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Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Duke Energy Carolinas, LLC.
William States Lee III Nuclear Station - Docket Nos. 52-018 and 52-019
AP1000 Combined License Application for the William States Lee III Nuclear Station Units 1 and 2
Response to Request for Additional Information

Reference: Letter from Brian C. Anderson (NRC) to Peter Hastings (Duke Energy *Request for Additional Information Letter No. 001 Related to SRP Section 08.02 for the William States Lee III Units 1 and 2 Combined License Application*, dated August 6, 2008.
Ltr # WLG2008.09-01

This letter provides the Duke Energy response to the Nuclear Regulatory Commission's requests for additional information (RAIs) included in the reference letter.

A response to each NRC request in the reference letter is addressed as a separate enclosure, which also identifies associated changes, when appropriate, that will be made in a future revision of the Final Safety Analysis Report for the Lee Nuclear Station.

If you have any questions or need any additional information, please contact Peter S. Hastings, Nuclear Plant Development Licensing Manager, at 704-373-7820.

Bryan J. Dolan
Vice President
Nuclear Plant Development

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NRO

Enclosures:

1) Duke Energy Response to Request for Additional Information Letter 001, RAI 08-02-001
2) Duke Energy Response to Request for Additional Information Letter 001, RAI 08-02-002

AFFIDAVIT OF BRYAN J. DOLAN

Bryan J. Dolan, being duly sworn, states that he is Vice President, Nuclear Plant Development, Duke Energy Carolinas, LLC, that he is authorized on the part of said Company to sign and file with the U. S. Nuclear Regulatory Commission this supplement to the combined license application for the William States Lee III Nuclear Station and that all the matter and facts set forth herein are true and correct to the best of his knowledge.

Bryan J. Dolan

Bryan J. Dolan

Subscribed and sworn to me on September 5, 2008

Phoebe P. Elliott

Notary Public

My commission expires: June 26, 2011

SEAL

xc (w/o enclosures)

Michael Johnson, Director, Office of New Reactors
Gary Holahan, Deputy Director, Office of New Reactors
David Matthews, Director, Division of New Reactor Licensing
Scott Flanders, Director, Site and Environmental Reviews
Glenn Tracy, Director, Division of Construction Inspection and Operational Programs
Charles Ader, Director, Division of Safety Systems and Risk Assessment
Michael Mayfield, Director, Division of Engineering
Luis Reyes, Regional Administrator, Region II
Loren Plisco, Deputy Regional Administrator, Region II
Thomas Bergman, Deputy Division Director, DNRL
Stephanie Coffin, Branch Chief, DNRL

xc (w/enclosures)

Brian Hughes, Senior Project Manager, DNRL

Lee Nuclear Station Response to Request for Additional Information (RAI)

RAI Letter No. 001

NRC Technical Review Branch: Electrical Engineering Branch

Reference NRC RAI Number(s): 08.02-1

NRC RAI:

Section 8.2.2 of the FSAR states that in order to maintain reactor coolant pump operation for 3 seconds following a turbine trip, the grid voltage on the high side of the step-up transformers (GSUs), and reserve auxiliary transformer (RATs) can not drop less than 80 percent of the nominal voltage at the Reactor Coolant Pump. In this regard, provide the following information:

a. Is this voltage based on worst expected switchyard voltage?

b. Is the 20% voltage drop requirement consistent with North American Electric Reliability Council (NERC) criteria (or local reliability council)?

c. Describe the effect of voltage drop of 20% on the operation of the onsite auxiliary power system equipment including the Class 1E battery chargers and uninterruptible power supplies.

Duke Energy Response:

a. At Lee Nuclear Station, there are two switchyards. Unit 1 connects to the 525 kV transmission system and Unit 2 connects to the 230 kV transmission system. These transmission systems are described in FSAR Subsection 8.2. In the Lee Nuclear Station Grid Stability Evaluation, switchyard equipment, including the transformers, were modeled to confirm required voltage would be available at the generator bus or high side of the transformer being used for bus supply. As indicated in FSAR Subsection 8.2.1.1, "The TSP/TSO maintains switchyard voltage such that steady state voltage on the 26 kV isophase bus is within 0.95 – 1.05 pu [per unit] of its nominal value." Based on the analysis, the expected voltage at the generator terminals is 1.01 pu for Unit 1 and 1.00 pu for Unit 2.

There were several different pre-contingency cases created with various generation outages that established initial conditions; then contingencies were applied. The base case, with all lines in service, and the combinations of generation outages and grid contingencies simulate different grid configurations that create several different pre-trip steady state voltages. Therefore, a series of different pre-trip voltages were studied. Steady state studies showed that, for Unit 1, a turbine trip with an Asbury West 525 kV line outage caused a 4.35 kV decrease on the 525 kV bus and a 1.18 kV decrease on the 230 kV bus, both less than a 1% change. For Unit 2, an outage of the 525/230 kV autotransformer caused a 3.29 kV decrease on the 230 kV bus and a 1.93 kV decrease on the 525 kV bus, both less than a 2% change.

The voltage changes from the worst case contingency on each unit satisfy the voltage requirement for the Reactor Coolant Pump. The contingency list used in the grid study is considered to be sufficiently extensive and at an appropriate severity level to bound the reasonably expected voltages.

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

c. The requirement that grid voltage on the high side of the GSUs and RATs not drop to less than 80 percent of the nominal voltage at the Reactor Coolant Pump does not translate to a requirement to postulate a 20% voltage drop on plant auxiliary equipment. As indicated in the response to question 08.02-1a. above, steady state studies showed changes of less than 1% and 2% for Units 1 and 2, respectively, based on contingencies considered to be sufficiently extensive and at an appropriate severity level to bound the reasonably expected voltages.

Nonetheless, even under a hypothetical transient voltage drop of 20% from a steady state condition, no adverse affect would be expected on plant auxiliary equipment. Such a hypothetical transient would be less severe than the motor starting transient described in NEMA MG1 for which the plant equipment is designed. As the NEMA MG1 transient bounds the turbine trip 3 second transient, the undervoltage relay scheme settings are designed not to trip during the turbine trip 3 second voltage transient. In specific reference to the uninterruptible power supplies (UPS), the UPS is isolated from the grid voltage by the battery charger and the batteries, and therefore is unaffected by this voltage transient.

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

Associated Revision to the Lee Nuclear Station Combined License Application:

None

Attachments:

None

Lee Nuclear Station Response to Request for Additional Information (RAI)

NRC Letter No.001

NRC Technical Review Branch: Electrical Engineering Branch

Reference NRC RAI Number(s): 08.02-2

NRC RAI:

Section 8.2.1.1 of the FSAR discusses the results of the Failure Mode and Effects Analysis (FMEA) of the Lee Nuclear Station switchyards. In order for the staff to evaluate the FMEA, describe in detail how each event (a breaker not operating during a fault on an offsite line; fault on a switchyard bus; fault on an autobank; a spurious relay trip; a loss of control power; and other cases discussed in the FSAR) in the FMEA was evaluated to conclude that the offsite power to each unit is not lost.

Duke Energy Response:

As indicated in FSAR Subsection 8.2.1.1:

> The design of the offsite power system provides for a robust system that supports reliable power production.
>
> 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 this main busline feed.
>
> No combination results in an outage on a GSU and the associated unit's RATs.

The results of the FMEA confirm that in each scenario, the power source for the unit auxiliary systems remains available, either to the GSU or the 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. The following events were evaluated in the FMEA:

- 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.

Associated Revision to the Lee Nuclear Station Combined License Application:

COLA Part 2, FSAR, Chapter 8, Subsection 8.2.1.1 will be revised from:

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. No combination results in an outage on a GSU and the associated unit's RATs.

To read:

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.

Attachments:

None