CONTENTS

LIST OF FIGURES

No figures are included in this chapter.

LIST OF TABLES

No tables are included in this chapter.

8 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 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 AP1000 passive design, and ensures that these systems have adequate capacity, capability, redundancy, independence, and testability in conformance with the current criteria established by the U.S. Nuclear Regulatory Commission (NRC).

Chapter 8, "Electric Power," of this safety evaluation report (SER) describes the results of the review by the staff (the staff) of the William States Lee III Nuclear Station (WLS) combined license (COL) final safety analysis report (FSAR), Part 2 of the COL application, submitted by Duke Energy (DE), the COL applicant (the applicant).

8.1 Introduction

8.1.1 Introduction

This section provides the applicant's description of the electric power system with regard to the interrelationships between the nuclear unit, the utility grid, and the interconnecting grids.

In addition, this section includes a regulatory requirements 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 (DC).

8.1.2 Summary of Application

WLS COL FSAR, Revision 9, Section 8.1, incorporates by reference AP1000 design control document (DCD), Revision 19, Section 8.1 with departures and/or supplements.

To address these departures and supplements, in WLS COL FSAR, Section 8.1, the applicant provided the following additional information:

Supplemental Information

- WLS SUP 8.1-1

The applicant provided supplemental (SUP) information in WLS COL FSAR Section 8.1, "Introduction," describing DE's 525 and 230-kilovolt (kV) transmission systems, and the connection interface with the WLS Unit 1 to the 230-kV switchyard and WLS Unit 2 to the 525-kV switchyard at the plant site.

- WLS SUP 8.1-2

The applicant provided supplemental information in WLS COL FSAR Section 8.1 describing additional information pertaining to regulatory guides and Institute of Electrical and Electronics Engineers (IEEE) standards identified in AP1000 DCD, Table 8.1-1 and to other applicable regulatory guides as indicated in WLS COL FSAR Table 8.1-201, "Site-Specific Guidelines for Electric Power Systems."

8.1.3 Regulatory Basis

The regulatory basis for the information incorporated by reference is addressed in NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," and its supplements.

In addition, the acceptance criteria associated with the relevant requirements of NRC regulations for the introduction to the electric power systems are given in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," Section 8.1.

The applicable regulatory requirements, guidelines, and related acceptance criteria for the supplemental information items are as follows:

- Title 10 of the *Code of Federal Regulations* (10 CFR) 50.63, "Loss of all alternating current power"
- RG 1.155, "Station Blackout"
- RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)"

8.1.4 Technical Evaluation

The staff reviewed WLS COL FSAR Section 8.1 and checked the referenced DCD to ensure that the combination of the DCD and the application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the introduction to the electric power systems. The results of the staff's evaluation of the information incorporated by reference in the WLS application are documented in NUREG-1793 and its supplements.

The staff reviewed the following information in the WLS COL FSAR:

Supplemental Information

- WLS SUP 8.1-1

The staff reviewed the resolution to the supplemental information WLS SUP 8.1-1 related to the DE transmission system and its connection to the WLS Units 1 and 2 included in WLS COL FSAR Section 8.1. The applicant provided the following supplements to WLS COL FSAR Section 8.1.1.

The DE transmission system consists of interconnected hydro plants, fossil-fueled plants, combustion turbine units and nuclear plants supplying energy to the service area at various voltages up to 525 kV. The 525-kV switchyard is tied to DE's 525-kV transmission network by two single-circuit overhead lines. The 230-kV switchyard is tied to the DE's 230-kV transmission network by two double-circuit overhead lines. Both switchyards utilize

[1] See Section 1.2.2 of this report for a discussion of the staff's review related to verification of the scope of information to be included in a COL application that references a DC.

breaker-and-a-half bus configurations. The two switchyards are connected by two 230-kV to 525-kV autotransformers.

The staff finds that the applicant has adequately described the WLS Units 1 and 2, connection to the utility grid and the information provided is in accordance with the recommendation of RG 1.206 and the guidance in NUREG-0800, Section 8.1.

- WLS SUP 8.1-2

The staff reviewed supplemental information in SUP 8.1-2, related to regulatory guidelines and industry standards and found it to be consistent with NUREG-0800, Section 8.1 with the exception of the information discussed below.

WLS COL FSAR Table 8.1-201, Item (1b) indicates that RG 1.155 is not applicable to WLS. This item was deemed as standard among COL applications being discussed in Bellefonte Nuclear Station's (BLN) response to request for additional information (RAI) 08.01-2. In a February 5, 2009, letter, the WLS applicant stated that the standard response to RAI 08.01-2 also applies to the WLS application.

The standard response submitted by BLN in a June 24, 2008, letter is summarized as follows. BLN stated that the AP1000 design meets the requirements of 10 CFR 50.63 for 72 hours and, therefore, no specific procedures or training specific to station blackout (SBO) are necessary. The staff determined that the above response was inconsistent with the recommendations of RG 1.155 and the requirements of 10 CFR 50.63. The staff recognizes that the passive systems can maintain safe-shutdown conditions after design-basis events for 72 hours, without operator action, following a loss of both onsite and offsite alternating current (ac) power sources. However, the applicant needs to establish SBO procedures and training for operators to include actions necessary to restore offsite power after 72 hours by addressing ac power restoration (e.g., coordination with transmission system load dispatcher), and severe weather guidance (e.g., identification of site-specific actions to prepare for the onset of severe weather such as an impending tornado) in accordance with RG 1.155, Regulatory Positions C.2 and C.3.4.

Several discussions were held between the staff and the BNL applicant regarding this issue. Subsequently, in an April 15, 2009, letter, the BLN applicant stated that the training and procedures to support mitigation of an SBO event would be implemented in accordance with BLN FSAR Sections 13.2 and 13.5, respectively. As recommended by NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," which is endorsed by RG 1.155, the loss of all ac power event mitigation procedures will address response (e.g., restoration of onsite power sources), ac power restoration (e.g., coordination with transmission system load dispatcher), and severe weather guidance (e.g., identification of actions to prepare for the onset of severe weather such as an impending tornado), as applicable. In addition, the BNL applicant stated that there are no nearby large power sources, such as a gas turbine or black start fossil fuel plant that can directly connect to the station to mitigate the event.

The staff verified that the WLS applicant has updated WLS COL FSAR Sections 1.9.5.1.5 and 1.9.6 to include the above-mentioned items including the implementation of training and procedures to support mitigation of an SBO event. The staff finds this update satisfies RG 1.155, Regulatory Positions C.2 and C.3.4. Based on the above, the staff finds this item resolved.

8.1.5 Post Combined License Activities

There are no post COL activities related to this section.

8.1.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the introduction to the electric power systems, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the WLS application are documented in NUREG-1793 and its supplements.

In addition, the staff compared the additional COL-specific supplemental information in the application to the relevant NRC regulations; guidance in NUREG-0800, Section 8.1, and other NRC regulatory guides and concluded that the applicant is in compliance with NRC regulations. The staff based its conclusion on the following:

- WLS SUP 8.1-1 is acceptable because the applicant provided sufficient information regarding the WLS connections to various transmission systems in accordance with the recommendations of RG 1.206.

- WLS SUP 8.1-2 is acceptable because the COL-specific regulatory guidelines and industry standards, and additional new regulatory guidelines are adequately addressed by the applicant. The applicant has also provided sufficient information for satisfying the requirements of 10 CFR 50.63 and the guidance in RG 1.155

8.2 Offsite Power System

8.2.1 Introduction

The offsite power system is referred to in regulatory guides and industry standards 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 and other switchyard components.

The AP1000 passive reactor plant standard design supports an exemption in 10 CFR Part 52, "Licenses, certifications, and approvals for nuclear power plants," Appendix D, "Design Certification Rule for the AP1000 Design," paragraph V.B.3, to the requirement of 10 CFR Part 50, "Domestic licensing of production and utilization facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 17, "Electric Power Systems," to have only one (not two) physically independent offsite circuit to provide for safety-related passive systems for core cooling and containment integrity. Therefore, for WLS Units 1 and 2, the single offsite power source provided from the transmission network is reviewed below to assure that it satisfies the requirements of GDC 17 with respect to its capacity and capability.

8.2.2 Summary of Application

WLS COL FSAR, Revision 9, Section 8.2, incorporates by reference AP1000 DCD, Revision 19, Section 8.2, with departures and supplements.

To address these departures and/or supplements, in WLS COL FSAR Section 8.2 the applicant provided the following additional information:

AP1000 COL Information Items

- WLS COL 8.2-1

The applicant provided additional information in WLS COL 8.2-1 to address COL Information Item 8.2-1 (COL Action Items 8.2.3-1 and 8.2.3.3-1) to address the design of the ac power transmission system and its testing and inspection plan. The information describes: (1) the designs of the plant site 525-kV and 230-kV switchyards, the two 525-kV transmission lines connecting the plant switchyard to DE's 525-kV transmission system, and the four 230-kV lines connecting the 230-kV switchyard, the connection of two switchyards through autotransformers, and the interface of the switchyards with the transmission grid; (2) the connections of the generator step-up (GSU) transformers and the reserve auxiliary transformers (RATs) to the switchyard; (3) the designs of the switchyard circuit breakers and disconnect switches; (4) the transformer area arrangement for each unit; (5) the ratings of the GSU transformers, unit auxiliary transformers (UATs), RATs, and autotransformers; 6) the design of the control building in the plant site 525-kV and 230-kV switchyards; (7) the administrative control of 525-kV and 230-kV switchyards and transmission lines circuit breakers; and (8) the switchyard and transmission lines testing and inspection plan; and 9) voltage operating range, frequency decay rate, and preservation of grid connection. WLS COL 8.2-1 is addressed in WLS COL FSAR Sections 8.2.1, 8.2.1.1, 8.2.1.2, 8.2.1.3, and 8.2.1.4.

In addition, the WLS applicant provided supplemental information describing details of a failure mode and effects analysis (FMEA) performed for the offsite power distribution system and the plant site switchyard.

- WLS COL 8.2-2

The applicant provided additional information in COL 8.2-2 to address COL Information Item 8.2-2 (COL Action Items 8.2.3.1-1, 8.2.3.1-2, and 8.2.3.1-3) describing: (1) the 525-kV and 230-kV switchyards arrangement and design of the protective relaying scheme; and (2) a transmission system study performed regularly to verify grid stability, switchyard voltage, and frequency to confirm the transmission system capability to maintain reactor coolant pump (RCP) operation for 3 seconds following a turbine trip as specified in AP1000 DCD Section 8.2.2. WLS COL 8.2.2 is addressed in WLS COL FSAR Sections 8.2.1.2.2, and 8.2.2.

Site-Specific Information Replacing Conceptual Design Information

- WLS CDI

The applicant provided COL-specific conceptual design information (CDI) describing the transformer area located next to each unit's turbine building and containing the GSU transformer, the UATs, and the RATs. This replaced the CDI located in the AP1000 DCD.

Supplemental Information

- WLS SUP 8.2-1

The applicant provided supplemental information on the transmission system provider/transmission system operator (TSP/TSO), and the detailed voltage and other requirements to be maintained by the TSP/TSO.

- WLS SUP 8.2-2

The applicant provided supplemental information describing the formal agreement between DE's Nuclear Generation Department (NGD) and DE's Power Delivery (PD) department, which is the TSO, setting the requirements for transmission system studies and analyses.

- WLS SUP 8.2-3

The applicant provided supplemental information describing the establishment of the PD department's responsibility for maintaining area bulk transmission system reliability and demonstrating, by power system simulation studies, projections, and analyses, the current and future reliability of the system.

- WLS SUP 8.2-4

The applicant provided supplemental information describing the agreement between the NGD and the PD departments demonstrating that protocols are in place for WLS to remain cognizant of grid vulnerabilities in order to make informed decisions regarding maintenance activities critical to the electric system.

- WLS SUP 8.2-5

The applicant provided supplemental information describing the reliability of the DE transmission system's 525-kV and 230-kV transmission lines based on 12 years of outage data.

Interface Requirements

The plant/offsite electrical power interfaces for the AP1000 standard design are discussed in AP1000 DCD Tier 2, Section 8.2.5. AP1000 DCD Tier 2, Table 1.8-1, Items 8.1, 8.2, and 8.3 identify these interfaces as non-nuclear safety (NNS) interfaces.

8.2.3 Regulatory Basis

The regulatory basis of the information incorporated by reference is addressed in NUREG-1793 and its supplements.

In addition, the acceptance criteria associated with the relevant requirements of NRC regulations for the offsite power system are given in NUREG-0800, Sections 8.1 and 8.2.

The regulatory bases for acceptance of the COL information and supplementary information items are established as follows:

- 10 CFR Part 50, “Domestic licensing of production and utilization facilities,” Appendix A, “General Design Criteria [GDC] for Nuclear Power Plants,” Criterion 17, “Electric power systems”
- GDC 5, “Sharing of structures, systems, and components”
- GDC 18, “Inspection and testing of electrical power systems”
- 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants”
- RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition)”
- Generic Letter (GL) 2006-02, “Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power”

8.2.4 Technical Evaluation

The staff reviewed WLS COL FSAR Section 8.2 and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff’s review confirmed that the information in the COL application and the DCD information incorporated by reference addresses the required information relating to the offsite power system. The results of the staff’s evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the DC and use this review in evaluating subsequent COL applications. To ensure that the staff’s findings on standard content that were documented in the SER for the reference COL application (Vogtle Electric Generating Plant (VEGP) Units 3 and 4) were equally applicable to the WLS Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.
- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed by the WLS COL applicant.
- The staff verified that the site-specific differences were not relevant.

The staff has completed its review and finds the evaluation performed for the standard content to be directly applicable to the WLS application. This standard content material is identified in this report by use of italicized, double-indented formatting. Any confirmatory items in the standard content material retain the numbers assigned in the VEGP SER. Confirmatory items that are first identified in this report section have a WLS designation (e.g., Confirmatory Item WLS 8.2-1).

The staff reviewed the information in the WLS COL FSAR:

AP1000 COL Information Item

- WLS COL 8.2-1

The applicant provided additional information in WLS COL 8.2-1 to resolve COL Information Item 8.2-1, which states:

> Combined License applicants referencing the AP1000 certified design will address the design of the ac power transmission system and its testing and inspection plan (DCD Section 8.2.5).

The commitment was also captured as COL Action Items 8.2.3-1 and 8.2.3.3-1 in NUREG-1793, Appendix F, which states:

> The operating voltage for the high side of the AP1000 transformer and transmission switchyard, as well as the frequency decay rate are site specific and, therefore, will be addressed in the COL application. The COL applicant will provide analysis of these matters, including transient stability, voltage operating range, and preservation of the grid connections, in the COL application (COL Action Item 8.2.3-1).
>
> Combined License applicants referencing the AP1000 certified design will address the design of the ac power transmission system and its testing and inspection plan (COL Action Item 8.2.3.3-1).

The staff reviewed the resolution to the WLS COL 8.2-1 related to the transmission system design, testing, and inspection included under WLS COL FSAR Section 8.2. The staff's evaluation is as follows:

WLS Units 1 and 2, receive offsite ac power from a common 525/230-kV switchyard, which is connected to the DE transmission network. The two switchyards are connected by two 230-kV to 525-kV autotransformers. Unit 2 is connected to the 525-kV switchyard, and Unit 1 is connected to the 230-kV switchyard. The power from Unit 2 is transmitted via overhead transmission line to the 525-kV switchyard. Similarly, the power from Unit 1 is transmitted via overhead transmission lines to the 230-kV switchyard.

There are four transmission lines connected to the 230-kV switchyard, and two transmission lines connected to the 525-kV switchyard. Each transmission line is tied into a DE transmission line or switchyard located between 19 and 95 miles from the station.

Unit 1 is connected to the DE Transmission System via the Roddey East and Roddey West 230-kV lines. The Roddey lines consist of a section of line, 55 km (34 miles (mi)) in length, from WLS to Catawba Nuclear Station and a section of line, 31 km (19 mi) in length, from WLS to Pacolet Tie. The 230-kV line is constructed on a 46 m (150 foot (ft)) wide right-of-way with double circuit lattice steel towers; varying in height from 37 m to 58 m(120 ft to 190 ft) with a nominal height of 46 m (150 ft). Unit 2 is connected to the DE Transmission System via the Asbury 525-kV line. This line consists of a section of line, 66 km (41 mi) in length, from WLS to Newport Tie and a section of line, 153 km (95 mi) in length, from WLS to Oconee Nuclear Station. The 525-kV line is constructed on a 61 m (200 ft) wide right-of-way with single circuit lattice steel towers, varying in height from 37 m to 46 m (120 ft to 150 ft) with a nominal height of 43 m (140 ft). Conductors are two per phase in a horizontal bundle. All lines are designed to

meet or exceed the requirements of the American National Standards Institute (ANSI) C2, "National Electric Safety Code."

The staff reviewed the layout of transmission lines and concluded that at least one offsite power source will be available to both Units 1and 2. The staff finds that the above satisfies the requirements of GDC 17.

In WLS COL FSAR Section 8.2.1.4, the applicant addressed the switchyard and transmission lines testing and inspection plan. In RAI 5, Question 08.02-7, the staff questioned the statement made in WLS COL FSAR Section 8.2.1.4, which states, "PD follows its own field test manuals, vendor manuals and drawings, industry's maintenance practices and observes Federal Energy Regulatory Commission (FERC) requirements and North American Electric Reliability Corporation (NERC) reliability standards." The staff requested the applicant explain whether the statement is intended to indicate that DE NGD will follow the FERC and NERC standards for switchyard maintenance and testing. In a September 5, 2008, response, the applicant stated that this statement was intended to indicate that DE follows the applicable NERC reliability standards associated with switchyard maintenance and testing. The applicant stated that it will revise the WLS COL FSAR as follows, for purposes of clarity:

> For performance of maintenance, testing, calibration, and inspection, TSO follows its own field test manuals, vendor manuals and drawings, and industry's maintenance practices to comply with applicable NERC reliability standards.

The staff has verified that the WLS COL FSAR has been updated to include the above-mentioned revised paragraph. Since the goal of GDC 18 is to assure testability of, in this case, the switchyard and transmission lines and the goal of GDC 17 is, among other things, to assure a high reliability of the offsite power system, full conformance to the applicable NERC reliability standards acceptably addresses the staff's concern. Therefore, the staff finds the issue in RAI 5, Question 08.02-7 resolved.

In COL 8.2-1 (WLS COL FSAR Section 8.2.1.1), the applicant also provided a brief summary of the FMEA performed on the WLS switchyard. In RAI 1, Question 08.02-2, the staff requested that the applicant describe in detail how each event (a breaker not operating during a fault on an offsite line; fault on a switchyard bus; fault on an auto bank; a spurious relay trip; a loss of control power; and other cases discussed in the WLS COL FSAR). In a September 5, 2008, response, the applicant provided the requested information and stated that the WLS COL FSAR will be revised to include the detailed FMEA.

The staff verified that WLS COL FSAR Section 8.2.1.1 has been updated to include the detailed FMEA results. The staff reviewed the FMEA of the WLS switchyard and concludes that a single initiating event, such as (1) a breaker not operating during a fault condition; (2) a fault on a switchyard bus; (3) a spurious relay trip; (4) or a loss of control power supply would not cause failure of more than one single offsite line, or a loss of offsite power to either WLS Unit 1 or 2. Therefore, the staff finds that the issue in RAI 1, Question 08.02-2 has been adequately addressed and resolved.

Additionally, the applicant provided the site-specific voltage and frequency variations expected at the WLS Units 1 and 2, switchyard during transient and steady state operating conditions and the site-specific frequency decay rate to satisfy COL 8.2-1.

- WLS COL 8.2-2

The applicant provided additional information in WLS COL 8.2-2 to resolve COL Information Item 8.2-2, which states:

> The Combined License applicant will address the technical interfaces for this nonsafety-related system listed in Table 1.8-1 and Section 8.2.2. These technical interfaces include those for ac power requirements from offsite and the analysis of the offsite transmission system and the setting of protective devices.

The staff's evaluation of the technical interfaces is addressed under "Interface Requirements" in this section of the report.

The commitment was also captured as COL Action Items 8.2.3.1-1, 8.2.3.1-2, and 8.2.3.1-3 in NUREG-1793, Appendix F, which states:

> The COL applicant will perform a site-specific grid stability analysis to show that, with no electrical system failures, the grid will remain stable and the reactor coolant pump bus voltage will remain above the voltage necessary to maintain the flow assumed in the Chapter 15 analyses for a minimum of 3 seconds following a turbine trip (COL Action Items 8.2.3.1-1 and 8.2.3.1-3).
>
> The COL applicant will set the protective devices controlling the switchyard breakers in such a way as to preserve the grid connection following a turbine trip (COL Action Item 8.2.3.1-2).

The staff reviewed the resolution to the COL Information Item WLS COL 8.2-2, related to the transmission system stability analysis and switchyard circuit breaker protective device settings included under WLS COL FSAR Section 8.2. The staff's evaluation is as follows:

WLS COL 8.2-2 was provided by the applicant describing details of: (1) the 525-kV and 230-kV switchyard arrangements and protective relaying schemes; and (2) a transmission system study performed regularly to verify grid stability, switchyard voltage, and frequency to maintain RCP operation for three seconds following a turbine trip as specified in AP1000 DCD Section 8.2.2. WLS COL 8.2-2 is addressed in WLS COL FSAR Sections 8.2.1.2.2 and 8.2.2.

The WLS 525-kV and 230-kV switchyards each have two main buses for each voltage level. All of the 525-kV and 230-kV lines and each of the GSU transformers are connected to both buses. The switchyards have breaker-and-a-half scheme. This arrangement is used for reliability and flexibility. This arrangement allows for isolation of components and buses, while preserving the plant's connection to the grid.

The transmission line relay protection circuits continuously monitor the conditions of the offsite power system and are designed to detect and isolate the faults with maximum speed and minimum disturbance to the system. Each of the 525-kV and 230-kV lines is protected by two independent pilot systems to clear a fault anywhere on the line. The two autotransformers each have primary and secondary protecting relaying. The primary and secondary relaying use separate instrument current transformers for monitoring, and use separate direct current (dc) power supplies.

In the event of a breaker failure, the breaker failure relays operate after a preset time delay. Should a breaker fail to trip within the time setting, the associated breaker failure trip relay will

trip and lock out all breakers necessary to isolate the failed breaker from all local sources. A breaker failure relay operation for 230-kV and or 525-kV switchyard breakers that are connected to a GSU, RAT, and auto bank transformers will also isolate the appropriate remote sources through a direct transfer trip operation.

The staff finds that the switchyard breaker arrangement, the protection of lines by independent high speed relay schemes, and the breaker failure scheme would preserve the WLS connection to the grid following a turbine trip. The staff finds this satisfies COL Action Item 8.2.3.1-2.

With regard to grid stability, the applicant stated that the WLS grid stability analysis confirms that, with no electrical system failures, the grid will remain stable and the RCP bus voltage will remain above the voltage necessary to maintain the flow assumed in the Chapter 15 analyses for a minimum of 3 seconds following a turbine trip as specified in AP1000 DCD Section 8.2.2 (COL Action Item 8.2.3.1-3). This requirement is also met when there is transmission element out of service, including the largest generator or most critical transmission line. Also, the grid stability analysis has confirmed that the interface requirements for steady state load, inrush kilovolt amp (kVA) for motors, nominal voltage, allowable voltage regulation, nominal frequency, allowable frequency fluctuation, maximum frequency decay rate and limiting under-frequency value for RCP have been met. Based upon the staff's review of this information, the staff finds that the design will maintain acceptable voltage and frequency at the RCP buses for a minimum of 3 seconds in accordance with the Chapter 15 safety analyses, and is therefore acceptable.

However, based upon the wording in WLS COL FSAR Section 8.2, the staff was concerned that at WLS, the grid voltage could drop up to 20 percent on the high side of the GSU and RATs. This voltage drop could damage auxiliary and safety-related equipment. Therefore, in RAI 1, Question 08.02-1, the staff requested that the applicant clarify: (a) if the 20 percent voltage drop was based on worst expected switchyard voltage; (b) if the 20 percent voltage drop criteria is consistent with NERC criteria (or those of a local reliability council); and (c) what effect this voltage drop will have on the operation of the onsite auxiliary power system equipment including the Class 1E battery chargers and uninterruptible power supplies (UPSs). Subsequent clarification of this issue was provided by the applicant as discussed in the following three paragraphs.

In a September 5, 2008, letter supplemented by a September 14, 2011, letter, the applicant stated that in the WLS grid stability evaluation, switchyard equipment, including the transformers, were modeled to confirm required voltage would be available at the generator bus or high side of the transformer being used for bus supply. In addition, the applicant stated that the TSP/TSO maintains switchyard voltage such that steady state voltage on the 26-kV isophase bus is within 0.95-1.05 per unit (pu) of its nominal value. Based on the analysis, the expected voltage at the generator terminals is 1.00 pu for Unit 1 and 1.01 pu for Unit 2. In addition, the applicant stated that there were several different pre-contingency cases created with various generation outages that established initial conditions; then contingencies were applied. The base case, with all lines in service, and the combinations of generation outages and grid contingencies simulate different grid configurations that create several different pre-trip steady state voltages. Therefore, a series of different pre-trip voltages were studied. Steady state studies showed that, for Unit 2, a turbine trip with an Asbury West 525-kV line outage caused a 4.35-kV decrease on the 525-kV bus and a 1.18-kV decrease on the 230-kV bus, both less than a 1 percent change. For Unit 1, an outage of the 525/230-kV autotransformer caused a 3.29-kV decrease on the 230-kV bus and a 1.93-kV decrease on the 525-kV bus, both less than a 2 percent change. The voltage changes from the worst case contingency on each unit satisfy the voltage requirement for the RCP.

With regard to item (b) above, the applicant stated that the DE Bulk Electric System is designed to meet NERC reliability standards. The NERC standards do not give specific voltage or voltage drop criteria, but require that the system remain stable and consistent with the voltage requirements of the control area. However, maintaining switchyard voltage such that steady state voltage on the 26-kV isophase bus is within 0.95-1.05 pu of its nominal value would be considered to be consistent with the NERC requirement for system stability. Additionally, the criterion that the voltage cannot drop below a level that provides less than 80 percent of the nominal voltage at the RCP is consistent with DE practices to supply sufficient voltage at the nuclear switchyards or notify the plant operator when the minimum voltage may not be available.

With regard to item (c) above, the applicant clarified that the 80 percent voltage level discussed in the WLS COL FSAR referred to the equipment ratings and was not part of their description of the stability study results. The steady state studies showed changes of less than 2 percent and 1 percent for WLS Units 1 and 2, respectively, based on contingencies considered to be sufficiently extensive and at an appropriate severity level to bound the reasonably expected voltages. Based upon the above clarification and detailed response of the applicant to RAI 1, Question 08.02-1, the staff has no further concerns on this item and considers RAI 1, Question 08.02-1 resolved.

In reference to the Class 1E battery chargers, the applicant stated that the battery chargers are a qualified Class 1E isolation device. The battery charger function is to provide isolation between input ac and the safety-related dc system and to provide dc source power when ac power is available. Safe shutdown of the plant does not require the support of the battery chargers. The battery charger is designed to allow the battery to support the dc loads during times of ac input undervoltage. This could occur during the 3-second turbine trip transient discussed above, during which the RCP must remain above 80-percent stall voltage. The battery charger supply breaker at the ac motor control center is not designed to trip on this undervoltage condition. Additionally, there is no design requirement in the AP1000 to lock out the battery charger on an ac input undervoltage condition.

The staff reviewed the above information and concludes that this information is sufficient to demonstrate that the grid will remain stable to maintain RCP operation for 3 seconds following a turbine trip. The staff finds that the applicant has satisfied the portion of COL Information Item 8.2-2 to maintain the voltage at the RCP to ≥ 80 percent for at least 3 seconds following a turbine trip, to maintain the reactor coolant flow assumed in the Chapter 15 analyses.

The staff finds the applicant's response acceptable because the analysis meets the AP1000 design requirements, the requirements of GDC 17 and the guidelines of RG 1.206. Therefore, the staff considers the issues in RAI 1, Question 08.02-1 resolved.

In RAI 5, Question 08.02-4, the staff stated that to confirm that the single offsite power circuit provided from the transmission network satisfies the requirements of GDC 17, the applicant should provide the voltage and frequency variations expected at the 525-kV and 230-kV switchyards and confirm that these voltage and frequency limits are acceptable for auxiliary power system equipment operation during different operating conditions.

Confirmation that these voltage and frequency limits are acceptable was shown by the following calculations: load flow analysis (bus and load terminal voltages of the station auxiliary system); short circuit analysis; equipment sizing studies; protective relay setting and coordination; motor starting with minimum and maximum grid voltage conditions. A separate set of calculations also was performed for each available connection to the offsite power supply. In addition, the

applicant provided a discussion of how the results of the calculations will be verified before fuel load.

In a September 26, 2008, response to RAI 5, Question 08.02-4, the applicant stated that there is no requirement for functionality of the offsite power to accomplish safe shutdown of the AP1000 and that the design is partially exempted from the GDC 17. The applicant also stated that the 525-kV switchyard voltage was set to 523-kV (525-kV nominal) and the 230-kV switchyard was set to 233-kV. This is the anticipated voltage and is consistent with standard practice for grid studies at DE. For an AP1000 turbine trip event, adequate grid voltage is required for 3 seconds. The unit's electric generator will motor immediately following a turbine trip, providing megavolt amp reactives (MVARs) to support this voltage and, therefore, the generator bus voltage remains relatively stable.

In addition, the applicant stated that the above grid voltage evaluation results are verified during the preoperational testing identified in AP1000 DCD Section 14.2.10, which includes the following tests:

- 100 Percent Load Rejection (DCD Section 14.2.10.4.21)
- Plant Trip from 100 Percent Power (DCD Section 14.2.10.4.24)
- Loss of Offsite Power (DCD Section 14.2.10.4.26)

In a public meeting with the Nustart Consortium on April 7, 2009, there was an agreement that portions of BLN RAI 177, Question 08.02-3 (equivalent WLS RAI 5, Question 08.02-4) were not within the scope of the BLN COL, but rather within the scope of the AP1000 DC. This is considered a standard item applicable to all COL applications including WLS. Therefore, the staff finds that the relevant portions of RAI 5, Question 08.02-4 are resolved for WLS.

In RAI 5, Question 08.02-3, the staff requested that the applicant provide a discussion as to how single offsite power circuits complied with GDC 2, “Design Bases for Protection Against Natural Phenomena”; GDC 4, “Environmental and Dynamic Effects Design Bases”; GDC 5, ”Sharing of Structures, Systems, and Components”; GDC 17, “Electric Power Systems”; and GDC 18, “Inspection and Testing of Electric Power Systems,” as well as with guidance in NUREG-0800, Section 8.2.II, and how the applicant intends to meet the requirements of 10 CFR 50.65. In a September 26, 2008, response, the applicant stated that there is no portion of the single offsite circuit required to comply with GDC 2, GDC 4, GDC 5, and GDC 18 and that these GDC are for structures, systems, and components (SSCs) important to safety. Based upon this response, the staff agrees that GDC 2 and GDC 4 do not apply to the AP1000 design.

With respect to GDC 5, the applicant stated that the transmission lines and switchyards are designed so the full output of the plants can be carried out to the network; the capacity is more than sufficient for any incoming power requirements. Based on the above, the staff concludes that since WLS Units 1 and 2 UATs and RATs are not shared among the units and the capacity of the offsite power system is more than sufficient compared to the minimal safety-related loads powered by the offsite power (battery chargers and UPS), the WLS Units 1 and 2 offsite power system design meets the requirements of GDC 5 and, therefore, the staff considers this item resolved.

With respect to GDC 17, the staff finds that the results of the grid stability analysis demonstrate the offsite source capacity and capability to power plant components during normal, shutdown, startup, and turbine trip conditions. The results of the failure modes and effects analysis

demonstrate the reliability of the offsite source, which minimizes the likelihood of its failure under normal, abnormal and accident conditions. Therefore, the staff concludes that the WLS Units 1 and 2 offsite power systems design meets the requirements of GDC 17, as it is applicable to AP1000 design; therefore, the staff considers this item resolved.

With regard to GDC 18, NUREG-1793, Section 8.2.3.2 identifies COL Action Item 8.2.3.3-1 to demonstrate that the testing and inspection capability of the offsite power system be in conformance with GDC 18; therefore, this interface item must also be satisfied by the applicant.

The staff verified that WLS COL FSAR Section 8.3.1.4 has been revised to include implementation of procedures for periodic verification of proper operation of the onsite ac power system capability for automatic and manual transfer from the preferred power supply to the maintenance power supply and return from the maintenance power supply to the preferred power supply. The staff finds that the above satisfies the requirements of GDC 18 and is therefore acceptable.

WLS COL FSAR Section 17.6 describes implementation of the requirements of 10 CFR 50.65. As indicated therein, implementation of the Nuclear Energy Institute (NEI) 07-02A, "Generic FSAR Template Guidance for Maintenance Rule Program Description for Plants Licensed Under 10 CFR Part 52," program description will determine the applicability of the maintenance requirements for the offsite power circuit. NEI 07-02A provides a template for presenting this information that also has been endorsed by the staff in a January 24, 2008, letter to NEI. The staff verified that the reference to this NEI report is in WLS COL FSAR Table 1.6-201. Since the scope of SSCs covered by the maintenance rule (MR) program is determined using the scoping procedures defined in the MR program description in accordance with NEI 07-02A, the offsite power system and its components will be evaluated for inclusion in the MR program in accordance with these scoping procedures during program implementation. The staff notes that NEI 07-02A, Section 17.X.1.5, "Risk Assessment and Risk Management per 10 CFR 50.65(a)(4)," addresses risk assessment and risk management from maintenance activities in accordance with 10 CFR 50.65(a)(4), and includes consideration of the issues associated with grid/offsite power system reliability as identified in NRC GL 2006-02, Items 5 and 6. Therefore, although detailed maintenance risk assessment is not anticipated in advance of the schedule defined in WLS COL FSAR Table 13.4-201, performance of "grid-risk-sensitive" maintenance activities is a necessary consideration of the program in accordance with NEI 07-02A guidance. Based on the above, the staff finds this item resolved.

With regard to the submerged or inaccessible electrical cable recommendations in GL 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," and the guidance in NUREG/CR-7000, and NUREG-0800 Section 8.2.III.1.L., WLS identified the standard content related to this item in its WLS COL FSAR Section 17.6.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 8.2.4:

> *Submerged/Inaccessible Electrical Cables*
>
> *In RAI 8.2-14, the staff asked the applicant to describe the inspection, testing and monitoring program to detect degradation of inaccessible or underground control and power cables that support equipment and other systems that are within the scope of 10 CFR 50.65. The description should include the frequency of testing and inspection. Guidance on the selection of electric cable condition monitoring*

can be found in Sections 3 and 4.5 of NUREG/CR-7000, "Essential Elements of an Electric Cable Condition Monitoring Program."

In a letter dated May 6, 2010, the applicant stated that the Maintenance Rule (MR) program will not be implemented until prior to fuel load; as such, specific information necessary to determine appropriate inspections, tests and monitoring is not available at this time. In order to determine the method and frequency, a review of detailed design and procurement information is needed. The applicant also stated that the latest industry experience and other available information, including NUREG/CR-7000, will be followed in developing a cable condition monitoring program as part of the MR program. The applicant also committed to revise its FSAR to include condition monitoring of underground or inaccessible cables in its MR program. The commitment will be reflected in the COL application Part 2, FSAR Chapter 17, Section 17.6 as shown below.

> *Condition monitoring of underground or inaccessible cables is incorporated into the maintenance rule program. The cable condition monitoring program incorporates lessons learned from industry operating experience, addresses regulatory guidance, and utilizes information from detailed design and procurement documents to determine the appropriate inspections, tests and monitoring criteria for underground and inaccessible cables within the scope of the maintenance rule (i.e., 10 CFR 50.65). The program takes into consideration Generic Letter 2007-01.*

Based on the above, the staff concludes that the applicant's condition monitoring program for underground or inaccessible cables satisfies the recommendations of GL 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," and the guidance in NUREG/CR-7000 and NUREG-0800 Section 8.2.III.1.L. Therefore, this item is resolved subject to the verification that the VEGP COL FSAR has been updated to include applicable portions of the RAI response. This is identified as Confirmatory Item 8.2-3.

Resolution of Standard Content Confirmatory Item 8.2-3

Confirmatory Item 8.2-3 is an applicant commitment to revise its FSAR Section 17.6 to address condition monitoring of underground or inaccessible cables. The staff verified that the VEGP COL FSAR was appropriately revised. As a result, Confirmatory Item 8.2-3 is now closed.

Supplemental Information

WLS SUPs 8.2-1 through 8.2-5 address information on the offsite power system requested by RG 1.206. RG 1.206 includes the request for detailed information about the offsite power system to allow the staff to determine the relative quality of the design. The requested information includes: a description of the overall grid configuration, interfaces with the grid operator, results of grid reliability studies, protocols for operation and pertinent historical grid reliability data.

- WLS SUP 8.2-1

With regard to WLS SUP 8.2-1, the applicant provided the following information:

> DE is a regulated, vertically integrated utility with regards to its electric generation and transmission operations. DE's NGD has a formal agreement titled Nuclear Switchyard Interface Agreement with the TSO which is DE's PD department. The PD department includes the Transmission Planning and Control Center (TCC), transmission System Operation Center (SOC), and Planning and Grid Operations (PGO). The Nuclear Switchyard Interface Agreement and the associated Department Directives serve as a communications protocol with the TSO.
>
> DE is also the transmission system provider. The TSP/TSO establishes a voltage schedule for the 525-kV and 230-kV switchyards. The nuclear power plant, while generating, is expected to supply or absorb reactive power to help regulate voltage in the 525/230-kV switchyard in accordance with TSP/TSO voltage schedule criteria. The TSP/TSO also maintains switchyard voltage such that voltage on the 26-kV isophase bus is within 0.95–1.05 pu of its nominal value.
>
> The plant's operator workstations monitor switchyard voltage, frequency, and other offsite power system parameters. The operator workstations are set to alert the nuclear plant operator if the grid may not be able to supply offsite power of sufficient voltage. Procedures direct the plant operators to contact the TSO and request a status of the most current contingency analysis for existing grid conditions. If the results of the contingency analysis indicate that insufficient voltage would exist in the switchyard, the procedures direct the plant operators to take appropriate actions.

The staff reviewed the information provided by the applicant on the functions of the TSO that establishes a voltage schedule for the WLS 500 kV switchyard and also maintains switchyard voltage such that steady state voltage on the 26 kV isophase bus is within 0.95-1.05 pu of nominal value. Based on the information provided by the applicant on the functions of the TSP/TSO and the detailed voltage and other requirements to be maintained by the TSP/TSO, the staff finds that the applicant has demonstrated that protocols are in place for WLS to remain cognizant of grid vulnerabilities in order to make informed decisions regarding maintenance activities critical to the electric system. This is, in part, consistent with GL 2006-2 in which one provision is to reduce the likelihood of losing offsite power. The staff finds that the information provided meets the requirements of GDC 17 and GDC 18 also conforms to the guidelines of RG 1.206. Therefore, the staff considers WLS SUP 8.2-1 acceptable.

- WLS SUP 8.2-2

With regard to WLS SUP 8.2-2, the applicant provided the following information:

> The Nuclear Switchyard Interface agreement between NGD and PD sets the requirements for transmission grid studies and analyses. These analyses demonstrate the capability of the offsite power system to support plant start up and shutdown.

The staff reviewed the information provided by the applicant on the Nuclear Switchyard Interface agreement. Based on the information provided by the applicant on the agreement, the staff finds that the applicant has demonstrated that analyses have been completed that demonstrate the capability of the grid to support operations, such as plant shutdown and startup. This is, in part, consistent with GL 2006-2 of which one provision is to reduce the likelihood of losing offsite power. The staff finds that the information provided complies with the requirements of GDC 17 and conforms to the guidelines of RG 1.206. Therefore, the staff considers WLS SUP 8.2-2 acceptable.

- WLS SUP 8.2-3

  DE's Power Delivery (PD) Department is the approving grid organization for reliability studies performed on the area bulk electric system. PD conducts planning studies of the transmission grid on an ongoing basis. Model data used to perform simulation studies of projected future conditions is maintained and updated as load forecasts and future generation/transmission changes evolve. Studies are performed annually to assess future system performance in accordance with NERC reliability standards. These studies form a basis for identifying future transmission expansion needs.

  New large generating units requesting to connect to the area bulk electric system are required to complete the Large Generator Interconnection Procedure. The studies performed by DE TSO as part of this procedure, examine the generating unit (combined turbine-generator-exciter) and the main step-up transformer(s).

The staff reviewed the information provided by the applicant on planning and reliability studies and simulation studies. Based on the information provided by the applicant, the staff finds that the information provided complies with the requirements of GDC 17 and conforms to the guidelines of RG 1.206 and GL 2006-2. Therefore, the staff considers WLS SUP 8.2-3 acceptable.

- WLS SUP 8.2-4

With regard to WLS SUP 8.2-4, the applicant provided the following information:

> The Nuclear Switchyard Interface Agreement between NGD and PD demonstrates protocols in place for the plant to remain cognizant of grid vulnerabilities and make informed decisions regarding maintenance activities critical to the electrical system.
>
> In the operations horizon, the DE TSO continuously monitors real-time power flows and assesses contingency impacts. Operational planning studies are also performed using offline power flow study tools to assess near term operating conditions under varying load, generation, and transmission topology patterns.

Based on the information provided by the applicant on the functions of TSO, the staff finds that the applicant has demonstrated that protocols are in place for WLS to remain cognizant of grid vulnerabilities in order to make informed decisions regarding maintenance activities critical to the electric system. Therefore, the staff finds that the application complies with the requirements of GDC 17 and GDC 18, 10 CFR 50.60 and conforms to the guidelines of GL 2006-2 of which one of the provisions is to reduce the likelihood of losing offsite power.

- WLS SUP 8.2-5

With regard to WLS SUP 8.2-5, the applicant provided the last 12 years of average outage data available on the DE transmission system as follows:

1. The Momentary Average Interruption Frequency Index is 0.28 for the 230-kV system and 0.78 for the 525-kV system.

2. The Transmission System Average Interruption Frequency Index for sustained (>1 minute) outages is 0.08 for the 230-kV system and 0.37 for the 525-kV system.

3. The Transmission System Average Interruption Duration Index (minutes) is 31.8 for the 230-kV system and 210 for the 525-kV system.

The staff reviewed the supplemental information provided regarding the grid availability historical data and finds that the information complies with the requirements of GDC 17 and conforms to the guidelines of RG 1.206. Therefore, the staff considers WLS SUP 8.2-5 acceptable.

- WLS SUP 8.2-6

With regard to WLS SUP 8.2-6, the applicant provided the following information in WLS COL FSAR Section 8.2.1.2.3.

> Section 8.2.1.2.3 Plant Response to High Voltage Open Phase Condition
>
> A monitoring system is installed on the credited GDC 17 offsite power circuit that provides continuous open phase condition monitoring of the MSU transformer HV input power supply (see Reference 201). The system detects an open phase condition (with or without a concurrent high impedance ground on the HV side of the transformer) on one or more phases under all transformer loading conditions. The open phase condition monitoring system provides an alarm to the operators in the control room should an open phase condition occur on the HV source to the MSU transformers. The system design utilizes commercially available components including state of the art digital relaying equipment and input parameters as required to provide loss of phase detection and alarm capability.
>
> Additionally, a high-voltage open phase condition with or without a ground fault can manifest itself as an unacceptable voltage on the 6.9 kV medium voltage ES-1 and ES-2 buses during normal loading conditions. The presence of unacceptable voltages on the ES-1 and ES-2 buses results in isolation of the affected medium voltage bus from the offsite power supply and enables the onsite standby diesel generators to start and restore AC power to the ES-1 and ES-2 buses and associated defense-in-depth loads. The onsite AC power system is described in DCD Section 8.3.1.
>
> Motor management relays for the medium voltage motors on ES-1 and ES-2 provide detection of unacceptably high negative sequence currents. High negative sequence current motor trips or other running load trips provide alarms in the MCR, which can assist in the detection of a high-voltage open phase condition with or without a ground fault. Electric circuit protection for the medium voltage system and equipment is described in DCD Section 8.3.1.1.1.1.

A high-voltage open phase condition with or without a ground fault can also manifest itself as an unacceptable voltage on the 480 VAC low-voltage buses powered from ES-1 and ES-2. The safety-related IDS battery chargers are powered from the low-voltage buses and continue to charge the IDS batteries unless the battery charger input or output monitored electrical parameters are unacceptable. If the monitored electrical parameters degrade to the point that the battery charger no longer provides sufficient DC bus voltage, the Class 1E electrical system DC bus receives power from the applicable IDS battery and the battery charger maintains isolation between the Non-Class 1E AC and Class 1E DC power systems which generates alarms in the MCR. The onsite AC power system is described in DCD Section 8.3.1 and the Class 1E DC power system is described in DCD Section 8.3.2.1.1.

Operator actions and maintenance and testing activities are addressed in procedures, as described in Section 13.5. Plant operating procedures, including off-normal operating procedures associated with the monitoring system will be developed prior to fuel load. Maintenance and testing procedures, including calibration, surveillance testing, setpoint determination and troubleshooting procedures associated with the monitoring system will be developed prior to fuel load.

Control Room operator and maintenance technician training associated with the operation and maintenance of the monitoring system will be conducted in accordance with the milestones for Non Licensed Plant Staff and Reactor Operator Training Programs in Table 13.4.201.

The staff has reviewed this supplement. The supplement acceptably addresses the staff position as to measures necessary to protect a plant against an open phase condition as described in NRC Bulletin 2012-01. The staff finds the information complies with the requirements of GDC 17 and conforms to the guidelines of RG 1.206 and GL 2006-2. Therefore, the staff finds this acceptable and the issue resolved.

The staff finds that the information provided in the above supplement is consistent with the information requested within RG 1.206 and the regulatory requirements and is therefore acceptable.

NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System"

In light of recent operating experience that involved the loss of one of the three phases of the offsite power circuit (i.e., loss of a single-phase) at Byron Station, Unit 2, the NRC issued Bulletin 2012-01, "Design Vulnerability in Electric Power System," on July 27, 2012, to all holders of operating and combined licenses requesting information about the facilities' electric power system designs. The above operating event resulted in neither the onsite nor the offsite electric power system being able to perform its intended safety functions (i.e., to provide electric power to the important to safety buses with sufficient capacity and capability to permit functioning of structures, systems, and components important to safety). NRC Bulletin 2012-01 was issued to operating and new reactor licensees to affirm compliance with GDC 17 requirements and to evaluate whether further NRC action is warranted to address this design vulnerability. Subsequently, the staff also issued RAI 108, Question 08-1, to the applicant for WLS Units 1 and 2, to address the matters described in NRC Bulletin 2012-01 and to ensure that the WLS design meets GDC 17.

In an October 23, 2012, letter, the applicant provided its response to RAI 108, Question 08-1, "Single-Phase Open Circuit Condition," for WLS Units 1 and 2. The proposed design utilized existing undervoltage relays on the ES-1 and ES-2 buses as well as existing undervoltage relays on the loads, on or downstream of the ES-1 and ES-2 buses. Based on review of this response, the staff could not determine whether the WLS Units 1 and 2 existing protection schemes would detect open circuit conditions on the high voltage side of a transformer connecting a GDC 17 offsite power circuit to the transmission system for all operating electrical system configurations and loading conditions.

On November 1, 2013, the NRC conducted a public meeting with representatives from the Nuclear Energy Institute and other industry representatives to discuss the industry initiative associated with resolving NRC Bulletin 2012-01. During the meeting, industry representatives provided feedback regarding their review of an offsite power two-phase open circuit event that occurred at Forsmark Nuclear Power Plant in Sweden (see NRC Information Notice 2006-18, Supplement 1: "Significant Loss of Safety-Related Electrical Power at Forsmark Unit 1 in Sweden"). The industry representatives informed the staff that their detailed analyses of this condition indicated that the proposed single-open phase detection system may not be sensitive enough to detect a two-phase open circuit condition. Therefore, the industry has taken the position that a two-phase open circuit condition must be considered when developing a resolution for the NRC Bulletin open phase issue.

GDC 17 requires, in part, "An 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: (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." For AP1000 reactors, the main ac power system is non-Class 1E and not safety-related. During a loss of offsite power, ac power is supplied by the onsite standby diesel generators, which are also not safety-related. However, the ac power system is designed such that plant auxiliaries can be powered from the grid under all modes of operation. Furthermore, the ac power systems do supply power to equipment that is important to safety since that equipment serves defense-in-depth functions. The offsite power supply system provides power to the safety-related loads through the battery chargers, and both the offsite power system and the standby diesel generators provide defense-in-depth functions to supplement the capability of the safety-related passive systems for reactor coolant makeup and decay heat removal. In this regard, offsite power is the preferred power source, and supports the first line of defense. In addition, the safety analyses take credit for the grid remaining stable to maintain reactor coolant pump operation for three seconds following a turbine trip in accordance with the guidance of RG 1.206. Accordingly, these electric power systems are important to safety, and subject to the requirements of GDC 17. Consequently, it was the staff's position that AP1000 COL applicants address the design vulnerability identified in NRC Bulletin 2012-01.

Furthermore, it is the staff's position that an acceptable approach for passive designs includes the following four elements: (1) a dedicated automatic detection for an offsite power system single-phase open circuit condition with, and without, a high impedance ground fault condition on the high voltage side of the main power transformer including two open phase conditions under all loading and operating configurations; (2) an alarm in the main control room for operators to take manual actions if the standby diesel generators are not automatically connected to the ES-1 and ES-2 buses; (3) an inspection, test, analysis, and acceptance criteria

(ITAAC) to confirm that the analyses for developing the proper set points were completed in accordance with the acceptance criteria and to perform testing to demonstrate that the design functions as described in the WLS COL FSAR; and (4) procedures and training for the operating and maintenance staff. This approach ensures the required offsite ac power source with adequate capacity and capability is available to important safety equipment including safety-related battery chargers to meet their intended safety function in accordance with GDC 17 requirements.

In an August 28, 2014, supplemental response to RAI 108, Question 08-1, the applicant provided text that will be added to the next revision of the WLS COL FSAR, including but not limited to, ITAAC to confirm that the analyses for developing the proper set points were completed in accordance with the acceptance criteria and to perform testing to demonstrate that the design functions as described in the WLS COL FSAR. These proposed additions to the WLS COL FSAR and the ITAAC acceptably address the staff's position as that which is necessary to protect a plant with regard to an open phase condition as described in NRC Bulletin 2012-01, and that the WLS design meets GDC 17. Therefore, the staff considers this issue resolved and RAI 108, Question 08-1, closed pending the staff's confirmation that the revisions to the WLS COL FSAR noted above are incorporated in the WLS Units 1 and 2 application. RAI 108, Question 08-1 was being tracked as Confirmatory Item 8.2-1.

Resolution of Confirmatory Item 8.2-1

Confirmatory Item 8.2-1 is an applicant commitment to update its WLS COL FSAR and ITAAC to include details necessary to protect a plant with regard to an open phase condition, described in NRC Bulletin 2012-01. The staff verified that the WLS COL FSAR and ITAAC were appropriately updated and that the WLS design meets GDC 17. Accordingly, the staff considers Confirmatory Item 8.2-1 related to RAI 108, Question 08-1, resolved.

Interface Requirements

The plant interfaces for the standard design of the AP1000 are discussed in AP1000 DCD Tier 2, Section 8.2.5 and DCD Table 1.8-1, Items 8.1, 8.2, and 8.3, where they are identified as "NNS" interfaces.

The applicant incorporated by reference AP1000 DCD Section 1.8. This section of the AP1000 DCD identifies certain interfaces with the standard design that have to be addressed in accordance with 10 CFR 52.47(a)(1)(vii).[2] As required by 10 CFR 52.79(d)(2), the COL application must demonstrate how these interface items have been met.

To satisfy AP1000 DCD, Tier 2, Table 1.8-1, Interface Item 8.1, the applicant provided a listing of the design criteria, regulatory guides, and IEEE standards in WLS COL FSAR Section 8.1.4.3 to which the applicant commits to as interface requirements for the offsite power system. The staff finds this information consistent with NUREG-0800, Section 8.1 as well as AP1000 DCD Table 1.8-1. Accordingly, the staff finds that this interface item for the offsite power system has been met.

With regard to plant AP1000 DCD, Tier 2, Table 1.8-1, Interface Item 8.2, the staff observed that in WLS COL FSAR Section 8.2.2, the applicant stated that the grid stability study has confirmed

[2] Following the update to 10 CFR Part 52 (72 *Federal Register* (FR) 49517), this provision has changed to 10 CFR 52.47(a)(25).

that the interface requirements for steady state load, nominal voltage, allowable voltage regulation, nominal frequency, allowable frequency fluctuation, and maximum frequency decay rate, have been met. In RAI 5, Question 08.02-6, the staff requested that the applicant provide the summary of the grid stability analysis results, the assumptions made, and the acceptance criteria for each case analyzed. Additionally, the staff requested that the applicant provide the nominal frequency, allowable frequency fluctuation, maximum frequency decay rate, and the limiting under-frequency values used for the RCP in the analysis. In a September 26, 2008, response to RAI 5, Question 08.02-6, the applicant provided the required parameter values and the associated analysis results. Additionally, the applicant stated that the WLS COL FSAR would be revised to include the parameter values. The staff has verified that Revision 4 to the WLS COL FSAR includes the proposed change. The staff has verified the change has been actualized in the WLS COL FSAR and concludes that the parameter values and the analysis results meet the AP1000 design requirements, the requirements of GDC 17 and the guidelines of RG 1.206. Accordingly, the staff considers this RAI resolved and AP1000 DCD Tier 2, Table 1.8-1, Interface Item 8.2 satisfied.

AP1000 DCD Tier 2, Table 1.8-1, Plant Interface Item 8.3 calls for a design feature that provides that "the protective devices controlling the switchyard breakers are set with consideration given to preserving the plant grid connection following a turbine trip." In the absence of a description of such a design feature, the staff asked the applicant to provide a reference as to where this issue is discussed in the application, or to provide a proposed revision to the application to address the issue (WLS RAI 74, Question 08.02-9).

In an August 20, 2009, response to WLS RAI 74, Question 08.02-9, the applicant identified a proposed revision to WLS COL FSAR Section 8.2.1.2.2 that states, "The protective devices controlling the switchyard breakers are set with consideration given to preserving the plant grid connection following a turbine trip." The staff verified that the WLS COL FSAR was updated to include this change and concludes that the switchyard arrangement, the protection of lines by independent high speed relaying, and the breaker failure scheme would preserve the WLS connection to the grid following a turbine trip satisfying the requirements of GDC 17. Therefore, the staff finds this interface has been met and the issue in WLS RAI 74, Question 08.02-9 resolved. On this basis, the staff considers COL Information Item 8.2.3.1-2, also resolved.

The staff reviewed the information supplied by the applicant and concludes that the applicant has adequately addressed AP1000 DCD Tier 2, Table 1.8-1, Interface Items 8.1, 8.2, and 8.3.

Inspections, Tests, Analyses and Acceptance Criteria

As part of the applicant's resolution of electrical power issues, discussed in the subsection NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," above, the applicant made changes to the WLS COL application, Part 10, Appendix B, "Inspections, Tests, Analysis and Acceptance Criteria." The applicant proposed the following site-specific ITAAC for the Main ac Power System (ECS) to be added as new Item 4.g in Table 2.6.1-4, in the application, to that already required by AP1000 DCD Tier 1, Section 2.6.1. This ITAAC was not required by the staff to make the acceptability finding for resolution of NRC Bulletin 2012-01.

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
4.g) The ECS provides an alarm in the MCR [main control room] and automatic protection actuation if an undervoltage condition is detected on any one or more AC phases of either switchgear ECS-ES-1 or ECS-ES-2.	i) Testing of the as-built ECS will be conducted by simulating an undervoltage condition on ECS-ES-1 and ECS-ES-2 to confirm that an MCR alarm is generated when one or more ECS bus phase voltages is below setpoint on either switchgear ECS-ES-1 or ECS-ES-2.	i) Undervoltage relays on ECS-ES-1 and ECS-ES-2 provide alarm when one or more AC phases on the 6.9 kV buses are below setpoint.
	ii) Testing of the as-built ECS will be conducted by simulating an undervoltage condition on ECS-ES-1 and ECS-ES-2 to confirm that loss of one or more ECS bus phases automatically actuates the electrical protection function logic.	ii) Undervoltage relays on ECS-ES-1 and ECS-ES-2 initiate protective action when one or more AC phases on the 6.9 kV buses are below setpoint.

The applicant proposed the following site-specific ITAAC for the offsite power system to be added in the WLS application, Part 10, Appendix B, as new line item 7 in AP1000 DCD Tier 1, Table 2.6.12-1.

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
7. The credited GDC 17 off-site power source is monitored by an open phase condition monitoring system that can detect the following at the high voltage terminals of the transformer connecting to the off-site source, over the full range of transformer loading from no load to full load: (1) loss of one of the three phases of the offsite power source a. with a high impedance ground fault condition, or b. without a high impedance ground fault condition; or (2) loss of two of the three phases of the offsite power source a. with a high impedance ground fault condition, or b. without a high impedance ground fault condition. Upon detection of any condition described above, the system will actuate an alarm in the main control room.	i) Analysis shall be used to determine the required alarm set points for the open phase condition monitoring system to indicate the presence of open phase conditions described in the design commitment. ii) Testing of the credited GDC-17 off-site power source open phase condition monitoring system will be performed using simulated signals to verify that the as-built open phase condition monitoring system detects open phase conditions described in the design commitment and at the established set points actuates an alarm in the main control room.	i) Alarm set points for the open phase condition monitoring system to indicate the presence of open phase conditions as described in the design commitment have been determined by analysis. ii) Testing demonstrates the credited GDC 17 off-site power source open phase condition monitoring system detects open phase conditions described in the design commitment and at the established set points actuates an alarm in the main control room.

The evaluation of the applicant-proposed site-specific ITAAC item 7 is presented in the subsection, NRC Bulletin 2012-01, “Design Vulnerability in Electric Power System,” above.

8.2.5 Post Combined License Activities

As discussed in the technical evaluation section above, the staff finds acceptable ITAAC items 4g and 7 as defined in the WLS COL application, Part 10, Appendix B.

8.2.6 Conclusion

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to the offsite power system, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the application are documented in NUREG-1793 and its supplements.

In addition, the staff concludes that the relevant information presented in the WLS COL FSAR is acceptable and meets the requirements of GDC 17 and GDC 18. The staff based its conclusion on the following:

- WLS COL 8.2-1 is acceptable because the applicant provided sufficient information involving the design details of the plant site switchyard, its interface with the local transmission grid, protective device settings, its testing and inspection plan and details of a FMEA performed for the plant site switchyard and meets the requirements of GDC 17 and GDC 18 and the guidelines of RG 1.206.

- WLS COL 8.2-2 is acceptable because the applicant provided sufficient information to demonstrate that the grid will remain stable to maintain RCP operation for three seconds following a turbine trip in accordance the requirements of GDC 17 and the guidelines of RG 1.206 and GL 2006-2.

- WLS CDI in WLS COL FSAR Section 8.2.1 is acceptable because the applicant provided sufficient information concerning the transformer area located next to each unit's turbine building in accordance with the requirements of GDC 17 and conforms to the guidelines of RG 1.206.

- WLS SUP 8.2-1 is acceptable because the applicant provided sufficient information on TSP/TSO, and the detailed voltage and other requirements to be maintained by TSP/TSO in accordance with the requirements of GDC 17 and GDC 18 and conforms to the guidelines of RG 1.206.

- WLS SUP 8.2-2 is acceptable because the applicant provided sufficient information describing the formal agreement between the NGD and PDs, which is the TSO, setting the requirements for transmission system studies and analyses in accordance with the requirements of GDC 17 and conforms to the guidelines of RG 1.206 and GL 2006-2.

- WLS SUP 8.2-3 is acceptable because the applicant provided sufficient information to describe the PD's responsibility for maintaining area bulk transmission system reliability and demonstrating, by power system simulation studies, projections, and analyses, the current and future reliability of the system in accordance with the requirements of GDC 17 and conforms to the guidelines of RG 1.206, and GL 2006-2.

- WLS SUP 8.2-4 is acceptable because the applicant provided sufficient information to demonstrate that protocols are in place for WLS to remain cognizant of grid vulnerabilities in order to make informed decisions regarding maintenance activities critical to the electric system in accordance with the requirements of GDC 17 and GDC 18, and 10 CFR 50.65, and conforms to the guidelines of RG 1.206 and GL 2006-2.

- WLS SUP 8.2-5 is acceptable because the applicant provided sufficient information regarding the 525-kV and 230-kV transmission lines outage data available over the past 12 years in accordance with the requirements of GDC 17 and GDC 18, 10 CFR 50.65, and conforms to the guidelines of RG 1.206.

- WLS SUP 8.2-6 is acceptable because the applicant provided sufficient information on a monitoring system for the offsite power circuit that provides continuous open phase condition monitoring that complies with the requirements of GDC 17 and conforms to the guidelines of RG 1.206 and GL 2006-2. Therefore, the staff finds this acceptable and considers the issue resolved.

- The applicant's addressing NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," is acceptable because the proposed additions to the WLS COL FSAR and the ITAAC acceptably address the staff position as that which is necessary to protect a plant with regard to an open phase condition as described in NRC Bulletin 2012-01, and that the WLS design meets GDC 17.

- The applicant provided sufficient information regarding the interfaces for standard design from the generic AP1000 DCD Table 1.8-1, Items 8.1, 8.2, and 8.3 in accordance with the requirements of GDC 17 for the staff to find acceptable.

- ITAAC – The applicant proposed the site-specific ITAAC for the Main ac Power System to be added to the WLS COL application, Part 10, Appendix B as new Item 4.g in Table 2.6.1-4. In addition, the applicant proposed site-specific ITAAC for the offsite power system to be added as new line Item 7 in AP1000 DCD Tier 1, Table 2.6.12-1. The staff finds that the proposed ITAAC items acceptably address the staff position with regard to an open phase condition as described in NRC Bulletin 2012-01, and that the WLS design meets the requirements of GDC 17.

8.2.A Site-Specific ITAAC for Offsite Power Systems

8.2.A.1 *Introduction*

This section specifically addresses the site-specific inspections, tests, analyses and acceptance criteria (SS-ITAAC), that the applicant proposed related to the offsite power system that are necessary and sufficient to provide reasonable assurance that the facility has been constructed and will operate in conformance with the COL, the provisions of the Atomic Energy Act of 1954, as amended, and NRC regulations.

8.2.A.2 Summary of Application

WLS COL FSAR, Revision 9, Section 14.3, incorporates by reference AP1000 DCD, Revision 19, Section 14.3, and contains the following supplemental information.

Supplemental Information

- STD SUP 14.3-1

The applicant provided supplemental information related to the offsite power system in STD SUP 14.3-1 in WLS COL FSAR Section 14.3.2.3.3.

8.2.A.3 *Regulatory Basis*

The regulatory basis for the review of the information incorporated by reference is addressed in NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," and its supplements. In addition, the acceptance criteria associated with the relevant requirements of NRC regulations for ITAAC are given in NUREG-0800, Section 14.3.

The applicable regulatory requirements for electrical SS-ITAAC are in 10 CFR 52.80(a), "Contents of applications; additional technical information."

8.2.A.4 Technical Evaluation

The staff reviewed WLS COL FSAR Section 14.3 and checked the referenced DCD to ensure that the combination of the DCD and the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to SS-ITAAC for offsite power systems. The results of the staff's evaluation of the information incorporated by reference in the WLS COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the design certification and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the report for the reference COL application (VEGP Units 3 and 4) were equally applicable to the WLS Units 1 and 2 COL application the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5 to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

The staff has completed its review and found the evaluation performed for the standard content to be directly applicable to the WLS COL application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the report for the reference application (VEGP) contains evaluation material from the report for the BLN Units 3 and 4, application.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 8.2.A.4:

Supplemental Information

- *STD SUP 14.3-1, addressing SS-ITAACs*

ITAAC Screening Summary Table 14.3-201 of the BLN FSAR identified the transmission switchyard and offsite power system as a site-specific system and selected them for ITAAC, but the table indicated "title only, no entry for COLA." Consequently, Section 2.6.12 of Part 10 of Appendix B, "License Conditions and ITTAC" of the BLN COL application (COLA) provided no ITAAC information for the transmission switchyard and offsite power system. The COL applicant must provide this site-specific ITAAC for compliance with 10 CFR 52.79(d) and 10 CFR 52.80(a). In RAI 14.3-1, the NRC staff stated that RG 1.206, CIII.7.2, Site-Specific ITAAC, recommends that applicants develop ITAAC for the site-specific systems that are designed to meet the significant interface requirements of the standard certified design, that is, the site-specific systems that are needed for operation of the plant (e.g., offsite power). Therefore, the applicant should justify why there is no ITAAC entry associated with offsite power, or revise Table 14.3-201 of the BLN FSAR to include ITAAC entries for the transmission switchyard and the offsite power system.

By letter dated June 24, 2008, the applicant stated that approved DCD Section 14.3 refers to the selection criteria and processes used for developing the AP1000 Certified Design Material (CDM) and identifies no interfaces (e.g., systems for storm drain, raw water, and closed circuit TV system, etc.) meeting this definition. Thus, according to the applicant, the CDM does not include ITAAC or a requirement for COL developed ITAAC for the offsite power interface system. The staff found the above response to be inconsistent with the requirements of 10 CFR 52.80(a), and guidance of NUREG-0800 Section 14.3 and RG 1.206.

Several discussions were held between the applicant and the NRC staff to discuss this issue. The staff pointed out that the offsite power system performs an important function in the passive designs as it provides power to the safety-related loads through battery chargers during normal, abnormal and accident conditions. It also provides power to those active systems that provide defense-in-depth capabilities for reactor coolant make-up and decay heat removal.

These active systems are the first line of defense to reduce challenges to the passive systems in the event of plant transients. The above function of the offsite power system in passive designs supports the need for ITAAC for these systems so that the staff can verify that (1) the designed and installed systems, structures, or components of the offsite power systems will perform as designed and (2) the required single circuit from the transmission network satisfies the requirements of GDC 17.

Subsequently, in a letter dated May 11, 2009, the applicant revised its response to RAI 14.3-1 and provided an ITAAC for the offsite power system to verify that the as-built offsite portion of the power supply from the transmission network to

the interface with the onsite ac power system will satisfy the applicable provisions of GDC 17. Specifically, the ITAAC shall verify:

(1) A minimum of one offsite circuit supplies electric power from the transmission network to the interface with the onsite portions of the ac power system.

(2) Each offsite circuit interfacing with the onsite ac power system is adequately rated to supply assumed loads during normal, abnormal and accident conditions.

(3) During steady state operation, each offsite circuit is capable of supplying required voltage to the interface with the onsite ac power system that will support operation of assumed loads during normal, abnormal and accident conditions.

(4) During steady state operation, each offsite circuit is capable of supplying required frequency to the interface with the onsite ac power system that will support operation of assumed loads during normal, abnormal and accident conditions.

(5) The fault current contribution of each offsite portion circuit is compatible with the interrupting capability of the onsite ac power system fault current interrupting devices.

(6) The reactor coolant pumps continue to receive power from either the main generator or the grid for a minimum of 3 seconds following a turbine trip.

To ensure that the requirements of GDC 17 for the adequacy of the offsite power source within the standard design scope are met, the proposed ITAAC would verify the capacity and capability of the offsite source to feed the onsite power system. The proposed ITAAC provides for the inspection of the connection of the offsite source to the onsite power system.

Additionally, the applicant identified all associated changes that will be made in a future revision of the Bellefonte FSAR. On the basis of its review, the staff finds that the applicant has adequately addressed the site-specific ITAAC for the offsite power system so that the staff can verify that the designed and installed systems, structures, or components of the offsite power system will perform as designed. Therefore, the staff concludes that the applicant meets the requirements of 10 CFR 52.79(d) and 10 CFR 52.80(a), and the guidance of SRP 14.3 and RG 1.206. The applicant will revise the BLN COL FSAR to include the proposed ITAAC for offsite power system. This is identified as Confirmatory Item 8.2A-1, pending NRC review and approval of the revised BLN COL FSAR.

<u>Resolution of Standard Content Confirmatory Item 8.2A-1</u>

The applicant proposed a license condition in Part 10 of the VEGP COL application, which will incorporate the ITAAC identified in Appendix B.

Appendix B includes ITAAC for the offsite power system. The license condition's proposed text is evaluated in Chapter 1 of this SER.

Confirmatory Item 8.2A-1 required the applicant to update its FSAR to include proposed ITAAC for the offsite power system. The NRC staff verified that the VEGP COL application was appropriately updated. The ITAAC associated with the offsite power system are shown in VEGP COL Part 10, Appendix B, Table 2.6.12-1. Table 8.2A-1 of this SER reflects this table. As a result, Confirmatory Item 8.2A-1 is resolved. Therefore, the staff will include the ITAAC for the offsite power system in the license.

8.2.A.5 *Post Combined License Activities*

For the reasons discussed in WLS COL FSAR, Part 10, Appendix B, Table 2.6.12-4, "Offsite Power System," the staff finds the ITAAC proposed by the applicant acceptable.

8.2.A.6 *Conclusion*

The staff concludes that the relevant information presented in the WLS COL FSAR is acceptable and meets the requirements of GDC 17 and GDC 18.

8.3 Onsite Power Systems

8.3.1 AC Power Systems

8.3.1.1 *Introduction*

The onsite ac power system includes those standby power sources, distribution systems, and auxiliary supporting systems provided to supply power to safety-related equipment or equipment important to safety for all normal operating and accident conditions. In the AP1000 passive reactor design used at WLS, the onsite ac power system is a non-Class 1E system that provides reliable ac power to the various system electrical loads. It does not perform any safety-related functions. These loads enhance an orderly shutdown under emergency conditions when offsite power is not available. Additional loads for investment protection can be manually loaded on the standby power supplies. Diesel generator sets are used as the standby power source for the onsite ac power system.

8.3.1.2 *Summary of Application*

WLS COL FSAR, Revision 9, Section 8.3 incorporates by reference AP1000 DCD, Revision 19, Section 8.3, and contains COL information items and supplemental information to address any departures and/or supplements.

COL Information Items

- WLS COL 8.3-1

WLS COL 8.3-1 describes: (1) the grounding grid system design within the plant boundary; and (2) a lightning protection risk assessment and general system design for the switchyard and buildings comprising WLS Units 1 and 2. This COL information item is also referenced in WLS COL FSAR Section 8.3.3.

- STD COL 8.3-2

STD COL 8.3-2 describes the details of: (1) Class 1E and non-Class 1E battery maintenance, clearing of faults, and testing of chargers and voltage regulating transformers; (2) the bases of operation, inspection, and maintenance procedures for the onsite standby diesel generators; and (3) procedures for the periodic testing of penetration overcurrent protective devices. This COL information item is also referenced in WLS COL FSAR Section 8.3.3.

Supplemental Information

- WLS SUP 8.3-1

WLS SUP 8.3-1 states that the site conditions provided in WLS COL FSAR Sections 2.1 and 2.3 are bounded by the standard site conditions used to rate the diesel engine and the associated generator in AP1000 DCD Section 8.3.1.1.2.3.

8.3.1.3 *Regulatory Basis*

The regulatory basis for the review of the information incorporated by reference is addressed in NUREG-1793, "Final Safety Evaluation Report Related to Certification of the AP1000 Standard Design," and its supplements. In addition, the acceptance criteria associated with the relevant requirements of the Commission regulations for the ac power systems are given in NUREG-0800, Section 8.3.1.

The regulatory basis for the review of WLS COL 8.3-1, addressing the grounding and lightning protection systems are the guidelines of:

- RG 1.204, "Guidelines for Lightning Protection of Nuclear Power Plants"
- IEEE Standard 80, "Guide for Safety in AC Substation Grounding"
- IEEE Standard 665, "Guide for Generating Station Grounding"
- IEEE C.62.23, "Application Guide for Surge Protection of Electric Generating Plants"
- National Fire Protection Association (NFPA) 780, "Standard for the Installation of Lightning Protection Systems"

The regulatory bases for the review of the part of STD COL 8.3-2 addressing the recommendations in operation, inspection, and maintenance procedures for the non-Class 1E onsite standby diesel generators are the manufacturer's guidelines. The regulatory bases for the review of the part of STD COL 8.3-2 addressing procedures for penetration protective device testing are the guidelines of RG 1.63, Revision 3, "Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants." The regulatory basis for the review of WLS SUP 8.3-1 was the standard site conditions outlined in NUREG-1793. The regulatory bases for acceptance of STD SUP 8.3-2 is the requirements of GDC 18, "Inspection and Testing of Electric Power Systems."

8.3.1.4 *Technical Evaluation*

The staff reviewed WLS COL FSAR Section 8.3.1 and checked the referenced DCD to ensure that the combination of the DCD information incorporated by reference and the information

included in WLS COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the ac power systems. The results of the staff's evaluation of the information incorporated by reference in the application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the design certification and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP Units 3 and 4) were equally applicable to the WLS Units 1 and 2 application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the WLS COL FSAR, Revision 9. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the COL application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

The staff completed its review and found the evaluation performed for the standard content to be directly applicable to the WLS application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the reference application (VEGP) contains evaluation material from the SER for the BLN Units 3 and 4 application.

The staff reviewed the information in the WLS COL FSAR:

COL Information Items

- COL 8.3-1

The staff reviewed COL 8.3-1 related to the AP1000 DCD COL Information Item 8.3-1 that states:

> Combined License applicants referencing the AP1000 certified design will address the design of grounding and lightning protection.

The commitment was also captured as COL Action Item 8.3.1.6-1 in NUREG-1793, Appendix F, which states:

> The COL applicant will provide the design of the site-specific grounding and lightning protection.

The staff reviewed the resolution to COL Information Item 8.3-1, related to the ground grid system and lightning protection included under WLS COL FSAR Section 8.3. The staff's evaluation is described below.

The applicant stated that a grounding system calculation was performed to establish a ground grid design within the plant boundary resulting in step and touch potentials near equipment that are within the acceptable limit for personnel safety. Computer analysis utilized actual resistivity measurements from soil samples taken at the plant site, and were used to create a soil model for the plant site. The ground grid conductor size was then determined using the methodology outlined in IEEE Standard 80, and a grid configuration for the site was created. The grid configuration was modeled in conjunction with the soil model. The resulting step and touch potentials were calculated, and found to be within the acceptable limit. Based on the above, the staff concludes that IEEE Standard 80 provides an acceptable method for determining the right size for ground conductors; therefore, the COL information item provided by the applicant on station grounding grid is acceptable.

In reference to lightning protection, the applicant states that in accordance with IEEE 665, a lightning protection risk assessment for the buildings comprising the WLS was performed based on the methodology in NFPA 780. The tolerable lightning frequency for each of the buildings was determined to be less than the expected lightning frequency; therefore, lightning protection is required for WLS buildings in accordance with NFPA 780 and IEEE C.62.23. The zone of protection is based on the elevations and geometry of the structures. It includes the space covered by a rolling sphere having a radius sufficient enough to cover the building to be protected. The zone of protection method is based on the use of ground masts, air terminals and shield wires. Either copper or aluminum is used for lightning protection. Lightning protection grounding is interconnected with the station or switchyard grounding system. Based on the above, the staff concludes that the applicant adequately addressed the guidance of IEEE Standard 80, IEEE Standard 665, IEEE C.62.23, and NFPA 780, and provided an acceptable method for lightning protection; therefore, the supplemental information provided by the applicant on lightning protection is acceptable.

With regard to the protection of electrical penetration assemblies and the onsite standby diesel generator inspection and maintenance, WLS identified the standard content related to these two items in its WLS COL FSAR Section 8.3. The following portion of this technical evaluation section is reproduced from VEGP SER Section 8.3.1.4.

- STD COL 8.3-2

The staff reviewed STD COL 8.3-2 related to AP1000 DCD COL Information Item 8.3-2, which states, in part:

> *The Combined License applicant will establish plant procedures as required for:*
>
> – *Periodic testing of penetration protective devices*
>
> – *Diesel generator operation, inspection and maintenance in accordance with manufacturers' recommendations*

The commitment was also captured as COL Action Items 8.3.1.2-1 and 8.4.1-1 in the staff's FSER for the AP1000 DCD, Appendix F (NUREG-1793), which state:

> *The COL applicant will establish plant procedures for preoperational testing to verify proper operation of the ac power system. (COL Action Item 8.3.1.2-1).*

> *The COL applicant will establish plant procedures for periodic testing of penetration protective devices. (COL Action Item 8.4.1-1).*

A part of standard information item, STD COL 8.3-2, was provided by the applicant describing the bases of the recommendations in operation, inspection, and maintenance procedures for the onsite standby diesel generators. This part of STD COL 8.3-2 is addressed in BLN COL FSAR Section 8.3.1.1.2.4.

A part of standard information item, STD COL 8.3-2, was provided by the applicant describing procedures for the testing of penetration protective devices. This portion of STD COL 8.3-2 is addressed in BLN COL FSAR Section 8.3.1.1.6.

The NRC staff reviewed the resolution to COL information item, STD COL 8.3-2, related to testing procedures for standby diesel generators and electrical penetrations included under Section 8.3 of the BLN COL FSAR. The NRC staff's evaluation follows.

For the operation, inspection and maintenance for diesel generators, the applicant's procedures will consider both the diesel generator manufacturer and industry diesel working group recommendations.

In RAI 8.3.1-2, the NRC staff stated that COL Action Item 8.3.1.2-1 in the NRC's FSER for the AP1000 DCD (NUREG-1793), contains the following discussion:

> *Preoperational tests are conducted to verify proper operation of the ac power system. The preoperational tests include operational testing of the diesel load sequencer and diesel generator capacity testing. The diesel generators are not safety-related and will be maintained in accordance with the requirements of the overall plant maintenance program. This program will cover the preventive, corrective, and predictive maintenance activities of the plant systems and equipment and will be presented in the COL application. This COL information is discussed in DCD Tier 2, Section 8.3.3, "Combined License Information for Onsite Electrical Power."*

In RAI 8.3.1-2, the applicant was asked to provide a reference to where the preoperational testing program and the preventive, corrective, and predictive maintenance activities for the diesel generators are discussed in the application, or provide a proposed revision to the application to address this issue.

In a letter dated April 6, 2009, the applicant stated that COL Action Item 8.3.1.2-1 in Appendix F of the FSER does not indicate that "pre-operational testing" of the diesel generators has been addressed in the DCD. Pre-operational testing of the ac power system is described in FSER Section 14, DCD Section 14, and BLN COL FSAR Chapter 14. Specifically, DCD Sections 14.2.9.2.15 and 14.2.9.2.17 address the onsite ac power system and diesel generator testing, including diesel generator capacity and sequencer tests. BLN COL FSAR Section 14.2.9.4.23 describes testing of the offsite power system. The NRC staff agrees that pre-operational testing of the diesel generators is addressed in DCD

Section 14.2.9.2.17 and was found acceptable by the staff as indicated in FSER NUREG-1793 Section 14.2.9. Based on the above, the NRC staff finds that the applicant's response to the portion of the RAI regarding COL areas of responsibility is acceptable.

In addition, the applicant stated that BLN COL FSAR Section 8.3.1.1.2.4 will be revised to include inspection and maintenance (including preventive, corrective, and predictive maintenance) procedures considering both the diesel generator manufacturer's recommendations and industry diesel working group recommendations.

The NRC staff concludes that following the manufacturer and industry diesel generator working group recommendations for onsite standby diesel generator inspection and maintenance including preventive, corrective, and predictive maintenance provides reasonable assurance that the diesel generators will be adequately maintained. Therefore, DCD COL Information, Item 8.3-2 and FSER COL Action Item 8.3.1.2-1 are resolved subject to the verification that the BLN COL FSAR has been updated to include applicable portions of the RAI response. This is identified as Confirmatory Item 8.3.1-1.

With regard to establishing plant procedures for periodic testing of protective devices that provide penetration overcurrent protection, the applicant will implement procedures to periodically test a sample of each different type of overcurrent device. 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*
- *Verification of long time, short time, and instantaneous trips of low voltage air circuit breakers*

Because the above testing is consistent with the recommendation of RG 1.63, the NRC staff concludes that the above information satisfies COL Information Item 8.3-2 and FSER COL Action Item 8.3.1.6-1, and that these items are resolved.

<u>Resolution of Standard Content Confirmatory Item 8.3.1-1</u>

Confirmatory Item 8.3.1-1 required the applicant to update its FSAR to specify that onsite standby diesel generator inspection and maintenance (including preventive, corrective, and predictive maintenance) procedures will consider both the diesel generator manufacturer's recommendations and industry diesel working group recommendations. The NRC staff verified that the VEGP COL FSAR was appropriately updated. As a result, Confirmatory Item 8.3.1-1 is resolved.

Supplemental Information

- WLS SUP 8.3-1

In WLS SUP 8.3-1, the applicant stated that its site conditions provided in WLS COL FSAR Sections 2.1 and 2.3 were bounded by the standard site conditions in AP1000 DCD Section 8.3.1.1.2.3 used to rate the diesel engine and the associated generator. The staff agrees that the WLS site conditions are bounded by the standard site conditions used to determine the rating.

- STD SUP 8.3-2

The applicant provided information in STD SUP 8.3-2 to include implementation of procedures for periodic verification of proper operation of the onsite ac power system capability for automatic and manual transfer from the preferred power supply to the maintenance power supply and return from the maintenance power supply to the preferred power supply. The staff finds that the above satisfies the requirements of GDC 18 and is acceptable.

8.3.1.5 *Post Combined License Activities*

There are no post COL activities related to this section.

8.3.1.6 *Conclusion*

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to onsite ac power systems, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the application are documented in NUREG-1793 and its supplements.

In addition, the staff compared the COL information items, the supplemental information, the interfaces for standard design, and the proposed design changes and corrections in the application to the relevant NRC regulations, guidance in NUREG-0800, Section 8.3.1, and other NRC regulatory guides and concludes that the applicant is in compliance with NRC regulations. The staff based its conclusion on the following:

- COL 8.3-1 is acceptable because the applicant provided sufficient information related to the grounding grid system design and lightning protection consistent with the recommendations of RG 1.204, IEEE Std. 80, IEEE Std. 665, IEEE Std. C.62.23, and NFPA 780.

- STD COL 8.3-2 is acceptable because the applicant demonstrated conformance to preoperational testing of the diesel generators and periodic testing of the penetration overcurrent protective devices consistent with manufacturers' guidelines for non-Class 1E onsite diesel generators and the recommendations of RG 1.63.

- WLS SUP 8.3-1 is acceptable because the applicant demonstrated conformance to site-specific conditions that are bounded by the standard site conditions in the AP1000 DCD for rating the diesel generator.

- STD SUP 8.3-2 is acceptable because the applicant established procedures for periodic verification of offsite power system capacity for automatic and manual transfer from the preferred power supply to maintenance power supply and vice versa, demonstrating compliance with the requirements of GDC 18.

8.3.2 Direct Current Power Systems

8.3.2.1 *Introduction*

The dc power systems include those dc power sources and distribution systems provided to supply motive or control power to safety-related equipment. Batteries and battery chargers serve as the power sources for the dc power system and convert power from the dc distribution system to ac instrumentation, and control power, as required. These components can provide a UPS that furnishes a continuous, highly reliable source of ac supply.

The AP1000 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 UPS.

8.3.2.2 *Summary of Application*

WLS COL FSAR, Revision 9, Section 8.3 incorporates by reference AP1000 DCD, Revision 19, Section 8.3. AP1000 DCD Section 8.3 also includes Section 8.3.2. AP1000 DCD, Revision 19 includes a standard COL information Item (STD COL 8.3-2) and a standard departure (STD DEP 8.3-1). However, the applicant proposed a COL information item, supplemental information, and a site-specific AP1000 FSAR Tier 2 departure (WLS DEP 8.3-1).

Tier 2 Departure

WLS DEP 8.3-1

The applicant added Departure WLS DEP 8.3-1 to the WLS COL FSAR, revising AP1000 DCD Section 8.3.2.2 to add information on the Class 1E battery chargers' voltage regulating.

COL Information Item

- STD COL 8.3-2

STD COL 8.3-2 describes the details of: (1) procedures for inspection, maintenance, and testing of Class 1E batteries; (2) the clearing of ground faults on the Class 1E dc power system; and (3) information related to periodic testing for the battery chargers and voltage regulating transformers.

Supplemental Information

- STD SUP 8.3-1

The applicant provided supplemental information stating that there are no site-specific non-Class 1E dc loads connected to the Class 1E dc system.

8.3.2.3 *Regulatory Basis*

The regulatory basis for the review of the information incorporated by reference is addressed in NUREG-1793, and its supplements. In addition, the acceptance criteria associated with the relevant requirements of NRC regulations for the dc power systems are given in NUREG-0800, Section 8.3.2.

The regulatory basis for review of WLS DEP 8.3-1 is established in:

- GDC 17, "Electric Power Systems"
- GDC 18, "Inspection and Testing of Electric Power Systems"
- RG 1.129, Revision 2, "Maintenance, Testing, and Replacement of Vented Lead-Acid Storage Batteries for Nuclear Power Plants
- RG 1.75, "Criteria For Independence Of Electrical Safety Systems," Revision 3
- IEEE Standard 384, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuit,"
- IEEE Standard 450, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications"

The regulatory basis for the review of WLS COL 8.3-1 is 10 CFR Part 52, Appendix D, Section VIII.B.5 and the guidance of IEEE 384, and RG 1.75.

The regulatory basis for the review of STD COL 8.3-2 is 10 CFR Part 52, Appendix D, Section VIII.B.5 and manufacturer's recommendations.

8.3.2.4 *Technical Evaluation*

The staff reviewed WLS COL FSAR Section 8.3.2 and checked the referenced DCD to ensure that the combination of the DCD information incorporated by reference and the information in the COL application represents the complete scope of information relating to this review topic.[1] The staff's review confirmed that the information in the COL application and the DCD information incorporated by reference addresses the required information relating to the dc power systems. The results of the staff's evaluation of the information incorporated by reference in the application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this report provides a discussion of the strategy used by the staff to perform one technical review for each standard issue outside the scope of the design certification and use this review in evaluating subsequent COL applications. To ensure that the staff's findings on standard content that were documented in the SER for the reference COL application (VEGP Units 3 and 4) were equally applicable to the WLS Units 1 and 2 COL application, the staff undertook the following reviews.

- The staff compared the VEGP COL FSAR to the WLS COL FSAR. In performing this comparison, the staff considered changes made to the WLS COL FSAR (and other parts of the application, as applicable) resulting from RAIs.

- The staff confirmed that all responses to RAIs identified in the corresponding standard content evaluation were endorsed.

- The staff verified that the site-specific differences were not relevant.

The staff completed its review and found the evaluation performed for the standard content to be directly applicable to the application. This standard content material is identified in this report by use of italicized, double-indented formatting. Section 1.2.3 of this report provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) includes evaluation material from the SER for the BLN Units 3 and 4, application. However, the applicant took an exception and included the following FSAR Tier 2 departure WLS DEP 8.3-1 from the AP1000 DCD:

Tier 2 Departure

- WLS DEP 8.3-1 and STD COL 8.3-2

The AP1000 DCD states that the Class 1E battery chargers and Class 1E voltage regulating transformers are designed to limit the input (ac) current to an acceptable value under faulted conditions on the output side. In a December 5, 2011, letter, the applicant took a departure from AP1000 DCD Section 8.3.2.2 and added information on the Class 1E voltage regulating transformers current limiting features. The applicant added Departure (WLS DEP 8.3-1) to the COLA, Part 7, Section A, "Summary of FSAR Departures from the DCD," and added a new Section 8.3.2.2 in WLS COL FSAR, Revision 9.

The departure relates to the AP1000 DCD Class 1E voltage regulating transformers current limiting features. Specifically, the applicant added a Tier 2 departure in WLS COL FSAR Section 8.3.2.2 where the isolation and protection function is provided by built-in circuit breakers between Class 1E loads and the non-Class 1E ac power source. The AP1000 voltage regulating transformers do not have active components to limit current. The applicant stated that the information in the similar departure for the reference COL is slightly different due to a certain supplier Deficiency Report (SDR) not being available at the time of the reference COL submittal; therefore, the WLS departure is site-specific. The applicant further stated that this Tier 2 departure does not impact the required design function (i.e., isolation) and, therefore, does not require NRC approval pursuant to 10 CFR Part 52, Appendix D, Section VIII.B.5. The staff finds the applicant's assessment consistent with IEEE 384 and RG 1.75 and, therefore, acceptable.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 8.3.2.4:

> *COL Information Item*
>
> - *STD COL 8.3-2, involving the inspection, maintenance, and testing of Class 1E batteries and clearing of ground faults on the Class 1E dc system.*
>
> *The NRC staff reviewed STD COL 8.3-2 related to COL Information Item 8.3-2. COL Information Item 8.3-2 states (in part):*
>
> > *The Combined License applicant will establish plant procedures as required for:*

- *Clearing ground fault on the Class 1E dc system*
- *Checking sulfated battery plates or other anomalous conditions through periodic inspections*
- *Battery maintenance and surveillance (for battery surveillance requirements, refer to DCD Chapter 16, Section 3.8)*

The commitment was also captured as COL Action Item 8.4.1-1 in Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

> *The COL applicant will establish plant procedures for periodic testing of penetration protective devices. (COL Action Item 8.4.1-1)*

The Class 1E 125 volts direct current (Vdc) system components undergo periodic maintenance tests to determine the condition of the system. The applicant has established procedures for inspection and maintenance of Class 1E batteries and non-Class 1E batteries. Class 1E battery maintenance and service testing is performed in conformance with RG 1.129. Batteries are inspected periodically to verify proper electrolyte levels, specific gravity, cell temperature and battery float voltage. Cells are inspected in conformance with IEEE 450 and vendor recommendations. In addition, the applicant has established procedures for clearing of ground faults on the Class 1E dc system. The battery testing procedures are written in conformance with IEEE 450 and the Technical Specifications. The NRC staff concludes that the applicant has established procedures for inspection and maintenance of Class 1E and non-Class 1E batteries to satisfy COL Information Item 8.3-2; therefore, this item is resolved.

With regard to periodic testing of electrical penetration protective devices (COL Action Item 8.4.1-1) for dc systems, the applicant has not addressed periodic testing of the penetration over load protective devices related to dc systems. In RAI 8.3.1-1, the staff requested that the applicant address the periodic testing of the electrical penetration primary and backup protective devices protecting Class 1E and non-Class 1E dc circuits. In a letter dated January 2, 2009, the applicant stated that the BLN COL FSAR will be revised in the next COLA submittal to include periodic testing of the electrical penetration primary and backup protective devices protecting Class 1E and non-Class 1E dc circuits, as well as control of protective devices. The staff has reviewed the information in the applicant's response, which provided for the testing of Class 1E and non-Class 1E dc penetration overload protection devices. The staff also reviewed the proposed change to BLN COL FSAR Section 8.3.1.1.6 and concludes that COL Action Item 8.4.1-1 is resolved subject to the verification that the BLN COL FSAR has been updated to include portions of the RAI response. This is identified as Confirmatory Item 8.3.2-1.

<u>Resolution of Standard Content Confirmatory Item 8.3.2-1</u>

Confirmatory Item 8.3.2-1 required the applicant to update its FSAR 0to provide for the testing of Class 1E and non-Class 1E dc penetration overload protection devices. The NRC staff verified that the VEGP COL FSAR was appropriately updated. As a result, Confirmatory Item 8.3.2-1 is resolved.

WLS Resolution of Standard Content Confirmatory Item 8.3.2-1

The staff verified that WLS COL FSAR Section 8.3.1.1.6 was appropriately updated. As a result, standard content Confirmatory Item 8.3.2-1 is resolved for WLS.

The following portion of this technical evaluation section is reproduced from VEGP SER Section 8.3.2.4:

> *Evaluation of Tier 2 Departure STD DEP 8.3-1 and Revised STD COL 8.3-2*
>
> *In a letter dated June 18, 2010, Westinghouse provided a response to Open Item OI-SRP8.3.2-EEB-09, Revision 3, related to the periodic testing of battery chargers and voltage regulating transformers. The response included a COL information item to be added to AP1000 DCD Section 8.3.3 to ensure that periodic testing is performed on the battery chargers and voltage regulating transformers. Specifically, this section will be revised to include the following COL information item:*
>
> > *The Combined License applicant will establish plant procedures as required for:*
> >
> > > *Combined License applicants referencing the AP1000 certified design will ensure that periodic testing is performed on the battery chargers and voltage regulating transformers.*
>
> *In a letter dated October 15, 2010, the applicant submitted its response to address the above identified AP1000 DCD revision to the Section 8.3.3 COL information item regarding battery charger and voltage regulating transformer testing. The applicant stated that procedures are established for periodic testing of the Class 1E battery chargers and the Class 1E regulating transformers in accordance with the manufacturer recommendations. The battery chargers and regulating transformers are tested periodically in accordance with manufacturer recommendations. Circuit breakers in the Class 1E battery chargers and Class 1E voltage regulating transformers that are credited for an isolation function are tested through the use of breaker test equipment. This verification confirms the ability of the circuit to perform the designed coordination and corresponding isolation function between Class 1E and non-Class 1E components. Circuit breaker testing is done as part of the MR program and testing frequency is determined by that program. Fuses/fuse holders that are included in the isolation circuit are visually inspected. Class 1E battery chargers are tested to verify current limiting characteristic utilizing manufacturer recommendation and industry practices. Testing frequency is in accordance with that of the associated battery.*
>
> *The applicant clarified that the voltage regulating transformers do not have active components to limit current and, therefore, the voltage regulating transformer in combination with fuses and/or breakers will interrupt the input or output (ac) current under faulted conditions on the output side. The NRC staff finds this to be inconsistent with AP1000 DCD Section 8.3.2.2, which states that Class 1E voltage regulating transformers are designed to limit the input (ac) current to an acceptable value under faulted conditions on the output side. As such the use of*

the breakers/fuses for regulating transformers for isolation function in lieu of current limiting characteristics as presented in the AP1000 DCD is a departure for VEGP. The applicant stated that Part 7 of the COL application will be revised to include a departure from AP1000 DCD Section 8.3.2.2 clarifying the current limiting feature of voltage regulating transformers. The applicant has included, in its response, the appropriate changes related to the above departure that will be included in VEGP COL FSAR Sections 8.3.2.1.4 and 8.3.2.2, in Chapter 1, Table 1.8-201 and in Part 7 of the VEGP COL application. These changes will be included in a future revision to the VEGP COL application.

The NRC staff has reviewed the proposed changes to the VEGP COL application and concludes that the applicant has provided sufficient information regarding the isolation function and the periodic inspection and testing of the isolating devices for the Class 1E battery chargers and Class 1E voltage regulating transformers. In addition, the staff finds that, although the use of the breakers/fuses for regulating transformers isolation function in lieu of current limiting characteristics as presented in the AP1000 DCD is a departure for VEGP, the departure is acceptable because the use of the breakers/fuses for regulating transformers for isolation function is consistent with the recommendations in IEEE-384, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," endorsed by RG 1.75. Therefore, COL Information Item STD DEP 8.3-1 and the revised STD COL 8.3-2 are resolved subject to NRC staff verification of the revision to the VEGP COL FSAR sections discussed above. This is being tracked as Confirmatory Item 8.3.2-2.

Resolution of Standard Content Confirmatory Item 8.3.2-2

Confirmatory Item 8.3.2-2 is an applicant commitment to revise its FSAR Table 1.8-201 and Section 8.3.2.1.4 to address COL Information Item STD COL 8.3-2 and a departure, STD DEP 8.3-1. The staff verified that the VEGP COL FSAR was appropriately revised. As a result, Confirmatory Item 8.3.2-2 is now closed.

WLS Resolution of Standard Content Confirmatory Item 8.3.2-2

In a December 5, 2011, letter, the applicant proposed a revision to FSAR Table 1.8-201, "Summary of FSAR Departures," WLS COL FSAR Section 8.3.2.1.4, "Maintenance and Testing," and WLS COL FSAR Section 8.3.2.2, "Analysis." The change to WLS COL FSAR Section 8.3.2.1.4 included a left margin annotation for STD COL 8.3-2, to establish procedures for periodic testing of the Class 1E battery chargers and Class 1E voltage regulating transformers. The applicant also took exception to STD DEP 8.3-1 and provided a site-specific departure, WLS DEP 8.3-1. The staff confirmed that Standard Content Confirmatory Item 8.3.2-2 and Departure 8.3-1 related changes were included in WLS COL FSAR, Revision 9. Accordingly, the staff considers this item resolved.

The following portion of this technical evaluation section is reproduced from BLN SER Section 8.3.2.4:

Supplemental Information

- *STD SUP 8.3-1*

STD SUP 8.3-1 was provided by the applicant indicating that there are no site-specific non-Class 1E dc loads connected to the Class 1E dc system. The staff finds this acceptable because it is consistent with the guidance in RG 1.206.

Evaluation of Site-specific Response to Standard Content

In VEGP COL FSAR, Revision 2, the VEGP applicant changed the number of the supplemental information item from STD SUP 8.3-1 to STD SUP 8.3-3. The associated VEGP COL FSAR, Revision 2 text, which is identical to the BLN COL FSAR, Revision 1 text accepted by the staff, was not changed. Therefore, the staff concludes that this difference is not relevant and that the staff's evaluation of STD SUP 8.3-1 for BLN applies to STD SUP 8.3-3 for VEGP.

8.3.2.5 *Post Combined License Activities*

There are no post COL activities related to this section.

8.3.2.6 *Conclusion*

The staff reviewed the application and checked the referenced DCD. The staff's review confirmed that the applicant addressed the required information relating to dc power systems, and there is no outstanding information expected to be addressed in the WLS COL FSAR related to this section. The results of the staff's technical evaluation of the information incorporated by reference in the application are documented in NUREG-1793 and its supplements.

In addition the staff concludes that the relevant information presented in the WLS COL FSAR is acceptable and meets the relevant NRC regulations, guidance in NUREG-0800, Section 8.3.2, and other NRC regulatory guides and concludes that with closure of the confirmatory item discussed above, the applicant is in compliance with NRC regulations. The staff based its conclusion on the following:

- WLS DEP 8.3-1 is acceptable because the applicant provided sufficient information involving the use of breakers/fuses for regulating transformers for isolation function that is consistent with IEEE-384, endorsed by RG 1.75.

- STD COL 8.3-2 is acceptable because the applicant provided sufficient information involving the inspection, maintenance, and testing of Class 1E batteries, the clearing of ground faults on the Class 1E dc system, and periodic testing of the battery chargers and voltage regulating transformers.

- STD SUP 8.3-1 is acceptable because the applicant made a commitment that there are no site-specific non-Class 1E dc loads connected to the Class 1E dc system.