The applicant commits (COM 8.3-2) to develop procedures that will demonstrate the functional capability of the electrical penetration assembly protective devices.

- COL License Information Item 8.15 Offsite Power Supply Arrangement

The applicant provides supplemental information to address COL License Information Item 8.15. The applicant commits (COM 8.3-3) to develop procedures that will specify the offsite power supply arrangement during normal operations.

- COL License Information Item 8.19 Load Testing of Class 1E Switchgear and Motor Control Centers

The applicant provides supplemental information to address COL License Information Item 8.19. The applicant commits (COM 8.3-4) to develop methods that will assure the availability of adequate voltage at the Class 1E loads.

- COL License Information Item 8.20 Administrative Controls for Bus Grounding Circuit Devices

The applicant provides supplemental information to address COL License Information Item 8.20. The applicant commits (COM 8.3-5) to develop operating procedures to assure that bus grounding circuit devices are appropriately controlled.

- COL License Information Item 8.21 Administrative Controls for Manual Interconnections

The applicant provides supplemental information to address COL License information Item 8.21. The applicant commits (COM 8.3-6) to develop procedures that will prevent the paralleling of redundant onsite Class 1E power supplies.

- COL License Information Item 8.23 Common Industrial Standards Referenced in Purchase Specifications

The applicant provides supplemental information to address COL License Information Item 8.23. The applicant commits to include appropriate industry standards in the purchase documents of Class 1E and non-Class 1E equipment.

- COL License Information Item 8.25 Control of Access to Class 1E Power Equipment

The applicant provides supplemental information to address COL License Information Item 8.25. The applicant commits (COM 8.3-8) to develop procedures for access control to Class 1E equipment.

- COL License Information Item 8.26 Periodic Testing of Voltage Protection Equipment

The applicant provides supplemental information to address COL License Information Item 8.26. The applicant commits (COM 8.3-9) to develop procedures in accordance with RG 1.118 for the periodic testing of voltage protection and control equipment.

- COL License Information Item 8.27 Diesel Generator Parallel Test Mode

The applicant provides supplemental information to address COL License Information Item 8.27. The applicant commits (COM 8.3-10) to develop test procedures that verify the return of the EDGs to their standby position in the event of a LOCA or the loss of preferred power (LOPP), while they are connected to the utility power system.

- COL License Information Item 8.28 Periodic Testing of Diesel Generator Protective Relaying

The applicant provides supplemental information to address COL License Information Item 8.28. The applicant commits (COM 8.3-11) to prepare procedures for the periodic testing of EDG protective relaying, in accordance with RG 1.9.

- COL License Information Item 8.29 Periodic Testing of Diesel Generator Synchronizing Interlocks

The applicant provides supplemental information to address COL License Information Item 8.29. The applicant commits (COM 8.3-12) to develop procedures for the periodic testing of the EDG synchronizing interlocks, in accordance with RG 1.9.

- COL License Information Item 8.30 Periodic Testing of Thermal Overloads and Bypass Circuitry

The applicant provides supplemental information to address COL License Information Item 8.30. The applicant commits (COM 8.3-13) to develop procedures for the periodic testing of thermal overloads and bypass circuitry for Class 1E motor operated valves (MOVs), in accordance with RG 1.106, Revision 1, “Thermal Overload Protection for Electric Motors on Motor-Operated Valves.”

- COL License Information Item 8.31 Periodic Inspection/Testing of Lighting Systems

The applicant provides supplemental information to address COL License Information Item 8.31. The applicant commits (COM 8.3-14) to prepare procedures for the periodic inspection and testing of the lighting system in safety-related areas.

- COL License Information Item 8.32 Controls for Limiting Potential Hazards into Cable Chases

The applicant provides supplemental information to address COL License Information Item 8.32. The applicant commits (COM 8.3-15) to develop procedures to control and limit the introduction of potential hazards into cable chases.

- COL License Information Item 8.33 Periodic Testing of Class 1E Equipment Protective Relaying

The applicant provides supplemental information to address COL License Information Item 8.33. The applicant commits (COM 8.3-16) to prepare procedures for the periodic testing of protective relays and overloads associated with Class 1E motor and switchgear equipment.

- COL License Information Item 8.34 Periodic Testing of CVCF Power Supplies and electrical protection assemblies (EPAs)

The applicant provides supplemental information to address COL License Information Item 8.34. The applicant commits (COM 8.3-17) to develop procedures for the periodic testing of constant voltage, constant frequency (CVCF) power supplies and EPAs.

- COL License Information Item 8.35 Periodic Testing of Class 1E Circuit Breakers

The applicant provides supplemental information to address COL License Information Item 8.35. The applicant commits (COM 8.3-18) to prepare procedures for the periodic calibration and functional testing of the fault interrupting capability of Class 1E circuit breakers.

- COL License Information Item 8.36 Periodic Testing of Electrical Systems and Equipment

The applicant provides supplemental information to address COL License Information Item 8.36. The applicant commits (COM 8.3-19) to develop procedures for the periodic testing of Class 1E electrical systems and equipment.

- COL License Information Item 8.40 Periodic Testing of Class 1E CVCF Power Supplies

The applicant provides supplemental information to address COL License Information Item 8.40. The applicant commits (COM 8.3-22) to develop test procedures to assure that CVCF power supplies have sufficient capacity to supply power to their connected loads.

- COL License Information Item 8.42 Periodic Testing of Class 1E Diesel Generators

The applicant provides supplemental information to address COL License Information Item 8.42. The applicant commits (COM 8.3-24) to prepare procedures for the periodic testing of EDGs to demonstrate their capability to supply the actual full design-basis load current for each load sequence step.

- COL License Information Item 9.25 Diesel Generator Requirements

The applicant provides supplemental information to address COL License Information Item 9.25. The applicant commits (COM 9.5-8) to develop periodic test procedures related to light loading requirements of EDGs.

8.3.1.3 *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 onsite ac power, and associated acceptance criteria, are in Section 8.3.1 of NUREG–0800.

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 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 affecting TS require prior NRC approval and are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.C.4.

In addition to the guidance in Section 8.3.1 of NUREG–0800, the regulatory bases for accepting Tier 1 and Tier 2 departures, COL license information items, and supplements are established as follows:

Tier 1 Departures

- Departure STD DEP T1 2.4-2 is subject to the guidelines of RG 1.75.
- Departure STD DEP T1 2.12-2 is subject to the requirements of GDC 17 and the guidelines of RG 1.75 and RG 1.32.
- Departure STD DEP T1 2.14-1 is subject to the guidelines of RG 1.9.

Tier 2 Departures Requiring Prior NRC Approval

- Departure STD DEP 8.3-1 (Figure 8.3-1) is subject to the requirements of GDC 17 and 10 CFR 50.63, "Loss of All Alternating Current Power," and the guidelines of RG 1.32 and RG 1.155, "Station Blackout."
- Departure STD DEP 8.3-3 (Table 8.3-1, Table 8.3-3, Figure 8.3-1, and Figure 8.3-2) is subject to the requirements of GDC 17 and the guidelines of RG 1.32; RG 1.9, and RG 1.75.

Tier 2 Departures Not Requiring Prior NRC Approval

Tier 2 departures are subject to the requirements of Section VIII.B.5 of 10 CFR Part 52, Appendix A which are similar to the requirements in 10 CFR 50.59.

COL License Information Items

- COL License Information Item 8.8 is subject to the guidelines of RG 1.32 and RG 1.9.
- COL License Information Item 8.10 is subject to the guidelines of RG 1.32 and RG 1.63, Revision 3, "Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants."
- COL License Information Item 8.15 is subject to the requirements of GDC 17.
- COL License Information Item 8.19 is subject to the guidelines of BTP 8-6.
- COL License Information Items 8.20 and 8.21 are subject to the guidelines of SRP Section 13.5.1, "Administration Procedures."
- COL License Information Item 8.23 is subject to the guidelines of SRP Sections 8.3.1 and 8.3.2.
- COL License Information Item 8.25 is subject to the guidelines of RG 1.75.
- COL License Information Items 8.26, 8.31, 8.33 through 8.36, and 8.40 are subject to the guidelines of RG 1.118.

- COL License Information Item 8.30 is subject to the guidelines of RG 1.106.

- COL License Information Item 8.32 is subject to the guidelines of RG 1.39, Revision 2, "Housekeeping Requirements for Water-Cooled Nuclear Power Plants," and RG 1.189, Revision 1, "Fire Protection for Nuclear Power Plants."

- COL License Information Items 8.27 through 8.29, 8.42, and 9.25 are subject to the guidelines of RG 1.9 and RG 1.118.

8.3.1.4 *Technical Evaluation*

As documented in NUREG–1503, the NRC staff reviewed and approved Section 8.3.1 of the certified ABWR DCD. The staff reviewed Section 8.3.1 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 relevant information related to this section.

The staff reviewed the following information in the COL FSAR:

Tier 1 Departures

The following Tier 1 departures identified by the applicant in this section require prior NRC approval and the full scope of their technical impact may be evaluated in other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by these Tier 1 departures.

- STD DEP T1 2.4-2 Feedwater Line Break Mitigation (Figure 8.3-1)

Subsection 8.3.1.1.1 pertains to the medium voltage Class 1E power distribution system. The applicant provides the following discussion regarding the design of the condensate pumps for trip circuit:

> The Safety System Logic and Control (SSLC) initiates a trip of the condensate pumps when a feedwater line break is detected in the drywell. Although not credited in the FWLB analysis in Section 6.2, this trip provides added assurance of conservatism in the feedwater mass flow used in the analysis. This FWLB mitigation has been added to the STP 3 & 4 design which adds safety related instrumentation to sense and confirm a FWLB based on high differential pressure between feedwater lines coincident with high drywell pressure to trip the condensate. In order to trip the condensate pumps, a provision of 13.8 kV medium voltage safety-related breaker in series with the nonsafety 13.8 kV feeder breaker exists for each condensate pump. The trip circuit of each safety-related 13.8 kV breaker includes two independent trip coils. Each trip coil is powered from a separate division of Class 1E 125V DC system. Two separate

[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

divisions of safety-related control signals for feedwater line break are provided to initiate the trip of each breaker. This dual breaker in series arrangement ensures that the condensate pumps will trip on a feedwater line break.

The 13.8 kV breakers (both safety-related and nonsafety-related) are located in the turbine building. The procurement and design of the safety-related breakers are required to meet the criteria for performing the safety function of tripping the condensate pump breakers in case of the feedwater line break design basis event. The 125V DC control power and trip circuits of the safety-related breakers are also required to meet the independence criteria per RG 1.75. In addition, the safety-related breakers and components are required to be seismically installed and missile protected at their location in the turbine building. Although the breaker control power and trip circuits will not fully meet the seismic Category I installation and RG 1.75 separation requirements, the following considerations provide reasonable assurance for the tripping of condensate pumps during a feedwater line break in the drywell:

- The control power and SSLC circuits are provided with isolation devices.
- The control power cables are installed in dedicated raceways. Adequate separation exists between control circuit raceways and other nonsafety raceways.
- The design of the raceway supports is performed considering seismic loads throughout their routing.
- The safety-related breakers are located in a separate electrical equipment room.
- The design of the safety-related breaker supports is performed considering seismic loads.
- The probability of trip and control power circuit failure is very low. Even in case of a failure of the nonsafety power cable, the breaker trip circuit is expected to perform the safety function of tripping the condensate pump feeder breakers due to the redundancy of trip coils, trip signals, and the control power supply.
- The design does not impact or degrade any other safety-related equipment or function.
- A reliability assessment for this design has been performed.

Regarding the use of dual trip coils to ensure that tripping of the condensate pumps will occur when a FWLB inside the drywell is detected, the applicant states that the breaker control power and trip circuits will not fully meet the RG 1.75 separation requirements. The NRC staff issued RAI 08.03.01-1 requesting the applicant to provide details regarding the separation criteria used for the application and to specify the separation guidance criteria of RG 1.75 that are not being met. Additionally, the staff requested the applicant to discuss the results of the reliability assessment performed in accordance with GDC 21, “Protection system reliability and testability." In its response to RAI 08.03.01-1 dated July 22, 2009 (ML092050077), the applicant states that the basis for the statement in question is that the IEEE Std 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," requirements for physical separation at the dual trip coil circuit breaker and auxiliary switch assembly are not fully met. However, using the guidance of RG 1.75, which allows "an analysis of non-safety-related circuits to demonstrate that the safety-related circuits are not degraded below an acceptable level" when minimum separation cannot be met, the applicant has performed an evaluation of the separation between nonsafety-related and safety-related components and the separation between safety-related components of different divisions. The justifications that "provide reasonable assurance for tripping of condensate pumps during a feedwater line break in the drywell" are listed in FSAR Subsection 8.3.1.1.1.

Regarding the reliability assessment, the applicant has determined that the probability of all three operating condensate pumps tripping in response to a FWLB signal is 0.99910027; the probability that two or more operating condensate pumps will trip in response to a FWLB signal is 0.99999973. The applicant also states that the condensate pump circuit breaker is equipment actuated by the protection system, but that the circuit breaker is not considered part of the protection system as defined by GDC 20, "Protection system functions," and GDC 21. Additionally, the applicant states that an acceptable containment response following a FWLB inside the containment is achieved without taking credit for the automated condensate pump trip, thereby eliminating concerns about the potential failure of a safety-related condensate pump breaker. The addition of the safety-related condensate pump breaker is an enhancement from the DCD design and is acceptable. This RAI is therefore resolved and closed.

The staff observed that the applicant uses two circuit breakers in series, one safety-related and one nonsafety-related, to assure the tripping of the condensate pumps in the event of a FWLB inside the containment. Because a nonsafety-related component cannot be relied upon to perform a safety-related function, the staff issued RAI 08.03.01-2 requesting the applicant to indicate why there are not two safety-related breakers to assure conformance with the single-failure criterion. In its response to RAI 08.03.01-2, dated July 22, 2009 (ML092050077), the applicant states that the condensate pump trip function is not part of the certified ABWR design. This feature was added to provide further assurance of acceptable results following a FWLB inside the containment. The applicant also refers to the response to RAI 06.02.01.01.C-1, dated July 15, 2009 (ML092010088), indicating that the containment response portion of the STP, Units 3 and 4, accident analysis has been re-performed using the GOTHIC computer program in place of the GESSAR computer program. The data confirmed an acceptable containment response to a FWLB inside the containment without taking credit for the automated condensate pump trip. Despite these conclusions, the applicant plans to maintain the FWLB mitigation function, including the condensate pump trip, as a safety-related feature of the STP design, consistent with its original intent "to provide added assurance of acceptable results" following a FWLB inside the containment. Based on the above information, the staff found that because the applicant had achieved an acceptable containment response following a feedwater break inside the containment, without crediting the automated condensate pump trip, the response eliminates concerns about the potential failure of a safety-related condensate pump breaker and the need for two safety-related breakers. This RAI is resolved and closed.

The staff found that the above design satisfies the guidance of RG 1.75 and is therefore acceptable.

- STD DEP T1 2.12-2 I&C Power Divisions

In Subsection 8.3.1.1.4.1, the applicant discusses the design of the 120 Vac Class 1E instrument power system and provides the following information:

> Individual regulating transformers supply 120 VAC to the four divisions of instrument power (Figure 8.3-2). Each Class 1E divisional transformer is supplied from a 480V MCC in the same division, except for the Division IV transformer, which is supplied from the 480V MCC of Division II. There are three divisions (I, II, and III), each backed up by its associated divisional diesel generator as the source when offsite source is lost. Division IV is backed up by the Division II diesel generator, when the offsite source is lost. Power is distributed to the individual loads from distribution panels, and to logic level circuits through the control room logic panels. Transformers are sized to supply their respective distribution panel instrumentation and control loads.

The NRC staff reviewed the above information pertaining to the use of four 120 Vac "Class 1E instrument power systems" rather than the three identified in the corresponding DCD. The staff issued RAI 08.03.01-3 requesting the applicant to discuss how the STP logic philosophy differs from the DCD philosophy. The staff also requested the applicant to discuss the utilization difference between the 120 Vac Class 1E power in this subsection and the 120 Vac vital power in Figure 8.3-3 of the ABWR DCD and the impact of a loss of voltage to the instruments supplied by the "Class 1E instrument power systems" for a period of ten minutes during a SBO event. In its response to RAI 08.03.01-3, dated July 22, 2009 (ML092050077), the applicant states that the subject Class 1E I&C power supplies discussed in this subsection provide interruptible, regulated ac power to Class 1E circuits that do not require a continuity of power during a loss of preferred power. Therefore, there is no impact as a result of a loss of voltage for a period of ten minutes during a SBO event, because the loads are limited to Class 1E circuits that do not require a continuity of power during a loss of preferred power. Regarding the use of four rather than three divisions, the applicant states that as described in STD DEP T1 2.12-2, adding a fourth Class 1E I&C power supply increases reliability and availability, even though two of the four power supplies are supported by the Division II source. The use of a separate regulating transformer and associated distribution panels for each instrument division improves both reliability and diagnostics, because most instrumentation power problems can be addressed online. Therefore, there is no difference between the ABWR and the DCD in the philosophy and utilization of 120 Vac Class 1E power. Because the proposed design is an improvement from the DCD, this issue is resolved.

The staff found the above design to be consistent with the requirements of GDC 17 and the guidelines of RG 1.75 and RG 1.32.

- STD DEP T1 2.14-1 Hydrogen Recombiner Requirements Elimination

In Tables 8.3-1, 8.3-3, and 8.3-4, the applicant identifies the revised EDG loads resulting from the elimination of the hydrogen recombiner from the Class 1E loads and the identification of the plant-specific loads, which differ considerably from the DCD-identified loads.

The NRC staff reviewed the departures and found the identification of the plant-specific loads consistent with industry standards and the design capabilities of the EDG. Additionally, the staff found that the EDG loading sequence is in conformance with the guidance of RG 1.9 and industry standards. The design is therefore acceptable.

Tier 2 Departures Requiring Prior NRC Approval

The following Tier 2 departures identified by the applicant in this section require prior NRC approval and the full scope of their technical impact may be evaluated in the other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by these Tier 2 departures.

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

As stated in Section 8.2, the applicant opted to use UATs and RATs with dual-voltage secondary windings rated 13.8 kV and 4.16 kV, respectively, rather than the DCD-proposed 6.9 kV for both secondary windings. Section 8.3.1 of the DCD is revised to reflect the design changes in the STP, Units 3 and 4. Additionally, as depicted in Figure 8.3-1, the transformer and bus arrangement depart significantly from the ABWR design. The differences include the following:

- The DCD uses three UATs and one RAT; each transformer is equipped with two secondary windings rated 37.5 and 62.5 MVA; the transformer output voltage is 6.9 kV for both windings. The STP design uses three UATs and two RATs; four of the five transformers, two UATs and two RATs, are equipped with dual secondary windings rated 13.8 kV/60 MVA and 4.16 kV/22.5 MVA, respectively; the fifth transformer, a UAT, is rated 22.5 kV and has a single 4.16 kV secondary winding.

- The DCD uses six PG buses and three PIP buses; each UAT supplies two PG buses and one PIP bus. The STP design uses four 13.8 kV buses, each of the two UAT 13.8 kV winding powers two buses; the three PIP buses are each powered by one of the 4.16 kV windings of the three UATs.

- In the DCD design, each of the three Class 1E buses is supplied power by a corresponding UAT; the single RAT provides alternate preferred power to all three Class 1E buses. In the STP design, each of the three Class 1E buses is supplied by the 4.16 kV winding of the corresponding UAT; alternate preferred power is provided by either of two RATs.

- In the DCD design, a 9 MWe CTG supplies power to a 6.9 kV bus; this bus can supply power to any of the PIP or Class 1E buses. In the STP design, a 20 MWe CTG supplies power to a 13.8 kV bus; this bus can supply power to any of the four PG buses and, through a transformer, to any of the PIP or Class 1E buses. Additionally, the CTG of STP, Unit 3 can supply power to the STP, Unit 4 CTG bus and vice versa.

- In the DCD design, the rating of the EDGs is 6.25 MVA. In the STP design, the rating of the EDGs is 9 MVA.

The NRC staff reviewed Figure 8.3-1 and found that the changes in the transformer ratings are acceptable and the medium-voltage bus levels are consistent with industry standards. The staff also found that the change in the CTG rating from 9 MWe to 20 MWe is conservative for the existing design. However, the staff identified the following area requiring clarification:

In NUREG–0800 Section 8.3.1, SRP Acceptance Criteria Item 4.J states (in part):

> Acceptance criteria for the interface between the onsite ac power system and the offsite power system to satisfy the requirements of GDC 17 in evolutionary light water reactor design applications are documented in SECY-91-078, which states that the design should include at least one offsite circuit to each redundant safety division supplied directly from one of the offsite power sources with no intervening non-safety buses in such a manner that the offsite source can power the safety buses upon the failure of any non-safety bus.

The staff observed that these guidance criteria are reflected in the DCD design, where one winding of the RAT is connected directly to a source breaker of each of the three safety-related buses. However, the staff reviewed FSAR Section 8.3.1 and Figure 8.3-1 and determined that the offsite circuit in the STP design is connected to the safety buses through an intermediate bus that also supplies nonsafety loads. The staff issued RAI 08.03.01-4 requesting the applicant to discuss how the STP design meets the SRP and SECY-91-078, "Chapter 11 of the Electric Power Research Institute's (EPRI's) Requirements Document and Additional Evolutionary Light Water Reactor (LWR) Certification Issues," (ML072150592) guidance stated above and how the design is consistent with the DCD design. In its response to RAI 08.03.01-4, dated July 22, 2009 (ML092050077), the applicant clarifies that during normal plant operations, all non-Class 1E buses and two Class 1E buses are powered through the UATs, and the remaining Class 1E bus is supplied from RAT B. Therefore, this division is immediately available without a bus transfer if the normal preferred power is lost to the other two divisions. The applicant also states that to reduce the number of non-Class 1E buses between the UATs, the RAT A, and the Class 1E buses, the intermediate stub buses will be deleted. The staff reviewed the applicant's clarifications and found that the design meets the intent of SECY-91-078. This RAI is therefore resolved. The staff confirmed that the proposed changes in this RAI are included in FSAR Revision 4. Therefore this RAI is closed.

In FSAR Section 8.3.1, the applicant describes the plant medium voltage electric system design and states:

> The onsite power system interfaces with the offsite power system at the input terminals to the supply breakers for the normal, alternate, and combustion turbine generator power feeds to the medium voltage (13.8 kV and 4.16 kV) switchgear. The system consists of four load groups on non-Class 1E 13.8 kV Power Generation (PG) buses, three load groups on non-Class 1E 4.16 kV Plant Investment Protection (PIP) buses, and three load groups on Class 1E 4.16 kV buses. The three load groups of the Class 1E power system (i.e., the three divisions) are independent of each other. The principal elements of the auxiliary AC electric power systems are shown on the single line diagrams (SLD) in Figures 8.3-1 through 8.3-3.
>
> Each Class 1E division has a dedicated safety-related, Class 1E diesel generator, which automatically starts on high drywell pressure, low reactor vessel level or loss of voltage on the division's 4.16 kV bus. The signals generated from high drywell pressure and low reactor vessel level are arranged in two-out-of-four logic combinations, and are utilized to sense the presence of a LOCA condition and subsequently start the diesel. These signals also initiate the emergency core cooling systems.

> The loss of voltage condition and the degraded voltage condition are sensed by independent sets of three undervoltage relays (one on each phase of the 4.16 kV bus), which are configured such that two-out-of-three trip states will initiate circuitry for transferring power from offsite power to the onsite diesel generator (after a time delay for the degraded voltage condition). The primary side of each of the instrument potential transformers (PTs) is connected phase-to-phase (i.e., a "delta" configuration) such that a loss of a single phase will cause two of the three undervoltage relays to trip, thus satisfying the two-out-of-three logic. (For more information on the degraded voltage condition and associated time delays, etc., see Subsection (8) of 8.3.1.1.7.)
>
> Each 4.16 kV Class 1E bus feeds its associated 480V unit power center through a 4.16 kV/480/277 V power center transformer.
>
> AC power is supplied at 13.8 kV or 4.16 kV for motor loads larger than 300 kW and transformed to 480 V for smaller loads. The 480 V system is further transformed into lower voltages as required for instruments, lighting, and controls. In general, motors larger than 300 kW are supplied from the 13.8 kV or 4.16 kV buses. Motors 300 kW or smaller but larger than 100 kW are supplied power from 480V switchgear. Motors 100 kW or smaller are supplied power from 480 V motor control centers.

The staff reviewed the above information and determined that the description addresses the change in the bus voltage that the applicant has opted to use. As discussed previously, the staff found that the STP departures from the DCD pertaining to the medium voltage levels that were used are consistent with industry standards and are therefore acceptable.

In addition, in Subsection 8.3.1.0.1, the applicant discusses the bus arrangements for the PG and PIP equipment and states:

> The non-Class 1E medium voltage power distribution system consists of four 13.8 kV PG buses and three 4.16 kV PIP buses. The four bus configuration was chosen to meet the requirement that the ten Reactor Internal Pumps (RIPs) be powered by four independent buses. This will minimize large core flow reduction events and match the mechanical power generation systems which are mostly four trains (e.g., four feedwater pumps, four condensate pumps, four condensate booster pumps, four heater drain pumps, and four circulating water pumps). The three bus configuration was chosen to match the supported mechanical systems, which typically consist of two or three trains.
>
> The four power generation buses supply power production loads. Each one of these buses has access to power from one winding of its assigned unit auxiliary transformer. Each PG bus also has access to a reserve auxiliary transformer or CTG as an alternate source, if its unit auxiliary transformer fails or during maintenance outages for the normal feed. Bus transfer between preferred power sources is manual dead bus transfer and not automatic.
>
> Plant Investment Protection (PIP) buses supply power to non-safety loads in three load groups. On loss of normal or alternate preferred power an automatic transfer of pre-selected buses occurs via a dead bus transfer to the combustion

> turbine which automatically starts on loss of power. The PIP systems for each selected load group automatically restart to support their loads.
>
> The non-Class 1E switchgear interruption ratings are chosen to be capable of clearing the maximum expected fault current. The continuous ratings are chosen to carry the maximum expected normal currents. The 13.8 kV/4.16 kV switchgear is rated at 15 kV/4.76 kV, respectively. Instrument and control power is from the non-Class 1E, 125 VDC power system. The 13.8 kV buses supply power to adjustable speed drives for the feedwater and reactor internal pumps. These adjustable speed drives are designed to the requirements of IEEE-519. Voltage distortion limits are as stated in Table 4 of the subject IEEE Std.
>
> Each medium voltage 13.8 kV and 4.16 kV bus has a spare space which can be used to insert a manual grounding circuit device for use during maintenance activities.

The staff reviewed Subsection 8.3.1.0.1. The staff found that regarding the PIP buses, the subsection states that upon the loss of normal or alternate preferred power, an automatic transfer of pre-selected buses occurs via the dead bus transfer to the CTG, which automatically starts upon the loss of power. Because alternate power to the PIP buses is provided through bus 4.16 kV CTG 3, and this same bus is normally supplied by RAT B, the staff issued RAI 08.03.01-5 asking the applicant to describe the interlocks that exist to prevent the paralleling of the CTG source with the RAT B source. In its response to RAI 08.03.01-5, dated July 22, 2009 (ML092050077), the applicant states that at bus 4.16 kV CTG 3, circuit breaker position interlocks normally prevents the paralleling of the CTG source with the RAT B source. In order to facilitate the orderly restoration of power sources during a SBO event, the paralleling of the CTG and RAT B sources may be performed. The applicant also indicates that the electrical interlocks will consist of contact logic and relay supervision of manual synchronizations consistent with IEEE Std 141–1986, "IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book)," and IEEE Std 242–1986, "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems." As such, bus transfers from the CTG source to the RAT B source will be supervised to verify that the two ac circuits are within the desired limits of frequency and voltage phase angle to permit them to operate momentarily in parallel. This transfer provides RAT B with the capability of being restored as an offsite power supply to the Class 1E buses without de-energizing the Class 1E bus. The staff found the applicant's response acceptable, and this RAI is therefore resolved.

In FSAR Subsection 8.3.1.0.2.1, the applicant addresses the medium voltage switchgear and provides the following description:

> Power for the non-Class 1E 480 V auxiliaries is supplied from power centers consisting of 13.8 kV/480 V or 4.16 kV/480 V transformers and associated switchgear (see Figure 8.3-1). There is at least one power center on each of the medium voltage PG and PIP buses.

Also in Subsection 8.3.1.1.2.1 regarding Class 1E power centers, the applicant states:

> Power for 480 V auxiliaries is supplied from power centers consisting of 4.16 kV/480 V transformers and associated switchgear (see Figure 8.3-1). There is at least two power centers in each Class 1E division.

The staff reviewed the above information and determined that the departures pertaining to the non-Class 1E power centers constitute changes to the voltage levels selected for the STP-specific non-Class 1E buses. As discussed previously, the staff found that the medium voltage levels used by the STP are consistent with industry standards and are therefore acceptable. This issue is resolved.

In FSAR Subsections 8.3.1.0.6.2 and 8.3.1.1.6.2, the applicant addresses the plant-specific grounding method and states:

> Station grounding and surge protection is discussed in Section 8A.1. The medium voltage system is low resistance grounded except that the combustion turbine generator is high resistance grounded to maximize availability.
>
> See Subsection 8.3.4.14 for COL license information pertaining to administrative control for bus grounding circuit devices.

The staff's review of the above subsection determined that the departure involves the deletion of 6.9 kV from the grounding description. The staff found that this description of the medium voltage level is consistent with industry standards and is therefore acceptable.

In FSAR Subsections 8.3.1.0.6.3 and 8.3.1.1.6.3, the applicant addresses the plant-specific bus protection methods and states that bus protection is as follows:

> 1) Medium voltage bus incoming circuits have inverse time over-current, ground fault, bus differential, and under-voltage protection.
>
> 2) Medium voltage feeders for power centers have instantaneous, inverse time over-current and ground fault protection.
>
> 3) Not Used
>
> 4) Medium voltage feeders used for motor starters have instantaneous, inverse time over-current, ground fault protection.

The staff's review of the above subsection determined that the departure involves the deletion of the voltage level 6.9 kV from the medium voltage bus description to make it consistent with 13.8 kV and 4.16 kV, which will be used for the STP design. The staff found the description acceptable.

Also in Subsection 8.3.1.1.1, the applicant discusses the bus arrangements for the Class 1E equipment and states:

> Class 1E AC power loads are divided into three divisions (Divisions I, II, and III), each fed from an independent 4.16 kV Class 1E bus. During normal operation (which includes all modes of plant operation; i.e., shutdown, refueling, startup, and run), two of the three divisions are normally fed from an offsite normal

> preferred power supply. The remaining division is normally fed from the alternate preferred power source (Subsection 8.3.4.9).
>
> The Class 1E buses are comprised of metal clad switchgear with normal and interrupting ratings that are sized to carry normal loads and to clear expected faults. Control and instrument power for each Class 1E division are supplied by its associated Class 1E 125 VDC power system.
>
> Each medium voltage 4.16 kV bus has a spare space which can be used to insert a manual grounding circuit device for use during maintenance activities. A main control room indication is provided when the bus grounding circuit device is installed.
>
> Standby AC power for Class 1E buses is supplied by diesel generators at 4.16 kV and distributed by the Class 1E power distribution system. Division I, II and III buses are automatically transferred to the diesel generators when the preferred power supply to these buses is ≤70% bus voltage.
>
> Class 1E microprocessor controlled protective relaying equipment senses fault current flowing in the non-Class 1E load. This equipment utilizes digital timers that can reproduce the timing requirements by sensing the number of cycles of the electrical waveform itself. Coordination of the definite time delay and the upstream bus feeder breakers allows termination of the fault current before the feeder breakers are free to trip. Tripping of the Class 1E feed breaker is normal for faults which occur on the Class 1E bus it feeds.

The staff's review of Subsection 8.3.1.1.1 pertaining to the medium voltage power distribution system noted the deletion of various bus ratings identified in the corresponding section of the ABWR DCD. Therefore, the staff issued RAI 08.03.01-6 asking the applicant to explain why it was not appropriate to discuss the STP Class 1E switchgear ratings in this subsection. In its response to RAI 08.03.01-6, dated July 22, 2009 (ML092050077), the applicant states that various ratings were removed from Subsection 8.3.1.1.1 because the Class 1E medium voltage system was changed to a 4.16 kV system from the values stated in the DCD. The applicant also indicates that the Class 1E power distribution system equipment has not yet been procured, so the actual equipment ratings cannot be specified in the FSAR. Based on the initial system sizing calculations, the Class 1E medium voltage bus and circuit breaker ratings will have a voltage rating of 4.76 kV, a continuous current rating of 2000 A (per Figure 8.3-1), an interrupting current rating of 63 kA, and a momentary current rating of 164 kA. DCD Tier 1, ITAAC Table 2.12.1, "Electric Power Distribution System," Item 9.a, will verify these ratings. The staff found the applicant's response acceptable, and this RAI is therefore resolved.

In Subsection 8.3.1.1.7, the applicant discusses the load shedding, bus transfer, and load sequencing following a loss of bus voltage. The description provided by the applicant follows the same lines as the standard ABWR design, except for bus voltage levels that differ from those specified in the ABWR and the maximum allowed time for combustion turbine operation, as stated under Item (9) of this subsection. Specifically, the applicant states:

> Station Blackout (SBO) considerations- SBO event is defined as the total loss of all offsite (preferred) and onsite Class IE AC power supplies, except for Class IE AC power generated through inverters from the station batteries. In such an

event, the combustion turbine generator (CTG) will automatically start and achieve rated speed and voltage in less than ten minutes. The CTG will then automatically assume pre-selected loads on the plant investment protection (PIP) buses. With the diesel generators unavailable, the reactor operator will manually shed PIP loads and connect the non-Class 1E CTG with the required shutdown loads within ten minutes of the event initiation. Specifically, the operator will energize one of the Class 1E distribution system buses by closing each of the circuit breakers (via controls in the main control room) between the CTG unit and the Class 1E bus. The circuit breaker closest to the Class 1E bus is Class 1E, and the other breakers are non-Class 1E. Later, the operator will energize other safety-related and non-safety-related loads, as appropriate, to complete the shutdown process.

The staff's review of the departures described in the above subsection found that the voltage changes are in conformance with the STP-specific design. The medium voltage levels used by the STP are consistent with industry standards and are acceptable. Additionally, the staff found that the availability of the CTG within ten minutes is in conformance with the requirements of 10 CFR 50.63 and the guidelines of RG 1.155.

In FSAR Subsection 8.3.1.2(4)(b), the applicant addresses other SRP criteria and the NRC Policy Issue, "Alternate Power for Non-safety Loads." The applicant provides the following information:

Normal plant operating loads can be supplied by either the reserve or unit auxiliary transformers. Any non-safety power generation loads can be manually connected to receive power from any of the two sources (i.e., the two switching stations represented by the UATs and RATs) due to the interconnection capability for the ABWR. Any Plant Investment Protection (PIP) load can be manually connected to receive power from three sources (i.e., two switching stations and the CTG). Any Class 1E safety bus can be manually connected to receive power from four sources (i.e., two switching stations, the CTG, and the EDGs). Either the UATs or either of the RATs can supply the three Class 1E safety buses. Administrative controls are provided to prevent paralleling of sources (Subsection 8.3.4.15). The ABWR therefore exceeds the requirements of the policy issue.

The staff's review of this item found that the applicant's discussions pertaining to the use of alternate power for nonsafety loads are reasonable.

In Subsection 8.3.3.6.1.1 pertaining to the Class 1E electric equipment arrangement, the applicant provides the following clarifications:

(4) An independent raceway system is provided for each division of the Class 1E electric system. The raceways are arranged, physically, top to bottom, as follows (based on the function and the voltage class of the cables):

Note: V5 = Medium voltage power, 13.8 kV (15 kV insulation class) for non-Class 1E systems only.

(a) V4 = Medium voltage power, 4.16 kV (5 kV insulation class).

(5) Class 1E power system power supplies and distribution equipment (including diesel generators, batteries, battery chargers, CVCF power supplies, 4.16 kV switchgear, 480V load centers, and 480V motor control centers) are located in areas with access doors that are administratively controlled.

The staff's review of the above information found that the described departures are the result of the changes in equipment voltage used by the STP in lieu of the voltage stated in the standard ABWR DCD. The staff observed that voltage changes are also noted in Subsection 8.3.1.1.8.1, "Redundant Standby AC Power Supplies;" Subsection 8.3.1.1.8.2, "Ratings and Capability;" Subsection 8.3.1.2, "Analysis;" and Subsection 8.3.3.5.1.3, "Raceway Identification." As discussed in the above subsections, the staff found that the medium voltage levels used by the STP are consistent with industry standards, the requirements of GDC 17, 10 CFR 50.63, guidance of RG 1.32 and RG 1.155 and this departure is therefore acceptable.

- STD DEP 8.3-3 Electrical Site-Specific Power and Other Changes (Table 8.3-1, Table 8.3-3, Figure 8.3-1, and Figure 8.3-2)

In Subsection 8.3.1.1.1, pertaining to the medium voltage Class 1E power distribution system, the applicant discusses the fine motion control rod drive (FMCRD) and states:

The Division I Class 1E bus supplies power to three separate groups of non-Class 1E fine motion control rod drive (FMCRD) motors (see Figure 8.3-1, sheet 4). Although these motors are not Class 1E, the drives may be inserted as a backup to scram and are of special importance because of this. It is important that the first available standby power be available for the motors, therefore, a diesel supplied bus was chosen as the first source of standby AC power and a combustion turbine supplied PIP bus as the second backup source. Division I was chosen because it was the most lightly loaded diesel generator.

On May 3, 2010, the applicant provides additional information that clarifies FMCRD power supplies as a supplemental response to RAI 08.03.01-4, Supplement 2 (ML101250476). On June 17, 2010, the applicant provides the revised response to RAI 08.03.01-4, Supplement 3 addressing the staff's questions raised during a teleconference on May 19, 2010 (ML101720635). In these responses, the applicant states that the capability to power the FMCRDs directly from a PIP bus will be met by providing transfer capability at the 480 volt level. The 480 V power supplies to FMCRD power distribution panels A-1, A-2, B-1, B-2, C-1, C-2 will be non-Class 1E. The electrical interfaces between Class 1E and non-Class 1E circuits utilize Class 1E isolation devices. The electrical isolation of power circuits is achieved by Class 1E isolation devices applied to interconnections of Class 1E and non-Class 1E circuits as defined by RG 1.75 and IEEE Std 384. In addition, the applicant deletes "The load breakers in Division I switchgear are part of the isolation scheme … and the upstream Class 1E bus feeder breakers." and "the zone selective interlock feature of the breaker for the non-Class 1E load" from ABWR DCD Subsection 8.3.1.1.1 and modifies this subsection as follows:

The fault interrupt capability of all Class 1E breakers, fault interrupt coordination between the supply and load breakers for each Class 1E load and Division I non-Class 1E load all have the capability of being tested (Subsection 8.3.4.29).

> Power is supplied to each FMCRD load group from either the Division I Class 1E bus or a non-Class 1E PIP bus through a non-Class 1E automatic transfer switch located between the power sources and the 480 V FMCRD power distribution panels. Switchover to the non-Class 1E PIP bus source is automatic on loss of power from the Class 1E diesel bus source. Switching back to the Class 1E diesel bus power is by manual action only. Per IEEE-384 and RG 1.75, isolation between the Class 1E and non- 1E load is maintained.
>
> The design minimizes the probability of a single failure affecting more than one FMCRD group by providing six independent feeds (two for each group) directly from Division I Class 1E and PIP 480 V buses (see sheet 3 and 4 of Figure 8.3.1). The two Class 1E protective devices connected in series provide isolation between the Class 1E bus and non-Class 1E load. The transfer switches are non-Class 1E. The feeder circuits from the non-Class 1E PIP bus to the transfer switch, and circuits downstream of the transfer switch are non-Class 1E.

The applicant revises ABWR DCD Subsection 8.3.1.2(2) Item (f): "RG 1.75–Physical Independence of Electric System," as follows:

> Regarding Position C-1 of Regulatory Guide 1.75 (Subsection 8.3.1.1.1), the non-Class 1E FMCRD motors are supplied power from Division I Class 1E bus. The Class 1E load breakers or protective devices for the bus are tripped by fault current for faults in the non-Class 1E load prior to initiation of a trip of upstream breakers. This meets the intent of the Regulatory Guide position.

The applicant also modifies ABWR DCD Subsection 8.3.3.5.1, "NOTE," by deleting "and associated Fine Motion Control Rod Drive (FMCRD) circuits are described in Section 8.3.1.1.1." The applicant deleted "AC isolation (the FMCRD drives on Division 1 is the only case) is provided by Class 1E interlocked circuit breaker coordination as described in Subsection 8.3.1.1.1" from the first paragraph of ABWR DCD Subsection 8.3.3.6.2.2.4. Finally, the applicant deleted "and each zone selective interlock feature of the breaker for each non-Class 1E load" from the ABWR DCD Section 8.3.4.29.

The staff's review of the applicant's responses to RAI 08.03.01-4, found that FMCRDs are powered from either the Division I Class 1E 480V power center Bus E10 or a non-Class 1E 480V power center Bus C30 through a non-Class 1E automatic transfer switch located between the power sources and the non-Class 1E 480 V FMCRD power distribution panels. The non-Class 1E 480 V FMCRD power distribution panels are isolated from Class 1E power center Bus E10 by two circuit breakers in series. The staff's review of the departure pertaining to the FMCRD power supply design found that the STP design conforms to the guidance of RGs 1.32 and 1.75. The staff agreed with the deletion of zone selective interlock feature of the breaker in the Division I switchgear for breaker coordination. Additionally, the staff agreed that the FMCRD circuits including transfer switches are not associated circuits. Therefore, RAI 08.03.01-4 is resolved. The staff confirmed that the applicant's proposed changes are incorporated in the FSAR Revision 6. Therefore, RAI 08.03.01-4 is closed.

In addition, in Subsection 8.3.1.1.8.2, the applicant discusses the rating and capability of the equipment. Regarding the EDGs, Item (12), this subsection provides the following information:

> The maximum loads expected to occur for each division (according to nameplate ratings) do not exceed 95% of the continuous power output rating of the diesel generator. See Table 8.3-1 for diesel generator loads applicable to each division.

The staff reviewed the EDG rating (as discussed above) and issued the following RAIs:

FSAR Subsection 8.3.1.1.8.2 (Item 12) states that the maximum loads expected to occur for each division do not exceed 95 percent of the continuous power output rating of the EDG. However, the staff observed that based on Table 8.3-1 for Diesel Generator B (Division II), the identified connected load exceeds the kW continuous rating of the EDG. Additionally, the operating loads exceed 92 percent of the generator's continuous rating, with an additional 677 kW in standby and short time loads. Therefore, the staff issued RAI 08.03.01-7, requesting the applicant to confirm that the total diesel loading, including standby and short time loads, does not exceed the stated 95 percent of the continuous rating of the EDG in accordance with the guidance of RG 1.9. In its response to RAI 08.03.01-17, dated July 22, 2009 (ML092050077), the applicant confirms that the total 'continuous' loading for the each EDG does not exceed the 95 percent of the continuous rating of the EDG. This determination is based on an EDG continuous rating of 7,200 kW and the EDG continuous loading specified in FSAR Table 8.3-1 for a LOCA plus a LOPP. The total continuous diesel loading for EDG B is 6,629 kW. Based on the above information, the staff found that total loads on the EDGs are within the 95 percent of the continuous rating of the EDG, which is consistent with the recommendation of RG 1.9 and is therefore acceptable. RAI 08.03.01-17 is closed.

The staff also observed that Departure STP DEP T1 2.15-2, "[Reactor Building Safety-Related Diesel Generator] RBSRDG HVAC," had revised DCD Tier 1, Section 2.15.5, "Heating, Ventilating and Air Conditioning," pertaining to the EDG engine room maximum temperature limit during EDG operation from 50 degrees Celsius (C) (122 degrees Fahrenheit [F]) to 60 °C (140 °F). The staff issued RAI 08.03.01-12, requesting the applicant to discuss the effect of the temperature increase from 50 °C to 60 °C (122 °F to 140 °F) on: (1) EDG performance (EDG rating, effects on electronic components associated with the EDG control system, etc.); (2) cable ampacity; (3) mild environmental equipment qualification; and (4) the operation of other equipment in the room, if any. In its response to RAI 08.03.01-12, dated July 22, 2009 (ML092050077), the applicant states that: (a) the equipment to be installed in the EDG room will be specified and procured to be suitable for the EDG room environmental conditions; (b) EDG equipment not suitable for the EDG room environmental conditions will be identified and located outside the EDG room; (c) cables to be routed into the EDG room shall have a suitable ampacity for the area that is consistent with the ampacity guidelines with temperature correction factors applied to a 60 °C (140 °F) ambient temperature; and (d) only safety-related equipment identified as suitable for the EDG room environmental conditions will be installed in the EDG room and will be consistent with the guidance of DCD Tier 2, Section 3.11.2, "Qualification Tests and Analyses."

The staff reviewed the applicant's original response to RAI 08.03.01-12, dated July 22, 2009, and observed that the applicant had failed to address EDG performance in the proposed ambient temperature. Therefore, the staff issued RAI 08.03.01-14, requesting the applicant to discuss any derating that will be required if the temperature of the inlet air to the diesel is increased from 50 °C to 60 °C (122 °F to 140 °F) and if the generator is required to operate in an ambient temperature of 60 °C (140 °F). Also, if a derating of the EDG is required, the staff requested the applicant to discuss the impact of a derating on the EDG loading, both transient and steady-state. In its response to RAI 08.03.01-12, dated November 10, 2009 (ML093170204), the applicant clarifies that the diesel engine combustion air intake is taken from outside of the reactor building; therefore, the increase in the EDG room temperature from 50 °C to 60 °C (122 °F to 140 °F) does not impact the EDG intake air temperature and, hence, it does not impact the diesel engine performance. Regarding the generator itself and other safety-related components housed within the EDG room, they are being specified and procured to the 60 °C (140 °F) temperature requirement; as such there will be no derating required. Based on the above, the staff found the EDG and other safety-related equipment in the EDG room will perform their functions as required and is consistent with the requirements of GDC 17 and the guidance of RG 1.32. Therefore, RAI 08.03.01-14 is resolved.

On April 1, 2010, the applicant provided a revision to its response to RAI 08.03.01-12 (ML100980067). In this response, the applicant clarifies that EDG control cabinets will be specified to be located outside of the EDG room. In addition, the applicant states that under Departure STD DEP T1 2.15-2, Table 3I-4, “Thermodynamic Environment Conditions Inside Reactor Building (Outside Secondary Containment) Plant Normal Operating Conditions,” and Table 3I-14, “Thermodynamic Environment Conditions Inside Reactor Building (Outside Secondary Containment) Plant Accident Conditions), in FSAR Appendix 3I will be revised to show a EDG room maximum temperature of 60 °C (140 °F). The staff found the applicant’s response consistent with the departure and is therefore, acceptable. The staff confirmed that the applicant’s proposed changes are incorporated in the FSAR Revision 4. Therefore, RAI 08.03.01-12 is closed.

Tier 2 Departures Not Requiring Prior NRC Approval

The following Tier 2 departures 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 07, Section 5.0 for a listing of all FSAR sections affected by these departures.

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

In FSAR Subsection 8.3.1, the applicant discusses the CTG and provides the following information:

> CTG Bus 1 can be tied to CTG Bus 2 by the manual closing of the CTG bus tie breaker. When the plant conditions are beyond the design basis, the plant operators have the capability to cross-connect an alternate power source from the other unit. The cross-tie breakers can only be closed after complying with the shedding requirements and loads limitations in accordance with off-normal/emergency procedures.

In Subsection 8.3.1.2(1), the applicant adds GDC 5 to the list of applicable GDC. Additionally, in Subsections 8.3.1.2(2)(l) and 8.3.2.2.2(2)(l), the applicant discusses compliance of the STP design with RG 1.81 and provides the following information:

> STP 3 & 4 is a dual-unit station. Units 3 & 4 do not share ac or dc onsite emergency and shutdown electric systems. The onsite electric power systems are independent, separate, and designed with the capability of supplying minimum Engineered Safety Feature loads and loads required for attaining a safe and orderly cold shutdown of each unit, assuming a single failure and loss of offsite power.

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 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 9.5-1 Diesel Generator Jacket Cooling Water System

In FSAR Subsection 8.3.1.2, paragraph (2)(h), the applicant deletes a reference to RG 1.108.

This departure replaces RG 1.108 with RG 1.9. 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 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 9.5-3 System Description - Reactor Internal Pump Motor Generator Sets

In FSAR Subsection 9.5.10.2, the applicant modifies the description of the electrical system design in the ABWR DCD relating to the MG sets and the interfaces between the MG sets and the RIPs. Specifically, this subsection clarifies that more than one UAT is used and that the interface between the MG sets and the adjustable speed drive (ASD) RIP loads is through three vacuum circuit breakers and three ASD input transformers. The subsection also clarifies the function of the components.

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 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 10.2-1 Turbine Design

In FSAR Figure 8.3-1, the applicant identifies the plant-specific rating of the STP turbine generator and the STP departures from the standard design.

The staff’s review of the figure found that the STP design meets the intent of the ABWR standard design. 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 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 Admin

The applicant provides editorial changes in FSAR Subsections 8.3.1.1.5 and 8.3.1.1.8. In FSAR Subsection 8.3.1.1.5, the applicant deletes an incorrect reference to DCD Section 8.2.3(16) for interface requirements. Additionally, in FSAR Subsection 8.3.1.1.8, the applicant adds two references for COL license information items.

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.

COL License Information Items

- COL License Information Item 8.8 Diesel Generator Design Details

In FSAR Subsection 8.3.4.2, the applicant discusses the steps that will be taken to assure that the EDGs will start and will reach full speed and voltage in 20 seconds. The applicant provides the following supplemental information as Commitment (COM 8.3-1):

> Procurement documents for the emergency diesel generators will specify that the diesel generators will be capable of reaching full speed and voltage within 20 seconds after the signal to start and that the vendor's testing that demonstrates this capability will be witnessed by QA. Procedure(s) which implement the testing guidance in RG 1.9 and IEEE 387 will be developed before fuel load to test that each emergency diesel generator meets the requirement to reach full speed and voltage within 20 seconds after the start signal is initiated. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. In addition, the Technical Specifications (see Chapter 16) require periodic retesting and verification that each emergency diesel generator meets this requirement. (COM 8.3-1).

The NRC staff reviewed the applicant’s response to the above COL license information item and found that the information conforms to the guidelines of RG 1.9 and RG 1.32. This COL license information item is therefore acceptable.

- COL License Information Item 8.10 Protective Devices for Electrical Penetrations

In FSAR Subsection 8.3.4.4, the applicant discusses the periodic testing of protective devices that STP will use to assure appropriate protection of the electrical penetrations. The applicant provides the following supplemental information as Commitment (COM 8.3-2):

> Procedure(s) will be developed before fuel load that demonstrates the functional capability of the electrical penetration assembly protective devices to perform their required safety functions. These procedures include periodic testing and calibration of the protective devices (except for fuses which will be inspected) to demonstrate their functional capability for the safety-related circuits that pass through the containment electrical penetrations assemblies. A sample of each different type of over current device is selected for periodic testing during refueling outages. The testing includes verification of thermal and instantaneous trip characteristics of molded case circuit breakers; verification of long time, short time, and instantaneous trips of medium voltage air circuit breakers; and verification of long time, short time, and instantaneous trips of low voltage air circuit breakers. The procedures will be developed before fuel load consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-2)

The NRC staff reviewed the applicant's response to the above COL license information item and found that in FSAR Subsection 8.3.4.4, the applicant states:

> Procedures include periodic testing and calibration of the protective devices (except for fuses which will be inspected) to demonstrate their functional capability for the safety-related circuits that pass through the containment electrical penetrations assemblies.

Because containment integrity can be compromised by short circuits affecting nonsafety-related circuits within the containment during a design-basis accident, the staff issued RAI 08.03.01-9, requesting the applicant to confirm whether the above procedures will also include the periodic testing and calibration of protective devices associated with the nonsafety-related circuits that pass through the containment electrical penetration assemblies. If not, the staff asked the applicant to justify the omission and to assess potential safety consequences. In its response to RAI 08.03.01-9, dated July 22, 2009 (ML092050077), the applicant states that the protective devices requiring special consideration, as defined by IEEE Std 741, "IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations," Section 5.4, "Primary containment electrical penetration assemblies," (Class 1E and non-Class 1E), will be included in FSAR Subsection 8.3.4.4 pertaining to identified procedure(s) for periodic testing and calibration of the protective devices. The applicant also states that FSAR Subsection 8.3.4.4 will be revised to include both safety-related and nonsafety-related protective devices. The staff found that COL License Information Item 8.10 is consistent with the guidance of RG 1.63 and RG 1.32 and is therefore acceptable. The staff confirmed that the applicant's proposed changes to Subsection 8.3.4.4 are included in the FSAR Revision 4. Therefore, this RAI is closed.

- COL License Information Item 8.15 Offsite Power Supply Arrangement

In FSAR Subsection 8.3.4.9, the applicant discusses the procedures that will be developed to assure that one of the divisional buses will be powered from an alternate preferred source under normal operation. The applicant provides the following supplemental information as Commitment (COM 8.3-3):

> Procedure(s) that require one of three divisional buses to be fed from an alternate source during normal operation to prevent the simultaneous de-energization of all divisional buses on the loss of one offsite power supply, will be developed prior to fuel load. Technical Specifications limit operation when both of the reserve auxiliary transformers or all three (3) unit auxiliary transformers are inoperable. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-3).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.9, "Offsite Power Supply Arrangement," and the requirements of GDC 17. This COL license information item is therefore acceptable.

- COL License Information Item 8.19 Load Testing of Class 1E Switchgear and Motor Control Centers

In FSAR Subsection 8.3.4.13, the applicant discusses the analysis that will be performed to address the adequacy of the voltage at the device load from Class 1E switchgear and motor control centers (MCCs). The applicant provides the following supplemental information as Commitment (COM 8.3-4):

> The availability of adequate voltage (+/-10%) at the device load from Class 1E switchgear and motor control centers for different operating scenarios will be determined by analysis. The electrical model for the analysis will be validated by site testing prior to fuel load. The capability of critical electrical equipment to operate within +/- 10% of nominal voltage will also be confirmed by vendor testing of the system components before shipment. (COM 8.3-4).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.13, "Load Testing of Class 1E Switchgear and Motor Control Centers," and the guidelines of BTP 8-6. This COL license information item is therefore acceptable.

- COL License Information Item 8.20 Administrative Controls for Bus Grounding Circuit Devices

In FSAR Subsection 8.3.4.14, the applicant discusses the procedures that will be developed to assure that the bus grounding circuit devices are properly controlled. The applicant provides the following supplemental information as Commitment (COM 8.3-5):

> Plant operating procedures will provide appropriate administrative controls to assure that bus grounding circuit devices are removed whenever the corresponding buses are energized. Operation and maintenance procedures, that provide directions to energize or de-energize high voltage electrical equipment, will also include instructions regarding bus grounding circuit devices to assure that they are in the correct position. These procedures will be developed prior to fuel load and be consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-5).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.14, "Administrative Controls for Bus Grounding Circuit Devices," and the guidelines of SRP Subsection 13.5.1. COL License Information Item 8.20 is therefore acceptable.

- COL License Information Item 8.21 Administrative Controls for Manual Interconnections

In FSAR Subsection 8.3.4.15, the applicant discusses the procedures that will be developed to assure that Class 1E power supplies are not paralleled. The applicant provides the following supplemental information as Commitment (COM 8.3-6):

> Plant operating procedure(s) to prevent paralleling of redundant onsite Class 1E power supplies from different buses and sources to power plant loads will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-6)

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.15, "Administrative Controls for Manual Interconnections," and the guidelines of SRP Section 13.5.1. COL License Information Item 8.21 is therefore acceptable.

- COL License Information Item 8.23 Common Industrial Standards Referenced in Purchase Specifications

In FSAR Subsection 8.3.4.17, the applicant addresses the standards that will be used for purchase specifications. The applicant provides the following supplemental information:

> The appropriate industrial standards, such as those listed in Subsection 8.3.5, for the assurance of quality manufacturing of both Class 1E and non-Class 1E equipment, will be referenced in the purchase documents.

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.17, "Common Industrial Standards Referenced in Purchase Specifications," and the guidelines of SRP Sections 8.3.1 and 8.3.2. COL License Information Item 8.23 is therefore acceptable.

- COL License Information Item 8.25 Control of Access to Class 1E Power Equipment

In FSAR Subsection 8.3.4.19, the applicant addresses the procedures that will be developed to properly control access to the Class 1E Power Equipment. The applicant provides the following supplemental information as Commitment (COM 8.3-8):

> Procedure(s) that contain appropriate administrative controls to limit access to Class 1E power equipment areas and Class 1E distribution panels, will be developed prior to fuel load. Class 1E power system power supplies and distribution equipment (including diesel generators, batteries, battery chargers, CVCF power supplies, 4.16 kV switchgear, 480 V load centers, 480 V motor control centers) are all located within the Vital Area areas and access is controlled accordingly. In addition, AC and DC distribution panels are located in the same areas or similar areas as Class 1E power supplies and distribution equipment or the distribution panels are capable of being locked, so that access to circuit breakers can be administratively controlled. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-8).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.19, "Control of Access to Class 1E Power Equipment," and the guidelines of RG 1.75. COL License Information Item 8.25 is therefore acceptable.

- COL License Information Item 8.26 Periodic Testing of Voltage Protection Equipment

In FSAR Subsection 8.3.4.20, the applicant discusses the procedures that will be developed to address the periodic testing of electrical equipment for the protection of the electrical distribution system. The applicant provides the following supplemental information as Commitment (COM 8.3-9):

> Procedure(s) which implement the testing requirements of RG 1.118 and IEEE 338 for the periodic testing of instruments, timers, and other electrical equipment designed to protect the distribution system from: (1) loss of offsite voltage, and (2) degradation of offsite voltage, will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-9).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.20, "Periodic Testing of Voltage Protection of Equipment," and the guidelines of RG 1.118. COL License Information Item 8.26 is therefore acceptable.

- COL License Information Item 8.27 Diesel Generator Parallel Test Mode

In FSAR Subsection 8.3.4.21, the applicant addresses the procedures that will be developed to address EDG testing. The applicant provides the following supplemental information as Commitment (COM 8.3-10):

> Procedure(s) will be developed prior to fuel load which provide for the periodic testing of the diesel generator interlocks which restore units to emergency standby in the event of a LOCA or LOPP. Such procedures shall require that each diesel generator set be operated independently of the other sets, and be connected to the utility power system only by manual control during testing or for bus transfer. Also, such procedures shall require that the duration of the connection between the preferred power supply and the standby power supply shall be minimized in accordance with Section 6.1.3 of IEEE 308. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-10).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.21, "Diesel Generator Parallel Test Mode," and the guidelines of RG 1.9 and RG 1.118. COL License Information Item 8.27 is therefore acceptable.

- COL License Information Item 8.28 Periodic Testing of Diesel Generator Protective Relaying

In FSAR Subsection 8.3.4.22, the applicant discusses the procedures that will be developed to address the periodic testing of the EDGs when they are required to operate in parallel with the preferred offsite sources. The applicant provides the following supplemental information as Commitment (COM 8.3-11):

> Procedure(s) which implement the testing requirements of RG 1.9 and IEEE 387 for periodic testing of diesel generator protective relaying, bypass circuitry, and annunciation will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-11).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.22, "Periodic Testing of Diesel Generator," and the guidelines of RG 1.9 and RG 1.118. COL License Information Item 8.28 is therefore acceptable.

- COL License Information Item 8.29 Periodic Testing of Diesel Generator Synchronizing Interlock

In FSAR Subsection 8.3.4.23, the applicant addresses the procedures that will be developed to address periodic testing of the EDGs, when they are required to operate in parallel with the preferred offsite sources. The applicant provides the following supplemental information as Commitment (COM 8.3-12):

> Procedure(s) which implement the testing requirements of RG 1.9 and IEEE 387 for periodic testing of diesel generator synchronizing interlocks, and to prevent incorrect synchronization whenever the diesel generator is required to operate in parallel with the preferred power supply will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-12).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.23, "Periodic Testing of Diesel Generator Synchronizing Interlock," and the guidelines of RG 1.9 and RG 1.118. COL License Information Item 8.29 is therefore acceptable.

- COL License Information Item 8.30 Periodic Testing of Thermal Overloads and Bypass Circuitry

In FSAR Subsection 8.3.4.24, the applicant addresses the procedures that will be developed for the periodic testing of thermal overloads and bypass circuits. The applicant provides the following supplemental information as Commitment (COM 8.3-13):

> Procedure(s) for the periodic testing of thermal overloads and associated bypass circuitry for Class 1E Motor Operated Valves (MOVs) to the requirements of RG 1.106 will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-13).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.24 and the guidelines of RG 1.106. COL License Information Item 8.30 is therefore acceptable.

- COL License Information Item 8.31 Periodic Inspection/Testing of Lighting Systems

In FSAR Subsection 8.3.4.25, the applicant addresses procedures that need to be developed for the periodic inspections and testing of lighting in safety-related areas. The applicant provides the following supplemental information as Commitment (COM 8.3-14):

> Procedure(s) for periodic inspection of all lighting systems installed in safety-related areas and in passageways leading to and from these areas and for periodic inspection of the lighting systems which are normally de-energized (e.g., DC-powered lamps), will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-14).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.25 and the guidelines of RG 1.118. COL License Information Item 8.31 is therefore acceptable.

- COL License Information Item 8.32 Controls for Limiting Potential Hazards in Cable Chases

In FSAR Subsection 8.3.4.26, the applicant addresses the procedures that have to be developed for the proper control of hazardous materials in cable chases. The applicant provides the following supplemental information as Commitment (COM 8.3-15):

> Procedure(s) to control and limit the introduction of potential hazards into cable chases and control room areas will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-15).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.26 and the guidelines of RG 1.39 and RG 1.189. COL License Information Item 8.32 is therefore acceptable.

- COL License Information Item 8.33 Periodic Testing of Class 1E Equipment Protective Relaying

In FSAR Subsection 8.3.4.27, the applicant addresses the required procedures to be developed for the periodic testing of Class 1E protective relays. The applicant provides the following supplemental information as Commitment (COM 8.3-16):

> Procedure(s) for the periodic testing of all protective relaying and thermal overloads associated with Class 1E motors and switchgear will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-16).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.27 and the guidelines of RG 1.118. COL License Information Item 8.33 is therefore acceptable.

- COL License Information Item 8.34 Periodic Testing of CVCF Power and EPAs

In FSAR Subsection 8.3.4.28, the applicant addresses the required procedures that need to be developed for the periodic testing of CVCF power supplies and Electrical Protection Assemblies (EPAs). The applicant provides the following supplemental information as Commitment (COM 8.3-17):

> Procedure(s) for the periodic testing of CVCF power supplies (including alarms) and associated Electrical Protection Assemblies (EPAs), which provide power to the Reactor Protection System, will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-17).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.28 and the guidelines of RG 1.118. COL License Information Item 8.34 is therefore acceptable.

- COL License Information Item 8.35 Periodic Testing of Class 1E Circuit Breakers

In FSAR Subsection 8.3.4.29, the applicant addresses the procedures to be developed for the periodic testing of Class 1E circuit breakers. The applicant provides the following supplemental information as Commitment (COM 8.3-18):

> Procedure(s) for the periodic calibration and functional testing of the fault interrupt capability of all Class 1E breakers; the fault interrupt coordination between supply and load breakers for each Class 1E load and each Division I non-Class 1E load; and each zone selective interlock feature of the breaker for each non-Class 1E load, will be developed prior to fuel load. These procedures

will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-18).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.29, "Periodic Testing of Class 1 E Circuit Breakers," and the guidelines of RG 1.118. COL License Information Item 8.35 is therefore acceptable.

- COL License Information Item 8.36 Periodic Testing of Electrical System and Equipment

In FSAR Subsection 8.3.4.30, the applicant addresses the procedures to be developed for the periodic testing of Class 1E electrical systems and equipment. The applicant provides the following supplemental information as Commitment (COM 8.3-19):

> Procedure(s) for the periodic testing of all Class 1E electrical systems and equipment in accordance with surveillance and test requirements of Section 7 of IEEE 308, will be developed prior to fuel load consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-19).

The staff reviewed the applicant's response to COL License Information Item 8.36. The staff found that the applicant plans to develop procedures for the periodic testing of electrical equipment, in accordance with surveillance and testing requirements of IEEE Std 308-1980, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations." To assure that all safety-related components will undergo periodic testing, the staff issued RAI 08.03.01-10, requesting the applicant to confirm that electrical equipment designated for periodic testing will include electrical isolation devices. In its response to RAI 08.03.01-10, dated July 22, 2009 (ML092050077), the applicant states that because Class 1E to non-Class 1E isolation devices are safety-related, they will be covered by FSAR Subsection 8.3.4.30. This subsection indicates that the applicant will develop procedures for the periodic testing of all Class 1E electrical systems and equipment, in accordance with surveillance and test requirements of Section 7, "Multiunit Station Considerations," of IEEE Std 308. The applicant, however, appears to imply that there will not be periodic testing of isolation devices in I&C circuits. The applicant reached this conclusion on the basis that IEEE Std 384, Section 7.2.1, "General," does not specifically include a requirement for the periodic testing of isolation devices in I&C circuits. That standard only requires that "the capability of a device to perform its isolation function shall be demonstrated by qualification tests."

The staff raised the following concerns:

1. The test requirement in Subsection 7.2.2.1, "General," of IEEE Std 384–1992 is only intended to confirm the isolation capability of the isolation device.

2. Appendix B, Criterion XI, "Test Control," states in part, "A test program shall be established to assure that all testing required to demonstrate that structures, systems, and components will perform satisfactorily in service" and makes no distinction between electrical and I&C components.

3. The guidance of Section 6.4, "Periodic Tests," of IEEE Std 308 requires the continuous capability of electrical devices to perform their safety function, but does not exclude isolation devices in the statement that "Tests shall be performed at scheduled intervals

to detect within practical limits the deterioration of the equipment toward an unacceptable condition."

The staff issued supplemental RAI 08.03.01-13, asking the applicant to confirm that isolation devices in I&C circuits will be included in the STP Periodic Test Program. Isolation devices include those components that are used to isolate redundant Class 1E circuits as well as safety-related circuits from nonsafety-related ones. The staff also requested the applicant to address the isolation devices in I&C circuits that are not included in the STP Periodic Test Program, by discussing how to assure that these devices will continue to perform their isolation function throughout the life of the plant.

In its response to RAI 08.03.01-13, dated November 10, 2009 (ML093170204), the applicant states that the I&C devices performing isolation functions will be included in the STP Periodic Test Program and will be tested at vendor-recommended intervals in accordance with vendor-approved test practices. The applicant also clarifies that in cases where isolation devices are not required to have periodic testing, the IEEE Std 384 qualification test is sufficient to demonstrate the capability of the isolation function. In FSAR Section 19B.3.2, "Testing of Isolators," the applicant addresses the inspection and test program for fiber optic type isolators used between safety-related and nonsafety-related systems and other types of isolators (e.g., those subject to electrical leakage due to maximum credible electrical faults) if used. Based on the above information, the staff found that the applicant's response is consistent with the requirements of GDC 18 and the guidelines of RG 1.118 and is therefore acceptable. Therefore, RAI 08.03.01-13 is resolved.

In addition, the staff issued RAI 08.03.01-8, requesting the applicant to discuss the procedures that will be developed for the periodic testing of uninterruptible power supplies that include rectifiers and inverters. The staff also requested the applicant to discuss the administrative controls that will be put in place to assure the proper control of the fuses used throughout the plant, as required by 10 CFR Part 50, "Domestic Licensing Of Production And Utilization Facilities," Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criterion III, "Design Control."

In its response to RAI 08.03.01-8, dated July 22, 2009 (ML092050077), the applicant clarifies the following as described in DCD Tier 1, Section 2.12.14:

> Each Class 1E power supply provides uninterruptible, regulated AC power to Class 1E circuits which require continuity of power during a loss of preferred power (LOPP). Each Class 1E Vital AC Power Supply is a constant voltage constant frequency (CVCF) inverter power supply unit.

The applicant also states that testing the uninterruptible Class 1E power supplies is addressed in FSAR Subsection 8.3.4.28 which states:

> Procedure(s) for the periodic testing of CVCF power supplies (including alarms) and associated Electrical Protection Assemblies (EPAs) which provide power to the Reactor Protection System will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5.

Regarding fuse control, the applicant states that as described in FSAR Subsection 13.5.3.3.1, administrative procedures will be developed based on the experiences of other STP operating plants and will be consistent with STP guidelines. The Fuse Control Program for STP, Units 1 and 2, will be used as a guideline for developing the STP, Units 3 and 4, Fuse Control Program. The staff found the applicant's response acceptable, because the applicant will develop procedures to assure the proper control of the fuses used throughout the plant. This RAI is therefore resolved.

- COL License Information Item 8.40 Periodic Testing of Class 1E CVCF Power Supplies

In FSAR Subsection 8.3.4.34, the applicant addresses the procedures that need to be developed for the periodic testing of CVCF power supplies to ensure a sufficient capacity to supply power to their connected loads. The applicant provides the following supplemental information as Commitment (COM 8.3-22):

> Procedure(s) for the periodic testing of Class 1E constant voltage constant frequency (CVCF) power supplies to ensure sufficient capacity to supply power to their connected loads, will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-22).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.34, "Periodic Testing of Class 1E CVCF Supplies," and the guidelines of RG 1.118. COL License Information Item 8.40 is therefore acceptable.

- COL License Information Item 8.42 Periodic Testing of Class 1E Diesel Generators

In FSAR Subsection 8.3.4.36, the applicant addresses the procedures that need to be developed for the periodic testing of EDGs to demonstrate their capability to supply design-basis currents. The applicant provides the following supplemental information as Commitment (COM 8.3-24):

> Procedure(s) for the periodic testing and/or analysis of Class 1E diesel generators to demonstrate their capability to satisfy the criteria in Subsection 8.3.1.1.8.2, to supply the actual full design basis load current for each sequenced load step, and to manually start each diesel generator will be developed prior to fuel load. These procedures will be developed prior to fuel load consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-24).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.36, "Periodic Testing of Class 1E Diesel Generator," and the guidelines of RGs 1.9 and 1.118. COL License Information Item 8.42 is therefore acceptable.

- COL License Information Item 9.25 Diesel Generator Requirements

In FSAR Subsection 9.5.13.8 [Items (1) and (3)], the applicant addresses the procedures that will be developed for the periodic load testing of EDGs as Commitment (COM 9.5-8). Specifically, the applicant provides the following Supplemental Information Items (1) and (3) (as they relate to EDG testing needs):

> (1) Diesel Generator procedures will be provided that require loading of the engine up to a minimum of 40% of full load (or lower per manufacturer's

recommendation) for 1 hour following up to 8 hours of continuous no-load or light-load operation. (COM 9.5-8)

(3) See Subsection 8.3.4.2 for a discussion of diesel generator no-load or low-load operation.

The staff reviewed the site-specific supplemental information included in FSAR Subsection 9.5.13.8. This subsection pertains to procedures that will be developed for the load testing of EDGs. The staff observed that in Item (3), the applicant refers to Subsection 8.3.4.2 for a discussion of EDG no-load or low-load operations. However, the referenced subsection does not address no-load or low-load operations. Therefore, the staff issued RAI 08.03.01-11, requesting the applicant to clarify the statement and either provide an appropriate reference or discuss the issue in the referenced subsection. In its response to RAI 08.03.01-11, dated July 22, 2009 (ML092050077), the applicant proposes to delete Item (3) in FSAR Subsection 9.5.13.8. The staff found the response acceptable and this issue is resolved. The staff confirmed that this change is incorporated in the FSAR Revision 6. Therefore, RAI 08.03.01-11 is closed.

The NRC staff found that the applicant's information is consistent with DCD Subsection 9.5.13.8, "Diesel Generator Requirements," and the guidelines of RG 1.9 and RG 1.118. COL License Information Item 9.25 is therefore acceptable.

8.3.1.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 8.3-1) – Procure documents and develop plant procedures consistent with the guidelines of RG 1.9 to demonstrate that each EDG is capable of reaching full speed and voltage within 20 seconds.
- Commitment (COM 8.3-2) – Develop plant procedures to demonstrate the functional capability of the electrical penetration assembly protective devices to perform their required safety functions.
- Commitment (COM 8.3-3) – Develop plant procedures to prevent the simultaneous de-energization of all divisional buses upon the loss of one offsite power supply.
- Commitment (COM 8.3-4) – Perform an analysis to address the adequacy of the voltage at the device load from Class 1E switchgear and motor control centers.
- Commitment (COM 8.3-5) – Develop plant procedures to assure that the bus grounding circuit devices are properly controlled.
- Commitment (COM 8.3-6) – Develop plant procedures to prevent paralleling of redundant onsite Class 1E power supplies from different buses and sources to power plant loads.
- Commitment (COM 8.3-8) – Develop plant procedures to assure that access to the Class 1E Power Equipment is administratively controlled.

- Commitment (COM 8.3-9) – Develop plant procedures consistent with the guidelines of RG 1.118 to assure that electrical equipment for the protection of the electrical distribution system is periodically tested.

- Commitment (COM 8.3-10) – Develop plant procedures for periodic testing of the diesel generator interlocks which restore units to emergency standby in the event of a LOCA or LOPP.

- Commitment (COM 8.3-11) – Develop plant procedures consistent with the guidelines of RG 1.9 for periodic testing of diesel generator protective relaying, bypass circuitry, and annunciation when the diesel generators are required to operate in parallel with the preferred offsite sources.

- Commitment (COM 8.3-12) – Develop plant procedures consistent with the guidelines of RG 1.9 for periodic testing of diesel generator synchronizing interlocks, and to prevent incorrect synchronization whenever the diesel generator is required to operate in parallel with the preferred power supply.

- Commitment (COM 8.3-13) – Develop plant procedures consistent with the guidelines of RG 1.106 for the periodic testing of thermal overloads and associated bypass circuitry for Class 1E MOVs.

- Commitment (COM 8.3-14) – Develop plant procedures for periodic inspection of all lighting systems installed in safety-related areas and in passageways leading to and from these areas and for periodic inspection of the lighting systems which are normally de-energized.

- Commitment (COM 8.3-15) – Develop plant procedures to control and limit the introduction of potential hazards into cable chases and control room areas.

- Commitment (COM 8.3-16) – Develop plant procedures for the periodic testing of all protective relaying and thermal overloads associated with Class 1E motors and switchgear.

- Commitment (COM 8.3-17) – Develop plant procedures for periodic testing of CVCF power supplies and associated EPAs which provide power to the Reactor Protection System.

- Commitment (COM 8.3-18) – Develop plant procedures for the periodic calibration and functional testing of the fault interrupt capability and coordination of all Class 1E breakers.

- Commitment (COM 8.3-19) – Develop plant procedures for the periodic testing of all Class 1E electrical systems and equipment.

- Commitment (COM 8.3-22) – Develop plant procedures for the periodic testing of Class 1E constant voltage constant frequency power supplies to ensure that they have sufficient capacity to supply power to their connected loads.

- Commitment (COM 8.3-24) – Develop plant procedures for the periodic testing of diesel generators to demonstrate their capability to supply design basis currents.

- Commitment (COM 9.5-8) – Develop plant procedures for the periodic testing of diesel generators for light load operation.

8.3.1.6 *Conclusion*

The NRC staff's finding related to information incorporated by reference is in NUREG–1503. The NRC 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 onsite ac power 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 onsite ac power 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 8.3.1 of NUREG-0800. The staff's review concluded that the applicant has adequately addressed the COL license information items and the Tier 1 and Tier 2 departures requiring prior NRC approval in accordance with Section 8.3 of NUREG-0800 and 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.

8.3.2 DC Power System

8.3.2.1 *Introduction*

This section of the FSAR provides descriptive information, analyses, and referenced documents including electrical single-line diagrams, electrical schematics, logic diagrams, tables, and physical arrangement drawings for the onsite dc power system.

The plant's dc power system is comprised of independent Class 1E and non-Class 1E dc power systems. Each system consists of ungrounded stationary batteries, dc distribution equipment, and an uninterruptible power supply.

The Class 1E dc system provides reliable power for the safety-related equipment required for the plant instrumentation, control, monitoring, and other vital functions needed to shut down the plant. In addition, the Class 1E dc system provides power to the emergency lighting in the MCR and at the remote shutdown control panel.

8.3.2.2 *Summary of Application*

Section 8.3.2 of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Section 8.3.2 of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Section 8.3.2, the applicant provides the following:

Tier 1 Departures

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

This departure discusses safety-related I&C architecture, as it relates to 125 Vdc loads. This departure is evaluated in Chapter 7 of this SER.

Tier 2 Departures Requiring Prior NRC Approval

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

This departure discusses voltage levels for the plant medium voltage electrical system. This departure is also addressed in SER Section 8.3.1.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 1.1-2 Dual Units at STP 3 & 4 (Table 8.2-1)

This departure addresses the applicability of GDC 5 and RG 1.81 to the STP-specific design. This departure is addressed in Section 8.3.1, "AC Power Systems."

- STD DEP Admin

The applicant provides editorial changes in FSAR Subsections 8.3.2.1.3.1.1 and 8.3.2.1.3.5. The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced DCD (i.e., misspellings, incorrect references, table headings, etc.).

COL License Information Items

- COL License Information Item 8.10 Protective Devices for Electrical Penetration Assemblies

The applicant provides supplemental information to address COL License Information Item 8.10 to develop procedures that demonstrate the functional capability of the electrical penetration assembly protective devices. (COM 8.3-2).

- COL License Information Item 8.19 Load Testing of Class 1E Switchgear and Motor Control Centers

The applicant provides supplemental information to address COL License Information Item 8.19 to develop methods that will assure the availability of adequate voltage at the Class 1E loads. (COM 8.3-4).

- COL License Information Item 8.23 Common Industrial Standards Referenced in Purchase Specifications

The applicant provides supplemental information to address COL License Information Item 8.23 pertaining to the inclusion of appropriate industry standards in the purchase documents of Class 1E and non-Class 1E equipment.

- COL License Information Item 8.25 Control of Access to Class 1E Power Equipment

The applicant provides supplemental information to address COL License Information Item 8.25 to develop procedures for access control to Class 1E equipment. (COM 8.3-8).

- COL License Information Item 8.30 Periodic Testing of Thermal Overloads and Bypass Circuitry

The applicant provides supplemental information to address COL License Information Item 8.30 to develop procedures for the periodic testing of thermal overloads and bypass circuitry for Class 1E MOVs, in accordance with RG 1.106. (COM 8.3-13).

- COL License Information Item 8.31 Periodic Inspection/Testing of Lighting Systems

The applicant provides supplemental information to address COL License Information Item 8.31 to prepare procedures for the periodic inspection and testing of the lighting system in safety-related areas. (COM 8.3-14).

- COL License Information Item 8.32 Control for Limiting Potential Hazards into Cable Chases

The applicant provides supplemental information to address COL License Information Item 8.32 to develop procedures that will control and limit the introduction of potential hazards into cable chases. (COM 8.3-15).

- COL License Information Item 8.33 Periodic Testing of Class 1E Equipment Protective Relaying

The applicant provides supplemental information to address COL License Information Item 8.33 to prepare procedures for the periodic testing of protective relays and overload associated with Class 1E motor and switchgear equipment. (COM 8.3-16).

- COL License Information Item 8.35 Periodic Testing of Class 1E Circuit Breakers

The applicant provides supplemental information to address COL License Information Item 8.35 to prepare procedures for the periodic calibration and functional testing of the fault interrupting capability of Class 1E circuit breakers. (COM 8.3-18).

- COL License Information Item 8.36 Periodic Testing of Electrical Systems and Equipment

The applicant provides supplemental information to address COL License Information Item 8.36 to develop procedures for the periodic testing of Class 1E electrical systems and equipment. (COM 8.3-19).

The above COL license information items are evaluated in Subsection 8.3.1.4.

- COL License Information Item 8.24 Administrative Controls for Switching 125 VDC Standby Charger

The applicant provides supplemental information to address COL License Information Item 8.24 to develop plant operating procedures and administrative key controls for the standby battery charger. (COM 8.3-7).

- COL License Information Item 8.38 Class 1E Battery Installation and Maintenance Requirements

The applicant provides supplemental information to address COL License Information Item 8.38 to prepare procedures for the installation, maintenance, testing, and replacement of Class 1E station batteries. (COM 8.3-20).

- COL License Information Item 8.39 Periodic Testing of Class 1E Batteries

The applicant provides supplemental information to address COL License Information Item 8.39 to develop procedures for the periodic testing of Class 1E batteries to ensure that they have sufficient capacity and capability to supply power to the connected loads. (COM 8.3-21).

- COL License Information Item 8.41 Periodic Testing of Class 1E Battery Chargers

The applicant provides supplemental information to address COL License Information Item 8.41 to prepare procedures for the periodic testing of Class 1E battery chargers. (COM 8.3-23).

8.3.2.3 *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 dc power system, and the associated acceptance criteria, are in Section 8.3.2 of NUREG–0800.

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 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.

Specifically, in addition to Section 8.3.2 of NUREG–0800, the regulatory guidance for accepting the Tier 2 departures, COL license information items, and supplements is established as follows:

Tier 2 Departures Requiring Prior NRC Approval

Departure STD DEP 8.3-1 (Figure 8.3-1) affects TS and is subject to the requirements of GDC 17 and the guidelines of RG 1.32.

Tier 2 Departures Not Requiring Prior NRC Approval

Tier 2 departures are subject to the requirements of Section VIII.B.5 of 10 CFR Part 52, Appendix A, which are similar to the requirements in 10 CFR 50.59.

COL License Information Items

- COL License Information Item 8.24 is subject to the guidelines of SRP Section 13.5.1.
- COL License Information Item 8.38 is subject to the requirements of GDC 18 and the guidelines of RG 1.128, Revision 2, "Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants."
- COL License Information Items 8.39 and 8.41 are subject to the requirements of GDC 18 and the guidelines of RG 1.118.

8.3.2.4 *Technical Evaluation*

As documented in NUREG–1503, the NRC staff reviewed and approved Section 8.3.2 of the certified ABWR DCD. The staff reviewed Section 8.3.2 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 relevant information related to this section.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Requiring Prior NRC Approval

The following Tier 2 departures identified by the applicant in this section require prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this SER. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 2 departure.

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

In FSAR Subsection 8.3.2.1.2, the applicant addresses the uses of dc power and provides the following information:

> The 125 VDC Class 1E power is required for emergency lighting, diesel-generator field flashing, control and switching functions such as the control of medium voltage and 480V switchgear, control relays, meters and indicators, multiplexers, vital AC power supplies, as well as DC components used in the reactor core isolation cooling system.

The NRC staff noted that the applicant had deleted a reference to the 6.9 kV from 6.9 kV medium voltage. This departure is acceptable because this deletion does not affect the above description. Also, the departure is consistent with the requirements of GDC 17 and the guidelines of RG 1.32.

[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 Admin

The applicant provides editorial changes in FSAR Subsections 8.3.2.1.3.1.1 and 8.3.2.1.3.5. In FSAR Subsection 8.3.2.1.3.1.1, the applicant deletes an incorrect reference to Subsection 8.3.4.6 which no longer exists. In FSAR Subsection 8.3.2.1.3.5, the applicant adds a reference to Section 1C.4.1, "Station Blackout Procedures," for COL license information.

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.

COL License Information Items

- COL License Information Item 8.24 Administrative Controls for Switching 125 VDC Standby Charger

In Subsection 8.3.4.18, the applicant discusses the procedures that will be developed to assure that the switching of the 125 Vdc battery charger is properly controlled. The applicant provides the following supplemental information as Commitment (COM 8.3-7):

> Plant operating procedure(s) and administrative key controls will be developed prior to fuel load to assure that all input and output circuit breakers for the standby battery charger are in the open position when the charger is not in use, and at least two circuit breakers in series are verified to be open between redundant divisions when the standby charger is placed into service (Subsection 8.3.2.1.3). The interlocks are also addressed in the single line diagrams (Figures 8.3-1). These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-7)

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.18, "Administrative Controls for Switching 125 VDC Standby Charger," and the guidelines of SRP Section 13.5.1. COL License Information Item 8.24 is therefore acceptable.

- COL License Information Item 8.38 Class 1E Battery Installation and Maintenance Requirements

In Subsection 8.3.4.32, the applicant addresses the procedures that that have to be developed for the installation, maintenance, periodic testing, and replacement of Class 1E station batteries. The applicant provides the following supplemental information as Commitment (COM 8.3-20):

> Procedure(s) for the installation, maintenance, testing and replacement of Class 1E station batteries which meet the requirements of IEEE 484 and Section 5 of IEEE 946, will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-20).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.32, "Class 1E Battery Installation and Maintenance Requirements," the requirements of GDC 18, and the guidance of RG 1.128. COL License Information Item 8.38 is therefore acceptable.

- COL License Information Item 8.39 Periodic Testing of Class 1E Batteries

In Subsection 8.3.4.33, the applicant addresses the procedures that need to be developed for the periodic testing of Class 1E station batteries to ensure sufficient capacity and capability to supply power to their connected loads. The applicant provides the following supplemental information as Commitment (COM 8.3-21):

> Procedure(s) for the periodic testing of Class 1E station batteries in accordance with the requirements of Section 7 of IEEE 308 to ensure sufficient capacity and capability to supply power to their connected loads will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-21).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.33, "Periodic Testing of Class1E Batteries," and the requirements of GDC 18 and the guidelines of RG 1.118. COL License Information Item 8.39 is therefore acceptable.

- COL License Information Item 8.41 Periodic Testing of Class 1E Battery Chargers

In Subsection 8.3.4.35, the applicant addresses the procedures that need to be developed for the periodic testing of Class 1E battery chargers. The applicant provides the following information as Commitment (COM 8.3-23):

> Procedure(s) for the periodic testing of Class 1E battery chargers to ensure sufficient capacity to supply power to their connected loads will be developed prior to fuel load. These procedures will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 8.3-23).

The NRC staff found that the applicant's information is consistent with DCD Subsection 8.3.4.35, "Periodic Testing of Class1E Battery Chargers," the requirements of GDC 18, and the guidelines of RG 1.118. COL License Information Item 8.41 is therefore acceptable.

8.3.2.5 *Post Combined License Activities*

The applicant identifies the following commitments:

- Commitment (COM 8.3-2) – Develop plant procedures to demonstrate the functional capability of the electrical penetration assembly protective devices to perform their required safety functions.

- Commitment (COM 8.3-4) – Perform an analysis to address the adequacy of the voltage at the device load from Class 1E switchgear and motor control centers.

- Commitment (COM 8.3-7) – Develop plant operating procedures and administrative key controls to ensure that the standby battery charger is correctly placed into and removed from service.

- Commitment (COM 8.3-8) – Develop plant procedures to assure that access to the Class 1E Power Equipment is administratively controlled.

- Commitment (COM 8.3-13) – Develop plant procedures consistent with the guidelines of RG 1.106 for the periodic testing of thermal overloads and associated bypass circuitry for Class 1E MOVs.

- Commitment (COM 8.3-14) – Develop plant procedures for periodic inspection of all lighting systems installed in safety-related areas and in passageways leading to and from these areas and for periodic inspection of the lighting systems which are normally de-energized.

- Commitment (COM 8.3-15) – Develop plant procedures to control and limit the introduction of potential hazards into cable chases and control room areas.

- Commitment (COM 8.3-16) – Develop plant procedures for the periodic testing of all protective relaying and thermal overloads associated with Class 1E motors and switchgear.

- Commitment (COM 8.3-18) – Develop plant procedures for the periodic calibration and functional testing of the fault interrupt capability and coordination of all Class 1E breakers.

- Commitment (COM 8.3-19) – Develop plant procedures for the periodic testing of all Class 1E electrical systems and equipment.

- Commitment (COM 8.3-20) – Develop plant procedures for the installation, maintenance, testing, and replacement of Class 1E station batteries.

- Commitment (COM 8.3-21) – Develop plant procedures for the periodic testing of Class 1E station batteries.

- Commitment (COM 8.3-23) – Develop plant procedures for the periodic testing of Class 1E battery chargers.

8.3.2.6 *Conclusion*

The NRC staff's finding related to information incorporated by reference is in NUREG–1503. The NRC 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 onsite dc power 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 onsite dc power 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 8.3.2 of NUREG-0800. The staff's review concluded that the applicant has adequately addressed the COL license information items, and Tier 2 departure requiring prior NRC approval in accordance with Section 8.3.2 of NUREG-0800 and 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.

8.4S Station Blackout

The applicant addresses the compliance of STP, Units 3 and 4, with 10 CFR 50.63, “Loss of All Alternating Current Power,” in Appendix 1C of the COL FSAR.

8.4S.1 Introduction

The requirements of 10 CFR 50.63, state that all nuclear power plants must have the capability to “withstand for a specified duration and recover from a station blackout.” The term “station blackout” refers to the complete loss of all AAC electric power to the essential and nonessential switchgear buses in a nuclear power plant, concurrent with a turbine trip and the unavailability of an emergency ac power system (typically the EDGs). In FSAR Appendix 1C, the applicant describes how STP, Units 3 and 4, conform to the ABWR DCD, the requirements of 10 CFR 50.63, and the guidelines of RG 1.155.

The CTG provides an additional source of electric power to the plant systems. The primary functions of the CTG are to provide: (1) the AAC power source during the SBO event, as defined in RG 1.155; (2) a standby, nonsafety-related power source located on the site to energize nonsafety-related PIP loads during LOPP events; and (3) a standby power source during shutdown operations. The CTG is discussed in Section 9.5.11, “Combustion Turbine/Generator,” of the STP, Units 3 and 4, FSAR.

8.4S.2 Summary of Application

Appendix 1C and Section 9.5.11 of the STP, Units 3 and 4, COL FSAR Revision 12 incorporates by reference Appendix 1C and Sections 9.5.11 and 9.5.13, “COL License Information,” of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 1C and Sections 9.5.11 and 9.5.13, the applicant provides the following:

Tier 2 Departures*

- STD DEP 1.8-1 — Tier 2* Codes, Standard and Regulatory Guide Edition Changes (Table 1C-3)

This departure updates the FSAR to refer to the 2006 International Building Code (IBC) and deletes the 1991 Uniform Building Code. This change incorporates the requirements of the Texas Building Code, which has adopted the 2006 IBC.

Tier 2 Departures Requiring Prior NRC Approval

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

This departure addresses the design basis of the CTG and its use during normal plant operations and as an AAC power source (and changes to reference in Tables 1C-1, “ABWR Design Compliance with 10CFR50.63 Regulations,” through 1C-3, “ABWR Design Compliance with NUMARC 87-00 Guidelines”).

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP Admin

In FSAR Section 1C, "ABWR Station Blackout Considerations," the applicant has proposed some editorial changes to Tables 1C-1, 1C-2, "ABWR Design Compliance with RG 1.155," and 1C-3 regarding station blackout considerations. The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced DCD (i.e., misspellings, incorrect references, table headings, etc.).

COL License Information Items

- COL License Information Item 1.13 Station Blackout Procedures

The applicant provides supplemental information to develop SBO procedures (COM 1C-1).

- COL License Information Item 9.36 Periodic Testing of Combustible Turbine Generator (CTG)

The applicant provides supplemental information describing the periodic tests that will be performed to demonstrate the capability of the CTG to power the load buses within the specified amount of time.

- COL License Information Item 9.37 Operating Procedures for Station Blackout

The applicant provides site-specific supplement information describing the content of the procedures that will be developed to address an SBO event (COM 1C-1).

- COL License Information Item 9.38 Quality Assurance Requirements for CTG

The applicant provides site-specific supplement information describing the Quality Assurance Program (QAP) for an SBO event and the procedures that will be developed to address the SSCs associated with this event.

8.4S.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 SBO, and the associated acceptance criteria, are in Section 8.4 of NUREG–0800.

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 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 affecting TS are subject to the requirements of 10 CFR Part 52, Appendix A, Section VIII.C.4.

In addition to the guidance in Section 8.4 of NUREG–0800, the regulatory bases for accepting the Tier 2* and Tier 2 departures, the COL license information items, and the supplements are established as follows:

Tier 2 Departures*

Departure STD DEP 1.8-1 (Table 1C-3) is subject to the applicability of the building codes for the turbine building, where the CTG is housed, and the general guidance of RG 1.155.

Tier 2 Departures Requiring Prior NRC Approval

Departure STD DEP 8.3-1 is subject to the requirements of 10 CFR 50.63 and the guidelines of RG 1.155.

Tier 2 Departures Not Requiring Prior NRC Approval

Departure STD DEP Admin is subject to the requirements of Section VIII.B.5 of 10 CFR Part 52, Appendix A, which are similar to the requirements in 10 CFR 50.59.

COL License Information Items

- COL License Information Item 1.13 is subject to the requirements of 10 CFR 50.63 and the guidelines of RG 1.155.
- COL License Information Item 9.36 is subject to the requirements of 10 CFR 50.63 and the guidelines of RG 1.155.
- COL License Information Item 9.37 is subject to the requirements of 10 CFR 50.63 and the guidelines of RG 1.155.
- COL License Information Item 9.38 is subject to the requirements of 10 CFR 50.63 and the guidelines of RG 1.155.

8.4S.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Appendix 1C and Sections 9.5.11 and 9.5.13 of the certified ABWR DCD. The staff reviewed Appendix 1C and Sections 9.5.11 and 9.5.13 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 SBO.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures*

The following Tier 2* departure identified by the applicant in this section require prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 2* departure.

[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 1.8.1 Tier 2* Codes, Standard and Regulatory Guide Edition Changes

In Subsection 1C.2.2.2, the applicant addresses the physical location of the CTG and the STP AAC source and states:

> The CTG will be housed in an International Building Code (IBC) structure which is protected from adverse site weather related conditions.

The NRC staff reviewed the applicant's statement pertaining to the location of the AAC. The review found that the information is consistent with the Nuclear Management and Resources Council (NUMARC) 87-00, Revision 1, "Guidelines and Technical Basis for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," which is endorsed by RG 1.155 and referenced in SRP Section 8.4. Therefore, this departure is acceptable.

Tier 2 Departures Requiring Prior NRC Approval

The following Tier 2 departure identified by the applicant in this section require prior NRC approval and the full scope of its technical impact may be evaluated in the other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by this Tier 2 departure.

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

In Subsection 1C.2.2.2, the applicant addresses the design basis of the CTG and the STP AAC source and states:

> The CTG will automatically start, accelerate to required speed, reach required voltage and frequency and be ready to accept PIP loads in less than 10 minutes of the receipt of its start signal.

Additionally, in Table 1C-3, "ABWR Design Compliance with Nuclear Management and Resources Council (NUMARC) 87-00 Guidelines," under Appendix A "Compliance," the applicant identifies the following departure from the ABWR DCD:

> i. Non-Class 1E normally open breakers, rather than a single breaker, separate the AAC CTG from the non-safety-related PIP buses (preferred power) (see Figure 8.3- 1).
>
> ii. The AAC power source automatically starts and is available for loading in less than 10 minutes, rather than 2 minutes.
>
> iii. The AAC power source automatically starts on LOPP, attains required speed and voltage in less than ten (10) minutes rather than 2 minutes.
>
> iv. The ABWR AAC power source is rated a minimum of 20, rather than 9 MWe. The shutdown loads are less than 7.2, rather than 5 MWe.

In addition, in Table IC-2, "ABWR Design Compliance with RG 1.155," the applicant identifies the following departures:

- The ABWR AAC power source is not normally connected to the preferred or the onsite emergency AC power system. At least two open circuit breakers, one Class 1E and the others non-Class 1E, separate the CTG from the safety-related emergency buses.

- The AAC power source is also not normally connected to any of the preferred AC power sources or their associated non-safety-related buses. At least two non-Class 1E circuit breakers separate the CTG from the PIP buses.

- At least two breakers separate the onsite emergency power buses from the CTG. One breaker is Class 1E and the breaker closest to the CTG is non-Class 1E (see Figure 8.3-1).

The NRC staff reviewed FSAR Table 1C-3. The requirements of 10 CFR 50.63 state that no coping analysis is required if the applicant demonstrates that an AAC source is available within ten minutes of the onset of an SBO. The staff issued RAI 08.04-1 requesting the applicant to discuss: (a) the time required to identify the existence of an SBO (when the SBO clock starts); (b) the time it will take to energize all required loads; and (c) the time it will take to energize the emergency bus when the AAC source is connected to a non-safety bus. In its response to RAI 08.04-1, dated July 22, 2009 (ML092050077), the applicant states the following:

> As discussed in Appendix I to NUMARC 87-00, the SBO "clock" starts after the immediate steps in the EOPs have been taken to verify the SCRAM (primary system parameters, etc.) and after the attempt to restore offsite power and start the EDGs from the control room per the EOP's. Because these procedures are not yet developed, a precise timeline cannot be established.
>
> The initial required loads (e.g., the RCIC system) are energized automatically and are not dependent on AC sources. Additionally, as discussed in DCD Table 1C-1, the CTG will start and automatically connect to a nonsafety bus. The re-alignment of the CTG to feed the prealigned Class 1E bus will require the tripping of the feed to the nonsafety bus and the manual closure of two circuit breakers from the control room. Manual actions will be required after the connection of the CTG to the Class 1E system. However, because these procedures are not yet developed, a precise timeline cannot be established.
>
> In the event of an SBO, the CTG will be running based on a loss of voltage signal from the PIP buses. So the only additional actions remaining will be the alignment of the CTG to feed the Class 1E bus. Because these procedures are not yet developed, a precise timeline cannot be established. However, due to the simplicity of the operation and the automatic start of the CTG, the applicant concludes that this operation can easily be performed to meet the NUMARC 87-00 time requirement.

The NRC staff noted that during an SBO inspection at one of the operating plants, it took as long as 15 minutes to declare the onset of an SBO after going through the emergency operating procedures and bringing the AAC power source to the safety-related bus in the next 10 minutes. As a result, this plant was in an unanalyzed condition for almost 25 minutes. This is inconsistent with the requirements of 10 CFR 50.63, which requires that the ten minute criterion shall start as soon as the plant loses both onsite and offsite power to the emergency buses. Therefore, the staff has determined that no additional time is allowed to restore the offsite power source or restart the EDG from the control room in order to determine the onset of an SBO.

Therefore, in RAI 08.04-4, the staff requested the applicant to revise its response to either demonstrate that the total time to identify the existence of an SBO and bringing the AAC power source to the safety-related bus can be accomplished within the ten minute criterion, or provide an ac-independent coping analysis for one hour. In its supplemental response to RAI 08.04-4, dated August 4, 2010 (ML102180177), the applicant states that:

> During the first 10 minutes of an SBO, the reactor will have automatically tripped, the main steam isolation valves (MSIVs) closed, and the reactor core isolation cooling (RCIC) actuated. The RCIC system will automatically control reactor coolant level. Any necessary relief valve operation will also be automatic. Within the 10 minute SBO interval, none of the above actions will require AC power or manual operator actions.
>
> In response to a LOOP, the CTG will automatically progress through its starting sequence in parallel with the operator performing the immediate steps in the EOPs. This sequence is described in FSAR Subsection 8.3.1.1.7(9) as follows:
>
>> In such an event, the CTG will automatically start and achieve rated speed and voltage in less than ten minutes. The CTG will then automatically assume pre-selected loads on the PIP buses. With the diesel generators unavailable, the reactor operator will manually shed PIP loads and connect the non-Class 1E CTG with the required shutdown loads within ten minutes of the event initiation. Specifically, the operator will energize one of the Class 1E distribution system buses by closing each of the circuit breakers (via controls in the main control room) between the CTG unit and the Class 1E bus. The circuit breaker closest to the Class 1E bus is Class 1E, and the other breakers are non-Class 1E. Later, the operator will energize other safety-related and non-safety-related loads, as appropriate, to complete the shutdown process.
>
> These actions (i.e., the CTG start sequence, automatic connections to the PIP bus, operator actions to verify or establish the appropriate conditions for energization of a Class 1E bus, and closing breakers to energize the Class 1E bus) must be completed in less than 10 minutes from the start of the SBO event. All circuit breakers required to perform these tasks are operable from the main control room.
>
> Additionally, FSAR Subsection 14.2.12.1.45.4(3)(m), which describes the pre-operational testing of the CTG, will confirm that this sequence can be completed within 10 minutes. Therefore, in accordance with 10 CFR 50.63(c)(2), an SBO coping analysis is not required because the AAC source will be demonstrated by test to be available to power the shutdown buses within 10 minutes of the onset of an SBO.

The NRC staff reviewed the applicant’s response and found that the applicant has adequately addressed the issue. The staff found that the applicant’s response is consistent with the guidance of RG 1.155 and NUMARC 87–00, and, therefore, RAI 08.04-1 and RAI 08.04-4 are resolved. As part of this response the applicant plans to make minor editorial changes in Subsection 9.5.11.1, and 9.5.13.19(3), and Table 1C-3. The staff found these editorial changes acceptable. The staff confirmed that the applicant's proposed changes are incorporated in the FSAR Revision 4, Subsections 9.5.11.1 and 9.5.13.19(3), and Table 1C-3. Therefore, RAI 08.04-4 is closed.

In addition, in Subsection 1C.2.3.1.1, the applicant addresses the uses of the CTG during normal plant operations and states:

> The normal and alternate preferred AC power sources supply safety-related and non-safety-related loads. Power to these loads is supplied from the unit auxiliary transformers (UATs) units and the reserve auxiliary transformers (RATs).
>
> The CTG is designed to supply standby power to the non-Class 1E 4.16 kV buses which carry the plant investment protection (PIP) loads. The CTG automatically starts on detection of under voltage on the PIP buses. When the CTG is ready to assume load, if the voltage is still deficient, power automatically transfers to the CTG (refer to Figure 8.3-1).
>
> The CTG can also supply standby power to the non-Class 1E 13.8 kV power generation buses which supply condensate and condensate booster pumps. These buses normally receive power from the unit auxiliary transformers. Breakers on the CTG buses and power generation buses may be manually reclosed if it is desired to operate a condensate and condensate booster pump from the combustion turbine generator or the reserve auxiliary transformer. This arrangement allows the powering of load groups of non-Class 1E equipment in addition to the Class 1E divisions which may be used to supply water to the reactor vessel (refer to Figure 8.3-1).

The staff reviewed the applicant's statements and departures from the ABWR DCD. The staff found that the intended uses for the CTG are reasonable and do not prevent it from also performing its AAC functions.

Additionally, in various subsections and tables, the applicant addresses: (1) the required connection time for the CTG (i.e., the CTG will reach operational speed and voltage in less than ten minutes rather than in the ABWR-specified two minutes); (2) bus voltage levels (i.e., 4.16 kV and 13.8 kV rather than the ABWR-specified 6.9 kV); (3) the CTG rating (i.e., the CTG will be rated at a minimum of 20 MWe rather than the 9 MWe specified in the DCD); and (4) the rating of the EDG (i.e., 7.2 MWe rather than the DCD-specified 5 MWe).

The staff reviewed these STP-specific departures from the DCD-specified values. The staff found that the departures are reasonable and conform to the requirements of 10 CFR 50.63 and the guidelines of RG 1.155. In particular, the CTG has an adequate capacity to support the required loads and is capable of being placed in operation within the maximum time allowed by 10 CFR 50.63 and RG 1.155 (i.e., ten minutes), without a coping analysis. As for the CTG voltage output rating, the staff found that it conforms to the medium voltage system design of the STP plant. As previously stated, the STP-specific medium voltage levels used conform to industry standards and are therefore acceptable.

Also in Subsection 9.5.11.1, the applicant addresses the design basis of the CTG and provides the following information regarding the STP departure from the ABWR DCD:

> (1) The CTG unit shall automatically start, accelerate to required speed, reach nominal voltage and frequency, and begin accepting load within ten minutes of receipt of its start signal.
>
> (4) The CTG shall have an ISO rating (continuous rating at site conditions) of at least 20 MW, with nominal output voltage of 13.8 kV at 60 Hz.

The staff's review of the departures described in the above subsection determined that they involve a change from two to ten minutes in the time required for the CTG to be ready to accept loads. Additionally, the power rating of the STP CTG was changed from 9 MWe to 20 MWe at 13.8 kV. This change in the CTG power rating is conservative and acceptable. With this larger size, the CTG will require more than two minutes to achieve the rated voltage and speed. The staff reviewed these departures and found that the changes are consistent with the design of the electrical system and conform to the requirements of 10 CFR 50.63 and the guidelines of RG 1.155. Also, the proposed change for the CTG to be ready to accept loads in ten minutes satisfies the ten-minute requirement of 10 CFR 50.63. The changes, as stated in the above departures, are therefore acceptable.

Additionally, in Subsection 9.5.11.2, the applicant provides the functional description of the CTG. At the same time, the applicant revises the PIP and Class 1E bus voltage level in the system description to concur with the level specified for STP, Units 3 and 4. Specifically, the applicant provides the following information:

> The CTG is designed to supply standby power to selected loads on any two of the three turbine building (Non-Class 1E) 4.16 kV buses which carry the plant investment protection (PIP) loads during LOPP events. The CTG automatically starts on detection of a voltage of ≤ 70% on its pre-selected PIP buses. When the CTG is ready to load, if the voltage level is still deficient, power is automatically transferred to the CTG.
>
> Manually controlled breakers also provide the capability of connecting the combustion turbine generator to any of the 4.16 kV Class 1E buses if all other power sources are lost. The reconfiguration necessary to shed PIP and connect the CTG to a pre-selected bus for emergency shutdown loads can be accomplished from the main control room within 10 minutes of the onset of a postulated station blackout event. Thus, the CTG meets the requirements for alternate AC (AAC) source (per Regulatory Guide 1.155) such that a station blackout coping analysis is not required. The additional connection capability for the remaining Class 1E buses enables the operator to start and operate redundant shutdown loads and other equipment loads if necessary.

The staff reviewed the information described in the above subsection. The staff determined that the departures involve a change in the voltage of the buses to be supplied by the CTG. This change is consistent with the change in the medium voltage level and is therefore acceptable.

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP Admin

This departure pertains to the deletion of not applicable or incorrect statements in the ABWR design description. Specifically, in Item (2) of Table 1C-1, the applicant deletes a statement indicating that "the ABWR design is a single unit plant arrangement design." The applicant is using a two-unit ABWR design. Also, in Table 1C-2 of the ABWR DCD, the applicant deletes the title, "Water Sources (Existing Condensate Storage Tank or Alternate)," which was incorrectly included under the heading, "Instrument Air (Compressed Air System)."

Additionally, in Table 1C-3 Item B.2, the applicant identifies the following departure from the ABWR DCD:

> The ABWR AAC power source is housed in a International Building Code (IBC) Building (Turbine Building), [rather than in a Uniform Building Code Building.]

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. The staff reviewed the revisions to Tables 1C-1, 1C-2 and 1C-3 and found that they are appropriate in that they address the differences between the STP design and the ABWR design. Additionally, the staff's review of the applicant's statement pertaining to the location of the AAC found that it is consistent with the NUMARC 87-00 guidelines endorsed by RG 1.155 and referenced by SRP Section 8.4. Therefore, the staff found it reasonable that this departure does not require prior NRC approval.

COL License Information Items

- COL License Information Item 1.13 Station Blackout Procedures
- COL License Information Item 9.37 Operating Procedures for Station Blackout

In Section 1C.4.1, the applicant provides the following supplemental information addressing COL License Information Item 1.13 as Commitment (COM 1C-1):

> The station blackout procedure(s) will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 1C-1).

In Subsection 9.5.13.20, the applicant provides the following site-specific supplemental information to address COL License Information Item 9.37:

> The station blackout procedure(s) will provide the direction to:
>
> 1) Operate the Alternate AC-CTG during an SBO event
>
> 2) Restore other plant offsite (preferred) and onsite emergency power sources as soon as possible
>
> 3) Recover plant heating, ventilation, and air conditioning (HVAC) Systems as soon as possible to limit heat increase

4) Provide additional core, containment, and vital equipment makeup and cooling services, as necessary

5) Establish orderly plant safe shutdown conditions

The station blackout procedure(s) will be developed consistent with the plant operating procedure development plan in Section 13.5. (COM 1C-1).

The staff reviewed the supplemental information to address the COL license information items cited in Section 1C.4.1 and Subsection 9.5.13.20 regarding SBO procedures. According to NUMARC 87-00, endorsed by RG 1.155, and referenced by SRP Section 8.4, the SBO response procedures include: (1) SBO Response Guidelines; (2) ac Power Restoration; and (3) Severe Weather Guidelines. The staff reviewed Subsection 9.5.13.20 of the FSAR, in which the applicant identified the operating procedures to address an SBO event. The staff found that the applicant's description of the operating procedures did not address severe weather guidelines. Therefore, the staff issued RAI 08.04-2, requesting the applicant to confirm that the STP SBO procedures included the three topics. Additionally, the staff requested the applicant to discuss the SBO procedures training that will be provided to the plant personnel.

In its response to RAI 08.04-2, dated July 22, 2009 (ML092050077), the applicant addresses the development of the SBO response guidelines and ac power restoration procedure. Regarding severe weather guidelines, the applicant points out that in the June 16, 1989, letter from T.E. Murley of the NRC to W. H. Rasin, NUMARC (which is Included in Appendix K of NUMARC 87-00), it is stated that not all plants are required to have procedures which require shutdown two hours prior to hurricane (i.e., severe weather guidelines) to address SBO. Since the ABWR has an AAC supply available within ten minutes of the SBO, there is no specific requirement for severe weather guidelines to be included as a SBO response procedure.

As indicated in the original RAI, NUMARC 87-00 states that the SBO response procedures include severe weather guidelines. NUMARC 87-00 also states that the actions contained within these guidelines "are important considerations during a station blackout" and that "Utilities should assure [that] these considerations are addressed." Therefore, the staff does not agree with the applicant's position that because the ABWR has an AAC supply available within ten minutes, there is no specific requirement for severe weather guidelines to be included as an SBO response procedure.

Regarding T. E. Murley's statement pertaining to a plant shutdown in anticipation of a hurricane, applicants are required to evaluate specific plant conditions as provided for in NUMARC 87-00, which are not based on whether or not an AAC source is available. The staff agreed that not all plants are required to have procedures to shut down the plant two hours before a hurricane. However, those plants are required to have a severe weather procedure per Section 4.2.3, "Severe Weather Guidelines (NUMARC Station Blackout Initiative 2.c)," of NUMARC 87-00. The shutdown requirement constitutes only one action (Action [4][a]) of the severe weather guidelines (Section 4.2.3). Regarding this issue, the staff reviewed the STP, Units 1 and 2, FSAR and observed that STP, Units 1 and 2, similar to the proposed design for STP, Units 3 and 4, include an AAC source that can be available within ten minutes. The staff also observed that for STP, Units 1 and 2, STP has provisions for shutting down in anticipation of a hurricane, albeit the STP procedures also include provisions for deviating from the NUMARC guidance when the shutdown could increase the likelihood of a LOOP. In addition, the staff found in the STP, Units 3 and 4, FSAR Appendix 19Q, "ABWR Shutdown Risk Assessment," (page 19Q-4), that the COL applicant has committed (COM 19Q-1) to develop a procedure to cope with and reduce the risk when responding to an approaching hurricane.

Based on the above information, the staff issued supplemental RAI 08.04-3, requesting the applicant to confirm the intent to develop severe weather procedures in accordance with NUMARC 87–00. Otherwise, the staff requested the applicant to provide a technical justification for not requiring a severe weather procedure and a discussion of why the STP, Units 3 and 4, SBO response procedures will be different from those currently in place at STP, Units 1 and 2.

In its response to RAI 08.04-3, dated October 29, 2009 (ML093430299), the applicant states that STP, Units 3 and 4, procedures will include provisions for shutting down in anticipation of a hurricane, unless it is determined that the shutdown would increase the likelihood of a LOOP. Additionally, the applicant provides the proposed revision to FSAR Subsection 9.5.13.20 to address the inclusion of severe weather procedures. The staff found the applicant's response and proposed FSAR revision is consistent with the requirements of 10 CFR 50.63 and the guidance of RG 1.155, SRP Section 8.4, and NUMARC 87–00; and, is therefore acceptable and adequately addresses COL License information Items 1.13 and 9.37. The staff confirmed that the proposed changes are incorporated in FSAR Revision 4, Subsection 9.15.13.20. In addition, per the applicant's RAI response and the staff's review of SER Sections 19.4 and 19Q.6, the item previously identified as COM 19Q-1 has been deleted and is addressed by COM 19.4-1 accordingly. Therefore, RAI 08.4-3 is closed.

- COL License Information Item 9.36 Periodic Testing of Combustible Turbine Generator (CTG)

In Subsection 9.5.13.19, the applicant identifies the periodic functional tests that are required to be conducted to verify the readiness of the CTG to perform its intended functions. The subsection includes appropriate departures from ABWR DCD to address STP, Units 3 and 4, CTG rating and performance requirements:

1) For each 4.16 kV emergency bus (staggered among the three buses at 18-month intervals), verify the CTG starts and energizes the bus within 10 minutes and energizes all required loads (as defined in the "LOCA-Loads" section of Table 8.3-4) within 15 minutes. The steady-state CTG voltage and frequency shall be 13.8 kV ± 10% and 60 Hz ± 2%. All CTG starts may be preceded by an engine pre-lube period.

2) The operator can accomplish this from the main control room.

3) One Class 1E circuit breaker and four non-Class 1E circuit breakers exist and are functional between each of the Class 1E diesel generator buses and the CTG. (Note that both the Class 1E and non-Class 1E breakers are normally open and they have no automatic function. The operator must manually align the CTG to the diesel generator buses.)

4) Each 92 days, verify the combustion turbine generator (CTG) starts and achieves steady state voltage (13.8 kV ± 10%), and frequency (60 Hz ± 2%) in less than 10 minutes. Load the CTG to ≥ 90% and ≤ 100% of its continuous rating and operate it with this load for at least 60 minutes. All CTG starts may be preceded by an engine pre-lube period.

Additionally, the applicant provides the following clarification:

> The revised test requirements are incorporated in the Technical Requirements Manual and included in testing procedures prepared prior to fuel load. The Technical Specifications include the functional testing requirements and test frequencies for the CTGs necessary to support completion times allowed in TS 3.8.1, AC Sources Operating.

The NRC staff reviewed the information in the above subsection. The staff determined that the supplemental information provided by the applicant addresses the medium voltage differences between the ABWR DCD and the STP design. As previously stated, the changes to the STP-specific medium voltage level conform to industry standards and are therefore acceptable. Additionally, the applicant addresses the breaker arrangement in the STP plant-specific design. The staff reviewed the description and found it reasonable and consistent with the design of the STP, Units 3 and 4, electrical systems. Lastly, the staff found that the periodic testing frequency of the CTG is consistent with the requirements of 10 CFR 50.63 and the guidance of RG 1.155 and NUMARC 87-00 and COL License Information Item 9.36 is therefore acceptable.

- COL License Information 9.38 Quality Assurance Requirement for CTG

In Subsection 9.5.13.21, the applicant addresses the QAP developed for an SBO event. Specifically, the applicant states:

> The South Texas Nuclear Operating Company (STPNOC) Quality Assurance Program Description (QAPD) referenced in Section 17.5S has incorporated the Quality Assurance requirements of Regulatory Position 3.5 and Appendix A to RG 1.155 into the QAPD Part III, Non-safety-Related Structures, Systems, and Components (SSC) Quality Control, Section 2 Non-safety-Related SSCs Credited for Regulatory Events. These requirements are translated into implementing procedures.

The NRC staff reviewed the applicant's information in Subsection 9.5.13.21 pertaining to the QAP for SSCs associated with an SBO event. The staff found this information is reasonable and consistent with the requirements of 10 CFR 50.63 and the guidance of RG 1.155 and the COL License Information Item 9.38 is therefore acceptable.

8.4S.5 Post Combined License Activities

The applicant identifies the following commitment:

- Commitment (COM 1C-1) – Develop plant procedures, consistent with the guidelines of RG 1.155 to address SBO event response, including operation of AAC and restoration of preferred and onsite emergency sources.

- Commitment (COM 19.4-1) – Develop an abnormal operating procedure for severe weather.

8.4S.6 Conclusion

The NRC staff's finding related to information incorporated by reference is documented in NUREG–1503. The NRC staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant has addressed the required information related to the SBO, 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 SBO 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 8.4 of NUREG-0800. The staff's review concluded that the applicant has adequately addressed the COL license information items and the Tier 2* and Tier 2 departures requiring prior NRC approval in accordance with Section 8.4 of NUREG–0800 and NRC regulations. The staff 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.

8A Miscellaneous Electrical Systems

8A.1 Introduction

This FSAR Appendix describes the miscellaneous electrical systems. These systems include station grounding, lightning and surge protection, cathodic protection, and electric heat tracing.

The electric grounding system is comprised of an instrument and computer grounding network; an equipment grounding network for grounding electrical equipment and selected mechanical components; a plant grounding grid; and a lightning protection network for the protection of all structures, transformers, and equipment. Cathodic protection is provided to the extent required. Its design is plant unique, is tailored to the site conditions, and conforms to the requirements of the National Association of Corrosion Engineers Standards. The electric heat tracing system provides freeze protection where required for outdoor service components and the warming of process fluids if required, either indoors or outdoors. If the operation of the heat tracing is required for the operation of a safety-related system, the heat tracing for the safety-related system is also required to be safety-related. Station grounding, surge protection, and lightning protection are in accordance with RG 1.204.

8A.2 Summary of Application

Appendix 8A of the STP, Units 3 and 4, COL FSAR Revision 12, incorporates by reference Appendix 8A of the certified ABWR DCD Revision 4, referenced in 10 CFR Part 52, Appendix A. In addition, in FSAR Appendix 8A, the applicant provides the following:

Tier 2 Departures Not Requiring Prior NRC Approval

- STD DEP 1.1-2 — Plant Grounding System (Figure 8A-1)

This departure addresses the plant grounding system and provides the information below pertaining to STP grounding.

- STD DEP 8A.1-1 — Regulatory Guidance for the Lightning Protection System

This departure addresses the plant lightning protection system and identifies the standards and guidelines used for the STP design.

- STD DEP Admin

The applicant provides editorial changes in FSAR Subsections 8A.1.1, “Description,” and 8A.4, “References.” The applicant defines administrative departures as minor corrections, such as editorial or administrative errors in the referenced DCD (i.e., misspellings, incorrect references, table headings, etc.).

COL License Information Items

- COL License Information Item   Grounding

The applicant provides supplemental information to address COL license information in Section 8A.1.3, “COL License Information.” The applicant commits (COM 8A-1) to perform plant-specific, ground resistance measurements per the guidance in IEEE Std 81-1983, “Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System,” to determine that the required value of one ohm or less has been met. (This COL license information item is not listed in the DCD Table 1.9-1, “Summary of ABWR Standard Plant COL License Information.”)

- COL License Information Item   Cathodic Protection

In Subsection 8A.2.3, “COL License Information,” the applicant provides supplemental information to address COL license information regarding cathodic protection that will be provided where applicable. (This COL license information item is not listed in the DCD Table 1.9-1.)

8A.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is in NUREG–1503. 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 Tier 2 departures.

The regulatory bases for accepting the departures, the COL license information items, and the supplements are established as follows:

Tier 2 Departures Not Requiring Prior NRC Approval

Tier 2 departures are subject to the requirements of Section VIII.B.5 of 10 CFR Part 52, Appendix A, which are similar to the requirements in 10 CFR 50.59.

COL License Information Items

- COL License Information Item “Grounding” is subject to the guidance of IEEE Std 81, “Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.”

- COL License Information Item “Cathodic Protection” is subject to the guidance of Chapter 11, Section 9.4 of the Utility Requirements Document issued by the EPRI.

8A.4 Technical Evaluation

As documented in NUREG–1503, the NRC staff reviewed and approved Appendix 8A of the ABWR DCD. The staff reviewed Appendix 8A 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 appendix.

The staff reviewed the following information in the COL FSAR:

Tier 2 Departures Not Requiring Prior NRC Approval

The following Tier 2 departures not requiring prior NRC approval identified by the applicant in this section may also be evaluated in other sections of this SER accordingly. For more information, refer to COLA Part 07, Section 5.0 for a listing of all FSAR sections affected by these departures.

- STP DEP 1.1-2 — Plant Grounding System (Figure 8A-1)

In Subsection 8A.1.1, the applicant addresses the plant grounding system and provides the information described under the STD Admin that follows below and pertains to STP grounding. Additionally, the applicant provides a pictorial description of the grounding in FSAR Figure 8A-1, "Site Plan (Grounding)."

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 from the certified ABWR DCD is subject to NRC inspections.

- STP DEP 8A.1-1 — Regulatory Guidance for the Lightning Protection System

In Subsection 8A.1.2, the applicant addresses the plant lightning protection system. The applicant references RG 1.204 and indicates compliance with the applicable codes and standards. In addition to the standards identified in the ABWR DCD, the applicant also identifies the following standards:

(5) IEEE Std 666–2007, Design Guide for Electric Power Service Systems for Generating Stations (Reference 8A-1)

(6) IEEE Std 1050–2004, Guide for Instrumentation and Control Equipment Grounding in Generating Stations (Reference 8A-2)

[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.

(7) IEEE Std C62.23–1995, Application Guide for Surge Protection of Electric Generating Plants (Reference 8A-3)

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 from the certified ABWR DCD is subject to NRC inspections.

- STD DEP Admin

In Section 8A.1.1, the applicant addresses the plant grounding system (making the type of grounding consistent with ABWR DCD Subsections 8.3.1.0.6.2 and 8.3.1.1.6.2) and provides the information below pertaining to STP grounding:

> The electrical grounding system is comprised of:
>
> - A plant grounding grid shared between STP Units 3 & 4
>
> The onsite, medium-voltage AC distribution system is low resistance grounded at the neutral point of the low-voltage windings of the unit auxiliary and reserve transformers.

Additionally, in Section 8A.4, the applicant lists the references that are included under Departure STP DEP 8A.1-1.

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. The NRC staff reviewed the administrative changes indicated above pertaining to system grounding and cathodic protection. Within the review scope of this section, the staff found it reasonable that this departure does not require prior NRC approval.

COL License Information Items

- COL License Information Item Grounding

In Subsection 8A.1.3, the applicant addresses plant-specific, ground resistance measurements that will be taken through Commitment COM 8A-1. The applicant provides the following supplemental information:

> Ground resistance measurements will be performed per guidance provided by IEEE 81 to determine that the required value of one ohm or less has been met and additions to the system will be made, if necessary, to meet the target resistance after site preparation and prior to construction of the permanent buildings. The FSAR will be updated in accordance with 10 CFR 50.71, "Maintenance of records, making of reports," subparagraph (e) to reflect the results of these evaluations. (COM 8A-1).

The NRC staff reviewed the applicant's commitment pertaining to ground resistance measurements and found it consistent with the DCD and the guidance of IEEE Std 81. Additionally, the applicant commits to add an ITAAC for ground resistance measurements of the offsite power system in the COLA, Part 9, Section 3.0, Table 3.0-2. Therefore the COL License Information Item regarding grounding is acceptable.

- COL License Information Item Cathodic Protection

In Section 8A.2.3, the applicant addresses plant-specific cathodic protection and provides the following supplemental information:

> The design of the cathodic protection system meets the following minimum requirements consistent with the requirements in Chapter 11, Section 9.4 of the Utility Requirements Document issued by the Electric Power Research Institute:
>
> 1) The need for cathodic protection on the entire site, portions of the site, or not at all is determined by analyses. The analyses are based on soil resistivity readings, water chemistry data, and historical data from the site gathered from before commencement of site preparation to the completion of construction and startup.
>
> 2) Where large protective currents are required, a shallow interconnected impressed current system consisting of packaged high silicon alloy anodes and transformer-rectifiers are normally used. The rectifiers are approximately 50% oversized in anticipation of system growth and possible higher current consumption.
>
> 3) The protected structures of the impressed current cathodic protection system are connected to the station grounding grid.
>
> 4) Localized sacrificial anode cathodic protection systems are used where required to supplement the impressed current cathodic protection system and protect surfaces which are not connected to the station grounding grid or are located in outlying areas.
>
> 5) Prepackaged zinc-type reference electrodes are permanently installed near poorly accessible protected surfaces to provide a means of monitoring protection level by measuring potentials.
>
> 6) Test stations above grade are installed throughout the station adjacent to the areas being protected for termination of test leads from protected structures and permanent reference electrodes.

The NRC staff reviewed the supplemental information pertaining to cathodic protection. The staff found that the steps taken by the applicant to address cathodic protection are reasonable and consistent with industry standards. Therefore the COL license information item regarding cathodic protection is acceptable.

8A.5 Post Combined License Activities

The applicant identifies the following commitment:

- Commitment (COM 8A-1) – Perform ground resistance measurements per guidance provided by IEEE Std 81 to determine that the required value of one ohm or less has been met.

8A.6 Conclusion

The NRC staff's finding related to information incorporated by reference is documented in NUREG–1503. The staff reviewed the COL FSAR and checked the referenced ABWR 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 miscellaneous electrical systems that were incorporated by reference have been resolved.

In addition, the staff compared the additional information in the application to the relevant NRC regulations and industry standards. The staff's review concluded that the applicant has adequately addressed the COL license information items in accordance with the NRC-approved industry standard (IEEE Std 81) and NRC regulations. The staff found it reasonable that the identified Tier 2 departures are characterized as not needing prior NRC approval per 10 CFR Part 52, Appendix A, Section VIII.B.5.