8.0 ELECTRIC POWER

The electric power system is the source of power for station auxiliaries during normal operation and for the reactor protection system and engineered safety features during abnormal and accident conditions at the Levy County Nuclear Plant (LNP). This chapter provides information on the functional adequacy of the offsite electric 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 NRC staff (the staff) of the LNP Combined License (COL) Final Safety Analysis Report (FSAR), Part 2 of the COL application (COLA), submitted by Progress Energy, 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 AP1000 design certification (DC).

8.1.2 Summary of Application

Section 8.1 of the LNP COL FSAR, Revision 6, incorporates by reference Section 8.1 of the AP1000 Design Control Document (DCD), Revision 19.

In addition, in LNP COL FSAR Section 8.1, the applicant provided the following:

Supplemental Information

- LNP SUP 8.1-1

The applicant provided supplemental (SUP) information in LNP COL FSAR Section 8.1, "Introduction," describing LNP's connections to Progress Energy Florida (PEF) electrical grid and the connection interfaces with neighboring utilities via the LNP, Units 1 and 2, 500/230-kilovolt (kV) switchyard at the LNP site.[1]

[1] The applicant, Duke Energy Florida, was formerly identified as Progress Energy Florida. In a letter dated April 15, 2013, Progress Energy Florida notified the NRC that its name was changing to Duke Energy Florida effective April 29, 2013. The name change and a 2012 corporate merger between Duke Energy and Progress Energy are described in Chapter 1 of the SER. Because a portion of the review described in this chapter was completed prior to the name change, the NRC staff did not change references to "Progress Energy Florida" or "PEF" to "Duke Energy Florida" or "DEF" in this chapter.

- LNP SUP 8.1-2

The applicant provided supplemental information in LNP COL FSAR Section 8.1 describing the function and connection of the reserve auxiliary transformers (RATs) A and B for LNP Units 1 and 2.

- LNP SUP 8.1-3

The applicant provided supplemental information in LNP 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 LNP COL FSAR Table 8.1-201.

8.1.3 Regulatory Basis

The regulatory basis for the information incorporated by reference is addressed in NUREG-1793, "Final Safety Evaluation Report [FSER] 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 introduction to the electric power systems are given in Section 8.1 of NUREG-0800, "Standard Review Plan [SRP] for the Review of Safety Analysis Reports for Nuclear Power Plants (LWR [light-water reactor] Edition)."

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

- Section 50.63, "Loss of All Alternating Current Power," of Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR 50.63)

- RG 1.155, "Station Blackout"

- RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)"

8.1.4 Technical Evaluation

The NRC staff reviewed Section 8.1 of the LNP COL FSAR 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.[2] The NRC 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 NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

[2] See Section 1.2.2 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.

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

Supplemental Information

- LNP SUP 8.1-1

The staff reviewed the supplemental information related to the PEF utility grid and its connection to neighboring utilities included under LNP SUP 8.1-1. The applicant's supplement to Section 8.1.1 is summarized as follows:

The PEF electrical grid consists of nuclear and fossil fuel generating facilities and an extensive 500/230-kV bulk power transmission system. PEF maintains multiple direct interconnections with neighboring utilities. These interconnections serve to increase the reliability of the PEF electrical grid.

LNP Units 1 and 2 are connected to a new common switchyard having dual voltages 500-kV and 230-kV. The switchyard also serves as units' preferred and maintenance source. The switchyard has both breaker-and-a-half and double breaker schemes. There are four 500-kV transmission lines that connect the switchyard to the grid.

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

- LNP SUP 8.1-2

The NRC staff reviewed the supplemental information related to the PEF onsite power system included under LNP SUP 8.1-2. The applicant's supplement to Section 8.1.1 is summarized as follows:

The LNP Units 1 and 2 reserve auxiliary transformers also serve as sources of maintenance power. They are supplied from the 500/230-kV step down transformers located in the switchyard.

The NRC staff finds that the applicant's description of the LNP Units 1 and 2 onsite power system is in accordance with the recommendations of RG 1.206 and the guidance in Section 8.1 of NUREG-0800.

- LNP SUP 8.1-3

The NRC staff also reviewed supplemental information included in LNP SUP 8.1-3, related to regulatory guidelines and industry standards and found it to be consistent with Section 8.1 of NUREG-0800 with the exception of the information discussed below.

LNP COL FSAR Table 8.1-201, Item 1b indicated that RG 1.155 is not applicable to LNP. This item was deemed standard among COL applications being discussed in Bellefonte's (BLN) response to Request for Additional Information (RAI) 8.1-2. In a letter dated December 15,

2008, the applicant stated that the standard response to RAI 8.1-2 applies to the LNP COL application.

The standard response submitted by BLN in a letter dated June 24, 2008, 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 NRC staff found the above response to be 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, Positions C.2 and C.3.4.

Several discussions were held between the NRC staff and the applicant regarding this issue. Subsequently, in a letter dated April 15, 2009, the BLN applicant stated that the training and procedures to support mitigation of an SBO event would be implemented in accordance with BLN COL 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 BLN 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. This response was found acceptable by the NRC staff.

In a letter dated December 7, 2009, the LNP applicant endorsed BLN's revised response.

The NRC staff has verified that LNP has updated Sections 1.9.5.1.5 and 1.9.6 of the LNP COL FSAR to include the above-mentioned items including the implementation of training and procedures to support mitigation of an SBO event. This satisfies RG 1.155, Positions C.2 and C.3.4. Based on the above, the NRC 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 NRC staff reviewed the application and checked the referenced DCD. The NRC 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 LNP COL FSAR related to this section. The results of the NRC staff's

technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff has 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 concludes that the applicant is in compliance with the NRC regulations. The staff based its conclusion on the following:

- LNP SUP 8.1-1 is acceptable because the applicant provided sufficient information regarding the PEF transmission system and its connection to neighboring utilities in accordance with the recommendations of RG 1.206.

- LNP SUP 8.1-2 is acceptable because the applicant's description of the LNP 1 and 2 onsite power system is in accordance with the recommendations of RG 1.206 and the guidance in Section 8.1 of NUREG-0800.

- LNP SUP 8.1-3 is acceptable because the applicant addressed COL-specific regulatory guidelines and industry standards and additional new regulatory guidelines, are adequately addressed by the applicant. In conclusion, the applicant has 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 RGs 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 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 LNP 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

Section 8.2 of the LNP COL FSAR, Revision 6, incorporates by reference Section 8.2 of the AP1000 DCD, Revision 19.

In addition, in LNP COL FSAR Section 8.2, the applicant provided the following:

AP1000 COL Information Items

- LNP COL 8.2-1

The applicant provided additional information in LNP 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 500-kV/230-kV switchyard and the transmission lines connecting Units 1 and 2 to the switchyard and the 500-kV switchyard to various substations throughout the transmission grid; (2) the connections of the generator step-up (GSU) transformers and the 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 designs of the GSU transformers, unit auxiliary transformers (UATs), and RATs; (6) the design of the control building in the plant site 500-kV/230-kV switchyard; (7) the administrative control of the 500-kV/230-kV switchyard and transmission line circuit breakers, (8) the switchyard and transmission line testing and inspection plan, and (9) voltage operating range, frequency decay rate, and preservation of grid connection. LNP COL 8.2-1 is addressed in FSAR Sections 8.2.1, 8.2.1.1, 8.2.1.2, 8.2.1.3, and 8.2.1.4.

- LNP COL 8.2-2

The applicant provided additional information in LNP 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 switchyard arrangement and design of the protective relaying scheme; and (2) a transmission system study performed 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. LNP COL 8.2-2 is addressed in LNP COL FSAR Sections 8.2.1.2.1 and 8.2.2.

Site-Specific Information Replacing Conceptual Design Information (CDI)

- LNP CDI

The applicant provided site-specific information 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

- LNP SUP 8.2-1

The applicant provided supplemental information describing details of a failure modes and effects analysis (FMEA) performed for the offsite power distribution system, plant site switchyard, and the transmission system.

- LNP SUP 8.2-2

The applicant provided supplemental information describing the formal agreement between LNP and PEF's Transmission Operations and Planning organization, which is the transmission system operator (TSO). The applicant provided supplemental information describing PEF's responsibility for assuring that adequate voltage is available to LNP Units 1 and 2; 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 addition, describing the interfaces between LNP and PEF's Transmission Operations that protocols are in place for LNP to remain cognizant of grid vulnerabilities in order to make informed decisions regarding maintenance activities critical to the electric system.

- LNP SUP 8.2-3

The applicant provided supplemental information describing the reliability of the 500-kV transmission lines that feeds the LNP site for the period from August 2003 to January 2008.

- LNP SUP 8.2-4

The applicant provided supplemental information describing the protective devices controlling the switchyard breakers, stating that their settings are determined with consideration given to preserving the plant grid connection following a turbine trip.

- LNP SUP 8.2-5

In a letter dated March 21, 2014, the applicant provided a supplemental response to RAI Letter No. 114 that proposed to revise the FSAR with a new Section 8.2.1.2.2 in order to address Bulletin 2012-01, "Design Vulnerability in Electric Power System."

Interface Requirements

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

Inspections, Tests, Analyses and Acceptance Criteria

In a letter dated March 21, 2014, the applicant provided a supplemental response to RAI Letter No. 114 that proposed to revise COL application Part 10, Appendix B, to include two new inspections, tests, analyses and acceptance criteria (ITAAC), numbered 4.g and 7, in order to address Bulletin 2012-01, "Design Vulnerability in Electric Power System."

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 the Commission regulations for the offsite power system are given in Sections 8.1 and 8.2 of NUREG-0800.

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

- 10 CFR Part 50, "Domestic licensing of production and utilization facilities," Appendix A, "General Design Criteria for Nuclear Power Plants" (GDC) Criterion 17 "Electric power systems;

- 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)"; and

- 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 NRC staff reviewed Section 8.2 of the LNP COL FSAR 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.[2] The NRC staff's review confirmed that the information in the application and incorporated by reference addresses the required information relating to the offsite power system. The results of the NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC 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 LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP 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 LNP COL application. This standard content material is identified in this SER 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 SER section have a LNP designation (e.g., Confirmatory Item LNP 8.2-1).

The staff reviewed the information in the LNP COL FSAR:

AP1000 COL Information Item

- LNP COL 8.2-1

The applicant provided additional information in LNP 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 Appendix F of NUREG-1793, 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 provide the design of the ac power transmission system and its testing and inspection plan (COL Action Item 8.2.3.3-1).

The NRC staff reviewed the resolution to COL information item, LNP COL 8.2-1, related to the transmission system design, testing, and inspection addressed in Section 8.2 of the LNP COL FSAR. The NRC staff's evaluation is described below.

LNP, Units 1 and 2, receive offsite ac power from a common 500/230-kV switchyard which is connected to the PEF transmission network. The applicant described the connection of the RATs to the 500-kV to 230-kV transformers in the switchyard. The normal power supply to the main ac power system is provided from the main generator through the unit auxiliary transformers (UATs). The 500-kV line is the preferred power supply and is the recognized GDC 17 offsite power source for LNP, Units 1 and 2. When either the normal power or the preferred power supply is available, the RATs serve as a source of maintenance power. Thus, when in use, the 230-kV line becomes the recognized GDC 17 offsite power source. The NRC staff reviewed the resolution to the supplemental information LNP COL 8.2-1 related to the

description of the offsite power system. The staff determined that additional information was needed to complete the technical evaluation of this item.

FSAR Section 8.2.1.1.1 describes the ratings for the 500-kV and 230-kV circuit breakers associated with the LNP 1 and LNP 2 and states that they are rated at 3000A, with interrupting capability of 50,000 amperes (amps) root-mean-square (RMS). This section further describes the rating for the disconnect switches. Since no basis is provided for the specified ratings, in RAI 8.2-1, the staff requested the applicant to explain why the ratings for circuit breakers and disconnect switches in the switchyard are adequate for the application. In particular, the staff asked the applicant to identify the maximum fault available from the system and confirm that the breaker interrupting ratings, both symmetrical and asymmetrical, are consistent with the available fault. In a letter, dated June 23, 2009, the applicant stated that it had used steady state power flow simulations to determine the required current capability of transmission facilities, such as circuit breakers and disconnect switches. The facility ratings were determined for all line-in and line-out conditions. The applicant determined that none of the 500-kV and 230-kV circuit breakers and disconnects switches showed a loading condition above 3000 amps and were, therefore, adequate. The applicant also stated that they had used short circuit simulations to determine the required maximum interrupting capability of the circuit breakers. The analysis assumed that all generating sources relevant to the new facility were in service. Under this assumption, the short circuit levels at the Levy substation were below 28kA. The applicant concluded that the interrupting capability of 50,000 amps for the circuit breakers was adequate. The staff finds the applicant's response acceptable because the design of the offsite system components meets the requirements of GDC 17. Therefore, the NRC staff finds the issues in RAI 8.2-1 are resolved.

With regard to switchyard and transmission lines testing and inspections, described in FSAR Section 8.2.1.4, in RAI 8.2-2 the staff requested the applicant to indicate the extent to which maintenance and modifications to the switchyard and substation will be reviewed, controlled, and approved through the LNP process. In a letter dated June 23, 2009, the applicant stated that PEF utilizes procedure NGGM-IA-0003, "Transmission Interface Agreement for Operations, Maintenance, and Engineering Activities at Nuclear Plants," for testing and inspections. Accordingly, an individual is assigned from the LNP engineering organization to serve as the Switchyard System Engineer (SSE) and another individual is assigned from LNP maintenance organization to serve as the Plant Transmission Activities Coordinator (PTAC). The PTAC serves as the point of contact for transmission maintenance activities impacting the nuclear plant, while the SSE serves as the point of contact for coordinating all transmission engineering and power system operation activities requiring pre-planning and scheduling among various nuclear and non-nuclear organizations. The PTAC is also responsible for ensuring that transmission equipment within the scope of the Maintenance Rule is maintained in compliance with NRC regulations and that design changes produced by Transmission Engineering are properly reviewed for impact by the Plant and Transmission Engineering. The staff review of the applicant's response observed that the list of PTAC's responsibilities does not include communication to the grid operator of risk-sensitive plant maintenance activities. Therefore, in RAI 8.2-8, the staff asked the applicant to indicate whether: (a) it coordinates Nuclear Power Plant maintenance activities that can have an impact on the transmission system with the PTAC and TSO; and (b) it has contacts with the TSO to determine current and anticipated grid conditions as part of the grid reliability evaluation performed before conducting grid-risk-sensitive maintenance activities. In a letter dated February 5, 2010, the applicant stated that the

Interface Agreement and associated communication protocols will be in accordance with the requirements of NERC Reliability Standard NUC-001. In particular, the applicant stated that the Interface Agreement requires that: (a) Nuclear Plant Operations notify the Transmission System Operator of any plant activity that has the potential to impact the generation capability of the plant or to create perturbations on the grid; and (b) Nuclear Plant Operations and the Transmission System Operator hold a pre-job briefing for field work activities, including maintenance. Part of the pre-job briefing is a discussion of the risk assessment that has been performed. The risk involved is determinant in the decision as to when and how to proceed with the activity. The staff finds the applicant's response to be acceptable because adequate communication is being established between the PTAC and the TSO, thus ensuring that grid-risk-sensitive activities are adequately addressed to ensure the reliability of the offsite system in conformance with the requirements of GDC 17. Therefore, the NRC staff finds the issues in RAI 8.2-2 and RAI 8.2-8 are resolved.

In RAI 8.2-3 the staff asked that the applicant to indicate how the information from the PTAC will be shared among the LNP units. In a letter dated June 23, 2009, the applicant stated that the PTAC is a member of the Nuclear Plant Engineering organization and provided examples of information requiring to be shared by the PTAC. These included, briefing management of any concerns related to maintenance backlogs, known deficiencies and maintenance test results; entering degradation trends, line, or component failures or transients into the site Corrective Action Program; advising plant management of design ratings of lines, structures, and insulators for wind speeds; and maintaining system health report and asset management plan. The staff finds the applicant's response acceptable because it is consistent with the requirements of GDC 18 and the guidelines of RG 1.206. Therefore, the NRC staff finds the issue in RAI 8.2-3 resolved.

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

- LNP COL 8.2-2

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

> The Combined License applicant will address the technical interfaces 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 NRC staff's evaluation of the technical interfaces is addressed under "Interface Requirements" in this section of the SER.

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 Appendix F of NUREG-1793, 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 NRC staff reviewed the resolution to COL information item, LNP COL 8.2-2, related to the transmission system stability analysis and switchyard circuit breaker protective device settings included under Section 8.2 of the LNP COL FSAR. The NRC staff's evaluation follows.

LNP COL 8.2-2 was provided by the applicant describing details of: 1) the switchyards arrangement and design of the protective relaying scheme; and 2) a transmission system study performed to verify grid stability, switchyard voltage, and frequency to confirm the transmission system capability to maintain RCP operation for three seconds following a turbine trip as specified in AP1000 DCD Section 8.2.2. LNP COL 8.2-2 is addressed in LNP COL FSAR Sections 8.2.1.2.1 and 8.2.2.

The 500-kV and 230-kV switchyards are locally interconnected and each designed with two (2) full-capacity main buses and composite breaker-and-a half/double-breaker arrangement for reliability and maintainability. This arrangement allows for isolation of components and buses, while preserving the plant's connection to the grid. The transmission line protection consists of three different high speed schemes for 500-kV and two high speed schemes for 230-kV lines. Each scheme has impedance backup non-pilot schemes and directional comparison blocking schemes with (as necessary) permissive over reach trip schemes used for bus fault protection. For both 500-kV and 230-kV systems, breaker failure protection schemes are also used. Transformer protection consists of two different high speed schemes.

The NRC 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 LNP's connection to the grid following a turbine trip. This satisfies COL Action Item 8.2.3.1-2.

With regard to grid stability, the applicant stated that LNP had completed a transmission system study of the offsite power system for the addition of LNP 1 and LNP 2. This study evaluated, overloads and voltage impact on the transmission system; transient and dynamic stability of LNP 1 and LNP 2; voltage and frequency response during a turbine trip followed by a generator trip; and frequency decay rate for large, regional generation/load mismatches. The applicant determined that, the transmission system, with the planned transmission system changes, will accommodate the addition of LNP 1 and LNP 2; the transient and dynamic stability performance of LNP 1 and LNP 2 is within acceptable limits for the proposed configuration; the results of turbine trip simulations demonstrate that the voltage and frequency of the 26-kV generator buses and 500-kV switchyard buses will remain within the required limits for at least 3 seconds following the turbine trip of either LNP 1 or LNP 2; and the simulations performed as part of joint studies within Florida Reliability Coordinating Council (FRCC) demonstrate that the rate of frequency decay for large generation/load mismatches is well within acceptable limits.

Therefore, the applicant concluded that the interface requirements for steady state load, nominal voltage, allowable voltage regulation, nominal frequency, allowable frequency fluctuation, maximum frequency decay rate, and the limiting under frequency value for the RCP are met. Therefore, the grid stability analysis confirmed that 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 DCD Section 8.2.2 (COL Action Items 8.2.3.1-1 and 8.2.3.1-3).

FSAR Section 8.2.2 states that, "in order to maintain Reactor Coolant Pump operation for three seconds following a turbine trip …, the grid voltage at the high side of the main step-up and reserve auxiliary transformers cannot drop from the pre-trip steady-state value by more than 15 percent of the rated voltage." Therefore, in RAI 8.2-6, the staff requested the applicant to indicate the estimated minimum pre-trip steady-state voltage at the transformers, whether this voltage was used in the analysis, and whether a system disturbance would meet the 15 percent requirement. In a letter dated June 23, 2009, the applicant stated that the estimated pre-trip steady-state voltage at the high side of the main step-up and reserve auxiliary transformers is between 0.95 and 1.05 per unit and that the high side voltage used in these analyses was 1.025 per unit for the main step-up transformers and 0.955 per unit for the reserve auxiliary transformers. The applicant also stated that computer simulations of a turbine trip with this alignment of the RCPs were performed using a pre-trip steady state generator bus voltage of 0.98 per unit. These simulations demonstrated that the generator bus voltage drop would be approximately 3 percent, significantly less than the maximum allowable drop of 15 percent. 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 NRC staff finds the issues in RAI 8.2-6 resolved.

The staff observed that LNP COL FSAR did not specifically discuss how power and control cables are routed from the switchyard to the plant. In RAI 8.2-5, the staff asked the applicant to describe whether routing of these cables is underground and to describe the cables design features and the monitoring program that will be implemented to avoid or arrest the degradation of cable insulation from the effects of moisture. In its response dated June 23, 2009, the applicant stated that high voltage connections between the AP1000 power block and the switchyard are routed overhead. The applicant also stated that, the power, control and instrumentation cables that are routed underground from the AP1000 power block to the switchyard will have moisture/water resistant jackets and manholes for duct bank access that are below the ground water level will have sump pumps. The staff found the response to be inadequate because it was not consistent with Generic Letter (GL) 2007-01's description of inspection, testing and monitoring programs to detect the degradation of inaccessible or underground power cables that support equipment and other systems that are within the scope of 10 CFR 50.65 (the Maintenance Rule). Therefore, in RAI 8.2-9, the staff requested the applicant: to indicate whether they had made any plans to implement a testing and inspection program for inaccessible or underground power cables; indicate the frequency for such testing and inspection; or provide justification for not developing such a program.

In its response dated February 5, 2010, the applicant reiterated that the Levy County site does not include any high voltage cables that are routed underground or any medium voltage cables that are routed between the AP1000 power block and the switchyard. Regarding low voltage cables that are routed between the AP1000 power block and the switchyard, the applicant

stated that, by definition, they are not exposed to significant voltage and that, due to the sump pumps, they will not be exposed to significant moisture as described in NUREG-1801, XI.E3, "Generic Aging Lessons Learned (GALL) Report." Therefore, the applicant concluded that the low voltage cables will not require periodic testing, beyond post installation testing and initial functional testing.

The staff did not agree with the applicant conclusions. While it is true that cable insulation degradation and negative effects increase with the voltage to which the cables are exposed, the low voltage cable insulation is not exempt from degradation due to moisture or submergence.

NUREG-1801, XI.E1, for instance, states, in part, "in a limited number of localized areas [of a nuclear power plant], the actual environments may be more severe than the plant design environment for those areas. Conductor insulation materials used in cables and connections may degrade more rapidly than expected in these adverse localized environments. An adverse localized environment is a condition in a limited plant area that is significantly more severe than the specified service environment for the cable. An adverse variation in environment is significant if it could appreciably increase the rate of aging of a component or have an immediate adverse effect on operability. The purpose of the aging management program described herein is to provide reasonable assurance that the intended functions of electrical cables and connections that are not subject to the environmental qualification requirements of 10 CFR 50.49 and are exposed to adverse localized environments caused by heat, radiation, or moisture will be maintained consistent with the current licensing basis through the period of extended operation." This statement does not exclude low voltage cables. Furthermore, as described in GL 2007-01, operating experience indicates the occurrence of failures of buried medium-voltage [as well as] alternating current (ac) and direct current (dc) low voltage cables from insulation failure. The concern is that exposure to 100 percent Relative Humidity and/or intermittent submergence may result in cable insulation degradation and multiple grounds that may go unnoticed until the cables are submerged again and, thus, prevent the affected components from performing their intended function. However, the NRC staff finds the issues in RAIs 8.2-5 and 8.2-9 resolved as follows:

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

> *<u>Submerged/Inaccessible Electrical Cables</u>*
>
> *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.

> *The 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

- LNP SUP 8.2-1

LNP SUP 8.2-1 was provided by the applicant describing details of a FMEA performed for the offsite power distribution system, plant site switchyard, and the PEF transmission system. The NRC staff has reviewed the FMEA of the LNP switchyard and confirmed that the applicant has identified no single initiating event, such as a breaker not operating during a fault condition; a fault on a switchyard bus; a spurious relay trip; and a loss of control power supply which would cause failure of more than one single offsite transmission line, or a loss of offsite power to either LNP1 or LNP2 via the GSU. The staff also finds that the applicant's analysis is in conformance with the guidance of RG 1.206. Therefore, LNP SUP 8.2-1 is acceptable.

- LNP SUP 8.2-2

With regard to LNP SUP 8.2-2 the applicant provided, in part, the following information:

> The interfaces between LNP and PEF's Transmission Operations and Planning Department are managed via a formal Interface Agreement. PEF conducts transmission system operations under a vertically integrated utility business model. Under [this] model, the System Operators (Grid Operators) are the TSOs, and operate both the transmission and generation systems (nuclear and non-nuclear) and work in the same company that will hold the license to operate LNP. LNP off-site power reliability is jointly managed by the system operators, transmission personnel, and licensed nuclear plant personnel through communications and actions governed by the formal Interface Agreement.
>
> The Interface Agreement specifies the responsibilities and lines of communication for the various organizations responsible for the operation, maintenance, and engineering of facilities associated with LNP. LNP operators are directed to notify the TSO of any plant activity that may impact generation capability. The TSO is required to monitor system conditions to ensure adequate voltage is maintained to support LNP, and promptly notify the LNP operators of existing, or anticipated conditions, which would result in inadequate voltage support.
>
> The TSO and LNP plant operators coordinate operations to maintain the switchyard voltage such that the steady state voltage on the 26-kV isophase bus is within 0.95 – 1.05 per unit (pu) of its nominal value.
>
> LNP procedures address the criteria used to determine when the main control room (MCR) is required to contact the TSO. The procedures used by the TSOs direct them to promptly notify the LNP operators of conditions for which there would not be adequate switchyard voltage, including predicted post LNP trip conditions. These procedures include separate steps that address both current and anticipated conditions. The intent of these separate steps is to provide, to the extent possible, early warning to the LNP operators of problem conditions.
>
> The TSO uses procedures based on enveloping transmission planning analyses to operate the grid. As long as the grid configuration is within that allowed by the procedure under various system loading conditions, adequate plant voltage support is assured. Specific case studies are also used to support planned grid configurations when not clearly bounded by existing analyses. In addition to the transmission system analysis-based procedures, the TSO also uses computer programs that can predict LNP switchyard voltages expected to occur upon realization of any one of a number of possible losses to the grid, including a trip of the LNP generator, a trip of another large generator, or the loss of an important transmission line. This program tool operates based on raw data from transducers across the system, which is processed through a state estimator to generate a current state of the system snapshot. The output is then processed through a contingency analysis program that generates a set of new results with various single elements of the system out of service. These results are then screened against a predetermined set of acceptance limits. Postulated scenarios which then do not meet the acceptance limits, are listed for review by the TSO. The predictive

> analysis computer program updates approximately every 10 minutes. Also, the grid operating procedures that are based on enveloping transmission system analyses are updated when transmission system or plant changes require it.
>
> Procedural guidance is provided regarding a target switchyard voltage schedule and operation of the main generator voltage regulator. Operation of the main generator within the plant voltage schedule ensures that a trip of the generator does not result in an unacceptable voltage drop in the switchyard. The TSO procedure defines the TSO's actions and requirements during high load conditions. These actions are based on transmission system enveloping analyses wherein the worst-case loss of a generating station (including LNP) on the PEF system is considered relative to LNP voltage support. In the event system conditions are outside the guidelines of the analysis-based procedure, the TSO will alert the LNP operators to that effect.

The NRC staff reviewed the information provided by the applicant on the functions of the TSO that establishes a voltage schedule for the LNP 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 its nominal value. Based on the information provided by the applicant on the functions of TSO, the NRC staff finds that the applicant has demonstrated that protocols are in place for LNP to remain cognizant of grid vulnerabilities in order to make informed decisions regarding maintenance activities critical to the electric system. This is consistent with Generic Letter (GL) 2006-2 of which one of the provisions is to reduce the likelihood of losing offsite power. The NRC finds that the information provided is also consistent with the guidelines of RG 1.206. Therefore, LNP SUP 8.2-2 is acceptable.

- LNP SUP 8.2-3

With regard to LNP SUP 8.2-2 the applicant provided, in part, the following information:

> From August 2003 to January 2008, the average grid availability for the existing PEF 500-kV transmission lines within the system is approximately 99.9 percent, with eleven (11) forced outages. The average frequency of forced line outages since 2003 is approximately 2.44 per year for the involved lines, with the majority due to public interference, animal or lightning strikes causing the outages. Leading causes of forced outages of significant duration that were recorded are public interference.

The NRC staff review of the supplemental information provided regarding the grid availability historical data finds that the supplemental information is consistent with the guidelines of RG 1.206. Therefore, LNP SUP 8.2-3 is acceptable.

- LNP SUP 8.2-4

With regard to LNP SUP 8.2-4 the applicant stated that the protective devices controlling the switchyard breakers are set with consideration given to preserving the plant grid connection following a turbine trip. The staff concludes that the switchyard breaker arrangement, the protection of lines by independent high speed relay schemes, and the breaker failure scheme would preserve the LNP's connection to the grid following a turbine trip. On this basis, LNP SUP 8.2-4 is satisfied.

- LNP SUP 8.2-5

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," (Agencywide Documents Access and Management System (ADAMS) Accession Number ML12074A115) on July 27, 2012, to all holders of operating and combined licenses (COL) 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). 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 No. 08-1 (ADAMS Accession Number ML12228A611), dated August 15, 2012, to Duke Energy Florida (DEF) for LNP Units 1 and 2, to address the matters described in Bulletin 2012-01 and to ensure that the LNP design meets GDC 17.

In response to RAI No. 08-1, "Single-Phase Open Circuit Condition," DEF provided its supplemental response in a letter dated June 4, 2013 (ADAMS Accession Number ML13157A025), for LNP 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 staff's review of this response, staff could not determine whether the LNP 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. Therefore, the staff requested DEF, in an RAI dated August 14, 2013 (ADAMS Accession Number ML13226A124), to clarify or provide supporting information for several statements from its June 4, 2013, RAI response to determine whether the LNP Units 1 and 2 design meets the GDC 17 requirements.

On November 1, 2013, the NRC conducted a public meeting (ADAMS Accession Number ML13309B117) with representatives from the Nuclear Energy Institute and industry 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. The industry informed NRC 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 Bulletin open phase issue.

GDC 17 requires, in part, that "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 that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are

not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents." For AP1000 reactors, the main alternating current (ac) power system is non-Class 1E and is 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. Further, the ac power systems do supply power to equipment that is important to safety since that equipment serves defense-in-depth functions, as follows: 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 LNP should address the design vulnerability identified in Bulletin 2012-01.

To address the electric power system vulnerability related to Bulletin 2012-01, it is the staff's position that an acceptable approach for passive designs includes the following four elements: 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; 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; 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 FSAR; and 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 to safety equipment including safety related battery chargers to meet their intended safety function in accordance with GDC 17 requirements.

In a letter dated March 21, 2014 (ADAMS Accession Number ML14010A421), the applicant provided a supplemental response to the Staff's RAI. In this response, the applicant added new features, described below, that address the staff's concerns. To make its conclusion on the acceptability of LNP SUP 8.2-5, the staff relied on information, detailed below, related to the loss-of-phase detection system installed on the credited GDC 17 offsite power circuit as provided in the applicant's March 21, 2014, supplemental RAI response, including the RAI response, proposed FSAR changes, and a proposed ITAAC. Because this information in the March 21, 2014, supplemental RAI response addresses this issue, the staff's analysis and finding does not rely on information including the RAI response, proposed FSAR language, and proposed ITAAC related to other design features in that or previous responses (dated January 9, 2014, October 24 and June 4, 2013, or September 14, 2012), including undervoltage protective relays, potential transformers on the medium voltage buses, negative sequence motor trips or other running load trips, and battery charger undervoltage detection. The staff evaluation does not address the capability of these other design features to detect a loss-of-phase condition.

As part of the March 21, 2014 supplemental response, the applicant provided text that will be added to the next revision of the FSAR. Some of the proposed text addressed the original design features and is not included below. The additional text that directly addresses the staff's position is as follows:

Associated LNP COL Application Revisions:

1) Add the following subsection to FSAR Chapter 8 following Subsection 8.2.1.2.1 with a LMA of LNP SUP 8.2-5:

8.2.1.2.2 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.

. . .

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.

2) Add the following subsection to FSAR Chapter 8:

8.2.6 References

Add the following information at the end of DCD Subsection 8.2.6.

201. NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," July 27, 2012.

. . .

4) In LNP COLA Part 10, Appendix B. Inspections, Tests, Analyses and Acceptance Criteria, add the following information as a new line item 7 in Table 2.6.12-1:

Design Commitment	**Inspections, Tests, 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.

These proposed additions to the FSAR and the ITAAC acceptably address the staff position as to what is necessary to protect a passive plant with regard to an open phase condition as described in Bulletin 2012-01, and that the LNP design meets GDC 17. Therefore, the staff finds this issue to be resolved and RAI 08-1 closed pending the staff's confirmation that the revisions to the FSAR noted above are incorporated in the LNP Units 1 and 2 COL application. The staff is tracking these revisions as **LNP Confirmatory Item 8.2-1**.

- LNP CDI

The CDI information provided by the applicant regarding the transformer area located next to each unit's turbine building is consistent with the AP1000 DCD and satisfies the applicable requirements of GDC 17.

Interface Requirements

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

The applicant incorporated by reference Section 1.8 of the AP1000 DCD. 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).[3] As required by 10 CFR 52.79(d)(2), the COL application must demonstrate how these interface items have been met.

In order to satisfy plant Interface Item 8.1 in AP1000 DCD Tier 2, Table 1.8-1, the applicant provided the design criteria, RGs, and IEEE standards in Section 8.1.4.3 of the LNP COL FSAR. The NRC staff finds the information to be consistent with Section 8.1 of NUREG-0800 and acceptable. Therefore, this interface item for offsite power system has been met.

With regard to plant Interface Item 8.2 in AP1000 DCD Tier 2 Table 1.8-1, the staff observed that in FSAR Subsection 8.2.2 the applicant states that the "transmission study has confirmed that the interface requirements for steady state load, nominal voltage, allowable voltage regulation, nominal frequency, allowable frequency fluctuation, maximum frequency decay rate, and the limiting under frequency value for the RCP have been met." In RAI 8.2-4 the staff asked the applicant to provide the summary of the grid stability analysis results, the assumptions made, and the acceptance criteria for each case analyzed. Additionally, the applicant was requested to provide the nominal frequency, allowable frequency fluctuation, maximum frequency decay rate, and the limiting under-frequency values used for the reactor coolant pump (RCP) in the analysis. In a letter dated June 23, 2009, the applicant provided a table comparing the required parameter values (acceptance criteria) and the associated analysis results. Additionally, the applicant stated that the LNP COL FSAR would be revised to include such table. The staff has verified that Revision 2 to the LNP FSAR contains the foregoing change. Therefore, the staff finds that the analysis results meet the AP1000 design requirements, the requirements of GDC 17 and the guidelines of RG 1.206. Therefore, this issue is resolved and Interface Item 8.2 in AP1000 DCD Tier 2 Table 1.8-1 is satisfied.

Regarding plant Interface Item 8.3 in AP1000 DCD Tier 2, Table 1.8-1, the applicant did not provide a statement affirming that "the protective devices controlling the switchyard breakers are set with consideration given to preserving the plant grid connection following a turbine trip." In RAI 8.2-7, the staff asked the applicant to provide a reference to where this issue is discussed in the LNP application, or to provide a proposed revision to the application to address the issue. In its response dated August 6, 2009, the applicant identified a proposed revision to LNP COL FSAR Section 8.2.1.2.1 to add LNP SUP 8.2.4 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 NRC staff verified that the LNP COL FSAR was updated to include this change and concludes that the switchyard arrangement, the protection of lines by independent high speed relaying, and breaker failure would preserve the LNP connection to the grid following a turbine trip satisfying the requirements of GDC 17. Therefore, the NRC staff

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

finds this interface has been met and the issue in RAI 8.2-7 resolved. On this basis, COL Information Item 8.2-3.1-2 is also resolved.

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

Inspections, Tests, Analyses and Acceptance Criteria

In a letter dated March 21, 2014, the applicant proposed to revise Part 10 of the COL application to include the following two site-specific ITAAC.

The applicant proposed the following site-specific ITAAC for the Main AC Power System (ECS) to be added to DCD Tier 1 Section 2.6.1 as new item 4.g in Table 2.6.1-4. This ITAAC was not necessary for the staff to reach its conclusions regarding LNP SUP 8.2-5. The staff did not evaluate it, and does not intend to include it in the license.

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
4.g.) The ECS provides an alarm in the MCR 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 as new line item 7 in Table 2.6.12-1 in LNP COL application Part 10, Appendix B.

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 No. 7 is presented above in the evaluation of LNP SUP 8.2-5.

8.2.5 Post Combined License Activities

For the reasons discussed in the technical evaluation section above, the staff finds acceptable ITAAC No. 7 as defined in SER Table 8.2A-1, “ITAAC for Offsite Power System.”

8.2.6 Conclusion

The NRC reviewed the application and checked the referenced DCD. The NRC 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 LNP COL FSAR related to this section. The results of the NRC staff’s technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

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

- LNP 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, and its testing and inspection plan in accordance with the guidelines of RG 1.206.

- LNP 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 with the guidelines of RG 1.206. In addition, the NRC 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 LNP's connection to the grid following a turbine trip.

- LNP CDI in Section 8.2.1 of the LNP COL FSAR is acceptable because the applicant provided sufficient information involving the transformer area being located next to each unit's turbine building in accordance with the guidelines of RG 1.206.

- LNP SUP 8.2-1 is acceptable because the applicant provided sufficient information describing details of a failure analysis performed for the offsite power distribution system, and plant site switchyard in accordance with the guidelines of RG 1.206.

- LNP SUP 8.2-2 is acceptable because the applicant provided sufficient information to describe PEF's responsibility for maintaining area bulk transmission system reliability. The applicant also provided sufficient information to demonstrate that protocols are in place for LNP to remain cognizant of grid vulnerabilities in order to make informed decisions regarding maintenance activities critical to the electric power system in accordance with the guidelines of RG 1.206 and GL 2006-2.

- LNP SUP 8.2-3 is acceptable because the applicant provided sufficient information regarding causes of outages of the transmission line over the past 5 years in accordance with the guidelines of RG 1.206.

- LNP SUP 8.2-4 is acceptable because the applicant provided sufficient information to satisfy the interface requirement regarding the setting of protective devices controlling the switchyard to preserve the LNP connection to the grid following a turbine trip satisfying the requirements of GDC 17.

- LNP SUP 8.2-5 and proposed ITAAC No. 7 are acceptable, pending closure of LNP Confirmatory Item 8.2-1, because the applicant provided sufficient information to address the loss-of-phase condition vulnerability described in Bulletin 2012-01 and to comply with GDC 17.

- The applicant provided sufficient information regarding the interfaces for standard design from the generic DCD Table 1.8-1, Items 8.1, 8.2, and 8.3.

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 is 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, and NRC regulations.

8.2.A.2 Summary of Application

Section 14.3 of the LNP COL FSAR, Revision 6, incorporates by reference Section 14.3 of the AP1000 DCD, Revision 19.

In addition, in LNP COL FSAR Section 14.3, the applicant provided the following:

Supplemental Information

- STD SUP 14.3-1

The applicant provided supplemental information related to the offsite power system in STD Supplement (SUP) 14.3-1 in LNP COL FSAR Section 14.3.2.3.

ITAAC

Part 10 of the COL application includes six SS-ITAAC in Table 2.6.12-1 addressing the offsite power system.

In a letter dated March 21, 2014, the applicant proposed an additional SS-ITAAC related to detection and alarm of a loss-of-phase condition. The staff's evaluation of this ITAAC appears in the preceding Section 8.2.

8.2.A.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 the Commission regulations for ITAAC are given in Section 14.3 of NUREG-0800.

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 NRC staff reviewed Section 14.3 of the LNP COL FSAR 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.[2] The NRC 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 NRC staff's evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC 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 LNP Units 1and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP 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 LNP COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) contains evaluation material from the SER for the BLN Units 3 and 4, COL application.

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

<u>Supplemental Information</u>

- *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 BNL 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.*

Resolution of Standard Content Confirmatory Item 8.2A-1

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 the technical evaluation section above, the staff proposes to include the following ITAAC related to the Offsite Power System:

- The licensee shall perform and satisfy the ITAAC defined in Table 8.2A-1, "Offsite Power System."

8.2.A.6 Conclusion

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

8.3 Onsite Power Systems

8.3.1 Alternating Current 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 LNP, 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 systems.

8.3.1.2 *Summary of Application*

Section 8.3 of the LNP COL FSAR, Revision 6, incorporates by reference Section 8.3 of the AP1000 DCD, Revision 19. Section 8.3 of the AP1000 includes Section 8.3.1. In addition, in LNP COL FSAR Section 8.3.1, the applicant provides the following:

AP1000 COL Information Items

- LNP COL 8.3-1

LNP COL 8.3-1 describes: 1) the grounding grid system design within the plant boundary; and 2) a lightning protection risk assessment for the buildings comprising LNP Units 1 and 2.

- LNP STD COL 8.3-2

STD COL 8.3-2 describes the details of: 1) the bases of the recommendations in operation, inspection, and maintenance procedures for the onsite standby diesel generators and 2) the procedures for the periodic testing of penetration overcurrent protective devices.

Supplemental Information

- LNP SUP 8.3-1

LNP SUP 8.3-1 describes the site conditions provided in Section 2.1 and Section 2.3 of the FSAR that are bounded by the standard site conditions used to rate the diesel engine and the associated generator in DCD Section 8.3.1.1.2.3.

- LNP SUP 8.3-2

LNP SUP 8.3-2 provides supplemental information describing the site-specific switchyard and power transformer voltage.

- LNP STD SUP 8.3-4

STD SUP 8.3-4 provides supplemental information regarding periodic verification of the onsite ac power system's capability to transfer between the preferred power supply and the maintenance power supply.

8.3.1.3 *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 the Commission regulations for the ac power systems are given in Section 8.3.1 of NUREG-0800.

The regulatory bases for acceptance of LNP 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 Std 80, "Guide for Safety in AC Substation Grounding"
- IEEE Std 665, "Guide for Generating Station Grounding"

The bases for acceptance of the part of STD COL 8.3-2, addressing the recommendations in operation, inspection, and maintenance procedures for the onsite standby diesel generators, are the guidelines of industry standards.

The regulatory bases for acceptance of the part of STD COL 8.3-2, addressing procedures for penetration protective device testing, are the guidelines of:

- RG 1.63, "Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants"

8.3.1.4 *Technical Evaluation*

The NRC staff reviewed Section 8.3.1 of the LNP COL FSAR and checked the reference DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[2] The NRC staff's review confirmed that the information contained in the application and incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC 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 (VEGP Units 3 and 4) were equally applicable to the LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP 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 LNP COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) contains evaluation material from the SER for the BLN Units 3 and 4 COL application.

The staff reviewed the information contained in the LNP COL FSAR:

AP1000 COL Information Items

- LNP COL 8.3-1

The NRC staff reviewed LNP COL 8.3-1 related to COL Information Item 8.3-1. COL Information Item 8.3-1 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 Appendix F of the NRC staff's FSER for the AP1000 DCD (NUREG-1793), which states:

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

The NRC staff reviewed the resolution to COL information item, LNP COL 8.3-1, related to the ground grid system and lightning protection included under Section 8.3 of the LNP COL FSAR. The NRC staff's evaluation is described below.

The applicant states that a grounding grid system design within the plant boundary includes a determination of step and touch potentials near equipment and ensuring that they are within the acceptable limit for personnel safety. Actual resistivity measurements from soil samples taken at the plant site were analyzed to create a soil model. The ground grid conductor size was then determined using the methodology outlined in IEEE 80, "IEEE Guide for Safety in AC Substation Grounding," and a grid configuration for the site was created. The grid configuration was modeled in conjunction with the soil model.

The NRC staff review of the grounding grid system design description observed that Table 8.1-201 of the LNP FSAR includes RG 1.204 which endorses IEEE Std. 665 for generation station grounding. The staff also observed that the same subsection of the DCD indicates compliance with IEEE Std. 665. Therefore, in RAI 08.03-01 the staff asked the applicant to discuss the extent to which the LNP ground grid design complies with IEEE Std. 665 and confirm that their use of IEEE Std. 80 did not invalidate the LNP conformance with the guidelines of RG 1.204. In a letter, dated July 13, 2009, the applicant stated that IEEE Std. 80 methodology was used in the determination of ground grid conductor size and that this methodology did not invalidate their conformance with the guidance of RG 1.204. The applicant also clarified that Appendix 1AA of the LNP COL FSAR includes RG 1.204, Revision 0, with no exceptions taken. The staff finds the applicant's response acceptable because it is consistent with the guidelines of RG 1.206. Therefore, the NRC staff finds the issues in RAI 8.03-01 resolved.

With regard to lightning protection, the applicant stated that, at LNP 1 and LNP 2, lightning protection is provided in accordance with the guidelines in RG 1.204. Specifically, the applicant stated that the zone of protection is based on 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. Lightning protection grounding is interconnected with the station/switchyard grounding system. The staff review of the applicant's description of the LNP lightning protection system design observed that in Table 8.1-201 of the LNP COL FSAR it is stated that RG 1.204 is implemented via IEEE Standard 665. Since the Regulatory Guide also endorses IEEE 666-1991, "IEEE design Guide for Electric Power Service Systems for Generating Systems," IEEE 1050-1996, "IEEE Guide for Instrumentation and Control Grounding in Generating Stations," and IEEE C62.23-1995, "IEEE Application guide for Surge Protection of Electric Generating Plants," in RAI 08.03-02 the staff requested that the applicant discuss the applicability of these other standards. On July 13, 2009, the applicant clarified that Appendix 1AA of the LNP COL FSAR includes RG 1.204, Revision 0, with no exceptions taken. Therefore, the applicant stated that they would also comply with the other standards in accordance with RG 1.204. Additionally, they stated that Table 8.1-201 of the LNP COL FSAR will be revised to remove the note: "Implemented via IEEE-665, IEEE Guide for Generating Station Grounding, (DCD Section 8.3, and Reference 201)," under the "Remarks" column for RG 1.204. The staff finds the applicant's response acceptable because it is consistent with the guidelines of RG 1.206. The staff also verified that the LNP FSAR has been revised to remove the note; therefore, the NRC staff finds the issues in RAI 8.03-02 resolved.

Based on the above, the staff concludes that IEEE Standard 665 provides an acceptable method for lightning protection; therefore, the supplemental information provided by the applicant on lightning protection is acceptable.

- LNP STD COL 8.3-2

The NRC staff reviewed LNP STD COL 8.3-2 related to STD COL 8.3-2 as follows.

The following portion of this technical evaluation section is reproduced from Section 8.3.1.4 of the VEGP SER:

- *STD COL 8.3-2*

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:*
>
> – *Periodic testing of penetration protective devices*
>
> – *Diesel generator operation, inspection and maintenance in accordance with manufacturer's recommendations*

The commitment was also captured as COL Action Items 8.3.1.2-1 and 8.4.1-1 in Appendix F of the NRC staff's FSER for the AP1000 DCD (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 LNP 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.

Resolution of Standard Content Confirmatory Item 8.3.1-1

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

- LNP SUP 8.3-1

The applicant stated in LNP SUP 8.3-1 that their site conditions are bounded by the standard site conditions in DCD Section 8.3.1.1.2.3 used to rate the diesel generators. The staff agrees that the LNP site conditions are bounded by the standard site conditions used to determine the rating.

- LNP SUP 8.3-2

The applicant provided information in LNP SUP 8.3-2 describing the site-specific switchyard and power transformer voltage. The staff found this statement of fact acceptable; no evaluation is required

- .LNP STD SUP 8.3-4

The applicant provided information in LNP STD SUP 8.3-4 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 above satisfies the requirements of GDC 18 and is, therefore, 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 NRC staff reviewed the application and checked the referenced DCD. The NRC staff's review confirmed that the applicant addressed the required information relating to ac power systems, and there is no outstanding information expected to be addressed in the LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff has compared the COL information items, the supplemental information, the interfaces for standard design, and the proposed design changes and corrections within 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 the NRC regulations pending resolution of the confirmatory item discussed above. The staff based its conclusion on the following:

- LNP 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 RGs 1.206 and 1.204.

- LNP STD COL 8.3-2 is acceptable because the applicant provided sufficient information related to preoperational testing of the diesel generators and periodic testing of the penetration overcurrent protective devices consistent with industry standards and the recommendations of RG 1.63.

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

- LNP SUP 8.3-2 is acceptable because the applicant adequately addressed the site-specific switchyard and transformer voltage.

- LNP STD SUP 8.3-4 is acceptable because the applicant will implement procedures for periodic verification of offsite power system capability for automatic and manual transfer from the preferred power supply to the maintenance power supply and vice versa to satisfy the requirements of GDC 18.

8.3.2 Direct Current Power Systems

8.3.2.5 *Introduction*

The dc-power systems include those dc power sources and their 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 inverters convert dc from the dc distribution system to ac instrumentation and control power, as required. These three components, when combined, provide an Uninterruptible Power Supply (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*

Section 8.3 of the LNP COL FSAR, Revision 6, incorporates by reference Section 8.3 of the AP1000 DCD, Revision 19. Section 8.3 of the AP1000 DCD includes Section 8.3.2. The advanced safety evaluation (ASE) with confirmatory items for Section 8.3.2 was based on the LNP COL FSAR, Revision 2 and DCD, Revision 17. After submitting DCD Revision 17 to the NRC, Westinghouse revised the COL information Item (COL 8.3-2) and the applicant took a departure (STD DEP 8.3-1) to address the revised COL information item. This COL information item has been incorporated into Revision 18 of the DCD; however, the discussion of the COL information item below did not change.

In addition, in LNP COL FSAR Section 8.3.2, the applicant provided the following:

Tier 2 Departure

- STD DEP 8.3-2

In a letter dated October 20, 2010, the applicant endorsed a Southern Nuclear letter dated October 15, 2010, for the VEGP application that proposed the following Tier 2 standard departure related to a proposed revision to AP1000 DCD Section 8.3.2.2. In the October 15, 2010, Southern Nuclear letter, Southern stated that the Class 1E battery chargers are designed to limit the input (ac) current to an acceptable value under faulted conditions on the output side; however, the voltage regulating transformers do not have active components to limit current; therefore, the Class 1E voltage regulating transformer maximum current is determined by the impedance of the transformer. 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. Since AP1000 DCD Section 8.3.2.2 states that the Class 1E voltage regulating transformers are designed to limit the input (ac) current to an acceptable value under faulted conditions on the output side, the use of the breakers/fuses for the regulating transformers for isolation function, in lieu of current limiting characteristics as presented in the AP1000 DCD, is a departure for VEGP. Because the issue is identified as a standard item it is also a departure for LNP.

AP1000 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; and 2) the clearing of ground faults on the Class 1E dc power system. In a letter dated March 1, 2011, the applicant endorsed a Southern Nuclear letter dated October 15, 2010, for the VEGP application that proposed to revise STD COL 8.3-2 by adding information related to periodic testing for the battery chargers and voltage regulating transformers.

Supplemental Information

- STD SUP 8.3-3

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 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 the Commission regulations for the dc power systems are given in Section 8.3.2 of NUREG-0800.

The regulatory basis for acceptance of COL information item, STD COL 8.3-2 and STD SUP 8.3-3, is established in:

- GDC 17
- GDC 18
- RG 1.206
- RG 1.129, “Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants”
- IEEE Std 450, “Recommended Practice for the Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications”

- RG 1.75, "Physical Independence of Electrical Systems," Revision 3

8.3.2.4 *Technical Evaluation*

The NRC staff reviewed Section 8.3.2 of the LNP COL FSAR and checked the referenced DCD to ensure that the combination of the DCD and the information in the COL represent the complete scope of information relating to this review topic.[2] The NRC staff's review confirmed that the information contained in the application and incorporated by reference addresses in the LNP COL application are documented in NUREG-1793 and its supplements.

Section 1.2.3 of this SER provides a discussion of the strategy used by the NRC 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 (VEGP Units 3 and 4) were equally applicable to the LNP Units 1 and 2 COL application, the staff undertook the following reviews:

- The staff compared the VEGP COL FSAR, Revision 5, to the LNP COL FSAR. In performing this comparison, the staff considered changes made to the LNP 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 LNP COL application. This standard content material is identified in this SER by use of italicized, double-indented formatting. Section 1.2.3 of this SER provides an explanation of why the standard content material from the SER for the reference COL application (VEGP) contains evaluation material from the SER for the BLN Units 3 and 4, COL application.

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

<u>AP1000 COL Information Item</u>

- *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****.*

Resolution of Standard Content Confirmatory Item 8.3.2-1

Confirmatory Item 8.3.2-1 required the applicant to update its FSAR to 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.

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-SRP 8.3.2-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, AP1000 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.

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

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 NRC staff reviewed the application and checked the referenced DCD. The NRC 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 LNP COL FSAR related to this section. The results of the NRC staff's technical evaluation of the information incorporated by reference in the LNP COL application are documented in NUREG-1793 and its supplements.

In addition, the staff concludes that the relevant information presented within the LNP 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 the applicant is in compliance with the NRC regulations. The staff based its conclusion on the following:

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

- STD SUP 8.3-3 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.

- STD 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.

Table 8.2A-1. ITAAC for Offsite Power System

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
1. A minimum of one offsite circuit supplies electric power from the transmission network to the interface with the onsite ac power system.	Inspections of the as-built offsite circuit will be performed.	At least one offsite circuit is provided from the transmission switchyard interface to the interface with the onsite ac power system.
2. Each offsite power circuit interfacing with the onsite ac power system is adequately rated to supply assumed loads during normal, abnormal and accident conditions.	Analyses of the offsite power system will be performed to evaluate the as-built ratings of each offsite circuit interfacing with the onsite ac power system against the load assumptions.	A report exists and concludes that each as-built offsite circuit is rated to supply the load assumptions during normal, abnormal and accident conditions.
3. During steady state operation, each offsite power source 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.	Analyses of the as-built offsite circuit will be performed to evaluate the capability of each offsite circuit to supply the voltage requirements at the interface with the onsite ac power system.	A report exists and concludes that during steady state operation each as-built offsite circuit is capable of supplying the voltage at 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.	Analyses of the as-built offsite circuit will be performed to evaluate the capability of each offsite circuit to supply the frequency requirements at the interface with the onsite ac power system.	A report exists and concludes that during steady state operation each as-built offsite circuit is capable of supplying the frequency at the interface with 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 circuit is compatible with the interrupting capability of the onsite short circuit interrupting devices.	Analyses of the as-built offsite circuit will be performed to evaluate the fault current contribution of each offsite circuit at the interface with the onsite ac power system.	A report exists and concludes the short circuit contribution of each as-built offsite circuit at the interface with the onsite ac power system is compatible with the interrupting capability of the onsite 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.	Analyses of the as-built offsite power system will be performed to confirm that power will be available to the reactor coolant pumps for a minimum of 3 seconds following a turbine trip when the buses powering the reactor coolant pumps are aligned to either the UATs or the RATs.	A report exists and concludes that voltage at the high-side of the GSU, and the RATs, does not drop more than 0.15 pu from the pre-trip steady-state voltage for a minimum of 3 seconds following a turbine trip when the buses powering the reactor coolant pumps are aligned to either the UATs or the RATs.

Table 8.2A-1. ITAAC for Offsite Power System

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
7) The credited GDC 17 offsite 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 offsite 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 offsite 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 offsite 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.