November 2, 1995

Mr. J. W. Hampton
Vice President, Oconee Site
Duke Power Company
P. O. Box 1439
Seneca, South Carolina 29679

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION RELATING TO OCONEE ELECTRICAL SYSTEM ISSUES (TAC NO. M93550)

Dear Mr. Hampton:

As a result of NRC staff review of modifications intended to correct single failure vulnerabilities in the Keowee emergency electrical system, additional concerns were identified related to testing of the electrical system and the effect of certain failures on Oconee safety loads. Additional information is required for us to complete our review of these issues. The staff's questions are identified in the enclosure to this letter. Your response to these questions is requested by November 17, 1995.

This requirement affects nine or fewer respondents and, therefore, it is not subject to the Office of Management and Budget review under P.L. 96-511.

If you have questions regarding this matter, contact me at (301) 415-1495.

Sincerely,
Original signed by:
L. A. Wiens, Senior Project Manager
Project Directorate II-2
Division of Reactor Projects-I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270
and 50-287

Enclosure: As stated

cc w/encl: See next page

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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Enclosure: As stated

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REQUEST FOR ADDITIONAL INFORMATION ON THE OCONEE EMERGENCY ELECTRICAL SYSTEM

1. Describe the periodic and one-time tests that have been or are being performed to demonstrate the ability of the emergency power sources (Keowee Hydro Units and Lee Gas Turbines) and associated controls and switching logic to perform their required design-basis actions. Describe the design-basis performance each test is meant to demonstrate and the degree to which it demonstrates that performance. Provide the basis for the acceptance criteria used in the test. If analytical work was done to further support the ability of the power sources to perform as intended (e.g., to verify design-basis accident loading capability where actual design-basis loading has not been performed), describe the analysis performed and how it supplemented the test results. Describe what tests or data was used to verify the accuracy of the analytical work and provide the degree of correlation between the analysis and verification tests/data.

2. a. In a document prepared by Duke Power for the Oconee resident inspectors, a comparison is made between typical plant diesel tests and the Keowee tests. It is indicated that the Keowee emergency start test and emergency power switching logic test (#1 and #2 in the document) is similar to the engineered safeguards test (#1 in the document) performed on diesel generators. The diesel tests typically required in technical specifications are intended to test the entire range of required diesel generator and switching logic performance, including LOOP, LOOP/LOCA, load reject, load capability, standby start and run, test mode override, hot start, automatic trip bypass, and transfer back to offsite power. The integrated LOOP and LOOP/LOCA load sequencing tests typically require that simulated or actual loss of offsite power and emergency safeguards actuation signals be applied and that all subsequent required automatic operations be demonstrated to occur as they normally would, up to and including loading of required loads to the diesel generators (utilizing final actuated equipment in its required operating mode where practicable). Identify the Keowee, Lee Gas Turbine, and related engineered safeguards tests that are performed periodically to demonstrate the full range of required capabilities comparable to diesel generator tests. For the Oconee emergency power sources these tests would include, but not necessarily be limited to: LOOP and LOOP/LOCA from standby and generating to the grid, swapover between overhead and underground paths given a failure of one or the other during an event, standby start and run, load capability, load reject, automatic trip bypass, and transfer back to offsite power. Are the LOOP and LOOP/LOCA tests done in an integrated fashion comparable to diesel tests?

Enclosure

b. In the document prepared for the Oconee resident inspectors, it is indicated that prior to 1987 an emergency power switching logic test was periodically performed that loaded a Keowee Unit (at 11 seconds) while it was still accelerating. At present that test is performed by loading the Keowee Unit after it has fully accelerated. Describe why the test was changed. It appears that both tests should be performed since the Keowee Units are required to perform in either manner depending on the event scenario. This would be consistent, for example, with the diesel generator load sequencing tests that are typically required to be performed periodically to demonstrate, to the extent practicable, the ability of machines to perform in a manner in which they would actually be called upon. Please comment.

3. We understand that an instrumented test similar to the pre-1987 test addressed above is intended to be performed during the next refueling outage. Please provide details of the intended test such as how the test will be performed, what electrical loads will be picked up, what will be the total megawatt and mva value of the loads energized, and what instrumented values will be recorded.

4. With regard to the above test, calculation number KC-Unit 1 & 2-2023 indicates on page 22 that the Keowee voltage regulator might be brought online very close to, or in excess of (9 seconds + 2.5 seconds = 11.5 seconds) the 11-second LOCA load application point of a Keowee standby unit. Will the intended test monitor the point at which the regulator is brought online during acceleration of the Keowee Unit? Because of the tight timing tolerances involved we believe this point should be monitored.

5. An emergency start test from standby was performed on Keowee Unit 2 on May 22, 1993. The instrument chart from that test indicates that at 11 seconds (the point at which LOCA loads would be loaded onto the unit if it were connected to the underground path) the voltage output on the unit was at 8.181 Kv and the unit rpm was 84. This gives a per-unit voltage of 0.593 and a per-unit frequency of 0.653, which results in a volts/hertz ratio of 0.908. Based on this, it appears that the Keowee Unit 2 voltage is running up at a slower rate than the frequency (at least during the first 11 seconds of the start) and the volts/hertz limiter in the regulator is not needed during this period (in fact, it may not even be online at this time, see above question). The reduced voltage relative to frequency may also affect the starting capability of equipment energized at 11 seconds. This appears to support the need for further testing to establish the Keowee voltage and frequency response to design basis accident loading at 11 seconds from standby, and the capability of equipment to start under those conditions. Also, in Duke's analysis of the onsite power system to demonstrate the capability to start and accelerate emergency loads, was this apparent low-voltage starting condition considered? If so, please describe how it was considered.

6. In response to EDSFI finding 5-a, a Duke Power Company letter dated July 6, 1993, states that calculation OSC-4995 documents that no credible single failure exists that would render the Keowee voltage regulators inoperable. Please provide this calculation. The Duke letter also states that the volts/hertz limiting feature of the regulator, which the EDSFI team questioned, is also included in the analysis. The concern with the Keowee voltage regulators is that they could fail in a manner that would result in out-of-tolerance voltages being applied to redundant Oconee electrical loads, potentially damaging or disabling the equipment. With regard to the volts/hertz limiter, Table C.1-1 in the Keowee PRA identifies an event on May 4, 1993, that resulted in "VARs going in the hole" while Keowee Unit 1 was generating to the grid. It indicated that the unit did not respond to the voltage adjust or the base adjust controls, and the problem was found to be in the volts/hertz limiter card. The result of the failure of the volts/hertz limiter card (VARS going in the hole) indicates that field excitation of the Keowee generator was reduced, which would have resulted in a voltage reduction on the output of the Keowee generator had it been supplying Oconee in the emergency mode. Please comment on this event relative to the analyzed single-failure potential of the volts/hertz limiter to create such a problem.

7. With regard to the single-failure potential of the Keowee voltage regulators, have internal power supply failures of the voltage regulators been analyzed? Such failures might include open-circuiting of rectifier bridge diodes or SCRs, and shorting or open-circuiting of coupling or filtering capacitors. Have failures of diodes or SCRs in other regulator circuits, such as in the field three phase bridge rectifier, been analyzed? Have failures of capacitors in other regulator circuits been analyzed? The effects of failures in power supply circuits, in particular, are often very difficult to predict because of the widespread affect on all circuits. Have the effects of high resistance in the control pots of the base adjust and voltage adjust portions of the voltage regulators been analyzed? We know that statements have been made that if the voltage adjust portion of the regulators fail, the base adjust portion will maintain voltage at an adequate value; but if the voltage adjust pots develop high resistance as the result of oxidation, corrosion, or contamination, what will the affect on the voltage be?

8. Calculation number KC-UNIT 1-2-0098 provides a single failure analysis that was performed on the Keowee Units 1 & 2 speed control governors. It states that governor linkages, cables, and gearing are inherently rugged and simple in operation; and there are no creditable failures of these items. Table C.1-1 in the Keowee PRA, however, identifies a problem on July 5, 1985, in the Keowee Unit 1 governor that was determined to be due to the linkage on the 33XY switch binding. The result was that the unit failed to reach rated speed when started for an

operability verification test. Although this would have had no affect on an emergency start since it is indicated that the circuitry is bypassed during an emergency start, it seems to refute the conclusion in the single failure analysis. Also, in report no. AO-269/75-4 dated May 14, 1975, an event is reported that resulted in Keowee Unit 2 no-load speed oscillations between 90 and 140 rpm. We were told that the reason for the speed oscillations was a failure of a linkage in the governor control. Please comment.

9. Calculation KC-UNIT 1-2-0098 also addresses failure of pressure tank float valve OG-7. It concludes that the valve serves no safety function; the only function of the valve is to make regaining control of the unit easier. Report RO-269/82-11 dated August 20, 1982, however, reported that a leak in that valve resulted in the Keowee Unit 1 turbine not being able to attain sufficient speed to parallel to the grid. It appears that this may have also resulted in lower than required frequency to Oconee loads if the unit was called upon to power them. Please correlate the effects seen during this event to the conclusions reached in the governor single failure analysis.

10. With regard to the potential for a failure in the Keowee voltage regulators or governors to create an out-of-tolerance voltage or frequency, please identify any voltage or frequency monitoring instrumentation available that would: 1) alarm the out-of-tolerance condition, 2) shut the Keowee units down or otherwise drive the condition to a fail-safe zero state, or 3) separate the Oconee electrical loads from the out-of-tolerance condition. Provide the setpoints, location, and sensing point of the instrumentation. If the instrumentation provides an alarm, identify the location of the alarm, the manning of the space the alarm is located in, and the procedures available that instruct the operator on what action to take when the alarm comes in.

11. Calculation KC-Unit 1 & 2-2023, "Analysis of Keowee Voltage Regulator Settings," indicates that a Keowee main stepup transformer tap change and reactive line-drop compensator feature in the voltage regulator is intended to be implemented in order to allow Keowee to provide additional MVARs to the grid and reduce the potential for over-excitation of the stepup transformer. The reactive line-drop compensator feature will replace the currently used reactive droop feature in the voltage regulator. The recommendation in the calculation is to set the line-drop compensator module to provide approximately 10 percent compensation. With this feature in place and both Keowee units providing rated MVARs to the grid at minimum grid voltage conditions, if one of the Oconee units developed a need for emergency power from Keowee, the voltage at the Keowee generator terminals through the underground path would be reduced up to 10 percent from its grid generating value due to the minimal MVARs required by the single Oconee

unit relative to the pre-event rated MVARs provided to the grid. Would this voltage be sufficient to adequately start and operate Oconee electrical equipment? If not, what procedural controls will be put in place to preclude Keowee from operating in this region? If calculations have been done to establish the adequacy of operating the Keowee units with the new tap settings and line-drop compensator in place, please provide them.

12. In Calculation OSC-5096, "Fault/Failure Analysis for Oconee Nuclear Station Emergency Power System When Two Keowee Hydro Units Are Generating to the Grid," dated January 20, 1993, there is no mention of the potential for a fault in the Oconee switchyard to actuate the 59GN relays connected to both Keowee units, and cause a simultaneous lockout of both units if they are generating to the grid. Item 22, "Ground Fault [Unit 1]," states "Due to the Delta configuration of the Main Stepup transformer primary, the ground fault will not be seen by the protective devices for Unit 2 13.8 Kv bus." The potential for this type of relaying protection (59GN) to actuate due to ground faults on the high-side of a stepup transformer can arise as a result of zero-sequence capacitive coupling between the windings of the transformer. Describe the coordination that exists between the 59GN relays and other protective relays to clear single-line-to-ground faults such that a single fault will not cause a relay lockout of both Keowee units while they are generating to the grid. Also address how this coordination would be affected by a fault which was not cleared by its primary protective device (i.e., the closest breaker fails to open and clear the fault).