Benjamin C. Waldrep
Vice President
Harris Nuclear Plant
5413 Shearon Harris Road
New Hill NC 27562-9300

919.362.2000

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

Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400/Renewed License No. NPF-63

Subject: Response to Request for Additional Information #3 Regarding License Amendment Request to Revise Technical Specification Table 3.3-4 Loss of Offsite Power 6.9 kV Emergency Undervoltage Primary Setpoints (TAC No. MF4294)

Ladies and Gentlemen:

By letter dated June 19, 2014, Duke Energy Progress, Inc. (hereafter Duke Energy), requested an amendment to the Technical Specifications (TSs) for Shearon Harris Nuclear Power Plant, Unit 1 (HNP). Duke Energy proposed to revise TS 3.3.2, “Engineered Safety Features Actuation System Instrumentation,” Table 3.3-4, “Engineered Safety Features Actuation System Instrumentation Trip Setpoints.” Specifically, the Functional Unit 9.a, Loss-of-Offsite Power 6.9 kilovolt Emergency Bus Undervoltage Primary, instrument trip setpoint and associated allowable value are being revised to correct a non-conservative TS. The proposed change incorporates portions of Technical Specification Task Force Traveler TSTF-493-A, Option A, related to the Loss-of-Offsite Power instrumentation surveillance requirements.

The NRC staff reviewed the request and determined that additional information is needed to complete their review. The letter formally requesting additional information was received on January 28, 2015. The Duke Energy response to the request is enclosed.

The response clarifies a sentence in the license amendment request, and the revised page is attached. The revision clarifies the background for the request but does not change the request, and the clarified sentence is not credited in the justification of the change. Therefore, the correction is administrative and does not impact the validity of the original Significant Hazards Consideration or the Environmental Consideration.

This document contains no new Regulatory Commitments.

Please refer any questions regarding this submittal to John Caves at (919) 362-2406.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on [JANUARY 30, 2015].

Sincerely,

Benjamin C. Waldrep

Enclosure: Response to Request for Additional Information #3

cc: Mr. J. D. Austin, NRC Sr. Resident Inspector, HNP (email)
Mr. W. L. Cox, III, Radiation Protection Section Chief, N.C. DHSR (email)
Ms. M. Barillas, NRC Project Manager, HNP (email)
Mr. V. M. McCree, NRC Regional Administrator, Region II (EIE)

Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400/Renewed License No. NPF-63

Response to Request for Additional Information #3
License Amendment Request to Revise Technical Specification Table 3.3-4
Loss of Offsite Power 6.9 kV Emergency Undervoltage Primary Setpoints

By letter dated June 19, 2014, Duke Energy Progress, Inc. (hereafter Duke Energy), requested an amendment to the Technical Specifications (TSs) for Shearon Harris Nuclear Power Plant, Unit 1 (HNP). Duke Energy proposed to revise TS 3.3.2, “Engineered Safety Features Actuation System Instrumentation,” Table 3.3-4, “Engineered Safety Features Actuation System Instrumentation Trip Setpoints.” Specifically, the Functional Unit 9.a, Loss-of-Offsite Power (LOOP) 6.9 kilovolt (kV) Emergency Bus Undervoltage Primary, instrument trip setpoint and associated allowable value are being revised to correct a non-conservative TS. The proposed change incorporates portions of Technical Specification Task Force Traveler TSTF-493-A, Option A, related to the LOOP instrumentation surveillance requirements.

The NRC staff reviewed the request and determined that additional information is needed to complete their review. The letter formally requesting additional information was received by HNP on January 28, 2015. The Duke Energy response to the request follows.

The NRC staff noted that the license amendment request (LAR) dated June 19, 2014, is in response to deficiencies identified in a Component Design Bases Inspection documented in Inspection Report (IR) 05000400-11-008, dated August 9, 2011 (ADAMS Accession No. ML112220337). Specifically, on Page 11 of IR, the following was stated:

> UFSAR [Final Safety Analysis Report] 8.3.1.1.3 states that motors can operate at 75% voltage for one minute without damage. Technical Specification Table 3.3-4 establishes the setpoint for the Secondary Loss of Offsite Power (degraded voltage) relay non-accident time delay as ≤ 60 seconds. It also established the setpoint for the Primary Loss of Offsite Power relay as ≥ 4692 V [Volts] (68% of 6900 V). This scheme would allow motors to be subjected to voltage below 75% for up to one minute, which is in excess of the capability claimed in the UFSAR.

In the LAR, the settings of the 6.9 kV Emergency Bus Undervoltage - Primary (Loss of Voltage) (LOV) are proposed to be revised. The staff requested the following additional information for its evaluation of the LAR:

<u>RAI 1:</u>

On Page 2 of the LAR, the licensee stated:

> “Specifically, the team determined that the trip setpoint and allowable value specified in the TS for the second time delay for the degraded voltage relays (i.e., the primary undervoltage protection) would allow motors to be subjected to voltage below 75% for up to one minute, which is in excess of the capability cited in the FSAR.”

The staff finds elsewhere in the LAR that the term “primary undervoltage protection” is used for Loss of Voltage (LOV) protection. The degraded voltage protection is typically considered a secondary protection. Please clarify the above sentence in the LAR, and provide a copy of revised page of the LAR.

RAI 1 Response:

The NRC staff is correct. Primary refers to loss of voltage, and secondary refers to degraded voltage.

The cited sentence in the LAR is clarified as follows:

> The team determined that the TS primary voltage and secondary time-delay setpoints would allow motors to be subjected to voltage below 75% for up to one minute, which is in excess of the capability claimed in the Final Safety Evaluation Report.

The revised LAR page is attached. Because the revision clarifies the background for the request, but does not change the request and is not credited in the justification of the change, the correction is administrative and does not impact the validity of the original Significant Hazards Consideration or the Environmental Consideration.

RAI 2:

On Page 2 of the LAR, the licensee stated:

> Upon actuation, the primary undervoltage protection logic automatically initiates separation of the emergency power system from the upstream balance-of-plant buses (i.e., the offsite source), load shedding and starting of the Emergency Diesel Generators (EDGs). When the EDGs attain adequate voltage and speed, the EDG supply breakers to the 6.9 kV Emergency Buses close and safety-related loads are connected to the buses automatically by the emergency load sequencer. Once EDG loading begins, the primary undervoltage protection scheme logic is blocked. The dropout setting of the primary undervoltage protection scheme is such that bus voltage does not drop below the setpoint during 'normal' transient conditions such as during motor starting.

Please clarify whether the LOV protection logic is unblocked after the EDG loading is completed. Provide a copy of the logic diagram of LOV and Degraded Voltage protection when a 6.9 kV emergency bus is fed from an offsite source and when fed from an EDG.

RAI 2 Response:

Both the primary (LOV) and secondary (degraded voltage) undervoltage protection schemes are "blocked" after re-energization of the emergency power system by the Emergency Diesel Generators following either a LOOP event or a LOOP with loss-of-coolant accident (LOCA) event. The LOV logic is blocked both during and after sequencing. The blocking circuit (provided by Sequencer Cabinet Relay UVX) is "sealed-in" until the operators restore offsite power to the emergency power system by re-closing the tie breakers to the balance-of-plant system, opening the EDG breaker, and resetting safety injection (if applicable).

Diesel Generator Logic Diagram 6-G-0039 (bottom of drawing) shows the logic for both the primary (LOV) and the secondary (degraded voltage) undervoltage protection schemes. The logic diagram shows that the trip function is only active if the Emergency Load Sequencer is not running either Program A (LOOP) or Program B (LOOP with loss-of-coolant accident).

Attached is 6-G-0039, Electrical Relay Logic Diagram – Diesel Generator Controls.

RAI 3:

On Page 3 of the LAR, the licensee stated:

> 75% of motor rated voltage is 4950 V. Therefore, based on motor voltage ratings, the UV [same as LOV] relay setpoint should be based on 4950 V at the motor terminals in consideration of protecting the motors against low voltage (below the motor voltage ratings). The existing settings are less than the motor voltage ratings and, therefore, do not assure adequate motor voltage under low system voltage conditions. The new proposed settings are based on 4950 V at the motor terminals. Voltage drop in the feeder cable from 6.9 kV bus to the motor is added to the motor terminal voltage of 4950 V; this is the new Analytical Limit for the UV relays.

RAI 3.a.

According to the FSAR [Final Safety Analysis Report], the motors are rated 75% voltage for one minute. Please confirm whether during running conditions, the motors can be considered to act as approximate constant load (constant kVA, kilovolt-amps).

RAI 3.a. Response:

Assuming that alternating current induction motors act as constant kVA circuit elements is standard practice in power system modeling and analysis and closely approximates how the motors and electrical distribution system react to varying loading and voltage conditions. The theory is that motor power factor, efficiency and speed do not vary significantly with changes in the applied terminal voltage. If the motor shaft speed does not vary, the driven load (fan, pump, etc.) speed will not vary and thus the brake horsepower requirements of the driven load will be constant. If brake horsepower does not change, motor output kilowatt requirements will not change. If efficiency does not change, then motor input kilowatt requirements will not change either. If power factor does not change, motor input kVA will not change. Therefore, the motor can be approximated as a constant kVA circuit element. Therefore, as motor terminal voltage decreases, line current must increase in order to keep motor input kVA approximately constant.

Thus, for determining motor current and motor feeder voltage drop at reduced terminal voltage, modeling the motor as a constant kVA device is appropriate.

RAI 3.b.

At lower voltage, the current increase will be in proportion to decrease in voltage. However, the motors will be able to handle lower voltages (up to the motor stalling voltage) for shorter durations (i.e., a few seconds) considering constant thermal capacity of motors for the short duration. The staff's concern is that raising the lower analytic voltage limit for the LOV relays could result in unnecessary separation from the grid. Please describe why this consideration was not accounted for while deriving the lower analytical voltage limit for the LOV relays.

RAI 3.b. Response:

In determining the appropriate setpoint for the undervoltage relays associated with the primary (LOV) undervoltage protection scheme, the selected setpoint was determined by careful consideration of the voltage requirements of the motors (the lower analytical limit) as well as conservatively calculated transient voltages which could occur during system events such as motor starting and fault clearing (the upper analytical limit).

For the lower analytical limit, the undervoltage relay setpoint was chosen to ensure the terminal voltage of the "worst case motor," considering the voltage drop throughout the emergency power system, would not result in terminal voltage being below 75% of rated (4950 V for motors fed from the 6.9 kV system and 345 V for motors fed from the 480 V system). Worst case electrical distribution system loading was included in the evaluation. This is determined in Calculation 0054-JRG, R4, Section 4.2, which was attached to the LAR.

For the upper analytical limit, it was considered that there will be an upper bound to how high you can set the undervoltage relays (to provide motor protection) without causing the potential for spurious tripping during voltage sags and transients. Refer to Calculation 0054-JRG, Section 4.2. Therefore, for the upper analytical limit, the undervoltage relay setpoint was chosen considering voltage "sags" during starting of the largest motors on the electrical distribution system with worst case distribution system loading and assuming the 230 kV switchyard is at the "analytical limit" (lowest allowed voltage during accident conditions with the main generator tripped). In addition, voltage transients which could occur during "fault clearing" events were evaluated. For conservatism, it was assumed that the postulated fault occurred during worst case distribution system loading conditions and worst case 230 kv Switchyard voltage conditions (switchyard at the analytical limit).

The interaction between the LOV and the Degraded Grid is further described in the response to question 5 and the upper limit as it pertains to electrical grid disturbances is further defined in the response to question 4.

RAI 4:

General Design Criterion 17 states that provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies. Generic Letter 2006-02 defines degraded grid reliability conditions as those conditions on the grid caused by load flow, operation of a transmission element or maintenance on a transmission element that could significantly increase the probability of a nuclear power plant trip or loss of adequate offsite power supply. Demonstrate the proposed LOV relay time setting is long enough to ride through short time system transients such as transmission system faults. Also, describe the maximum fault clearing time of the transmission lines connected to HNP and any impacts to the LOV relay timing.

RAI 4 Response:

FSAR Section 8.2.2.3, "Analysis of Operating Voltages," discusses the acceptability of expected HNP 230 kV switchyard voltage and frequency fluctuations which could occur under transient conditions caused by worst-case analyzed transmission system grid disturbances. This evaluation is based upon a postulated fault event in conjunction with the assumed failure of the primary protective relaying in the switchyard. In the analyzed case, the primary protective relaying, if available, would remove the faulted circuit in approximately 4 cycles. However, if the primary protective relaying is not functional, the secondary protective relaying would remove the faulted circuit from the HNP switchyard in approximately 10 cycles.

The existing TS allowed value for LOV scheme time delay is ≤ 1.5 seconds. The allowed value is not being changed. The existing TS setpoint for time delay is ≤ 1.0 seconds. The TS setpoint value is proposed to be increased from ≤ 1.0 seconds to ≤ 1.46 seconds. The actual field setpoint is then proposed to be increased from the existing ≤ 1.0 second setpoint to ≤ 1.2 seconds. This will increase the margin with respect to ensuring that spurious actuation will not occur during transmission system grid disturbances.

<u>RAI 5:</u>

The LOV relay at HNP is of an instantaneous type with a separate timer. Explain how the licensee covers the voltage gap between the voltage setting of LOV relay and degraded voltage relay setting.

<u>RAI 5 Response:</u>

The setpoints discussed below are nominal values for the purpose of explanation. The actual actuation time would vary depending upon the field settings, which is within the TS allowable tolerances.

The degraded grid voltage (secondary) relays are set at 6420 V (dropout). There are two time delay relays. The first is set at 12 seconds which will separate the emergency power system from the degraded offsite source if the 6.9 kV emergency bus voltage drops below 6420 V for a minimum of 12 seconds if there is a LOCA. The second time delay is set at 54 seconds which will separate the emergency power system in 54 seconds if there is no LOCA. The degraded grid voltage protection scheme is “definite time” (not inverse time) device. Therefore, if the voltage goes below 6420 V, the emergency power system will separate in 12 seconds if a LOCA is present or 54 seconds if a LOCA is not present no matter how low the voltage goes below the 6420 V setpoint.

The Loss of Voltage undervoltage relays (primary UV relays) are proposed to be set at 5526 V (dropout). There is only one time delay relay with a proposed setpoint of 1.2 seconds. These relays are also not inverse time devices and will separate at 1.2 seconds no matter how low the voltage goes.

Therefore (with offsite power supplying the emergency power system):

1. If the 6.9 kV emergency bus voltage is above the 6420 V dropout setting of the degraded grid voltage relay, all safety related equipment will be operating within the manufacturer’s specified voltage range (e.g. at or above 90% terminal voltage for motors).

2. If the 6.9 kV emergency bus voltage drops to between 5526 V (proposed primary UV relay setting) and 6420 V (secondary UV relay setting), the degraded grid voltage relay protection scheme will become activated. Motor terminal voltages will be at or above 75% of rated during this time. This condition will not persist for more than 1 minute which is within the

capability of the motors. If there is a LOCA present, the emergency power system will separate from the degraded offsite source in 12 seconds. The 12-second time delay will allow voltage recovery during safeguards sequencing to ensure that sequencer-started motors will not cause spurious actuation of the logic. Degraded grid voltage relay setpoint calculation E2-0005.09 provides an evaluation to demonstrate safety system response times will be met considering concurrent LOCA and degraded grid event with the 12-second delay. If there is no LOCA signal present, annunciation will occur at 12 seconds and if the condition persists, separation will occur at 54 seconds. The 54-second time delay will provide some amount of time for the condition to be resolved (either naturally or by operator action) and will ensure that running motors will not be damaged (since they are specified to be capable of running for a minimum of 60 seconds at 75% voltage without incurring damage).

3. If the 6.9 kV emergency bus voltage drops below the proposed 5526 V dropout setting of the LOV relay, separation of the emergency bus from the offsite source will occur in 1.2 seconds (proposed setting). The 1.2 second time delay ensures separation in as short a time as possible while ensuring that voltage transients (during fault clearing) will not cause spurious actuation. This setting also keeps the motors from dropping below 75% voltage for an extended period of time.

Therefore, with the combination of the degraded voltage relay and the LOV relays the plant has maintained adequate protection for all levels of voltage degradation to ensure plant equipment will not be damaged, while not separating from the preferred voltage source unnecessarily.

Attached:

Revised LAR page 2 of 5
Drawing 6-G-0039, Electrical Relay Logic Diagram – Diesel Generator Controls

UV protection). These UV relays monitor the voltage on these buses and separate them from offsite power if the bus voltage goes below the UV relay setpoint for a specific time delay. Each set of UV protection (i.e., DGVR and primary UV protection) gets input from three UV relays (i.e., three for DGVR and three for primary UV) with two-out-of-three trip logic.

The primary undervoltage protection scheme consists of Undervoltage Relays 27-1, 27-2 and 27-3 along with Time Delay Relay 2. Its function is to protect the emergency power system against loss of voltage utilizing a nominal setting (existing setting is 4830 V per TS Table 3.3-4) and time delay (the existing time delay is 1.0 second per TS Table 3.3-4). Upon actuation, the primary undervoltage protection logic automatically initiates separation of the emergency power system from the upstream balance-of-plant buses (i.e., the offsite source), load shedding and starting of the Emergency Diesel Generators (EDGs). When the EDGs attain adequate voltage and speed, the EDG supply breakers to the 6.9kV Emergency Buses close and safety-related loads are connected to the buses automatically by the emergency load sequencer. Once EDG loading begins, the primary undervoltage protection scheme logic is blocked. The dropout setting of the primary undervoltage protection scheme is such that bus voltage does not drop below the setpoint during “normal” transient conditions such as during motor starting. The 6.9 kV bus undervoltage protection is described in the HNP Final Safety Analysis Report (FSAR) Sections 8.3.1.1.2.8 and 8.3.1.1.2.11.

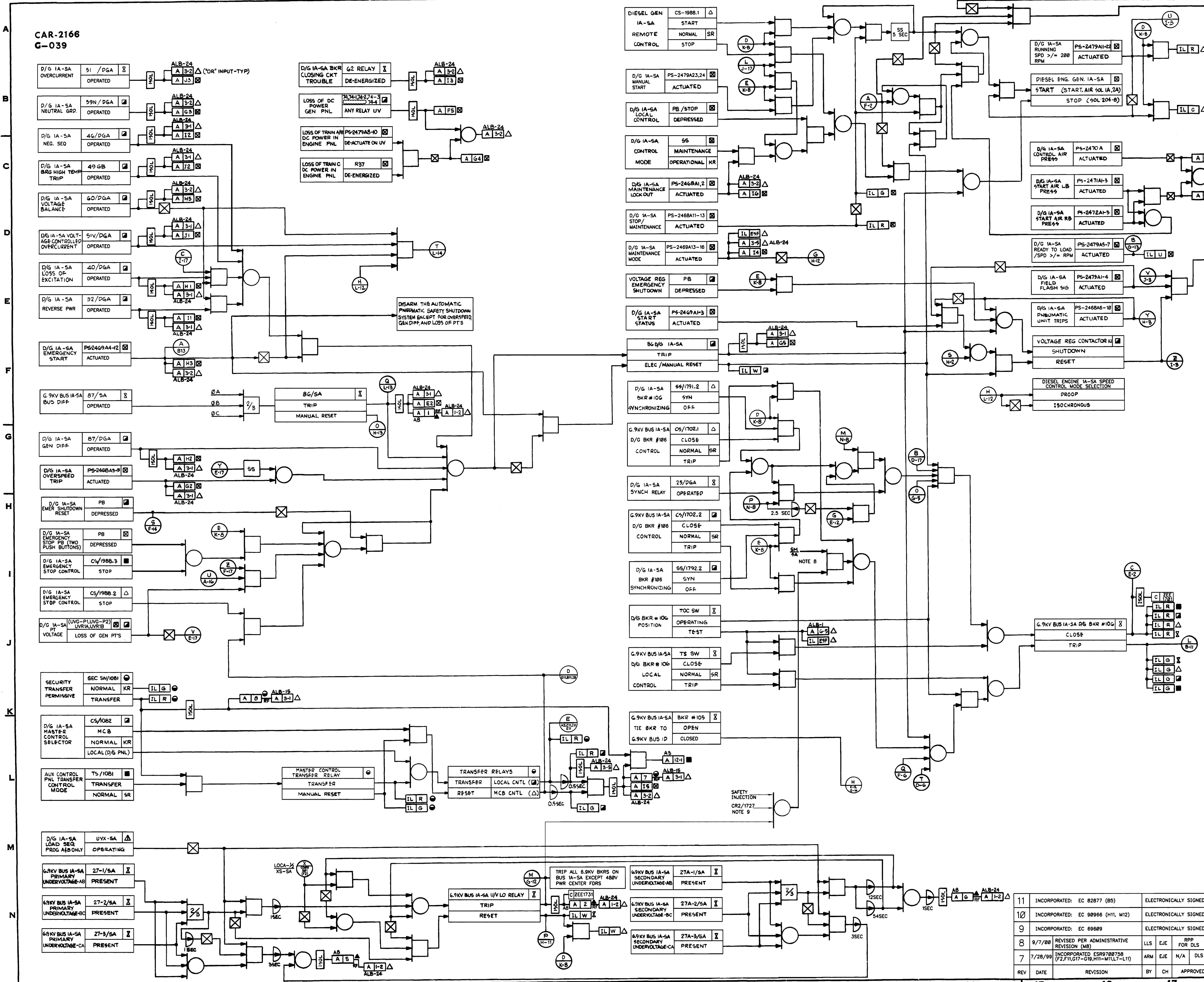
During a Component Design Basis Inspection performed from March 21, 2011, to April 21, 2011 (Reference a), the NRC inspection team identified a green non-cited violation. The team determined that the TS primary voltage and secondary time-delay setpoints would allow motors to be subjected to voltage below 75% for up to one minute, which is in excess of the capability claimed in the FSAR.

Branch Technical Position PSB-1 Position B.1 states that setpoints shall be determined from an analysis of the voltage requirements of the Class IE loads. HNP FSAR section 8.3.1.1.3 states that motors can operate at 75% voltage for one minute without damage. TS Table 3.3-4 establishes the setpoint for the secondary Loss-of-Offsite Power (degraded voltage) relay non-accident time delay and for the primary Loss-of-Offsite Power relay.

Duke Energy addressed the condition in the HNP Corrective Action Program and determined that the TS Table 3.3-4 Functional Unit 9.a (Loss-of-Offsite Power, 6.9 kV Emergency Bus Undervoltage – Primary) trip setpoint and allowable value minimum voltage limits, as well as the associated setpoint in the field, should be increased to ensure that the trip of the safety-related AC bus will occur at a voltage at or above the minimum voltage necessary to operate the applicable safety-related loads. The TS Table 3.3-4 Functional Unit 9.b degraded voltage relay setting will remain unchanged by this LAR.

The existing TS trip setpoint for the subject UV relays is 4830 V with an allowable value of 4692 V on safety buses 1A-SA and 1B-SB. This equates to a setting of 70% with an allowable value of 68% of bus nominal voltage rating (6900 V). On a motor rated-voltage base (which is 6600V), this equates to 73.2% for the setting and 71.1% for the allowable setting. Note that both of these values are less than the motor voltage ratings as explained below.

Safety-related (Class 1E) 6.9 kV motors are designed to start at 75% of motor rated voltage and have a transient running voltage rating of 75% at the motor terminals. Transient running voltage



LOCATION SYMBOLS

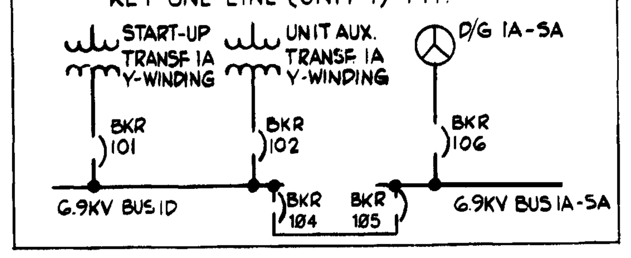
- ● MAIN GENERATOR RELAY PANEL NO. 1A
- ╪ MAIN GENERATOR RELAY PANEL NO. 1B
- ◩ DIESEL GENERATOR CONTROL PANEL NO.1A
- ⧗ 6900V SWITCHGEAR
- △ MAIN CONTROL PANEL
- ■ AUX CONTROL PANEL
- ⊖ TRANSFER RELAY PANEL
- ⊠ DIESEL ENGINE CONTROL PANEL NO.1A
- ▲ AUXILIARY EQUIPMENT PANEL AEP-2
- ◪ SOLID STATE PROTECTIVE CAB
- ⚠ EMER LOAD SEQ CAB 1A-SA

FIELD FLASH
SEE NOTE 7

NOTES:

1. THIS DRAWING IS TYPICAL FOR DIESEL GENERATORS 1A–SA & 1B–SB.
2. EMERGENCY DIESEL GENERATOR WILL START AUTOMATICALLY BY ACTION OF LOOP SIGNAL, SAFETY INJECTION SIGNAL, OR CLOSURE OF 52s/b CONTACT FOR BREAKER 1Ø5/125. 52s/b CONTACT ALSO PROVIDES SEAL–IN FOR DE–ACTIVATION OF SHUTDOWN LOGIC DURING EMER. OPERATION.
3. MANUAL PARALLELING OF NORMAL & EMERGENCY SOURCES OR VICE-VERSA IS PERMISSIBLE AND SOURCES MAY REMAIN PARALLELED FOR EXTENDED PERIODS. SYNCHRONIZING SWITCHES ARE PROVIDED TO ENSURE SYNCHRONIZING.
4. SYNCHRONIZING FACILITIES FOR EACH DIESEL GENERATOR WILL BE PROVIDED AT BOTH THE MAIN CONTROL PANEL AND THE DIESEL GENERATOR LOCAL PANEL.
5. UNLESS OTHERWISE NOTED, ALL ANNUNCIATORS ARE LOCATED IN THE DIESEL GENERATOR CONTROL PANEL.
6. SYMBOL "SR" STANDS FOR–SPRING RETURN, "KR"–KEY REMOVAL, "RF"–REFLASH, "SS"–SINGLE SHOT.
7. FIELD FLASH OCCURS AT 2ØØ RPM ON EMERGENCY START VERSUS 37Ø RPM ON A MANUAL START.
8. SM/SA RELAY IS ENERGIZED UPON DG BKR 1Ø6 CS "CLOSE" ACTUATION, PROVIDED BOTH BKRs 1Ø4 & 1Ø5 ARE CLOSED.
9. CR2/1727 RELAY IS ENERGIZED UPON BKRs 1Ø1 & 1Ø2 TRIP, OR BKR 1Ø1 TRIP AND EITHER ONE OF GEN LOCKOUT RELAYS TRIP.

KEY ONE LINE (UNIT 1) TYP.



REFERENCE DRAWINGS:	CAR-2166
MAIN & 6900 VOLT AUXILIARY ONE LINE WIRING DIAGRAM UNIT 1	G-029
CONTROL WIRING DIAGRAMS	B-401

NUCLEAR SAFETY RELATED

REV	DATE	REVISION	BY	CH	APPROVED	
11		INCORPORATED: EC 82877 (B5)	ELECTRONICALLY SIGNED			
1Ø		INCORPORATED: EC 9Ø966 (H11, M12)	ELECTRONICALLY SIGNED			
9		INCORPORATED: EC 696Ø9	ELECTRONICALLY SIGNED			
8	9/7/ØØ	REVISED PER ADMINISTRATIVE REVISION (M8)	LLS	EJE	RPP FOR DLS	
7	7/28/99	INCORPORATED ESR97ØØ758 (F2,F11,G17–G19,H11–M11,L7–L11)	ARM	EJE	N/A	DLS

CAROLINA POWER & LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT

ELECTRICAL RELAY LOGIC DIA.
DIESEL GENERATOR CONTROLS
UNIT 1

EBASCO SERVICES INCORPORATED

SCALE ~ | APPROVED | DATE 10-23-78
DIV. ELEC.
DR. O. GRANT
CH. R. WERONICK

CAR–2166
G–Ø39