UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE ADEQUACY OF STATION ELECTRICAL DISTRIBUTION SYSTEM VOLTAGES

CAROLINA POWER & LIGHT COMPANY

BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2

DOCKET NOS. 50-325 AND 50-324

INTRODUCTION AND SUMMARY

Carolina Power & Light Company (CP&L) was requested by NRC letter dated August 8, 1979 to review the electric power system at Brunswick Steam Electric Plant, Units 1 and 2. The review was to consist of:

(a) Determining analytically the capacity and capability of the offsite power system and the onsite distribution system to start automatically and to operate all required loads within their required voltage rating in the event of (1) an anticipated transient, or (2) an accident (such as LOCA) without manual shedding of any electric loads.

(b) Determining if there are any events or conditions which could result in the simultaneous or consequential loss of both required circuits from the offsite network to the onsite electric distribution system thus violating the requirements of GDC 17.

The August 8, 1979 letter included staff guidelines for performing the required voltage analysis. The licensee was further required to perform a test in order to verify the validity of the analytical results. CP&L's responses consisted of a voltage analysis dated October 8, 1979 and letters dated July 24, 1980; October 15, 1980; February 16, 1981; April 9, 1981; February 6, 1984; August 30, 1984; and January 18, 1985. A detailed review and technical evaluation of the submittals were performed by EG&G under contract to the NRC and with general supervision by the NRC staff. This work is reported by EG&G in the attached Technical Evaluation Report (EGG-EA-6773) dated May, 1985 and entitled: "Adequacy of Station Electric Distribution System Voltages,

Brunswick Nuclear Power Station Units 1 and 2." We have reviewed this report and concur in the conclusions that the onsite distribution system in conjunction with the offsite power source are capable of providing acceptable voltages to the Class 1E equipment under worst case station electric loads and expected grid voltage limits.

EVALUATION CRITERIA

The criteria used by EG&G in this technical evaluation of the analysis includes GDC 5 ("Sharing of Structures, Systems, and Components"), GDC 13 ("Instrumentation and Control"), GDC 17 ("Electric Power Systems") of Appendix A to 10 CFR 50; IEEE Standard 308-1974 ("Class 1E Power Systems for Nuclear Power Generating Stations"), ANSI C84.1-1977 ("Voltage Ratings for Electric Power Systems and Equipment - 60 Hz"); and the staff positions and guidelines in NRC letter to CP&L dated August 8, 1979.

ANALYSIS AND TEST FEATURES

There are at least six tie-breakers at the Brunswick Station, which somewhat complicated the voltage analysis. The status of these ties are as follows:

(1) The tie between non-1E buses 1B and 2B can only be closed if one source set of links and one feeder breaker are opened. This tie can only be utilized if one unit is shut down.

(2) The tie between non-1E buses "Common A" and "Common B" can be closed only if a source breaker is opened. This tie can be utilized during full power operation of both units; therefore, its effect on station voltage levels has been analyzed.

(3) The two inter-unit 4 kV 1E ties each utilize two normally-opened breakers. An accident signal will cause these ties to open if they are closed.

(4) The intra-unit 4 kV 1E ties have been disconnected and their breakers racked out.

(5) The intra-unit 480 volt 1E tie is normally open at both ends.

CP&L has analyzed each offsite source to the onsite distribution system under extremes of load and offsite voltage conditions to determine the terminal voltages to 1E equipment. The worst case Class 1E equipment terminal voltages occur under the following conditions:

1. The maximum voltages occur when the 230 kV grid is at its maximum value, Unit 1 is shut down, and SAT-2 is supplying the minimum plant auxiliary loads.

2. The minimum steady-state voltages will occur during a simultaneous occurrence of (1) minimum 230 kV grid voltage, (2) LOCA in Unit 2, (3) shutdown of Unit 1, (4) SAT-2 supplying all Unit 2 loads and (5) SAT-2 supplying the Unit 1 non-1E loads form the Common A bus via the intertie.

3. The minimum transient voltage occurs under the conditions of Paragraph 2 above when all RHR and Core Spray System pumps in Unit 2 start due to a LOCA and Unit 1 is beginning a shutdown routine.

The computer analysis used by CP&L was verified by taking actual voltage measurements and comparing these measurements with the corresponding calculated values. For the 4 kV buses, the error was not greater than 1.99% which is within the accuracy of the measuring instruments. For the 480V buses, the maximum steady state error was 2.27%, the maximum error for the transient motor starting condition was 3.68%. Thus, the staff finds that the test has demonstrated the analytical values, outlined in the study, were within acceptable limits of actual measured values.

DESIGN CHANGES

As a result of the voltage analysis, a transformer tap change from -2.5% to -5% has been recommended on unit substation Common C to maintain adequate voltage on the non-safety system. CP&L has also proposed certain modifications to improve the voltage at certain non-Class 1E equipment during worst-case steady-state voltage conditions. The staff concurs with the proposed modifications and finds them acceptable.

CONCLUSIONS

We have reviewed the EG&G Technical Evaluation Report and concur in their findings that:

1. Voltages within the operating limits of the Class 1E equipment are supplied for all projected combinations of plant load and normal offsite power grid conditions, including an accident in one unit and a safe shutdown of the other unit.

2. CP&L's test has verified the accuracy of their analysis.

3. CP&L has demonstrated that there is no potential for either a simultaneous or a consequential loss of both offsite power sources.

4. Loss of offsite power to the Class 1E buses due to spurious operation of voltage protection relays will not occur within its expected voltage range.