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Southern Nuclear Operating Company
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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Joseph M. Farley Nuclear Plant
Request for Additional Information Regarding
Southern Nuclear Operating Company Responses To
The FNP Electrical Distribution System Functional Inspection
Degraded Grid Voltage Unresolved Item

Ladies and Gentlemen:

By letter dated April 20, 1995, the NRC requested additional information regarding Southern Nuclear Operating Company responses to issues related to the Farley Nuclear Plant (FNP) Electrical Distribution System Functional Inspection (EDSFI) Degraded Grid Voltage Unresolved Item. During a conference call involving NRC personnel and SNC staff, additional clarification was provided regarding the NRC Request for Additional Information (RAI). Attached is the information that SNC agreed to provide for each RAI topic.

If further clarification is necessary, please advise.

Respectfully submitted,

Dave Morey

RAH/maf:edsfirai.doc

Attachment

cc: Mr. B. L. Siegel
Mr. S. D. Ebneter
Mr. T. M. Ross

A001

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION FOR EDSFI DEGRADED GRID VOLTAGE UNRESOLVED ITEM

1. **Provide the results of the investigation performed to determine the feasibility of raising the degraded grid voltage setpoint.**

   Response:

   (Refer to Attachment 1) The current minimum switchyard voltage required to ensure that adequate voltage will be supplied to all components needed during a LOCA is 98.3% of 230kV. Raising the 4160 volt relay lower tolerance to protect at the present minimum required voltage (MRV) would provide less margin for operational and dynamic voltage excursions such as motor starts or system transients. In consideration of relay accuracy, this would currently place the relay upper tolerance at approximately 101.9% of switchyard voltage which would result in a voltage higher than the minimum expected switchyard voltage. This would be undesirable since this would increase the probability of separating from the preferred power source and tripping the Units when it would be safer to remain on the preferred power source and on line.

2. **Identify defined range (lower and upper limit) for switchyard voltage and measures to insure that switchyard voltages are maintained within this defined range.**

   Response:

   The existing range for switchyard voltage is 101.6% to 104.2% of 230kV per agreement with system operations and planning. The Power Quality Guideline (PQG), a document that delineates the guidelines for system planning and operational activities that affect Farley Nuclear Plant, allows for voltages down to 99.8% for temporary abnormal system conditions. This still provides a 1.5% margin above the present MRV at the 230kV voltage level.

   System operations ensures that this range is maintained by continuous monitoring and evaluating the next single contingency every 30 minutes. An alarm is given for any contingency that results in FNP 230kV bus voltage less than 101.6%. System operators are required by the PQG to notify the plant when an alarm is received.

   System operators can bring on additional generation, reduce load, or cut off system sales if required to improve voltage. In addition, voltage can be raised via Farley generators if either unit is on line.

   The criteria in the PQG is utilized by system planning in yearly operational and planning studies to ensure that switchyard voltages are maintained within this defined range.

3. **Provide control room degraded grid alarm relay setpoint and operator actions required as a result of this alarm.**

Response:

The control room degraded grid alarm relay setpoint is 3950 volts (tolerance +/- 0.5% or 3929 to 3979 volts).

Upon receipt of the 4160 volt bus undervoltage alarm, the control room operator will refer to the abnormal operating procedure (FNP-1/2-AOP-5.2 - DEGRADED GRID) for actions to be taken.

The AOP instructs the operator to:

1) Check the voltage to determine if a low voltage condition exists;
2) Restore any out of service major plant components to service as soon as possible;
3) Verify EDGs are aligned for auto start;
4) Consult with Operations Manager;
5) Direct switchboard operator to begin efforts to correct degraded grid conditions
6) Monitor voltage and, if voltage is less than 3950 volts for greater than 1 hour, then place the Unit in Hot Standby within 6 hours and in Cold Shutdown within the following 30 hours.

4. **Explicitly identify the potential range of degraded voltage where automatic protection is not provided for postulated events. Address the effect of bus loading on the bus voltage for both LOCA and shutdown events and how degraded voltage and alarm setpoints accommodate these effects.**

Response:

(Refer to Attachment 1) The deadband for which automatic protection may not exist for voltages below the current minimum expected switchyard range is currently 88.3% to 90.7% of 4160 volts (3675 to 3775 volts). This deadband (enveloping both trains of both units) represents the range of 4160V safety bus voltages from the degraded grid relay setpoint (3675 volts) to the present MRV (3775 volts). The MRV is the currently calculated voltage at which the required safety loads have been evaluated to start and run, in response to an automatic SI actuation. The maximum loading and minimum voltages for safety-related buses occur in response to an automatic SI actuation. The addition of the SI actuated loads to the normal bus loading results in approximately 1% lower 4160V bus voltage, for a given 230kV switchyard voltage.

Protection is afforded by system and plant alarms and the resulting operator actions. The system grid alarm is currently set at 101.6% of 230kV. This alarm monitors both the actual voltage level and the calculated voltage level which would result in the event of the next single contingency (unit trip). In addition, in-plant alarms on the 4160V safety buses are currently set at 95% of 4160 volts (3950 expected minimum range, which provides margin above the MRV of 90.7%. The degraded grid relay protection is set at 88.3% of 4160 volts (3675 volts).

5. **Provide information on the reliability of the grid system connecting to the Farley station, specifically:**

   - **the monitoring and contingency analysis system; and**
   - **the worst-case postulated failure for a given system configuration and resulting minimum required voltage.**

   Response:

   Plant Farley is part of the Southern electric grid system which is a member of the Southeastern Electric Reliability Council. The Southern Electric System employs state-of-the-art monitoring and contingency analysis systems for the electric power grid on a real time basis. System Operators ensure adequate voltage is provided and the contingency analysis feature allows system operations to predict adverse effects from postulated grid system failures. Planning and operational studies show that the worst case postulated failure (one FNP unit tripped, the other in a LOCA) can occur without allowing the FNP 230kV bus voltage to fall below 101.6% of 230kV, which is well above the minimum required voltage (MRV) for the Class 1E equipment.

6. **Provide contingency measures if switchyard voltage decreases below currently defined minimum level; specifically:**

   - **measures and actions to be performed, including those by grid system and Farley control room operators;**
   - **expected voltage changes resulting from performing these specific measures and actions;**
   - **if contingency measures and actions fail to improve switchyard voltage, provide specific instructions/actions to be performed by the system grid and Farley control room operators (instructions/actions such as restoring inoperable EDG, limiting maintenance or surveillance activities on equipment, closely monitoring voltage values on 4160 volt safety-related buses, etc.); and**
   - **identify any limiting conditions of operation.**

   Response:

   The actions to be taken by system and control room operators are outlined in the response to questions 2 and 3.

   The expected voltage changes resulting from these actions will vary depending on the specific system configurations. The PQG allows the system operators to take the best specific action based on system and plant conditions on a real time basis.

   Contingency measures are contained in FNP-1/2-AOP-5.2 (see parts 1 through 5 of the response to question 3).

   The non-Technical Specification "limiting conditions for operation" are stated in FNP-1/2-AOP-5.2 (see part 6 of the response to question 3).

7. **Identify any provisions incorporated into abnormal operating procedures that contain actions/measures to be taken for degraded voltage conditions and any associated operator training.**

Response:

AOP-5.2 was established for both units to ensure that there was a contingency procedure in the event of a degraded grid condition. For additional information included in this AOP, refer to the response to question 3. Training on this procedure is conducted every two years in conjunction with the FNP License Simulator Retraining Program.

8. **Provide any PRA-type information related to :**
   - **frequency estimates for the offsite voltage at Farley being below the lower switchyard minimum value including the primary source of the information. In addition, provide similar information for LOCA events; and**
   - **the likelihood of simultaneous events of degraded grid voltage and LOCA.**

Response:

The following is a summary of the best available information for the major factors that contribute to this probability.

FOR FREQUENCY OF VOLTAGE LESS THAN SWITCHYARD MINIMUM VALUE

The minimum switchyard voltage level at FNP is postulated to occur as a result of summer peak conditions (greater than 80% system load) concurrent with the outage of both units at FNP. This forms our basis for proving our capability to endure a LOCA on one unit, with the other unit tripped.

The basis for the system loading impact is:

System load greater than 79% = 0.0838 / event (averaged over last 5 years)

Note that this is the probability of our worst case EXPECTED conditions. The system is controlled on a real-time basis and typically operates under much better conditions. For the system voltage to dip appreciably lower, other system events would most likely be involved. For example, the forced outage rates for transmission lines and auto-transformers are expected to be less than 1E-5. This is based on the corresponding probabilities for the Georgia Power system as were used in similar evaluations for Plant Hatch.

Using data for FNP :

Frequency of forced outage: Unit 1 = .0069 / event (averaged over last 5 years)
Unit 2 = .0247 / event (averaged over last 5 years)

From the Farley Nuclear Plant Units 1 and 2 Individual Plant Examination Report in response to Generic Letter 88-20, the following initiating event frequencies are applicable to FNP:

FOR LOCA

EVENT	**FREQUENCY (per year)**
Large LOCA	3.0E-04
Medium LOCA	7.7E-04
Small LOCA	4.7E-03
Interfacing Systems LOCA	5.4E-06
Reactor Vessel Rupture	1.0E-07
Steam Generator Tube Rupture	1.0E-02
Total	1.58E-02

The likelihood of simultaneous events of degraded grid voltage and LOCA:

Unit 1 : (1.58E-2 / yr) (2.47E-2) (8.38E-2) = 3.27E-5 / yr
Unit 2 : (1.58E-2 / yr) (6.9E-3) (8.38E-2) = 9.14E-6 / yr
4.18E-5 / yr

9. **Provide evaluations for other potential events (evaluations should address equipment not subjected to degraded voltage conditions):**
   - **sustained degraded grid conditions (no LOCA or plant trip);**
   - **dynamic voltage excursion (no LOCA or plant trip); and**
   - **sustained degraded grid condition or dynamic voltage excursion with both Farley units tripping (with or without a LOCA).**

Response:

As stated in the response to Item 4, the maximum loading and minimum voltages for safety-related buses occur in response to an automatic SI actuation. Current analyses are primarily focused on the evaluation of those loads which are required to mitigate this event. Bus voltage levels for non-LOCA events are higher, thus the voltage levels at required loads are enveloped by the LOCA evaluation. Attachment 2 provides a list of loads (based on a typical train of equipment) which are normally running, that are also needed for LOCA events.

Sustained degraded grid conditions (no LOCA or plant trip):

To further emphasize the impact of the previous responses, the switchyard voltage level is maintained within the acceptable limits with either of the units on-line to provide voltage support. Although the potential for a sustained degraded grid is very unlikely under these conditions, either the system or plant voltage alarms would provide indication of degraded voltage levels in this event. System grid operators would take action to restore the system voltage and plant operators would implement the actions described in the abnormal operating procedure.

Due to the low likelihood of this event and the actions which would be taken, the consequences of raising the degraded grid relay setpoint could result in an unnecessary plant trip. A unit trip under such postulated system conditions could only worsen the system's ability to correct the voltage problem.

Normally running plant loads which are also required to mitigate a LOCA (refer to Attachment 2) will not experience voltages less than those previously evaluated for a LOCA event. Due to the time constraints of the abnormal operating procedure, these loads will be only temporarily exposed to lower than normal voltages, but would continue to run without damage at a 4160 volt bus voltage corresponding to the degraded grid relay setpoint.

Dynamic voltage excursion (no LOCA or plant trip):

Although the potential for dynamic excursions may exist, the automatic and manual actions which can be taken by the system operators would limit the duration of the resulting voltage level degradation (on the order of minutes). As previously stated, if the automatic system controls did not immediately restore the system voltage, the system or plant voltage alarms would provide indication of the degraded voltage level. This would result in the same operator actions described above.

Normally running plant loads which are also required to mitigate a LOCA would experience temporary voltage fluctuations. The current analyses do not specifically consider the effects of transient conditions; however, it is our judgment that these loads would not incur significant damage for such momentary voltage dips. It should be noted that because both the degraded grid and undervoltage relays have inverse-time characteristics, the relays will actuate faster at lower voltages, thus limiting the amount of time that connected loads would be subjected to voltages below the relay setpoint, and providing increased protection at lower voltages.

Sustained degraded grid condition or dynamic voltage excursion with both Farley units tripping (with or without a LOCA):

The minimum expected voltage (MEV) is based upon one unit in a LOCA and the other unit tripped, thus the resulting 4160 volt bus voltage is not expected to fall below the MRV. In the event that it does fall below the MRV, the same automatic and manual actions described above would apply. For non-LOCA events the impact to the required loads would be the same as described above.

For LOCA events, the likelihood of this potential scenario has been shown to be low as provided in the response to item 8. If such an event were to occur, the plant operators would be provided with indication of both the degraded voltage and the LOCA event. At voltage levels below the MRV but above the degraded grid relay setpoint, some LOCA loads may not receive adequate voltage to start and/or run continuously. In the assessment of the plant conditions required by the emergency operating procedures, operators will have status indication of loads which have failed to perform their intended function. Plant operators would take action to restore and/or bypass those functions.

Additional Conditions

1. **A commitment to include the degraded grid voltage alarm relays in the plant Technical Specifications along with the degraded voltage relays which initiate automatic actions.**

   Response:

   SNC plans to include the degraded grid alarm relays (LCO and surveillance) in the Improved Technical Specifications package. If SNC decides not to implement the improved Technical Specifications, we will submit the Technical Specification amendment within 6 months of that decision which will be made no later than July, 1995. The degraded voltage relays which initiate automatic actions are currently in Technical Specifications. Prior to including the alarm in Technical Specifications, SNC plans to review the current alarm setpoint to optimize the protection and operational margins. This review is intended to preclude unnecessary operator impact and unit shutdown for voltage levels at or near the minimum expected system voltage level.

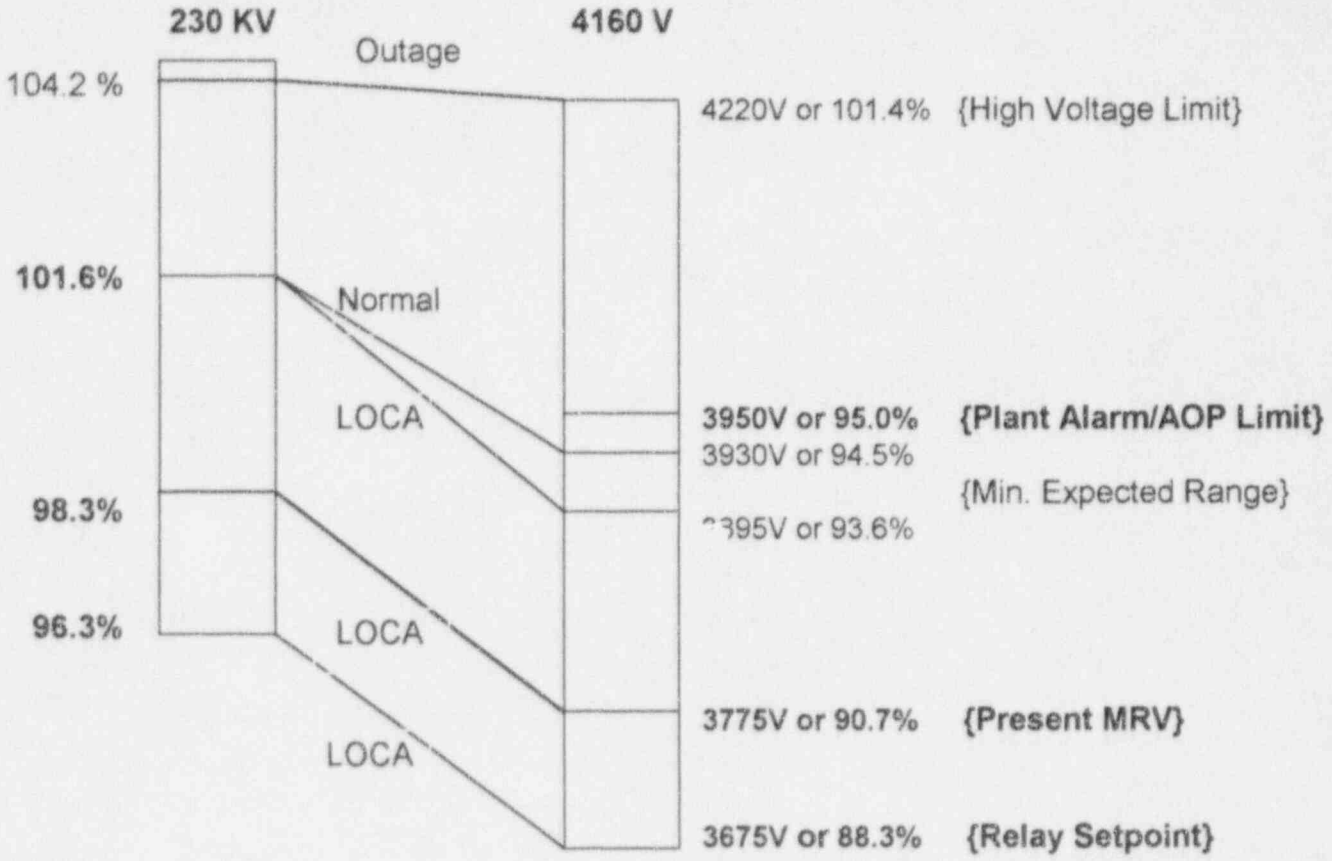
2. **A commitment to document the offsite system operating voltage levels and their significance with respect to the Farley approach to meet the degraded grid voltage requirements in the FSAR so the impact of possible future changes can receive appropriate consideration.**

   Response:

   SNC will document the offsite system operating voltage range and its purpose in the FSAR update to be performed in Spring 1996.

ATTACHMENT 1

Degraded Grid Alarm and Trip Diagram



ATTACHMENT 2

LOADS WHICH RUN DURING NORMAL PLANT OPERATION THAT ARE ALSC NEEDED DURING A LOCA

4160V LOADS
COMPONENT COOLING WATER PUMP
CHARGING-HHSI PUMP
SERVICE WATER PUMP

600V LOAD CENTER LOADS
BATTERY CHARGER
CONTAINMENT COOLER
INSTRUMENT AIR COMPRESSOR

600V MCC LOADS
CHARGING PUMP ROOM COOLER
CCW PUMP ROOM COOLER
SWITCHGEAR ROOM COOLER
BATTERY CHARGER RM COOLER
MCC ROOM COOLER
SERVICE WATER PUMP ROOM FAN
SERVICE WATER STRAINER MOTOR
SERVICE WATER PUMP COOLER STRAINER
CONTROL ROOM A/C BLOWER
CONTROL ROOM A/C CONDENSER
CONTROL ROOM FILTER EXHAUST FAN
BATTERY ROOM EXHAUST FAN
REGULATED AC TRANSFORMER SOURCE
VITAL AC ALTERNATE SOURCE (CVT)
TDAFW UPS