Florida
Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302

September 10, 1993
3F0993-03

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: Emergency Diesel Generator Voltage Dips

References: 1. FPC to NRC letter, 3F0693-10, dated June 16, 1993

Dear Sir:

This letter summarizes the current situation regarding the voltage dips experienced during block loading testing on the emergency diesel generators at Crystal River 3 (CR-3). This letter supplements a previous submittal by Florida Power Corporation (FPC) (Reference 1) which included data from testing conducted in Spring 1993. Attachment 1 to this letter provides data from testing conducted in November 1991. This testing included voltage measurements at selected locations at 480 and 120 volts.

At a meeting on June 16, 1993, the NRC Staff expressed concerns about the significance of the voltage dips that occur during block loading of the emergency diesel generators. Attachment 2 to this letter provides the basis for FPC's conclusion that the dips are not significant from an equipment performance perspective.

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In addition, FPC currently plans to replace the "B" Engineered Safeguards 4160/480 volt transformer during the refueling outage in Spring 1994. Because of this replacement, FPC plans to take transient voltage data at selected 480 and 120 volt locations in addition to the 4160 volt generator output. The results of that testing should also be available for NRC review at the plant site by July 1, 1994.

Sincerely,

Gary Boldt for

P. M. Beard, Jr.
Senior Vice President
Nuclear Operations

PMB/AEF:ff

Attachments

xc: Regional Administrator, Region II
NRR Project Manager
Senior Resident Inspector

RESPONSE TO NRC CONCERNS CONCERNING EQUIPMENT PERFORMANCE DURING EMERGENCY DIESEL GENERATOR BLOCK LOADING

Introduction

This evaluation addresses safety related equipment performance during emergency diesel generator (EDG) voltage dips. The voltage dips occur during EDG block loading. There are 6 load blocks and it takes 30 seconds from the start of block 1 to the end of block 6 (the load blocks are 5 seconds each). The voltage dips occur at the start of each block and last approximately 1 second. During the remaining 4 seconds, the voltage exceeds 4160 volts but returns towards 4160 volts before the next load block is applied. At the conclusion of block loading, the EDG voltage returns to a steady state value of 4160 volts. The following discussion is limited to safety related equipment performance during the 30 second block loading period. There are no concerns after the 30 second period because voltage is maintained at a steady state value of 4160 volts.

Evaluation of motors

Ability to develop required torque

FPC has performed transient motor starting calculations to determine the ability of the motors to develop the required torque during block loading. These calculations were performed using the switchyard as the voltage source with the switchyard voltage set to a level representing degraded grid conditions. If, instead of switchyard, the EDG was used as a voltage source, then the 4160 volt bus voltage would dip to a lower level during the 1 second following the loading of each block than during the same period of time if fed from switchyard. However during the rest of the time before the next load block is applied (approximately 4 seconds), the voltage is above 4160 volts and considerably above the level that it would be during the same period when fed from switchyard with degraded grid conditions in switchyard. It is during this 4 second period of the block that it is expected that motors will accelerate quicker than they would if the switchyard were the voltage source. Therefore comparing the entire block (5 second interval) it can be said that any "sluggishness" in motor acceleration during the first second will be offset by quicker acceleration during the remaining 4 seconds. Therefore, on balance, motors will develop sufficient torque to accelerate their loads at least as quickly as the transient motor starting analysis showed they would with switchyard voltage in a degraded grid condition. The results of this analysis was acceptable and was reviewed by the NRC during the recently completed EDSFI.

Motor thermal limit evaluation

FPC has not considered it necessary to perform formal thermal analysis during degraded grid or diesel loading conditions. From the standpoint of thermal heating of motors during voltage dips, the worst case conditions apply to motors required to start in block 1. Subsequent to the block 1 dip, all block 1 motors will begin to accelerate and will be subjected to the block 2 dip either during acceleration or after reaching running speed. Because of the momentum gained by the motor and its driven equipment, it is

expected that the motors will not stall during the subsequent 1 second voltage dips. However the motors will draw more current during the voltage dips. Therefore, during the dip, a given motor will heat up more than it would have had there been no voltage dip. During the post dip 4 second period, when the voltage is above nominal, the motor will draw less current than nominal, and therefore will heat up less than it would have while drawing nominal current. Also during these 4 seconds the motor will be able to dissipate some of the excess heat generated during the 1 second voltage dip. During each block, the overall additional thermal heating of the motor is not expected to be significant. Over the entire block loading interval it is expected that the thermal limits of the motors will not be exceeded.

Evaluation of Control Devices

Control devices include contactors and other control circuit devices such as relays, solenoid valves, etc.

Ability of Control Devices to Pick-up

During the voltage dip of the first block, which lasts approximately 1 second, there may not be sufficient voltage at the terminals of the control devices to pick-up. However after the 1 second voltage dip, the voltage rises above nominal. During this 4 second interval, the control devices will pick-up. The pick-up delay is described in FSAR Section 8.2.3.1, on page 8-24, and 2 seconds is conservatively assumed.

Ability of Control Devices to Continue Holding In

After having picked up during block 1, there is insufficient formal information available at this time to demonstrate that the control devices will, or won't continue to hold in during the voltage dips of blocks 2 through 6. Such an analysis is a two step evaluation. First, the block 2 portion of the transient motor starting calculation will be run at a switchyard voltage corresponding to the lowest voltage level on the 4160 volt bus that occurs during the EDG block 2 voltage dip. Second, the engineered safeguards (ES) motor control centers (MCC's) voltage level reached at this lowest point will be used to rerun the drop-out portion of the AC control circuits calculation. Any resulting problems with control circuit devices will then be addressed on a case by case basis.

Evaluation of Protective Devices

Motor Overload devices

There are thermally operated overload relays for motors fed from 480 volt MCC's, electromagnetically operated or solid state overload trip devices for motors fed from 480 volt switchgear, and electromagnetically operated overcurrent relays for motors fed from 4160 volt switchgear. These devices are set to allow time for motors to accelerate. The motor acceleration time is greater than the 1 second voltage dip. Therefore, the increased current during EDG voltage dips will not cause these overload devices to trip.

Control Circuit Fuses

Control circuit fuses have been analyzed to show that they can withstand the inrush current of control circuit devices for 5 seconds. Therefore the increased control circuit current during EDG voltage dips will not cause blown control circuit fuses.

Actuation of Second Level Undervoltage Relays (SLUR's)

The SLUR's are by-passed when ES busses are connected to EDG, therefore actuation of SLUR relays during EDG voltage dips will not occur.