UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-269/95-10, 50-270/95-10 and 50-287/95-10

Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Docket Nos.: 50-269, 50-270, and 50-287 License Nos.: DPR-38, DPR-47, and DPR-55

Facility Name: Oconee Nuclear Station Units 1, 2 and 3

Inspection Conducted: June 5 - 16, 1995

Inspector: S. Rudisail 7/7/95
S. Rudisail Date Signed

Accompanying Personnel: V. Beaston, NRR

Approved by: M Shymlock 7-12-95
M. Shymlock, Chief Date Signed
Plant System Section
Engineering Branch
Division of Reactor Safety

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of electrical design to review the licensee action in response to Electrical Distribution System Functional Inspection (EDSFI) findings and other EDSFI issues identified in NRC Inspection Report 50-269, 270, 287/93-02. These items were being resolved as part of the licensee's Power Upgrade Project (PUP).

Results:

In the areas inspected, violations or deviations were not identified.

The inspector reviewed the licensee response and corrective actions for violation 94-26-01, Failure to Perform Procedure as Corrective Action. This violation was closed.

Deviation 93-02-02 was also closed. The licensee had completed the remaining corrective actions for the deviation.

Enclosure

The inspectors reviewed various PUP items completed in response to EDSFI findings. These findings were identified as Inspector Follow-up Item (IFI) 93-02-03.

Overall, the calculations were of good quality with no problems identified during the calculation reviews. The licensee corrective actions for these items were technically sound and through.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

L. Azzarello, Mechanical Systems Engineering
*K. Burchfield, Regulatory Compliance
P. Colaianni, Nuclear General Office, License Renewal
D. Coyle, Mechanical Systems Engineering
*J. Davis, Engineering
T. Grant, Electrical Systems Engineering
*J. Hampton, Site Vice-president
T. Ledford, Electrical Systems Engineering
*C. Little, Electrical Systems Engineering
D. Patterson, Regulatory Compliance
*B. Peele, Plant Manager
J. Stevens, Electrical Systems Engineering

Other licensee employee contacted during this inspection included craftsmen, engineers, technicians, and administrative personnel.

NRC Employees:

P. Harmon, Senior Resident Inspector
*L. Keller, Resident Inspector
K. Poertner, Resident Inspector

*Attended exit interview

Acronyms and abbreviations used throughout this report are identified in the last paragraph.

2. Background

During January 25 through March 5, 1993, the NRC conducted the Electrical System Distribution Functional Inspection (EDSFI). The purpose of this inspection was to assess the capability of the Oconee Electrical Distribution System to perform it functions during normal operations and accident conditions. The conclusion of the EDSFI team was that the electrical distribution system would perform its intended function pending further analysis and testing by the licensee. During the EDSFI inspection a violation and several deviations were identified. Additionally, findings identified during the EDSFI were collectively identified as IFI 93-02-03.

3. Review of Corrective Action for Violation and Deviations (IP 92702)

The inspector reviewed a violation identified during a previous EDSFI follow-up inspection and three deviations identified at Oconee during the EDSFI. These items are discussed in the following paragraphs.

3.1 (Closed) Violation 50-269, 270, 287/94-26-01, Failure to Perform Procedure as Corrective Action was closed. This violation was identified after it was determined that Keowee procedure OP/A/2000/45, Lock Verification had not been performed. This procedure was issued as part of the corrective action for deviation 93-02-02. During a review of the corrective actions for this deviation it was determined that this procedure had not been performed until the results were requested for review by the inspector. This procedure was required to be performed semi-annually. During this inspection the corrective actions for this violation were reviewed. The inspector verified that this procedure had been included in the procedure tracking system and reviewed the results of the most recently completed procedure. The results of this review were adequate. This violation was closed.

3.2 (Closed) Deviation 93-02-02, Item 1, Deviation from FSAR Color Coding Requirements for Cables was one of three examples of this deviation identified during the EDSFI. The first example was identified as power cables 1XS2 and 1XS48 not being correctly color coded. These cables run from the motor control centers 1XS1 and 1XS2 to transformer CT4 cooling fans. Final Safety Analysis Report (FSAR) section 8.3.1.3 states that motor control center (MCC) 1XS1 power and control system cable are color coded gray and that MCC 1XS2 cables are color coded yellow. Contrary to this requirement, both cables were color coded black.

The licensee responded to this deviation and agreed that it was a deviation from the requirements of the FSAR and an oversight during initial installation. The licensee considered the color coding was intended to ensure separation during installation. The separation requirements are for mutually redundant cables to be run in separate trays. The cables are routed in different cable trays until they reach the block house of the CT4 transformer. The cable is interlocked armor type cable. The licensee determined the impact of failure of both cables and concluded that should they fail the transformer would continue to operate as designed with only a small impact on transformer life. Alarms are available to indicate loss of power to the fans and high oil and winding temperature in the transformer. Operator action would be required upon receipt of alarms. The licensee concluded that the impact on safety due to the cable being color coded black was insignificant. The inspector agreed with this conclusion. The licensee proposed additional corrective action to perform an inspection of all plant, switchyard, and Keowee cables fed from safety related busses not previously identified as having mutually redundant safety related functions.

The inspector reviewed the results of the cable separation study. This was identified as item 13 of the licensee's PUP. This study identified several cables of mutually redundant systems at Keowee which were routed in the same cable tray. The licensee had determined that these cables were routed such that the distance between the cables was sufficient to preclude the need for re-routing the cables for the purpose of cable tray separation. The inspector performed a walkdown of the affected cables to determine if the licensee evaluation of their safety

significance was appropriate. These cables were interlocked armor type cables and were adequately separated. The inspector agreed that these cables were sufficiently separated to preclude the mutual failure of both cables. This deviation item was closed.

3.3 (Closed) Deviation 93-02-02, Item 2, identified mutually redundant cables for Unit 2 emergency core cooling isolation valves 2LP-19 and 2LP-20 being routed in the same cable tray. This was contrary to the requirements of FSAR section 8.3.1.4.6.2. The licensee agreed that this was a deviation.

The corrective action for this deviation was to perform a modification to separate the cables. Minor modification OE-5990 was prepared to separate the cables. The inspector reviewed this modification and the scope of work accomplished during its performance. This modification accomplished the required corrective action. Inspection of Unit 1 and Unit 3 cable for valves LP-19 and LP-20 were performed and the separation problem did not exist. The licensee proposed additional corrective action to perform an inspection of all plant, switchyard, and Keowee cables fed from safety related busses not previously identified as having mutually redundant safety related functions. This study was discussed in item 1 of the deviation. Item 2 of the deviation was closed. This closes deviation 93-02-02. Item 3 of the deviation was closed in inspection report 50-269,270,287/94-26.

4. Review of Inspector Follow-up Items (IP 92903, TI 2515/111)

The inspector reviewed the items identified at Oconee as Findings. IFI 93-02-03, EDSFI Findings consisted of six findings with several issues identified in each finding. This finding was closed in NRC inspection report 50-269, 270, 287/94-26 to document the findings which were closed in that report. IFI 94-26-02 was opened to identify the EDSFI finding items which remain opened.

4.1. Finding 2 was an identification of analyses, studies and calculations which were not complete or had not been performed. There were ten elements identified in this finding. Item 2.j was closed in IR 50-269, 270, 287/94-26. The other nine items identified in finding 2 remained open. Some of these items were reviewed during this inspection and are discussed below:

4.1.1 Finding 2.a identified that calculation OSC-2059, Oconee Unit 1 Voltage and Load Study may not have bound the worst case. During the EDSFI review of the Oconee short circuit and voltage studies, the team identified deficiencies in calculation OSC-2059. The Unit 2 and Unit 3 calculation were being revised during the EDSFI and were not available for review. The team noted during the review of OSC-2059 the following.

(1) The momentary current on the 4.16 kV supply breakers under the worst case scenario was 83 kiloamperes (kA) exceeding the breaker rating of 80 kA. The team noted that some of the breakers had been successfully tested at 83 kA by the manufacturer.

(2) There was only one input file for both short circuit and voltage drop calculations which may not bound the worst case minimum and maximum voltages.

(3) The calculation did not adequately model the transformer tap position or the pre-fault bus voltage.

(4) When determining the total loads on transformers the study used 75 degree cable temperature, and constant motor efficiency and power factor at full load.

(5) Only one 230 kV system impedance was modeled in the study.

However, the EDSFI team previously concluded that even though the calculation results may not be bounding that they were acceptable and no operational problems were identified.

Item 22 was identified to address this EDSFI finding. The inspector reviewed the following calculations revised to address this finding. Calculation OSC-2059 Rev. 3, calculation OSC-2060 Rev. 3, Oconee Unit 2 Voltage and Load Study, and OSC-2061 Rev. 2, Oconee Unit 3 Voltage and Load Study. The calculations were reviewed to ensure that adequate voltage would be provided to the units auxiliary power system and that the fault duty of the switchgear and protective devices were adequately sized. The concerns identified in the EDSFI were also reviewed to ensure that they were addressed by the revisions to the calculations. The methodology used to perform the calculations was reviewed to ensure each item was addressed. The inspector determined from review of the calculation that only one input file is needed as this file contains manufacturers and test data and actual cable lengths. The revision incorporated the actual transformer impedance for the tap setting and modeled pre-fault bus voltages. The calculation uses actual motor KVA and power factors. The worst case 230 kV system impedance was used to calculate fault currents. The results of the revised calculation lowered the magnitude of the calculated faults thus addressing the circuit breaker rating concern. This item was closed.

4.1.2 Item 2.c identified that a transient voltage study for the 4kV safety loads when supplied by the Lee or Central substation was not available. The licensee responded that a calculation to demonstrate dynamic modeling of the Lee and Central power sources would be completed. In EDSFI report section 2.6.2 a concern was expressed that during starting of a unit's LOCA loads and two unit's shutdown loads, the transient voltage dip could exceed 20 percent. The licensee agreed to prepare a transient voltage study for the 4 kV safety load groups when they are supplied by the Lee gas turbine or from Central substation. During this inspection the revision to calculation OSC-3585, Voltage Study for the Oconee Auxiliary System When Fed from the 100 kV System via CT5 Rev. 1 was reviewed. This revision computed the transient reactance of the 100 kV system (while being supplied from the central substation) to the standby bus. The transient reactance when the Oconee auxiliary system is supplied by the 100 kv system is 1.5 times less than when the Oconee

auxiliaries are supplied from Keowee. This results in a smaller transient dip when supplied by the 100 kV system. The inspector concluded that the calculation OSC-3585 demonstrated the ability of the 100 kV system (while being supplied from the central substation) to supply adequate voltage to the Oconee auxiliaries and recover from the postulated transient. This part of finding 2.c will be closed. The review of the voltage study for Lee gas turbine supplying the Oconee auxiliaries remains open.

4.1.3 Item 2.d identified that a study to review control cable length and the size of fuses that protect them had not been conducted. This item was addressed by the licensee as PUP item 22. The licensee completed three calculations in response to this finding. The inspector reviewed calculation OSC-5930 Rev. 0, Unit 1 QA1 Motor Starter Circuit and Fuse Adequacy Calculation, calculation OSC-6143 Rev. 0, Unit 2 MCC Contactor Voltage Adequacy and Fuse Adequacy Verification and OSC-6144 Rev. 0, Unit 3 MCC Contactor Voltage Adequacy and Fuse Adequacy Verification. The purpose of the calculations was to demonstrate that each units motor control circuits would have adequate voltage during a LOCA degraded grid scenario and that during an overvoltage condition the fuses would not blow. The results of the calculations demonstrate that adequate voltage is available for each of the motor starting circuits and fuses are adequately sized for the circuit application. The inspector did not identify any additional concerns during the calculation reviews. This item was closed.

4.1.4 Item 2.e of the EDSFI identified that the Keowee 600V Auxiliary Power System Voltage Analysis did not evaluate maximum and minimum expected voltages. PUP item 4.a was identified to address this EDSFI item. The licensee completed calculation KC-UNIT-1-2-0095 Rev. 0 to address voltage adequacy in the auxiliary power system. The calculation documented and analyzed the adequacy of Keowee electrical distribution system voltages when supplied by either the 230 kV switchyard or the Keowee generators. The results of the calculation demonstrate that the Keowee Station auxiliary electrical system will be within acceptable limits to allow performance of their design functions under all system configurations and at minimum and maximum predicted switchyard voltages. The inspectors reviewed the calculation and found the results demonstrated the adequacy of the voltage supplied to the Keowee electrical auxiliaries. This item was closed.

4.1.5 Item 2.f, was a concern that no analysis existed to support that the Keowee auxiliaries would not be damaged by overvoltage or overfrequency when supplied by one Keowee unit. Item 2.h identified that an analysis to support the assumption that Oconee safety loads could properly perform during an overfrequency transient lasting 40-50 seconds. The licensee plans to complete an analysis to support this assumption.

During a previous inspection documented in NRC inspection report 50-269, 270, 287/94-26, the inspector reviewed the actions completed for these finding. One calculation had been completed. The calculation to demonstrate the effect of overvoltages and overfrequencies on the Keowee

auxiliaries was complete. The calculation OSC-5701 Rev. 0, Oconee Keowee Overhead Path Analysis identified weaknesses that limit the percent power the Keowee units can generate to the grid and the alignment of the Keowee units. Additionally, calculation OSC-5952 Rev. 0, Oconee-Keowee Underground Path Analysis Using Cyme was reviewed during this inspection and discussed in paragraph 4.2.2 of this report. Corrective actions identified by these calculations are being addressed in modification NSM 52966 currently being reviewed by the NRC. This item will remain open pending the completion of this review and implementation of the modification by the licensee.

4.1.6 Item 2.i identified that calculations for the Safe Shutdown Facility were not complete. PUP items 16 and 17 was identified to address this finding. The inspector reviewed the completed calculations for this finding. The licensee had completed calculation OSC-5093 Rev. 0, SSF Electrical Distribution System Load Flow, Voltage Adequacy, and Fault Study. The inspector reviewed the results of this calculation. The results of the calculation for the SSF Diesel Static Analysis which was attachment 5 of the calculation indicated a potential overload of the feeder breaker for load center MCC XSF. The feeder breaker had a long time setting of 660 amperes. The calculation demonstrated that this breaker could be subjected to 863 amperes. This loading could result in a breaker trip after 5 minutes. PIP 4-095-0400 was initiated based on this calculation result. Immediate corrective actions were taken to ensure SSF operability. Four duct heater breakers (for room heating) were tagged out which would reduce loading sufficiently to correct the problem. Long term corrective action included a minor modification to replace the breaker trip element to a size sufficient to support the calculated loading. Other than this problem the results of the calculation demonstrated the adequacy of the SSF electrical system ratings. This finding was closed.

4.2 Finding 5 of the EDSFI was the identification that Keowee engineering analyses were not sufficiently comprehensive and specific values had not been established which would bound the design criteria. Four items were identified in this finding. Finding 5.a identified that all credible failure modes for the governor control system and voltage regulator had not been considered. This item was not reviewed during this inspection and remains open. The additional items for finding 5 are addressed in the following paragraphs.

4.2.1 The inspectors reviewed PUP item 5 which addressed EDSFI finding 5.b.

Finding 5.b of the Oconee EDSFI report stated "The basis for bypassing Keowee trip functions during emergency start of the unit was not fully analyzed or documented."

Section 3.2.4.2 of the Oconee EDSFI inspection report, "Protective Feature Issues," stated that "the control logic bypasses all of the Keowee normal automatic electrical and mechanical protective trips on an emergency start. The bypassed trips included generator and turbine bearing overtemperatures, volts/hertz, overspeed, governor oil pressure,

generator field ground, and maximum excitation." The EDSFI team had concluded that the basis for bypassing Keowee trip functions during emergency start of the units was not fully analyzed. As a result of the concern, the licensee initiated PIP 0-093-0081 to request an analysis of Keowee lockout relay trip signals.

The inspectors reviewed calculation/analysis KC-0107, Analysis of Keowee Lockout Relay Trip Signals, dated May 22, 1995. This analysis documented the bases which would be used to determine lockout trip signals at Keowee.

The Keowee hydro units are equipped with two lockout relays (LOR), designated as the Emergency LOR (86E) and the Normal LOR (86N). In addition each unit has a shutdown relay (99SX) which causes the wicket gates to close when deenergized and an Alarm LOR (30X) which will prevent non-emergency automatic starts of the Keowee units. The 86E LOR is designed to immediately separate a Keowee unit by tripping the generator output breakers without unloading the unit. The 86E LOR is not bypassed during an emergency start of the Keowee units. The 86N LOR is designed to unload the generator by activating the 99SX relay first and allowing the wicket gates to reach their speed-no-load positions prior to tripping the generator output breakers. The 86N LOR is bypassed during an emergency start of the Keowee units.

The Keowee lockout relay analysis concluded that the existing design was adequate to ensure proper unit response to an emergency, however, it also recognized that system enhancements could be achieved. One of the recommendations made in the analysis was to move the volts/hertz and generator overexcitation trips from the 86N LOR to the 86E LOR. This recommendation will be addressed by Keowee Voltage Regulator modification NSM ON-52965. The overspeed trip will be removed when NSM ON-52966 is implemented and replaced by a time-delay trip input to the 86E LOR. The analysis also recommended that the mechanical systems group review the bearing overtemperature trips setpoints to see if they could be set just below the bearings' material melting points, thereby allowing operators more time to take action.

The inspectors found the licensee's basis for bypassing Keowee trip functions during emergency starts acceptable, and concluded that the basis had been adequately analyzed and documented. The licensee was tracking the recommendations of the analysis with PIP 4-095-0577. This item was closed.

4.2.2 The inspectors reviewed PUP item 4.h which addressed EDSFI items 5.c and 5.d.

Findings 5.c of the Oconee EDSFI report stated "The effect of frequency of the electrical power supplied by Keowee to the ECCS pump motors had not been fully evaluated."

Finding 5.d of the Oconee EDSFI report stated "Acceptable voltage and frequency limitations for the Keowee electrical auxiliaries and the emergency power system should be defined. Additionally, acceptable recovery times from voltage and frequency excursions should also be identified."

Section 3.4.1 of the Oconee EDSFI inspection report, "Review of Voltage and Frequency Analyses and Tests," identified concerns with the licensee's analysis of the Keowee hydro units ability to supply adequate power to Oconee auxiliaries during voltage and frequency transients.

The inspectors reviewed calculation OSC-5952, Oconee-Keowee Underground Path Analysis Using Cyme, dated May 25, 1995. The purpose of this calculation was to determine the adequacy of the Keowee units when used to provide emergency power to the Oconee auxiliaries via the underground path. The calculation contained voltage and frequency plots for five different scenarios. Also provided in the calculation were the transient start data for the ECCS pump motors. The five scenarios modeled were:

(1) A Keowee unit running at steady state, no load, accepts Oconee Unit 1 LOCA loads and Oconee Units 2 & 3 LOOP loads simultaneously;

(2) A Keowee unit running at steady state, no load, accepts Oconee Unit 1 LOCA loads followed 20 seconds later by Oconee Units 2 & 3 LOOP loads;

(3) A Keowee unit running at steady state, no load, accepts Oconee Unit 1 LOCA loads along with one condensate booster pump;

(4) A Keowee unit supplying 75 MW to the grid receives an emergency start demand, the Keowee unit accepts Oconee Unit 1 LOCA loads plus a condensate booster pump once the governor reduces system frequency to 110% of its rated value, Oconee Units 2 & 3 LOOP loads are accepted by the Keowee unit 9 seconds later;

(5) A Keowee unit supplying 75 MW to the grid receives an emergency start demand, the Keowee unit accepts Oconee Unit 1 LOCA loads, Oconee Unit 2 LOOP loads, plus a condensate booster pump once the governor reduces system frequency to 110% of its rated value, Oconee Units 3 LOOP loads are accepted by the Keowee unit 9 seconds later.

The licensee compared the results of the transient analysis using the following criteria to determine the operability of the Oconee auxiliary system:

(1) At the 4 kV level, voltages on switchgear 1TD (Bus 115) were compared against the settings of the 27S relays to determine the effects of transient voltages on the relays operation;

(2) At the 600 V and lower level, voltages at MCC XS1, XS2, and XS3 were compared with pick-up and drop-out voltages of contactors to determine the effects of transient voltages on contactor operations. The licensee based the pick-up and drop-out voltages for contactors on test values provided by GTE Sylvania;

(3) Motor starting currents were compared against the settings of their associated overcurrent relays to determine the effects of transient voltage on motor operation.

The inspectors were concerned about how the initial voltage level of the Keowee unit would affect the ability of the ECCS pump motors to start. At the request of the inspectors, the licensee performed an analysis of scenario one above for a case were the initial generator output voltage of the Keowee unit was only 13.2 kV, instead of the 13.8 kV used in the calculation. This analysis was requested to determine how sensitive the computer simulations might be to small inaccuracies in the input data, and to determine how much margin might exist between the nominal operating voltage of the Keowee units and the minimum values needed to ensure proper operation of the Oconee safety loads.

To address the inspectors concern about low generator output voltage, the licensee plotted the starting currents for the low pressure service water pump and the reactor building spray pump motors at Keowee output voltages of 13.8 kV, 13.5 kV, and 13.2 kV along with the associated overcurrent protection relay curves. These motors had been previously identified by the licensee as the most limiting ECCS motors at Oconee when started under degraded voltage or frequency conditions. From these plots the inspectors were able to see how the motor start currents and start times where changing with Keowee generator output voltage and frequency, and gain some insight into what the computer simulation was predicting and the actual trip settings of the overcurrent protection relays. Based on these plots and the conservatism of the assumptions used by the licensee in the analysis, the inspectors had no concerns that the ECCS motors would not start.

The transient simulations conducted by the licensee for calculation OSC-5952 showed that underfrequency effects were not a problem when the Keowee generator output voltage was within its currently specified operating band of 13.5 kV to 14.1 kV prior to loading. The transient analysis also showed that overfrequency effects were not a problem once the licensee completes a modification of the Keowee units which will ensure that the Oconee electrical distribution systems are not connected to a Keowee generator output until after the system frequency has returned to 110% of its rated value following a Keowee unit load rejection. The adequacy of this proposed modification of the Keowee units is currently under review by the NRC's Office of Nuclear Reactor Regulation.

Based on a review of calculation OSC-5952, which documents the adequacy of the Keowee units to supply power to Oconee auxiliaries via the underground path, prior NRC review of the adequacy of the Keowee units

to supply the Oconee auxiliaries via the overhead path as analyzed in calculation OSC-5701, Oconee Keowee Overhead Path Analysis and discussed in NRC IR 50-269, 270, 287/94-26, and the licensee's proposed modification to eliminate the Keowee overspeed/overfrequency concerns currently under review by the Office of Nuclear Reactor Regulation, the inspectors concluded that the issues identified as findings 5.c and 5.d of Oconee Inspection Report 93-02 have been adequately addressed. These items will remain open pending completion of a safety evaluation by the Office of Nuclear Reactor Regulation documenting the adequacy of the licensee's corrective actions for the Keowee hydro units overspeed/overfrequency concerns.

5. Review of Power Upgrade Project Items not Identified as EDSFI Findings (IP 92903)

5.1 The inspectors reviewed PUP item 4.f, Keowee Voltage Regulator Setpoints.

While performing an emergency start test of Keowee Unit 1 on September 20, 1993, it was noted that the generator output voltage leveled-off at 13.3 kV instead of its rated output voltage of 13.8 kV. The low generator output voltage was later determined by the licensee to have been due to the improper setting of the voltage regulator control signal (See Problem Investigation Process (PIP) 4-093-0793). The root cause of the problem was determined to be the lack of a documented voltage setpoint. As a result, the licensee decided to formally document the voltage regulator setpoints and incorporate the acceptable generator output voltage operating band into the Keowee emergency start test procedure.

The inspectors reviewed calculation/analysis KC-Unit 1 & 2-2023 dated June 4, 1995. This calculation/analysis analyzed the operation of the Keowee voltage regulator, and documented the bases for the Keowee voltage regulator settings. The voltage regulator settings should maintain the Keowee generator output voltage between 13.5 kV and 14.1 kV. This voltage range was based on dynamic computer simulations performed by the licensee which showed the band to be adequate to ensure operation of Oconee safety loads.

The licensee's analysis identified that the order in which certain modules of the voltage regulator were calibrated was critical in ensuring proper generator voltage during emergency operations. A new calibration procedure for the voltage regulator was being written which would specify the order. The analysis also recommended that the current Keowee main step-up transformer tap setting be changed to tap three. This change would allow the Keowee generators to operate in a voltage band of 13.8 kV ± 5 percent. Changing the transformer tap setting would also increase the safety margin that currently exists between the Keowee generator operating voltage and the minimum voltage needed to ensure operation of Oconee safety loads. Implementing this recommendation however would require further analysis and coordination of the electrical system as a whole.

The inspectors concluded that the licensee's analysis adequately documented the bases for the Keowee voltage regulator settings. This item was closed.

5.2 The inspectors reviewed PUP item 19 which was the Penetration Overcurrent Protection Calculation.

Section 6.1.2 of the Oconee EDSFI inspection report; "Protection, Coordination and Containment Electrical Penetration Protection;" stated "the licensee is not committed to and does not comply with IEEE-317 requirements for penetration back-up protection. In addition, formal calculations were not available to demonstrate the adequacy of primary protection."

The inspectors review calculation OSC-4151, Revision 1; "A Review of Penetration Overcurrent Protection;" dated May 16, 1995. The purpose of the calculation was to demonstrate the adequacy of primary protection devices for containment electrical penetrations. The calculation analyzed the maximum fault currents available at each type of penetration installed except for penetrations associated with low energy thermocouple and instrumentation circuits. The fault current levels were then compared to the field cable insulation thermal limits, conductor fusing limits, and cable and penetration time-current protection device settings associated with each type of penetration.

The results of the licensee's calculation showed that electrical penetrations and their associated cables currently installed at Oconee are adequately protected by primary overload and fault protection devices. This protection should be adequate to ensure electrical circuits passing through the reactor building will not degrade containment integrity before, during or after a design basis event. Section "J" of the analysis made recommendations to enhance penetration overcurrent protection. These recommendations included: (1) adding a note to design documents which clearly identify type D-12 penetration load limits; (2) replacing 100 amp circuit breakers associated with type C_2 penetrations with 50 or 60 amp circuit breakers; and (3) providing operators with explicit response guidelines to manually shutdown a reactor coolant pump upon detection of a sustained overcurrent. These recommendations were being tracked by the licensee with PIP O-095-0606.

Based on a review of calculation OSC-4151, Revision 1; A Review of Penetration Overcurrent Protection; the inspectors concluded that the license's primary protection was adequate. The licensee does not comply with IEEE-317 requirements for penetration back-up protection, however they are not committed to this requirement. This item was closed.

5.3 The inspectors reviewed PUP item 20 which identified a revision to the degraded grid voltage relay setpoints and a change to the degraded grid voltage detection configuration.

In Section 2.3.2 of the Oconee EDSFI inspection report, "Degraded Grid Protection System," team members noted the following concerns with the system design:

(1) All three single voltage measurements were monitoring the same "Z" phase of the 230 kV bus;

(2) The three-relay scheme which only monitored the "Z" phase of the bus was insensitive to phase voltage unbalance;

(3) The licensee did not have any operating procedure or surveillance test to monitor the phase voltage unbalance.

The inspectors reviewed calculation OSC-5579, "Design Inputs and 10 CFR 50.49 Evaluation for NSM-ON-52950." Modification NSM-ON-52950 installs three new QA-1 Capacitor Coupled Voltage Transformers (CCVTs) in the Oconee 230 kV switchyard, and provides a voltage input to the degraded grid voltage protection logic. Additionally, the modification adds three new QA-1 undervoltage relays to the protection logic, and replaces three Yellow Bus and three Red Bus CCVTs (a total of six CCVTs).

The new CCVTs and undervoltage relays will add a second set of 2-out-of-3 protection logic to the Oconee degraded grid protection system. The three new CCVTs will monitor different phases of the Yellow Bus and add diversity to the Oconee degraded grid protection system. Because the new CCVTs will be connected to three different phases of the Yellow Bus, modification NSM-ON-5579 addresses the phase voltage unbalance concerns noted during the EDSFI inspection.

The inspectors had no concerns as a result of their review of calculation OSC-52950. This item was closed.

5.4 The inspectors reviewed PUP item 92 which analyzed the voltage adequacy of 208/120 VAC Power Panel Voltage.

The inspectors reviewed calculation OSC-6135, "208/120 VAC Power Panel Voltage Accuracy," dated June 1, 1995. This calculation performed a evaluation of each 208/120 VAC station auxiliary panel circuit to determine if each end device required to operate during a LOCA would operate at the steady state LOCA reduced voltage conditions.

The calculation used the panel board voltages calculated in OSC-2059, OSC-2060, and OSC-2061; the voltage and load studies for Oconee Units 1, 2 & 3 respectively. From these steady state panel board voltages, end device terminal voltages were calculated based on cable impedances and the expected end devices' load currents. Results of the calculation showed that in general the calculated end device voltage levels were greater than or equal to the minimum operating voltages published by the manufacturers. Several end device voltages however were slightly less than the manufactures' published minimum operating voltages. In these instances, the licensee relied upon other vendor documentation or test data to conclude that the reduced voltages were acceptable.

Due to the volume and details of the calculation, the inspectors only reviewed a portion of the OSC-6135, to verify that all loads fed from the 208/120 VAC station auxiliary panels would have adequate voltage available to perform under a worst case voltage condition. This included instances were an end device would be supplied with a terminal voltage less than the published manufacturer's minimum operating voltage. The inspectors noted during their review that there was conservatism included in both calculation OSC-6135 and the voltage and load study calculations used to determine the steady state panel board voltages.

Based on a review of calculations OSC-6135 and the review of calculations discussed in paragraph 4.1.1, the inspectors concluded there was adequate assurance that loads fed from the 208/120 VAC panel boards would be supplied with the minimum voltage needed to perform during a design basis accident. The inspectors did not however review or consider transient voltage conditions which might occur during a design basis accident. This item was closed.

5.5 The inspectors reviewed PUP item 113. This item documented an evaluation of the 230 kV Switchyard 125 VDC Power System for float charging the switchyard batteries at a higher voltage. The Oconee 230 kV switchyard batteries were recently replaced with larger capacity cells with a 60 cell battery bank. The previous batteries were 59 cell batteries and were floated at 2.17 to 2.25 volts per cell (VPC) resulting in a maximum system voltage of 132.75 Volts Direct Current (VDC). With a 60 cell configuration and a maximum floating voltage of 2.25 VPC the maximum system voltage would be increased to 135 VDC. An evaluation of the 125 VDC system components was needed to determine if the increased voltage would exceed the allowable voltages of the devices powered from the batteries and charger.

Calculation OSC-5976 Rev. 0, 230 kV Switchyard 125 VDC Power System Overvoltage Evaluation was reviewed by the inspector. The inspector reviewed each component identified within the calculation that would be affected by the increased voltage. Documentation was included within the calculation to document the acceptability of the increased voltage for these components. All components identified within the calculation were found to be adequate for application in a system operating at the higher voltage with the following exceptions:

(1) Cooper Bussman type REN fuses are recommended for replacement by Cooper Bussman with type KNW-R, KTN-R, and FRN-R type fuses.

(2) Cooper Bussman type NON-0.5 and NON-3 fuses should be replaced with NON-15 type fuses.

(3) Gould Shawmut type OT-6 fuses rated 10 amperes or less should be evaluated and replaced as necessary.

PIP No. 4-095-0522 was initiated to document the fuse replacements. This PIP is still open. The 125 VDC System is being operated at the original float voltage of 132.75 VDC pending completion of the corrective actions required by this PIP.

No additional concerns were identified by the inspector during this review. PUP item 113 was closed.

6. Exit Meeting

The inspection scope and results were summarized on June 16, 1995, with those individuals indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection findings. There was no dissenting comments received from the licensee. Proprietary information is not contained in this report.

(Closed) Violation 50-269, 270, 287/94-26-01, Failure to Perform Procedure as Corrective Action

(Closed) Deviation 50-269, 270, 287/93-02-02, Deviation from Separation and Color Coding Requirements for Cable and Overpressure Protection for Piping

7. Acronyms and Abbreviations

CFR	Code of Federal Regulations
ECCS	Emergency Core Cooling System
EDSFI	Electrical Distribution System Functional Inspection
FSAR	Final Safety Analysis Report
IEEE	Institute of Electrical and Electronics Engineers
IFI	Inspector Follow-up Item
IP	Inspection Procedure
IR	Inspection Report
kA	Kiloamperes
kV	Kilovolts
KVA	Kilo- Volt- Amperes
LOCA	Loss of Coolant Accident
MCC	Motor Control Center
MVA	Mega Volt Amperes
NRC	Nuclear Regulatory Commission
NRR	Nuclear Reactor Regulation
MW	Mega-Watts
PIP	Problem Investigation Process
PUP	Power Upgrade Project
SSF	Safe Shutdown Facility
TI	Temporary Instruction
V	Volts
VAC	Volts Alternating Current
VDC	Volts Direct Current
VPC	Volts Per Cell