CHAPTER 8

ELECTRIC POWER

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CHAPTER 8

ELECTRIC POWER

8.1 INTRODUCTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

8.1.1 UTILITY GRID DESCRIPTION

Replace the existing information in DCD Subsection 8.1.1 with the following information:

WLS SUP 8.1-1 Duke Energy is an investor-owned utility serving the Piedmont region of North Carolina and South Carolina. The Duke Energy transmission system consists of interconnected hydro plants, fossil-fueled plants, combustion turbine units and nuclear plants supplying energy to the service area at various voltages up to 525 kV. The transmission system is interconnected with neighboring utilities, and together, they form the Virginia-Carolina Subregion of the Southeastern Electric Reliability Council.

Lee Nuclear Station Units 1 and 2 are located in the eastern portion of Cherokee County in north central South Carolina, approximately 35 miles southwest of Charlotte, North Carolina, approximately 25 miles northeast of Spartanburg, South Carolina and approximately 7.5 miles southeast of Gaffney, South Carolina. The power from Unit 1 is transmitted via an overhead transmission line to a 230 kV switchyard. Similarly, the power from Unit 2 is transmitted via an overhead transmission line to a 525 kV switchyard.

The 230 kV switchyard is located south of Unit 1 and is tied to the Duke Energy Carolinas 230 kV network by two double circuit overhead lines, namely Roddey East (northeast to Catawba) and Roddey West (southwest to Pacolet).

The 525 kV switchyard is located east of the 230 kV switchyard and is tied to the Duke Energy 525 kV network by two single circuit overhead lines, namely Asbury East (northeast to Newport) and Asbury West (southwest to Oconee). The 525 kV switchyard is also connected to the 230 kV switchyard through autotransformers.

8.1.4.3 Design Criteria, Regulatory Guides, and IEEE Standards

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Add the following information between the second and third paragraphs of DCD Subsection 8.1.4.3:

WLS SUP 8.1-2 Offsite and onsite ac power systems conformance to Regulatory Guides and IEEE Standards identified by DCD Table 8.1-1 as site specific and to other applicable Regulatory Guides is as indicated in Table 8.1-201.

WLS SUP 8.1-2

TABLE 8.1-201
SITE-SPECIFIC GUIDELINES FOR ELECTRIC POWER SYSTEMS

Criteria				Applicability (FSAR[a] Section/Subsection) 8.2	8.3.1	8.3.2	Remarks
1.	Regulatory Guides						
	a.	RG 1.129	Maintenance, Testing, and Replacement of Vented Lead-Acid Storage Batteries for Nuclear Power Plants			G	Battery Service tests are performed in accordance with the requirements of the Regulatory Guide.
	b.	RG 1.155	Station Blackout				Not applicable[b]
	c.	RG 1.204	Guidelines for Lightning Protection of Nuclear Power Plants		G		Implemented via IEEE 665.
	d.	RG 1.206	Combined License Applications for Nuclear Power Plants (LWR Edition)	G	G	G	
2.	Branch Technical Positions						
	a.	BTP 8-3 (BTP ICSB-11 in DCD)	Stability of Offsite Power Systems	G			Stability Analysis of the Offsite Power System is performed in accordance with the BTP.

a) "G" denotes guidelines as defined in NUREG-0800, Rev. 3, Table 8-1 (SRP). No letter denotes "Not Applicable."

b) Station Blackout, and the associated guidelines, was addressed as a design issue in the DCD.

8.2 OFFSITE POWER SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

8.2.1 SYSTEM DESCRIPTION

Delete the first, second, and sixth paragraphs, and the first and last sentences of the fourth paragraph of DCD Section 8.2.1. Add the following information before the fifth paragraph of DCD Subsection 8.2.1.

WLS COL 8.2-1 Lee Nuclear Station is connected into an interconnection switchyard designed to operate at a nominal voltage of 230 kV and 525 kV.

Unit 1 is connected to the 230 kV switchyard, and Unit 2 is connected to the 525 kV switchyard.

There are four transmission lines connected to the 230 kV switchyard, and two transmission lines connected to the 525 kV switchyard. As shown below, each transmission line is tied into a Duke transmission line or switchyard located between 19 and 95 miles from the station. The interconnection of Units 1 and 2, the switchyard, and the 230 and 525 kV transmission systems is shown in Figures 8.2-201 and 8.2-202.

Transmission Line	Termination Point	Length (miles)	Thermal Rating (MVA)
Roddey West WH (230 kV)	Pacolet Tie	19	916
Roddey West BL (230 kV)	Pacolet Tie	19	916
Roddey East WH (230 kV)	Catawba Nuclear Station	34	1114
Roddey East BL (230 kV)	Catawba Nuclear Station	34	1114
Asbury East (525 kV)	Newport Tie	41	3910
Asbury West (525 kV)	Oconee Tie	95	3910

Unit 1 is connected to the Duke Transmission System via the Roddey East and Roddey West 230 kV lines. The Roddey lines consist of a section of line, 34 miles in length, from Lee Nuclear Station to Catawba Nuclear Station and a section of line, 19 miles in length, from Lee Nuclear Station to Pacolet Tie.

The 230 kV line is constructed on a 150 ft. wide right-of-way with double circuit lattice steel towers, varying in height from 120 ft. to 190 ft. with a nominal height of

150 ft. Conductors are two per phase in a horizontal bundle. The vertical phase spacing is 19.5 ft. to 22.5 ft. The lines are designed to meet or exceed the requirements of the ANSI C2 National Electric Safety Code (DCD Section 8.2 Reference 1). The 230 kV lines are designed to keep the electric field at the conductor surface significantly below corona inception.

Unit 2 is connected to the Duke Transmission System via the Asbury 525 kV line. This line consists of a section of line, 41 miles in length, from Lee Nuclear Station to Newport Tie and a section of line, 95 miles in length, from Lee Nuclear Station to Oconee Nuclear Station. The 525 kV line is constructed on a 200 ft. wide right-of-way with single circuit lattice steel towers, varying in height from 120 ft. to 150 ft. with a nominal height of 140 ft. Conductors are two per phase in a horizontal bundle. The lines are designed to meet or exceed the requirements of the ANSI C2 National Electric Safety Code (DCD Section 8.2 Reference 1). The 525 kV lines are designed to keep the electric field at the conductor surface significantly below corona inception.

WLS CDI A transformer area containing generator step-up (GSU) transformers, unit auxiliary transformers (UATs), and reserve auxiliary transformers (RATs) is located next to each turbine building.

8.2.1.1 Transmission Switchyard

Replace the information in DCD Subsection 8.2.1.1 with the following information:

WLS COL 8.2-1 The 230 kV switchyard connects Unit 1 to the 230 kV transmission system. The 525 kV switchyard connects Unit 2 to the 525 kV transmission system. Both switchyards utilize a “breaker and a half” bus configuration with a “red” and “yellow” bus. All breakers are in the closed position with red and yellow buses energized under normal operation. The two switchyards are connected by two 230 kV to 525 kV autotransformers.

The 230 kV switchyard is configured to accept a maximum of four 230 kV lines interconnecting the transmission grid by two 230 kV double circuit lines. There are two terminals dedicated to accommodate the two autotransformers, one terminal for the Unit 1 GSU connection, one terminal for connection to the Unit 1 RATs, one terminal for connection to the Unit 2 RATs, and three spare circuit positions.

The 525 kV switchyard is configured to accommodate two incoming transmission lines, two autotransformer connections, the Unit 2 GSU, and three spare circuit positions.

The configuration of the switchyard is shown in Figure 8.2-201. The switchyard structure is tubular steel design with all power circuit breakers and switches fully

rated for the ultimate load and fault current levels to which the switchyard might be exposed. The nominal continuous current ratings of the installed equipment (based on a nominal operating temperature of key elements at 90 Deg C) is 3000 amperes for the 230 kV switchyard and 4000 amperes for the 525 kV switchyard. Circuit breakers are equipped with an appropriate compliment of current transformers to support relay, control and metering functions.

Failure Analysis

The design of the offsite power system provides for a robust system that supports reliable power production. Offsite power is not required to meet any safety function and physical independence is obviated by this lack of safety function and by the AP1000's partial exemption to General Design Criteria (GDC) 17 granted by the NRC during design certification. Nevertheless, multiple, reliable transmission circuits are provided to support operation of the facility. Neither the accident analysis nor the Probabilistic Risk Assessment has identified the non-safety related offsite power system as risk significant for normal plant operation.

The 230 kV switchyard is connected to four transmission lines and the 525 kV switchyard is connected to two transmission lines. No single transmission line to either switchyard is designated as the preferred circuit, but each line has sufficient capacity and capability from the transmission network to power the safety-related systems and other auxiliary systems under normal, abnormal, and accident conditions.

A failure modes and effect analysis (FMEA) of the Lee Nuclear Station switchyard confirms that a single initiating event, such as an offsite transmission line fault, plus a single breaker failure still provides the availability of at least one off-site transmission source to the switchyards. This evaluation recognizes that a single failure of some switchyard components could directly cause the loss of switchyard feed to the GSU, such as a fault on the main busline feed.

Evaluated events in the FMEA include a breaker not operating during a fault on an offsite transmission line; fault on a switchyard bus; fault on an autobank; a spurious relay trip; and a loss of control power supply. Some possible component outage combinations that can occur as a result of a single faulted zone and a breaker failure to trip are: 1 line and a bus, 1 line and a unit's RATs, 1 bus and an autobank or 2 autobanks. In summary:

- In the event of a fault on a 230kV or 525kV transmission line, the line protection relays sense the fault and cause the associated breakers to trip. The four busses, two autobanks, and the unaffected transmission lines remain energized. Both units continue operation.

- In the event of a fault on a transmission line concurrent with a stuck bus breaker, breaker failure protection causes circuit breakers on the associated bus to trip and isolate the fault. The three unaffected busses, the two autobanks, and the unaffected transmission lines remain energized. Both units continue operation.

- In the event of a fault on a transmission line concurrent with a stuck middle breaker, breaker failure protection causes circuit breakers on the associated Unit RAT busline to trip and isolate the fault. The four busses, the two autobanks, and the unaffected transmission lines remain energized. The affected unit's RATs are de-energized, and both units continue operation.

- In the event of a fault on a Unit RAT busline line concurrent with a stuck bus breaker, breaker failure protection causes circuit breakers on the associated bus to trip and isolate the fault. The three unaffected busses, the two autobanks, and the transmission lines remain energized. The affected unit's RATs are de-energized, and both units continue operation.

- In the event of a fault on the Unit RAT busline concurrent with a stuck middle breaker, breaker failure protection causes the associated transmission line breakers to trip and isolate the fault. The four busses, the two autobanks, and the unaffected transmission lines remain energized. The affected unit's RATs are de-energized, and both units continue operation.

- In the event of a fault on a 230kV/525kV autobank, transformer protective relays sense the fault and trip the associated autobank breakers. The four busses, one autobank, and the transmission lines remain energized. Both units continue operation.

- In the event of a fault on a 230kV/525kV autobank concurrent with a stuck bus breaker, breaker failure protection causes circuit breakers on the associated bus to trip and isolate the fault. The three unaffected busses, one autobank, and the transmission lines remain energized. Both units continue operation.

- In the event of a fault on a 230kV/525kV autobank concurrent with a stuck middle breaker, breaker failure protection causes the circuit breakers associated with both autobanks to trip and isolate the fault. The four busses and the transmission lines remain energized. Both units continue operation.

- In the event of a fault on a bus, the bus differential relays sense the fault and trip the associated bus breakers. The three unaffected busses, the two autobanks, and the transmission lines remain energized. Both units continue operation.

- In the event of a fault on a bus concurrent with a stuck breaker associated with a transmission line, breaker failure protection causes the associated transmission line breakers to trip and isolate the fault. The three unaffected busses, the two autobanks, and the unaffected transmission lines remain energized. Both units continue operation.

- In the event of a fault on a bus concurrent with a stuck breaker associated with an autobank, breaker failure protection causes the associated

autobank breakers to trip and isolate the fault. The three unaffected busses, one autobank, and the transmission lines remain energized. Both units continue operation.

- In the event of a bus fault concurrent with a stuck breaker associated with a Unit RAT busline, breaker failure protection causes the associated RAT busline middle breaker to trip and isolate the fault. The three unaffected busses, the two autobanks, and the transmission lines remain energized. The affected unit's RATs are de-energized, and both units continue operation.

- In the event of a fault on a bus concurrent with a stuck unit busline breaker, breaker failure protection causes the adjacent busline breaker to trip, interrupting power to the associated GSU and UATs resulting in a reactor trip. The three unfaulted busses, the two autobanks, and the transmission lines remain energized. In this event, both units' RATs remain energized and the unaffected unit continues operation. The affected unit's auxiliary systems are powered through the associated RATs.

- In the case of a loss of DC control power, the loss of control power to a breaker or switchyard primary protective relay is compensated for by redundant trip coils powered from a different source which allows the protective function to occur. Both units continue operation.

- In the case of a spurious trip output of a single protective relay providing line, autobank, or bus protection; the associated switchyard breakers trip, isolating the one affected line, autobank, or bus. The unaffected busses, autobank(s), and transmission lines remain energized. Both units continue operation.

- In the case of a spurious trip output of a single breaker failure protective relay; the switchyard breakers of the two associated protection zones trip, isolating two zones of protection. The specific combinations of affected zones are documented above in the stuck breaker events.

The results of the analysis confirm that in each scenario, the power source for the unit auxiliary systems remains available, either to the GSU or the RATs. No combination results in an outage on a GSU and the associated unit's RATs. While continued operation of the unit is not a success criterion, the fact that the units continue operation through most failure scenarios is an indication of the robustness of the switchyard design.

Transmission System Provider/Operator:

WLS SUP 8.2-1 Duke Energy is a regulated, vertically integrated utility with regards to its electric generation and transmission operations. Duke Energy's Nuclear Generation

Department (NGD) has a formal agreement titled Nuclear Switchyard Interface Agreement with the transmission system operator (TSO), which is Duke Energy's Power Delivery (PD) department. The PD department includes the Transmission Control Center (TCC), transmission System Operation Center, and transmission Planning and Grid Operations. The Nuclear Switchyard Interface Agreement and associated Department Directives serve as the communications protocol with the TSO. These documents facilitate adequate and prompt communications between the TSO and the plant operators.

Duke Energy is also the transmission system provider (TSP). The TSP/TSO establishes a voltage schedule for the 230 kV & 525 kV switchyard. The nuclear power plant, while generating, is expected to supply or absorb reactive power to help regulate voltage in the 230/525 kV switchyard in accordance with TSP/TSO voltage schedule criteria. The TSP/TSO also maintains switchyard voltage such that voltage on the 26 kV isophase bus is within 0.95 – 1.05 p.u. of its nominal value.

The plant's operator workstations monitor switchyard voltage, frequency, and other offsite power system parameters. The operator workstations are set to alert the nuclear plant operator if the grid may not be able to supply offsite power of sufficient voltage. Procedures direct the plant operators to contact the TSO and request a status of the most current contingency analysis for existing grid conditions. If the results of the contingency analysis indicate that insufficient voltage would exist in the switchyard, the procedures direct the plant operators to take appropriate actions.

WLS SUP 8.2-2 The Nuclear Switchyard Interface Agreement between NGD and PD sets the requirements for transmission system studies and analyses. These analyses demonstrate the capability of the offsite provider of supporting plant start up and normal shutdown.

WLS SUP 8.2-3 PD is the approving grid organization for reliability studies performed on the area bulk electric system. PD conducts planning studies of the transmission grid on an ongoing basis. Model data used to perform simulation studies of projected future conditions is maintained and updated as load forecasts and future generation / transmission changes evolve. Studies are performed annually to assess future system performance in accordance with North American Electric Reliability Corporation (NERC) reliability standards. These studies form a basis for identifying future transmission expansion needs.

New large generating units requesting to connect to the area bulk electric system are required to complete the Large Generator Interconnection Procedure (LGIP). The studies performed by Duke Energy TSO as part of this procedure, examine

the generating unit (combined turbine-generator-exciter) and the main step-up transformer(s).

WLS SUP 8.2-4 The Nuclear Switchyard Interface Agreement between NGD and PD demonstrates protocols in place for the plant to remain cognizant of grid vulnerabilities and make informed decisions regarding maintenance activities critical to the electrical system.

In the operations horizon, the Duke Energy TSO continuously monitors real-time power flows and assesses contingency impacts. Operational planning studies are also performed using offline power flow study tools to assess near term operating conditions under varying load, generation, and transmission topology patterns.

8.2.1.2 Transformer Area

Add the following paragraph and subsections at the end of DCD Subsection 8.2.1.2:

WLS COL 8.2-1 The transformer area for each unit contains the GSU (3 single phase transformers plus one spare), three UATs, and two RATs. The two RATs per unit are connected to the 230 kV switchyard. The secondary (high voltage side) windings of the three single-phase generator step-up (GSU) transformers are connected in wye configuration and connect to the 230 kV switchyard and 525 kV switchyard for Units 1 and 2, respectively.

8.2.1.2.1 Switchyard Transformer Ratings

The autotransformers connect the 230 kV and 525 kV switchyards. Each autotransformer is rated 525 kV to 230 kV, 750/810 MVA @ 55°C/65°C with a tertiary winding rated 13 kV, 54.2/60.7 MVA @ 55°C/65°C.

8.2.1.2.2 Switchyard Protection Relay Scheme

WLS COL 8.2-2 The 230 kV and 525 kV switchyards each have two main buses for their respective voltage level. All of the 230 kV and 525 kV lines and each of the GSUs are normally connected to both buses in their respective switchyard. This switchyard scheme is referred to as a “breaker and a half” scheme. This arrangement is used for reliability and flexibility, and allows for isolation of components and buses, while preserving the plant’s connection to the grid.

Under normal operating conditions, all circuit breakers and all bus sectionalizing motor operated disconnects are closed, and all bus sections are energized.

The transmission line relay protection circuits continuously monitor the conditions of the offsite power system and are designed to detect and isolate the faults with maximum speed and minimum disturbance to the system. The principal features of these schemes are described below:

Each of the 230 kV and 525 kV lines are protected by two independent pilot systems to clear for a fault anywhere on the line. The two autotransformers each have primary and secondary protective relaying.The primary and secondary relaying use separate instrument current transformers for monitoring, and separate DC power supplies.

The breaker failure relays operate after a preset time delay. Should a breaker fail to trip within the time setting, the associated breaker failure trip relay will trip and lock out all breakers necessary to isolate the failed breaker from all local sources. A breaker failure relay operation for 230 kV and/or 525 kV switchyard breakers that are connected to GSU, RAT, and Autobank transformers will also isolate the appropriate remote sources through a direct transfer trip operation.

The protective devices controlling the switchyard breakers are set with consideration given to preserving the plant grid connection following a turbine trip.

8.2.1.2.3 Plant Response to High Voltage Open Phase Condition

WLS SUP 8.2-6 A monitoring system is installed on the credited GDC 17 offsite power circuit that provides continuous open phase condition monitoring of the MSU transformer HV input power supply (see Reference 201). The system detects an open phase condition (with or without a concurrent high impedance ground on the HV side of the transformer) on one or more phases under all transformer loading conditions. The open phase condition monitoring system provides an alarm to the operators in the control room should an open phase condition occur on the HV source to the MSU transformers. The system design utilizes commercially available components including state of the art digital relaying equipment and input parameters as required to provide loss of phase detection and alarm capability.

Additionally, a high-voltage open phase condition with or without a ground fault can manifest itself as an unacceptable voltage on the 6.9 kV medium voltage ES-1 and ES-2 buses during normal loading conditions. The presence of unacceptable voltages on the ES-1 and ES-2 buses results in isolation of the affected medium voltage bus from the offsite power supply and enables the onsite standby diesel generators to start and restore AC power to the ES-1 and ES-2 buses and associated defense-in-depth loads. The onsite AC power system is described in DCD Section 8.3.1.

Motor management relays for the medium voltage motors on ES-1 and ES-2 provide detection of unacceptably high negative sequence currents. High negative seguence current motor trips or other running load trips provide alarms in the MCR, which can assist in the detection of a high-voltage open phase condition

with or without a ground fault. Electric circuit protection for the medium voltage system and eguipment is described in DCD Section 8.3.1.1.1.1.

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

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

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

8.2.1.3 Switchyard Relay House

WLS COL 8.2-1 A Relay House is erected to serve the needs of the switchyard. The size of this building is approximately 40 ft. x 60 ft. The Relay House contains the switchyard batteries (redundant battery systems are contained in separate battery rooms and appropriately ventilated) and is capable of accommodating a sufficient number of relay/control panels. A primary and backup heat pump is installed to keep electronic equipment at an acceptable temperature.

230 kV and 525 kV breakers associated with the GSUs (yellow bus and mid-tie breakers) are under operational control of the plant. Engineering and maintenance is the responsibility of PD. The controls for these breakers will be located inside the plant. Manual controls will be duplicated in the switchyard Relay House as well.

TCC will have operational control over all the other breakers in the 230 kV and 525 kV switchyards (including those associated with the RATs) with manual controls located in the switchyard Relay House.

8.2.1.4 Switchyard & Transmission Lines Testing & Inspection

WLS COL 8.2-1 PD, as owner of the interconnection facilities, has ongoing inspection and maintenance programs to provide for the continuous reliable operation of those facilities and others under the charge of the transmission owner. The maintenance and inspection programs leverage a combination of best utility practices, operating experience and equipment manufacturer's recommendations to determine the frequency and type of maintenance.

For performance of maintenance, testing, calibration and inspection, PD follows its own field test manuals, vendor manuals and drawings, industry's maintenance practices to comply with applicable NERC Reliability Standards.

Aerial inspection of transmission lines in the Duke Energy system are performed twice per year. The inspection has a specific focus on right-of-way encroachments, vegetation management, conductor and line hardware condition assessment, and supporting structures. Herbicides are used to control vegetation within the boundaries of the transmission line rights-of-way. Where herbicides cannot be applied, vegetation is cut and removed. This cutting and removal effort is extended beyond the formal right-of-way limit to address the presence of any danger trees which may adversely impact the operation of the transmission line.

The interconnecting switchyard as well as other switchyard facilities have multiple levels of inspection and maintenance. These include the following:

- Walk through and visual inspection of the entire switchyard facility.
- Relay functional tests.
- Oil sampling of large power transformers. Oil samples are evaluated through the use of gas chromatography and dielectric breakdown analysis.
- Power circuit breakers are subjected to three levels of inspection and maintenance. The frequency of each is a function of number of operations and time. Maintenance leverages the use of external visual inspection of all functional systems, an external test, and an internal inspection. Frequency of the various maintenance/inspection efforts is based on a combination of operating history of the type of breaker, industry practice and manufacturer's recommended maintenance requirements.
- A power test (Doble Test) is typically performed on oil filled equipment.
- Thermography is used to identify potential thermal heating issues on bus, conductors, connectors and switches.

8.2.2 GRID STABILITY

Add the following information at the end of DCD Subsection 8.2.2:

WLS COL 8.2-2 The Duke transmission system is designed to conform to transmission planning standards established by the NERC. The NERC transmission planning standards are written such that each member's system is designed to avoid system cascading upon the occurrence of several categories of events, including loss of generation, loss of transmission, and loss of load.

Studies are made periodically to verify that the transmission facilities conform to the NERC standards.

A grid stability study of the offsite power system was performed, and is updated as necessary for significant system changes. In order to maintain reactor coolant pump (RCP) operation for three seconds following a turbine trip as specified in DCD Subsection 8.2.2, the grid voltage at the high-side of the GSU and RATs cannot drop below a level that provides less than 80 percent of the nominal voltage at the RCP.

The Lee Nuclear Station grid stability analysis and criteria are summarized below:

- The steady-state load is 78,234 kW and 41,888 kVAR;
- The inrush kVA for motors is 56,712 kVA[1];
- The nominal voltage is 1.00 pu for both the 525 kV and 230 kV switchyards;
- The allowable voltage regulation is 0.95 – 1.05 pu (steady state);
- The nominal frequency is 60 Hz;
- The allowable frequency fluctuation is ±1/2 Hz (steady state);
- The maximum frequency decay rate is 5 Hz/sec; and
- The limiting under frequency value for RCP is greater than 57.7 Hz.

The study analyzes cases for load flow and transient stability using the Duke Energy system summer peak case. In order to complete the forward-looking study, the following assumptions are made:

1. Based on the inrush of a single 10,000 HP feedwater pump, assuming efficiency = 0.95, pf = 0.9, inrush = 6.5 X FLA, and locked rotor power factor = 0.15.

- Grid voltage is 230 kV and 525 kV.
- GSU tap settings selected are 235 kV (+2.5%) for 230 kV System and 525 kV (nominal) for the 525 kV system.
- GSU output voltage is 1.00 p.u. for Unit 1 and 1.01 p.u. for Unit 2.
- Autotransformer (230/525 kV) tap setting is 240/537.5 kV.

The computer analysis is performed using the Siemens Power Technology International PSS/E software. The analysis examines three conditions:

1. Normal Running
2. Turbine Trip
3. Not in Service/Shutdown

Each condition is modeled both with and without the other Lee Nuclear Station unit running. Other conditions (i.e. startup, normal shutdown) are bounded by these analyses.

The results of the study conclude that the transmission system remains stable preserving the grid connection, and supports RCP operation for at least three seconds following a turbine trip under the modeled conditions. The 80 percent voltage requirement is also met when there is another transmission element out of service, including the largest generator or most critical transmission line. The study finds that both Lee Nuclear Station units are transiently stable and meet voltage requirements for the evaluated contingencies.

The turbine trip does cause a brief period of machine power and bus voltage oscillations. However, the effects were not detrimental to the overall reliability of the transmission system.

Grid stability analysis has confirmed that the interface requirements for steady state load, nominal voltage, allowable voltage regulation, nominal frequency, allowable frequency fluctuation, and maximum frequency decay rate have been met.

WLS SUP 8.2-5 Twelve years of average outage data available on the Duke transmission system can be summarized as follows:

1. The Momentary Average Interruption Frequency Index is 0.28 for the 230 kV system and 0.78 for the 525 kV system.
2. The Transmission System Average Interruption Frequency Index for sustained (>1 minute) outages is 0.08 for the 230 kV system and 0.37 for the 525 kV system.

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

8.2.5 COMBINED LICENSE INFORMATION FOR OFFSITE ELECTRICAL POWER

WLS COL 8.2-1 This COL item is addressed in Subsections 8.2.1, 8.2.1.1, 8.2.1.2, 8.2.1.3, and 8.2.1.4.

WLS COL 8.2-2 This COL item is addressed in Subsections 8.2.1.2.2 and 8.2.2.

8.2.6 REFERENCES

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

8.3 ONSITE POWER SYSTEMS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

8.3.1.1.2.3 Onsite Standby Power System Performance

Add the following information between the second and third paragraphs of DCD Subsection 8.3.1.1.2.3:

WLS SUP 8.3-1 The Lee Nuclear Station site conditions provided in Sections 2.1 and 2.3 are bounded by the standard site conditions used to rate both the diesel engine and the associated generator in DCD Subsection 8.3.1.1.2.3.

Add the following subsection after DCD Subsection 8.3.1.1.2.3:

8.3.1.1.2.4 Operation, Inspection, and Maintenance

STD COL 8.3-2 Operation, inspection and maintenance (including preventive, corrective, and predictive maintenance) procedures consider both the diesel generator manufacturer's recommendations and industry diesel working group recommendations.

8.3.1.1.6 Containment Building Electrical Penetrations

Add the following text at the end of DCD Subsection 8.3.1.1.6:

STD COL 8.3-2 Procedures implement periodic testing of protective devices that provide penetration overcurrent protection. A sample of each different type of overcurrent device is selected for periodic testing during refueling outages. 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 vacuum circuit breakers.
- Verification of long time, short time, and instantaneous trips of low voltage air circuit breakers.

- Verification of Class 1E and non-Class 1E dc protective device characteristics (except fuses) per manufacturer recommendations, including testing for overcurrent interruption and/or fault current limiting.

Penetration protective devices are maintained and controlled under the plant configuration control program. A fuse control program, including a master fuse list, is established based on industry operating experience.

8.3.1.1.7 Grounding System

Replace the sixth paragraph of DCD Subsection 8.3.1.1.7 with the following information:

WLS COL 8.3-1 A grounding system calculation was performed to establish a ground grid design within the plant boundary resulting in step and touch potentials near equipment that are within the acceptable limit for personnel safety. Computer analysis utilized actual resistivity measurements from soil samples taken at the plant site, and were used to create a soil model for the plant site. The ground grid conductor size was then determined using the methodology outlined in IEEE 80, ”IEEE Guide for Safety in AC Substation Grounding” (Reference 201), and a grid configuration for the site was created. The grid configuration was modeled in conjunction with the soil model. The resulting step and touch potentials were calculated, and are within the acceptable limit.

8.3.1.1.8 Lightning Protection

Replace the third paragraph of DCD Subsection 8.3.1.1.8 with the following information:

WLS COL 8.3-1 In accordance with IEEE 665, “IEEE Standard for Generating Station Grounding”, a lightning protection risk assessment for the buildings comprising the Lee Nuclear Station was performed based on the methodology in NFPA 780. The tolerable lightning frequency for each of the buildings was determined to be less than the expected lightning frequency; therefore, lightning protection is required for Lee Nuclear Station buildings in accordance with NFPA 780 and IEEE C.62.23 (Reference 202). The zone of protection is based on the elevations and geometry of the structures. It includes the space covered by a rolling sphere having a radius sufficient enough to cover the building to be protected. The zone of protection method is based on the use of ground masts, air terminals and shield wires. Either

copper or aluminum is used for lightning protection. Lightning protection grounding is interconnected with the station or switchyard grounding system.

8.3.1.4 Inspection and Testing

Add the following text at the end of DCD Subsection 8.3.1.4

STD SUP 8.3-2 Procedures are established 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.

8.3.2.1.1.1 Class 1E DC Distribution

Add the following text at the end of DCD Subsection 8.3.2.1.1.1:

STD SUP 8.3-1 No site-specific non-Class 1E dc loads are connected to the Class 1E dc system.

8.3.2.1.4 Maintenance and Testing

Add the following text at the end of DCD Subsection 8.3.2.1.4:

STD COL 8.3-2 Procedures are established for inspection and maintenance of Class 1E and non-Class1E batteries. Class 1E battery maintenance and service testing is performed in conformance with Regulatory Guide 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.

The clearing of ground faults on the Class 1E dc system is also addressed by procedure. The battery testing procedures are written in conformance with IEEE 450 and the Technical Specifications.

Procedures are established for periodic testing of the Class 1E battery chargers and Class 1E voltage regulating transformers in accordance with the 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 Maintenance Rule 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.

8.3.2.2 Analysis

Replace the third paragraph of DCD Subsection 8.3.2.2 with the following information:

WLS DEP 8.3-1 The Class 1E battery chargers are designed to limit the input (ac) current to an acceptable value under faulted conditions on the output side. Fault current in the Class 1E voltage regulating transformers is limited by the impedance of the transformer. The Class 1E battery chargers and Class 1E voltage regulating transformers have built-in circuit breakers at the input and output sides for protection and isolation. The circuit breakers are coordinated and periodically tested as part of the Maintenance Rule program. The Class 1E battery chargers and Class 1E voltage regulating transformers are qualified as isolation devices between Class 1E and non-Class 1E circuits in accordance with IEEE 384 and Regulatory Guide 1.75.

8.3.3 COMBINED LICENSE INFORMATION FOR ONSITE ELECTRICAL POWER

WLS COL 8.3-1 This COL Item is addressed in Subsections 8.3.1.1.7 and 8.3.1.1.8.

STD COL 8.3-2 This COL Item is addressed in Subsections 8.3.1.1.2.4, 8.3.1.1.6 and 8.3.2.1.4.

8.3.4 REFERENCES

201. Institute of Electrical and Electronics Engineers (IEEE), “IEEE Guide for Safety in AC Substation Grounding” Document Number IEEE 80-2000.

202. Institute of Electrical and Electronics Engineers (IEEE), “Application Guide for Surge Protection of Electric Generating Plants: Document Number IEEE C.62.23-1995 (R2001).