Duke Energy Carolinas

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April 5, 2010

10 CFR 50.90

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC (Duke Energy)
Catawba Nuclear Station, Units 1 and 2
Docket Numbers 50-413 and 50-414

Request for Additional Information (RAI), Technical Specification 3.8.1, "AC Sources-Operating" to Revise Emergency Diesel Generator Voltage Limits

Reference: Letter from Duke Energy to the NRC, same subject Dated May 28, 2009 (ADAMS Accession NO. ML091540013)

The reference letter requested a license amendment pursuant to 10 CFR 50.90 to revise the Unit 1 and Unit 2 Technical Specifications (TS). The requested amendment revises the voltage limits to assure compliance with plant design bases and plant operation, thus assuring the Diesel Generators are capable of supplying power with the correct voltage to the required electrical loads.

On December 11, 2009, the NRC electronically transmitted a Request for Additional Information (RAI). The purpose of this letter is to formally respond to the NRC RAIs.

Enclosure 1 of this letter contains Catawba Nuclear Station RAI responses. The format of the responses is to restate each RAI question, followed by the station response in bold.

Duke Energy requests NRC approval of the proposed changes within one calendar year of the submittal, dated May 28, 2009.

There are no regulatory commitments contained in this letter or its enclosure.

Pursuant to 10 CFR 50.91, a copy of this letter and its enclosure is being sent to the designated official of the State of South Carolina.

A001
NRR

Inquiries regarding this matter should be directed to Adrienne F. Driver at (803) 701-3445.

Very truly yours,

James R. Morris

AFD/s

Enclosure

James R. Morris affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

James R. Morris, Vice President

Subscribed and sworn to me: 4/5/2010 Date

Notary Public

My commission expires: 1/31/2018 Date

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MY COMMISSION EXPIRES 1/31/2018
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Enclosure 1

Response to NRC Request for Additional Information

REQUEST FOR ADDITIONAL INFORMATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REGARDING LICENSE AMENDMENT TO REVISE TS 3.8.1 EMERGENCY

DIESEL VOLTAGE LIMITS

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

1. Provide a summary of engineering evaluation which determined that the current EDG voltage requirements in TS 3.8.1 are non-conservative considering the TS allowable value for the emergency bus degraded voltage conditions.

Duke Energy Response:

The request to limit the Emergency Diesel Generator (EDG) lower voltage requirements in Technical Specification (TS) 3.8.1 to minus five percent of 4160V is due to evaluating the effect of a two percent EDG over frequency on Motor Operated Valve (MOV) torque capability.

An evaluation to review the effect(s) of the frequency variation for MOVs was conducted with respect to motor actuator capability for safety-related MOVs powered from the EDG. As described, in accordance with the "Standard Handbook for Electrical Engineers" the motor torque capability is inversely proportional to the square of the frequency, thus a two percent decrease in the frequency would increase the motor torque capability; in contrast a two percent increase in frequency would decrease the motor torque capability. A two percent increase in EDG frequency coupled with a ten percent decrease in EDG voltage presented limitations that would have resulted in negative margin on some of the MOVs. Due to this operability concern, it is requested to amend the TS 3.8.1 lower voltage limit to minus five percent of 4160V for the EDGs.

The CNS Power Systems Loss of Coolant Accident (LOCA) analyses determine the MOV terminal voltage values throughout the committed LOCA load sequence, as controlled and loaded by the Diesel Generator Load Sequencing System (EQB). The CNS Power Systems LOCA analyses are performed with the 4160V essential busses at the minimum allowable Degraded Grid Voltage Relay (DGVR) setpoint (i.e., 89.86% voltage on the 4160V essential busses), and at nominal system frequency (i.e., 60.0 Hz). Therefore, the MOV terminal voltage values calculated by the CNS Power Systems LOCA analyses are the minimum expected voltage values, at nominal system frequency. The GL 89-10 MOV analyses calculate the torque generated by the MOV actuators using the voltage values calculated by the CNS Power Systems LOCA analyses (i.e., minimum expected voltage values), at nominal system frequency. The torque generated by the MOV actuators with the 4160V essential busses being supplied by an EDG operating at the current minimum allowable voltage (i.e., 3740V) and the maximum allowable frequency (i.e., 61.2 Hz) would be lower than the torque values (of the MOV actuators) calculated using the voltage values calculated by the CNS Power

Systems LOCA analyses. However, the torque generated by the MOV actuators with the 4160V essential busses being supplied by an EDG operating at the proposed minimum allowable voltage (i.e., 3950V) and the maximum allowable frequency (i.e., 61.2 Hz) would be higher than the torque values (of the MOV actuators) calculated using the voltage values calculated by the CNS Power Systems LOCA analyses, and therefore bounded by the present GL 89-10 MOV analyses. Thus, limiting the minimum allowable EDG voltage to 3950V, while maintaining the current frequency limits, allows all MOVs to generate sufficient torque to perform their required safety functions.

For the non-GL 89-10 safety-related MOVs, the same philosophy would apply. Using this approach, of a two percent EDG frequency increase coupled with a five percent EDG voltage decrease, all safety-related MOVs are considered operable. However, the EDGs are considered Operable but Degraded and Non-conforming (OBDN) due to a non-conservative Technical Specification with regards to the allowable voltage range. It is requested to amend the lower TS voltage limit of 3740V to 3950V.

The Degraded Voltage Sensing circuit is not active following an EDG actuation due to a "Black Out" (i.e., Loss of Offsite Power (LOOP)). This is accomplished through interlocks from the 4160V essential buses normal and alternate incoming breakers, which are opened automatically on a load sequencer actuation due to "Black Out" (i.e., LOOP). With both breakers open, the timing circuits associated with degraded voltage are not initiated, thus precluding a subsequent sequencing event in that respect.

2. Explain how drift, measurement uncertainty, and margin are accounted for in the calculations or analyses that support that the proposed minimum EDG voltage would be sufficient for the required loads.

Duke Energy Response:

CNS Power System LOCA analyses (i.e., calculations) are performed which ensure that the required LOCA non-MOV loads have sufficient voltage to "start" and "run" in order to perform their safety function(s). Since low voltage conditions are of primary concern with respect to the "start" and "run" ability of safety-related motors, the LOCA analyses are performed at maximum load and minimum source voltage conditions. The most limiting auxiliary power system alignment, with voltage at the 4160V essential buses is modeled to occur during plant steady-state power operation at the TS minimum allowable DGVR value. Note that MOVs are appropriately modeled within the LOCA analysis, and motor terminal voltage values are calculated. The additional analysis (i.e., GL 89-10 MOV) is performed to ensure that the MOVs will develop sufficient torque at the calculated terminal voltage values in order to perform their safety function(s).

Thus, the question of drift, measurement uncertainty and margin applies to the DGVR setting, which is used in the Power System LOCA analyses to ensure that sufficient voltage exists for the required loads. The minimum allowable DGVR setpoint provides the second level of degraded voltage protection, as described in CNS TS Bases 3.3.5. Potential transformer accuracy, as well as relay and

calibration instrumentation tolerances are considered when determining the DGVR nominal setpoint (the degraded voltage NOMINAL TRIP SETPOINT in CNS TS Surveillance Requirement 3.3.5.2) and the minimum DGVR value (the degraded voltage allowable value in CNS TS Surveillance Requirement 3.3.5.2). The "Square-Root-Sum-of-the-Squares (SRSS)" methodology is used to combine uncertainty terms to determine total loop uncertainty, as directed in Duke Energy engineering directives. Therefore, performing the Power System LOCA analyses at the minimum allowable DGVR value incorporates all appropriate instrumentation uncertainties, while ensuring that required 1E loads have sufficient voltage to perform their safety function(s).

The EDG voltage regulator is designed so that initial EDG output voltage is determined by a pre-position function. At each EDG shutdown, the pre-position circuit automatically adjusts so that for the next start, voltage will be that of the desired value. For an emergency start of the EDG, the pre-position circuit initially operates again to ensure that the EDG will provide the desired voltage. The response of the voltage regulator pre-position circuit is verified through calibration procedures to ensure that the EDG output voltage attains within one percent of the desired 4160V.

Instrumentation used to verify EDG voltage for TS surveillances is calibrated on a periodic basis by station procedures under the station's preventive maintenance program. Analog metering currently calibrated on an 18 month frequency may be used to satisfy the EDG voltage surveillance. This metering is calibrated to plus or minus two percent accuracy of full scale. A chart recorder voltage indication currently calibrated on a semi-annual frequency may also be used to satisfy the EDG voltage surveillance. This indication is calibrated to plus or minus one percent accuracy of the indicated range. These components are identified as being within the scope of Catawba station directives, which specify the manner by which process instrumentation, used to satisfy acceptance criteria on regulatory-required tests, shall be controlled. This process includes identification of "Out of Tolerance" instruments when found during periodic calibration. The process also provides for engineering evaluation of the out of tolerance components, and for engineering review of chronic (repetitive) problems involving the same instruments. Uncertainty terms have not been included in the surveillance procedures which identify the acceptance limits for EDG output voltage, but rather the instrumentation used to control and monitor voltage is calibrated and maintained so that the TS value will not be challenged.

3. Provide a summary of the analyses including all assumptions which show that with the proposed TS voltage limit requirement (> 3950 Volt (V) and < 4580 V), all safety related loads can be sequenced successfully while maintaining the voltage and frequency within its limits. Include a scenario in the analysis where the EDG output voltage could be at 4580 V and a motor (nameplate voltage 4000 V) is starting.

Duke Energy Response:

The conversion to the standardized technical specifications was approved by the NRC in the Safety Evaluation Report (SER) dated September 30, 1998. This TS

value remained unchanged from the original TS value of 4160V + 420V that was approved in the NRC SERs dated January 17, 1985 (Unit 1) and May 15, 1985 (Unit 2). The conversion to the improved TS changed only the "presentation" of the EDG voltage value(s) (i.e., 4160 +420 = 4580). This submittal requests an amended change to the lower TS limit value for the EDGs only.

There are multiple analyses (i.e., calculations) that together provide the full answer to this RAI. These analyses are discussed separately:

CNS Power System LOCA Analyses

CNS Power System LOCA analyses (i.e., calculations) are performed which ensure that the required 1E LOCA non-Motor Operated Valve (MOV) loads have sufficient voltage to "start" and "run" in order to perform their safety function(s). Since low voltage conditions are of primary concern with respect to the "start" and "run" ability of safety-related motors, the LOCA analyses are performed at maximum load and minimum source voltage conditions. The most limiting auxiliary power system alignment, with voltage at the 4160V essential buses is modeled to occur during plant steady-state power operation at the TS minimum allowable DGVR value. Note that MOVs are appropriately modeled within the LOCA analyses, and motor terminal voltage values are calculated. The additional analysis (i.e., GL 89-10 MOV) is performed to ensure that the MOV will develop sufficient torque at the calculated terminal voltage values in order to perform their safety function(s).

The calculations perform motor starting analyses for the committed LOCA sequence, as loaded by the Diesel Generator Load Sequencing (EQB) System. Throughout the sequence, induction motors are modeled both accelerating (i.e., drawing Locked Rotor Amps (LRA)) and running in steady state (i.e., drawing Full Load Amps (FLA)), as appropriate. These power system LOCA analyses demonstrate that appropriate 1E LOCA non-MOV loads have sufficient voltage to perform their safety functions, with 4160V bus voltage at the DGVR Minimum Dropout value. The assumptions used in the LOCA analyses are:

- All non-safety normally operating plant loads continue to operate for the full duration of the LOCA event.
- Tolerance values for the various timers associated with the automatic load sequencer device for the committed sequence have been incorporated into the static acceleration times for the 4000V motors.
- The Nuclear Service Water (RN) system swap over from Lake Wylie to the Standby Nuclear Service Water Pond (SNSWP) will not occur simultaneously with a LOCA event.
- MOVs starting in the OPEN position and required to go to the CLOSED position start unloaded, and thus, they do not have a significant impact on the starting of non-MOV loads.
- Manually initiated MOV and active MOVs which may be manually repositioned once all LOCA loads are operating, are assumed to start and complete their stroke one at a time. Steady state voltages for the motor

control centers (MCCs) with all LOCA steady state loads operating are used to calculate the MOV terminal voltages for starting and running.

CNS Transient Power System LOCA Analysis

The existing CNS transient power system LOCA analysis ensures that the EDGs can successfully provide power to the loads in the committed LOCA load sequence while maintaining voltage and frequency within the requirements of Regulatory Guide 1.9.

The assumptions used in the dynamic LOCA analyses are:

- When calculating static loads on 600V MCC, a power factor of 1.00 or 0.85 can be used to simplify the calculation. The effects of this assumption of the EDG responses are negligible because 600V static loads represent only a fraction of the total EDG loads.
- The EDG is in a steady state condition before the first load group is applied.
- Using field flashing when starting, the EDG can reach its steady state condition within 10 seconds.
- Low voltage cables are treated as 5000V cables yielding conservative results.
- Since all EDGs are of the same specification, and LOCA loads are very similar for both Catawba Units 1 and 2, the results of this calculation are applicable to all CNS EDGs.
- Essential motors and associated protective devices are designed/selected to allow the motors to start with 80 percent voltage.

CNS MOV Torque Capability Evaluation

As a result of a Component Design Basis Inspection (CDBI) audit, an analysis was performed to evaluate the effect of the plus or minus two percent EDG frequency variation on the actuator motor torque capability for all Class 1E MOVs. A two percent decrease in EDG frequency is not a concern because this increases the actuator motor torque capability. A two percent increase in EDG frequency would cause an approximate four percent decrease in actuator motor torque capability. However, since voltage also affects motor torque capability the frequency effect combined with the voltage effect must be evaluated.

The conditions that bound the worst case scenario are a two percent increase in EDG frequency coupled with a ten percent decrease in EDG voltage. These EDG conditions presented limitations that would have resulted in negative margin on some of the Class 1E MOVs. Due to this operability concern, the minimum voltage for the EDG will be changed to minus five percent (3950V) from minus ten percent

(3740V). Presently the GL 89-10 MOV calculations reduce the actuator motor torque capability by a reduced voltage specific to each MOV taken from the CNS Power Systems LOCA analyses at a DGVR minimum setpoint of 3738V at the 4160V bus. This is approximately the same voltage as the present TS EDG minimum voltage, 3740V. Changing the minimum voltage requirement on the EDG to 3950V increases the motor torque capability which allows margin for a reduction due to increased frequency. Therefore, operating the EDG at a voltage of 3950V and a frequency of plus two percent is bounded by the present GL 89-10 MOV calculations of motor torque capability at the DGVR minimum setpoint.

For the non GL 89-10 Class 1E MOVs, the CNS Power System LOCA analyses determines the minimum terminal voltage of these MOVs at a minimum allowable DGVR setpoint. These MOVs have been reviewed to ensure they have adequate motor torque capability at the DGVR minimum setpoint, 3738V. Therefore, these MOVs would also have adequate motor torque capability when powered from the EDG at a voltage of 3950V and a frequency of plus two percent.

<u>CNS Voltage Analysis of Motor Starter and Interposing Relay Coils</u>

Catawba analysis evaluated voltage drop for safety related motor control center control circuits. These circuits are powered from control power transformers in the motor control centers. Control circuits were evaluated based on minimum bus voltage associated with the Degraded Grid Voltage Relay (DGVR) as discussed in the Duke Energy Response to Question 1 above. The control circuits were shown to operate properly for this postulated minimum voltage level. The proposed TS voltage lower limit is higher than the voltage levels these circuits have already been evaluated for.

4. The licensee, in its application, stated that the two components 1RN225B "Containment Spray Heat Exchanger Inlet Isolation Valve" and 2VI77B "Containment Isolation Valve" did not meet the standard conservative criteria, but were found acceptable with current administrative controls. Explain the following:

    a. What are the minimum design basis voltage and frequency requirements for these two motor operated valves?

Duke Energy Response:

The design basis operational requirements for 1RN225B and 2VI77B are given in relation to stroke time, not voltage and/or frequency. The standard criteria for stroke time requirements are in accordance with the Inservice Testing Program (IST) governed by 10 CFR 50.55a (f). In addition to the IST Program and regulatory requirement(s), per UFSAR Section 8.3.1.1.4 when operating on the grid, these two motor operated valves (MOVs), 1RN225B and 2VI77B, are reviewed to have adequate torque to meet design basis requirements at reduced voltage conditions. Catawba's reduced voltage condition is a DGVR minimum setpoint of 3738V at the 4160V bus.

    b. Explain how these valves meet the design basis voltage and frequency requirements?

Duke Energy Response:

Both 1RN225B and 2VI77B failed the "stroke time criterion" that was part of the original review. The stroke time of an MOV is affected only by a frequency variation not a voltage variation.

Engineering performed an evaluation to review the impact of frequency variation with respect to valve stroke time requirements. A decrease in EDG frequency has a direct impact on MOV operation by increasing the stroke time. For the basis of this evaluation a two percent decrease in EDG frequency is assumed to cause a two percent decrease in motor speed resulting in an increase in MOV stroke time. Engineering evaluated a two percent stroke time increase for all valves as defined in the IST program.

The most recent stroke time data for 1RN225B and 2VI77B was reviewed to determine the impact of a two percent decrease in frequency, which causes a two percent decrease in motor speed, resulting in a two percent increase in actuator stroke time. Upon discovery of the actual stroke time for 1RN225B and 2VI77B exceeding their respective acceptable stroke time requirements, further review was conducted. During this review it was determined that the stroke time of these valves could be increased to accommodate for the two percent increase in stroke time. These changes were processed in accordance with Duke Energy Nuclear Station Directives and/or, 10 CFR 50.59 and 10 CFR 70.71 (e) for changes to the UFSAR.

5. Confirm that the terminology "Black Out" used in the license amendment application and in the Catawba UFSAR is actually meant for "loss of offsite power to the 4 kV class 1E essential bus" and it is not used for the "Station Black Out" as described in the UFSAR.

Duke Energy Response:

This License Amendment Request (LAR) describes system response to a "Black Out" (i.e., LOOP). "Black Out" is defined for Catawba as a loss of normal power to the 4160V essential buses. This will start the EDGs. A Station Blackout (SBO) is defined for Catawba as a loss of all normal and all alternate AC power. No AC power is available from the grid, the main generators, or the diesel generators. UFSAR Section 8.4 describes Catawba's response to an SBO event. In this LAR the terminology used as "Black Out" is described to be the same as a LOOP.