## 4.0 LEE EMERGENCY POWER SYSTEM AND 100 kV CENTRAL POWER SYSTEM

The 100 Kv power distribution system at Oconee consists of the Central switchyard and the Lee CTG. This system serves a dual purpose. The Lee CTG system serves as an emergency power supply as required by TS when the normal on-site power supply at Keowee is not available or when in a LCO. The Central switchyard serves as a back-up source of power to the off-site power supply in a worst case scenario when normal off-site power is lost and the emergency power source fails.

### 4.1 Review of Design

The team reviewed the design of the Lee Emergency Power System and the 100 Kv Central Switchyard System.

#### 4.1.1 Lee Power System

The Lee Emergency Power System was reviewed to ensure adequate voltage would be available to supply the Oconee auxiliary power system and also to verify that the system had proper protection and coordination.

Calculation OSC-3290, "Voltage Study for Oconee Auxiliary Power Systems When Fed From Lee Combustion Turbine Via CT-5 Auxiliary Transformer" was reviewed to ensure adequate voltage would be available at the standby bus when supplied by a Lee CTG. During the review of this calculation it was noted that the Lee CTG was modeled as an infinite source. The licensee agreed that this source was not infinite. The program used to perform the voltage study was not capable of properly modeling the generator so it was treated as an infinite source. To ensure that this lack of conservatism did not adversely affect voltage levels within the auxiliary power system, administrative controls were in effect which increased the output voltage from the Lee CTG from 13.8 kV to 14.1 kV. Other administrative controls which were in effect when the Lee CTG was supplying the standby busses were the delayed loading of load centers X5 and X6 on non-LOCA units and placing the standby HPI pump in the OFF position. Procedures were reviewed to ensure that all administrative controls resulting from this voltage study were incorporated.

The team conducted discussions with the licensee concerning the Lee voltage study. Specifically, the modeling of the generator in the voltage study as an infinite bus. The licensee stated that the next revision of OSC-3290 would use the new CYME computer program. This software has the capability to model the CTG more accurately and the infinite source assumption would be deleted. The licensee expressed confidence that there was no immediate need to revise that calculation because of the added conservatism of increasing the output of the generator to 14.1 kV. Additionally, the Lee CTG would be at rated output voltage and frequency when placed in service. The licensee had tested the response of the Lee CTG by adding a load of two 3500 HP motors. The transient voltage dip lasted only 0.8 seconds. After thorough review of the Lee emergency power system the team concluded that the Lee CTG would supply adequate voltage to the standby busses to meet load voltage requirements.

4.1.2 Central Switchyard

The team reviewed the 100 kV electrical distribution system under the conditions of transformer CT-5 being supplied from the Central switchyard. The licensee has recently installed degraded grid protection on that line. The modification package and supporting calculations were reviewed.

Calculation OSC-4513,"Design Input Calculation Relative To NSM-52878," provided a voltage study of the auxiliary power system when the system was being supplied from the Central switchyard. The calculation was used to determine the setpoints for the degraded grid protection system for the 100 kV system. No concern were noted.

4.2 Operation of the Lee Power and Central 100 kV System

Procedure OP/0/A/1107/03, "100 kV Power Supply" includes enclosure 3.10 which allows the MFB of a unit whose startup transformer was out of service to be energized from the Central switchyard. This alignment is not indicated in the existing TS or UFSAR.

In reviewing the Operating Procedure, enclosure 3.10, the team noted that step 1.3 requires at least 2 energized transmission circuits connected to the Central switchyard. The procedure does not require that both of these circuits not be Oconee transmission circuits. If all generating output from Oconee station was lost, the Central switchyard would also be compromised and unavailable as a last resource when providing emergency power. Therefore, the procedure should be evaluated to specify one circuit coming from a substation other than Oconee.

5.0 STANDBY SHUTDOWN FACILITY

The team reviewed the electrical distribution, mechanical systems, operation and testing for the SSF. The design basis specification for the 4160/600/120V SSF Essential AC Power System, Spec. OSS-0254.00-00-2-14, Rev. 0 was reviewed. The SSF was designed to provide the necessary equipment with an independent power source to achieve and maintain hot shutdown on any or all Oconee units for up to 72 hours in the event of a station blackout, loss of normal shutdown capability due to a fire as postulated by 10 CFR 50 Appendix R, sabotage, or turbine building flood. The SSF consists of a diesel generator, diesel service water system, SSF HVAC service water system, SSF diesel air system, SSF HVAC system, SSF auxiliary service water system, and SSF RC makeup system. In accordance with the above design basis document, the SSF is not required to meet single failure criteria since it is a backup to other existing safety systems installed in the Oconee units.

5.1 Review of Design

The team reviewed the EDS for the SSF. Calculations for the SSF were incomplete. A fault study for the SSF electrical system has never been performed. This was identified as an open item in the licensee's DBD for the completion of calculation OSC-5093. The licensee considers that the system design was adequate for potential faults on the SSF electrical system. The licensee provided three reasons for this conclusion. The electrical equipment was the same as equipment purchased for the plant thus they have the same fault duty ratings. The fault currents would be less within the SSF electrical system than faults within the Oconee units electrical system because of voltage drops through the cable. The SSF diesel generator was a smaller source of fault current than plant fault sources.

The licensee also identified possible miscoordination in the SSF electrical system. As identified in calculation OSC-1366, "Relay Settings for SSF Facility and Related Equipment," a possible miscoordination exists between the MCC XSF incoming breaker and the XSF feeder breakers. This cannot be determined until the completion of a fault study for the SSF facility.

Additionally, a voltage study has never been performed to document the adequacy of voltage in the SSF electrical system when it is being supplied from the SSF diesel generator. The licensee intends on performing these basic calculations to promote an increased confidence in the SSF electrical system. (See Appendix A, Finding 2)

The team's review of the RC makeup system determined that the pumps are required to deliver 26 gpm through the reactor coolant pump seal injection lines during an SSF event. The purpose of the 26 gpm is to provide cooling water to the reactor coolant pump seals to maintain the seals intact during an SSF event and to maintain RCS inventory. TS 3.1.6.9 states that loss of reactor coolant through reactor coolant pump seals and system valves to connecting systems (which vent to the gas vent header and from which coolant can be returned to the reactor coolant system) shall not be subject to the consideration of TS 3.1.6.1 through 3.1.6.7. An exception that such losses when added to leakage shall not exceed 30 gpm. This TS allows operation with leakage in excess of 26 gpm which exceeds the SSF makeup pump capacity.

The team questioned the adequacy of TS 3.1.6.9 with respect to the SSF. The licensee stated that the criteria for makeup capacity to the reactor coolant system is based upon Oconee operating experience and vendor information rather than allowable TS leakage rates. The intent is to provide makeup capability to the RCS based upon experience rather than extreme postulated conditions. The licensee also identified that the SSF SER dated 4/28/83 states that the capacity of the SSF RC makeup subsystem is sized to account for normal RCS leakage and shrinkage. The licensee stated that leakage rates approaching the limits stated in TS 3.1.6.9 are beyond the design basis of the SSF.

The team did not agree with the licensee position's that TS 3.1.6.9 was adequate as written. The team concluded that total leakage exceeding the capacity of the SSF makeup pump could result in questioning the operability of the makeup pump. The value specified in the TS exceeds the required capability of the SSF makeup system. This item is identified for further NRC review. This will be identified as IFI 93-02-04.

## 5.2 Testing

The inspection team reviewed the procedure, IP/0/A/0385/001B, "SSF 125 VDC Battery Service Test and Annual Surveillance", and observed the actual test and results for this battery surveillance. The results of the service test were consistent with the calculations performed by the team. No discrepancies were noted.

OSC-1132, 125 Volt DC Standby Shutdown Facility Auxiliary Power System Battery and Battery Charger Sizing Calculation was reviewed to verify the discharge amperages used to test the SSF 125 Volt DC battery systems for the yearly discharge test. This calculation is conservative and fully tests the capacity of the battery. No discrepancies were noted.

## 6.0 LOW VOLTAGE 600 VAC AND BELOW

## 6.1 600/208 VAC Power Systems Review

The team reviewed the 600/208 VAC low voltage power system to assess load current and short circuit current capabilities, voltage regulation, protection and coordination, and single failure criteria.

The team concluded that the 600/208 VAC low voltage power and 125 VDC systems were capable of supplying power of adequate voltage to safety-related loads and that sufficient redundancy exists to enable the systems to function despite a single failure of a safety related component. The team noted that some worst case scenarios were not considered in calculations, but preliminary calculations provided during the inspection demonstrated operability. It is expected that these calculations will be formalized to confirm the preliminary results. In addition, the team noted that testing used to demonstrate operability of equipment at voltages lower than manufacturer's guaranteed minimums was less than rigorous, and, in some cases, results were non-conservatively applied. The team did note, however, that testing generally demonstrated wide margins of available voltage so that this does not present a safety concern.

### 6.1.1 Voltage and Short Circuit Calculations

The team determined that voltage calculations did not consider worst case scenarios. Calculation OSC-2059, Oconee Unit 1 Voltage and Load Study, (without loss of off-site power) did not consider a single failure consisting of the spurious application of a large unscheduled load. Since the 4160 volt ES busses are interconnected, voltage effects caused by such a failure would affect redundant safety strings. The licensee provided preliminary calculations which demonstrated that transient and steady state voltages resulting from this scenario would be 6% and 2.5% lower than previously analyzed, respectively, but these were bounded by worst case voltages determined in calculation OSC-2444 for a LOCA/LOOP fed by Keowee through the underground path.

Neither calculation OSC-2059 nor OSC-2444 considered worst case system alignments such as a feed from an alternate source. Preliminary calculations provided in response to the team's question demonstrated that voltages at safety busses could be approximately 1.5% lower than previously analyzed.

Voltage at the terminals of MCC control circuits had not been determined. Preliminary calculations provided in response to the team's inquiry showed voltages slightly lower than manufacturer's published minimums for starters, 82.16% of rated vs. 85% required. Base voltage used for this calculation was not derived from worst case scenarios, so slightly worst results are expected when these calculations are formalized. Alternate criteria cited in OSC-2059 were 65% for size 2 starters and 70.2% for size 5 starters. These criteria were based on tests of only one device of each size but they were nonetheless termed "minimum voltage criteria." The team agreed that adequate margin existed between the tested values and calculated voltage, but that a more rigorous approach was needed to establish conservative "minimum" operating voltages.

Calculation OSC-2059 demonstrated that all low voltage circuit breakers were applied within their interrupting ratings except one non-safety breaker which was applied approximately 2% in excess of its rating. This condition did not affect safety related equipment and was not considered significant. The licensee had not developed justification for fuses applied at voltages slightly higher than published ratings as recommended by the SITA team. Although the team considered this to be a valid concern, the fuses in question were used only in non-safety circuits and would experience overvoltage only during plant shutdown, and thus did not present a nuclear safety concern.

### 6.1.2 Protection, Coordination and Containment Electrical Penetration Protection

Coordination documented in calculation OSC-3120 was adequate although there was a lack of coordination between MCC load breakers and the MCC feeder breakers in the instantaneous region due to series molded case circuit breakers. Load cable impedance generally reduced fault levels such that coordination existed for faults at the loads. Armored cable was used and only one string was affected by faults near the output of breakers so this was adequate.

There was a slight loss of coordination between the 600 VAC MCC feeders and certain older model downstream 208 VAC MCC feeders. This miscoordination was in a narrow range and was not a significant problem.

Protective devices for low voltage motors were not expected to actuate during severe voltage dips experienced during loading from Keowee underground since control circuit fuses were sized for sustained inrushes and delayed contactor pickup was tolerable. Overload protection was oversized to avoid tripping of motors and Motor Operated Valve (MOV) motors could withstand stall conditions for the duration of expected voltage excursions.

The team noted that 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 licensee stated that a formal calculation was in progress.

6.1.3 Equipment Ratings

Calculations OSC-4441 and OSC-2059 demonstrated that ratings of load center transformers were adequate for expected loadings. There was no calculation relating to cable sizing, but a review of several cables by the team indicated conservative sizing for continuous, overload, and short circuit loading.

6.2 125 VDC Instrumentation and Control Power System

The 125 VDC Instrumentation and Control Power System was reviewed to assess battery capacity, system voltage, load and short circuit current capabilities, protection and coordination, and single failure criteria.

6.2.1 Battery Sizing and Battery Chargers

Battery capacity calculation OSC-2429 did not consider a single failure consisting of a fault on the system or the worst case configuration allowed by TS which would result in three batteries with 58 cells each available. Preliminary calculations performed by the licensee demonstrated that first minute voltage resulting from these scenarios would be lower by 0.7V and 0.9V, respectively, than the previously analyzed worst case. This difference was not sufficient to alter conclusions relative to system voltage as discussed below.

Calculation OSC-2059 demonstrated that battery chargers did not receive rated voltage under severely degraded grid conditions. The licensee provided an analysis to support operability of the chargers but no test data or vendor concurrence was available. The team noted that reduced battery charger output would not cause an immediate operability concern and that sustained operation at a voltage just above the first level protection setpoint was extremely unlikely. The licensee also stated that all of the chargers would be replaced within two years with equipment specified and tested to meet the postulated voltage extreme. On this basis, the team found the condition to be acceptable.

Per calculation OSC-4653, battery chargers were sized to meet the existing design basis of a one hour duty cycle. New chargers will be sized to meet the IEEE-946 criteria for an eight hour duty cycle.

6.2.2 System Voltage and Short Circuit Calculations

Draft calculation OSC-4276 indicated that system voltage was not sufficient to provide manufacturer's recommended minimum voltage to some equipment. Voltage shortfalls were small (less than 10% below guaranteed minimums) but component tests to prove adequacy were questionable in some cases.

Calculation OSC-2182 demonstrated that circuit breakers were adequately rated to interrupt the maximum available fault current.

6.2.3 Protection and Coordination

Data in calculation OSC-3120 indicated a lack of coordination in the instantaneous region between a non-safety load breaker and the upstream isolating diode protection and panelboard feeder breakers. This lack of coordination was for cable faults near or at the load breaker. Cable and fault resistance allow selective tripping for faults at the load. Armored cable was used and only one string was affected by unlikely close in faults, so this was adequate.

Calculation OSC-3120 further demonstrated that non-safety inverter isolating diode protection did not coordinate with upstream distribution center protection such that a bolted fault at the diode output could disable redundant 125 VDC strings. In response to the team's concern, the licensee performed preliminary calculations based on revised cable lengths which demonstrated adequate coordination.

6.3 Switchyard 125 VDC Power System

The Switchyard 125 VDC Power System was reviewed to assess battery capacity, system voltage, load and short circuit current capabilities, protection and coordination, and single failure criteria.

6.3.1 Battery Sizing

Calculation OSC-4458 determined switchyard battery capacity using a combination of measured loads and tabulated loads and was found to be adequate.

6.3.2 System Voltage and Short Circuit Calculations

Draft calculation OSC-4458 indicated that system voltage was not sufficient to provide manufacturer's recommended minimum voltage to some equipment. For example, the calculation determined that voltage at the terminals of the Cutler Hammer Type M relay used in the PCB trip on Transformer Lockout circuits was 71.5 VDC. This was less than 60% of rated voltage. Manufacturer's guaranteed pickup was 85% of rated, or

102 VDC. The calculation listed alternative minimum pickup voltages of 50% and 60% of rated for cold coils and warm coils respectively. These values were based on a test of 6 relays but the test report indicated that these were average values. These average values were incorrectly interpreted as the minimum values. The actual range of tested voltages was not known so the margin between the maximum tested values and calculated values could not be determined. (See Appendix A, Finding 2)

The team felt that rigorous testing of a statistically significant sample under controlled conditions, with conservative margins applied to the results should have been performed when manufacturer guaranteed minimums were not met. Test data presented to the team did not meet these standards.

Calculation OSC-3120 demonstrated that circuit breakers were adequately rated to interrupt the maximum available fault current.

6.3.3 Protection and Coordination

Data in calculation OSC-3120 indicated a lack of coordination in the instantaneous region of series molded case circuit breakers such that a fault at the output of the PCB control circuit isolation diodes could cause a loss of redundant panelboards. In response to the team's concern, the licensee performed preliminary calculations based on revised cable lengths which demonstrated that adequate coordination would exist for at least one panelboard, thus eliminating the possibility of losing redundant panelboards.

6.4 120 VAC Vital Power

Calculation OSC-4653 demonstrated adequate inverter capacity. Calculation OSC-3120 demonstrated adequate circuit breaker and fuse coordination.

EXIT MEETING

The team met with licensee representative noted in Appendix C at the conclusion of the inspection on March 5, 1993, at the plant site. There were no dissenting comments received. Proprietary information is not contained in this report.

## Appendix A

Finding 1: Lack of Integrated Test of Emergency Power Source for Oconee and lack of test to demonstrate design capability.

Description:

The following electrical features of the emergency power source (Keowee) have not been tested nor has the power path been fully tested to demonstrate design capability:

The switchyard isolation (relay 94) of the EGIPS had never been tested. The switchyard isolate complete feature had not been tested. (para. 2.3.1)

The overhead path from Keowee to the switchyard has never been tested. (para. 3.3.1)

Keowee Hydro Emergency Start (PT/0/A/0620/16) test procedure does not test the units in the method that UFSAR Section 8.3.1.1.1 indicates that the unit is loaded. ( para. 3.4.2.1)

The composite of the present Keowee tests do not bound the design requirements. (para. 3.4.2.1)

Safety Significance:

Tests would demonstrate that the emergency power system will perform its design bases function satisfactorily. A lack of these types of test could lead to the emergency power source being unavailable.

Finding 2: Analyses, study, or calculations not complete or not performed.

Description:

The following are examples of calculations that were not complete, or supportive:

The calculation OSC-2059 may not have taken the worst bounding condition when determining the voltage on the 4160V and lower voltage safety busses. (para. 2.3.2)

The team noted that there was no analysis nor test to verify that the rapid transfer (transfer of power to MFBs) timing was correct. (para. 2.5)

The licensee did not have a transient voltage study for the 4 kV safety load groups when they are supplied from the Lee gas turbine or from Central substation. (para 2.6.1)

No study had been conducted to review control cable length and the size of the fuses being used to protect such circuits. (para. 2.7.3)

KC-0073, Auxiliary Power System Voltage Level, Rev 1, (3/9/92), a voltage analysis of the Keowee 600V auxiliaries was considered incomplete. The maximum and minimum expected voltages should have been determined for the evaluation. (para. 3.2.4.4)

Analysis to support the fact that Keowee auxiliaries will not be degraded due to overvoltages or overfrequency conditions when being supplied from one Keowee Unit. (para. 3.2.4.4)

Identify the full scope and complete individual voltage component calculations for Keowee. (para. 3.2.4.4)

The licensee could not provide an analysis to support the assumption that Oconee safety loads could properly perform during an overfrequency transient lasting 40-50 seconds. (para. 3.3.3)

Several calculations were not complete for the SSF. (para. 5.1)

To support calculation OSC-4458 for the Switchyard 125 VDC power a more rigorous test of the minimum required pickup voltage may be needed. (para. 6.3.2)

Safety Significance:

Incomplete or inadequate design calculations can lead to unclear design bases, improper equipment specification and equipment qualification evaluations, performance, and modifications.

Finding 3: Examples of inadequate control of drawings and setpoint document.

Description:

Inaccuracies were noted in the recently developed Keowee mechanical support systems flow diagrams. Drawings of the Keowee air systems were not available. This was acknowledged as PIP-0-093-0197. (para. 3.2.2)

A controlled document for the setpoints at Keowee (except for electrical relay settings) was not available. (para. 3.3.4.3)

Safety Significance:

Lack of correct and controlled documents can effect how systems and components are maintained and operated.

Finding 4: Areas where additional licensee actions are warranted to complete corrective actions.

Description:

The response of the Keowee governor system to postulated failures (ie., loss of oil level) was not fully analyzed or understood. (para. 3.2.4.1)

Implementation of the setpoint revision to the Loss of Field relay at Keowee had not been implemented. (para. 3.2.4.1)

Safety Significance:

Corrective actions should be thorough and complete to assure that the complete problem is understood and corrected.

Finding 5: Keowee engineering analyses were not sufficiently comprehensive and specific values had not been established that would bound design criteria.

Description:

The licensee did not consider all credible failure modes for the Keowee govenor control system and voltage regulator. (para. 3.2.4.1)

The basis for bypassing Keowee trip functions during emergency start of the unit was not fully analyzed or documented. (para. 3.2.4.2)

The effect of frequency of the electric power supplied by Keowee to ECCS pump motors had not been fully evaluated. (para. 3.4.1)

Acceptable voltage and frequency limitations for Keowee electrical auxiliaries and the emergency power system should be defined. Additionally, acceptable recovery times from voltage and frequency excursions should also be identified. (para. 3.4.1)

Safety Significance:

Engineering analysis should be complete and address the application to which the equipment or system must perform.

Finding 6: Design Features and Mechanical Components at Keowee Were Identified That Were Not Being Tested.

Description:

The team identified several components involved in the operation of the Keowee units during an emergency start which were not being tested. (para. 3.4.2.4)

Testing was not being performed on safety related mechanical components (ie., coolers and pumps). (3.4.2.4)

Safety Significance

All design features and components that could effect the performance of the design bases function should be included in the testing of that function.

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| A | Amperes |
| ABB | Asea Brown Boveri |
| ACB | Air-operated Circuit Breaker |
| AEOD | Analysis and Evaluation of Operational Data, Office for (NRC) |
| AGC | Automatic Generation Control |
| AIT | Augmented Inspection Team |
| ANSI | American National Standards Institute |
| CCVT | Coupling Capacitor Voltage Transformer |
| CSMP | Continuous System Modeling Program |
| CTG | Combustion Turbine Generator |
| DBD | Design-basis Document |
| DBE | Design-basis Event |
| DED | Design Engineering Department |
| ECCS | Emergency Core Cooling System |
| EDS | Electrical Distribution System |
| EFW | Emergency Feed Water |
| EGTPS | External Grid Trouble Protection System |
| ES | Engineered Safeguards |
| GOPT | Governor Oil Pressure Tank |
| HPIP | High-pressure Injection Pump |
| HVAC | Heating, Ventilation, and Air Conditioning |
| IEEE | Institute of Electrical and Electronics Engineers |
| IPCEA | Insulated Power Cable Engineers Association |
| JTA | Job Task Analysis |
| KFD | Keowee Flow Drawing |
| kV | Kilovolts |
| LCO | Limiting Condition for Operation |
| LER | License Event Report |
| LOCA | Loss of Coolant Accident |
| LOOP | Loss of Offsite Power |
| LPI | Low Pressure Injection |
| LPSW | Low Pressure Service Water |
| MCC | Motor Control Center |
| MDEFW | Motor Driven Emergency Feedwater |
| MFBMP | Main Feeder Bus Monitoring Panel |
| MFB1 | Main Feeder Bus 1 |
| MFB2 | Main Feeder Bus 2 |
| MOV | Motor Operated Valve |
| MVA | Megavolt-Ampere |
| MW | Megawatt |
| NPRDS | Nuclear Plant Reliability Data System |
| NRC | Nuclear Regulatory Commission |
| ONS | Oconee Nuclear Station |
| PIP | Problem Identification Process |
| PIR | Problem Identification Report |
| PMG | Permanent Magnet Generator |
| PRA | Probablistic Risk Assessment |
| QC | Quality Control |
| QSM | Quality Standards Manual |
| RBS | Reactor Building Sprays |
| RCP | Reactor Coolant Pump |

| | |
|---|---|
| RCS | Reactor Coolant System |
| RFO | Refueling Outage |
| TS | Technical Specifications |
| SITA | Self Initiated Technical Audit |
| SQUG | Seismic Qualification Utility Group |
| UFSAR | Updated Final Safety Analysis Report |
| USAS | United States of America Standards |
| VAC | Volts Alternating Current |

## APPENDIX C

## PERSONS CONTACTED

Licensee Employees

| | |
|---|---|
| *S. Adams | Manager, Community Relations, Oconee |
| *A. Ballard | Corporate Communications, Charlotte |
| *W. Barron | Station Manager |
| R. Beaver | Electrical Engineer |
| R. Brock | Electrical Engineer |
| *D. Brown | Electrical Engineering |
| *R. Colaianni | Nuclear Licensing |
| D. Couch | Keowee Plant Manager |
| *D. Coyle | Systems Engineering Manager |
| *J. Davis | Safety Assurance Manager |
| D. Deatherage | Operations Support Manager |
| *R. Dobson | Supervisor, Electrical Engineering |
| *J. Hampton | Site Vice-President, Oconee site |
| *D. Hubbard | Component Engineering Manager |
| *D. Jamil | Electrical Engineering |
| *C. Little | I & E Superintendent |
| *B. McAlister | Supervisory Engineer, Component Engineering |
| *P. North | Compliance Engineer |
| *M. Patrick | Compliance Manager |
| *B. Peele | Engineering Manager |
| *G. Rothenberger | Superintendent, Work Control |
| *J. Rowley | Systems Engineering |
| *M. Sills | Civil Engineering |
| P. Stovall | Director of Operator Training |
| *P. Street | Systems Engineering |
| D. Sweigart | Operations Superintendent |
| *H. Tucker | Vice President Nuclear Operations |

Other licensee employees contacted during this inspection included engineers, operators, technicians, and administrative personnel.

NRC Personnel:

| | |
|---|---|
| *F. Burrows | NRR, Electrical Engineer |
| *K. Clark | Public Affairs |
| *B. Desai | Resident Inspector |
| *N. Fields | NRR, Events Assessment |
| *A. Gibson | Director, Division of Reactor Safety |
| *P. Harmon | Senior Resident Inspector |
| *A. Herdt | Branch Chief, Division of Reactor Projects |
| *C. Julian | Branch Chief, Division of Reactor Safety |
| *D. Matthews | NRR, Project Directorate |
| *J. Rosenthal | Branch Chief, Reactor Operations Analysis Branch, AEOD |
| *E. Weiss | NRR, Section Chief, Electrical Engineering |
| *L. Wiens | NRR, Project Manager |

* Attended Exit Meeting

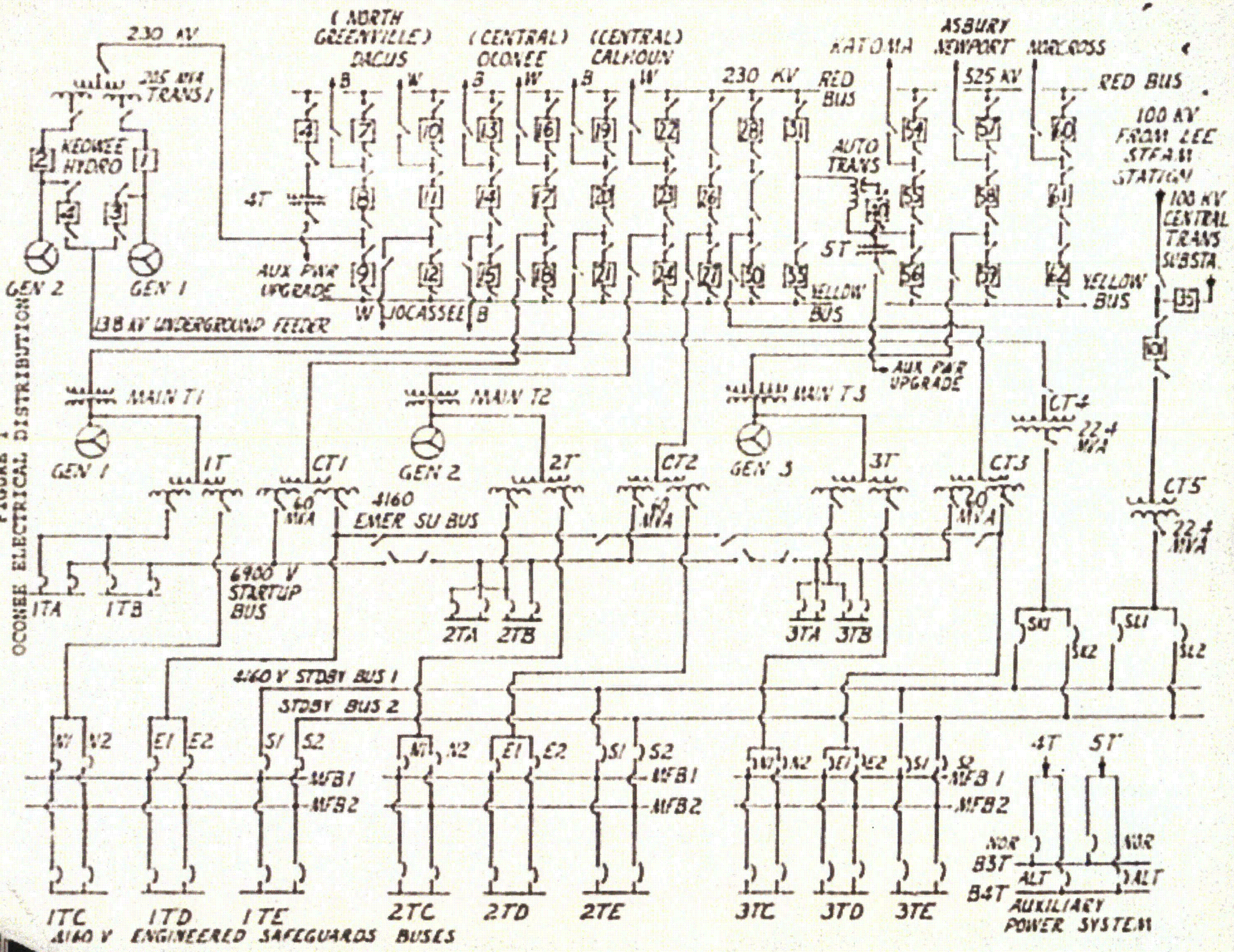


FIGURE 1
OCONEE ELECTRICAL DISTRIBUTION

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

MEMORANDUM TO: Meena K. Khanna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: John E. Thorp, Chief
Instrumentation and Controls Branch
Division of Engineering
Office of Nuclear Reactor Regulation

SUBJECT: LICENSE AMENDMENT REQUEST FOR SUSQUEHANNA STEAM ELECTRIC STATION THE CHANGE TO TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENT (SR) 3.5.1.12 (TAC NOS. MF1955 AND MF1956)

By letter dated June 6, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13158A096), the licensee requested approval for the proposed amendments to the Susquehanna Steam Electric Station (SSES) Unit 1 and Unit 2 Technical Specifications (TS) and Surveillance Requirements (SR). This license amendment would change Surveillance Requirements (SR) 3.5.1.12 in Technical Specification 3.5.1 "ECCS - Operating."

Specifically, the proposed amendments would eliminate the TS requirement for the Automatic Depressurization System (ADS) valves to open during manual actuation of the ADS circuitry test. Additionally, the proposed amendments change the surveillance frequency from "24 months on a staggered test basis for each valve" to "24 months." The proposed change will reduce the potential for valve seat misalignment and leakage during operation that can be caused by opening the valve to perform SR 3.5.1.12.

The Instrumentation and Controls Branch (EICB) has reviewed the licensee's submittal. Within the scope of its review, the EICB staff finds the proposed TS changes to be acceptable. EICB's safety evaluation input is enclosed.

Enclosure:
Safety Evaluation

CONTACT: Karl Sturzebecher, NRR/DE/EICB
(301) 415-8534

MEMORANDUM TO: Meena K. Khanna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

FROM: John E. Thorp, Chief
Instrumentation and Controls Branch
Division of Engineering
Office of Nuclear Reactor Regulation

SUBJECT: LICENSE AMENDMENT REQUEST FOR SUSQUEHANNA STEAM ELECTRIC STATION FOR THE CHANGE TO TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENT (SR) 3.5.1.12 (TAC NOS. MF1955 AND MF1956)

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Enclosure:
Safety Evaluation

CONTACT: Karl Sturzebecher, NRR/DE/EICB
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# SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION INSTRUMENTATION AND CONTROLS BRANCH LICENSE AMENDMENT REQUEST FOR SUSQUEHANNA STEAM ELECTRIC STATION FOR THE CHANGE TO TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENT (SR) 3.5.1.12 (TAC NOS. MF1955 AND MF1956) DOCKET NUMBERS 50-387 AND 50-388

## 1.0 INTRODUCTION

By letter dated June 6, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13158A096), the license amendment request (LAR) along with the requests for additional information (RAIs) provided sufficient information for a technical review of the requested Technical Specifications (TS) and Surveillance Requirements (SR) changes. The specific changes evaluated herein are for TS 3.5.1 and SR 3.5.1.12 and the associated Bases for this requirement allow stroking of only the reactor safety/relief valves (S/RVs) actuator to demonstrate operability without moving the valve stem and seat.

The Susquehanna Automatic Depressurization System (ADS) S/RVs are Crosby Model HB-65-BP Dual Function S/RVs, which are designed to perform as either a safety valve or as a relief valve. The safety valve mode of operation is independent and separate from the relief valve mode. The safety valve mode of operation is initiated when the increasing static inlet steam pressure overcomes the restraining spring and frictional forces acting against the inlet steam pressure to move the disc in the opening direction. The relief valve mode of operation is initiated when an electrical signal is received at any or all of the solenoid valves located on the pneumatic relief-mode actuator assembly. The manual actuation of the ADS valves is initiated from the control room. The solenoid and air control valve will open to allow an air source to pressurize the lower side of the piston in the pneumatic cylinder to push it upwards. This action is transmitted through a lever arm and pivot mechanism which in turn pulls the valve lifting nut upwards, thereby opening the valve to allow steam discharge through the valve. Upon de-energizing the solenoid, the air valve will reposition to allow the pressurized air in the cylinder to vent to atmosphere and thus close the valve. Six of the S/RVs use the relief valve mode to perform the ADS function.

Each Susquehanna unit use six of the S/RVs as ADS valves to reduce reactor pressure during small breaks in the event of High Pressure Coolant Injection (HPCI) failure. After reactor vessel pressure is reduced to the capability of the low-pressure systems, Residual Heat Removal (RHR) low pressure coolant injection (LPCI) mode and Core Spray (CS), these low pressure systems provide inventory makeup to maintain acceptable post-accident temperatures. The ADS functions to depressurize the Reactor Coolant System (RCS) to allow the combination of the LPCI and CS operation to inject into the RCS. The ADS valves can be opened automatically or manually.

The current SR 3.5.1.12 verifies the ADS valves can be manually opened with the associated solenoids and are functioning properly by observations. The SR is required to be performed at least once per 24 months on a staggered test basis for each solenoid. During each refueling outage in accordance with the SR, the ADS valves are removed from the plant and setpoints tested. The setpoint testing program includes the manual actuation of the ADS valves during bench testing of the valves. The ADS valves are reinstalled in the plant and the SR is performed on all of the ADS valves to manually actuate the valves with plant-installed equipment.

## 2.0 REGULATORY EVALUATION

The NRC staff regulatory evaluation is based on the following guidance and regulations documents below:

- Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.36 requires in part that the operating license of a nuclear production facility include technical specifications. Paragraph (c)(2)(ii) of that part requires that a limiting condition for operation (LCO) of a nuclear reactor must be established for each item meeting one or more of four criteria. The S/RV functions identified in LCO 3.5.1 meet Criterion 3, "A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier." Paragraph (c)(3) further requires the establishment of surveillance requirements, "relating to test, calibration, or inspection to assure ... that the limiting conditions for operation will be met." As discussed above, the proposed changes in the surveillance requirements for the S/RVs are sufficient to demonstrate the safety and relief modes of operation for the S/RVs, and therefore, are sufficient to ensure the limiting conditions for operation are met.

- IEEE 279-1971, "Criteria for protection systems for nuclear power generation stations," describes test data for equipment qualifications, which on a continuing basis need to achieve a particular level of system accuracy, as per 4.4 "Equipment qualifications." The extrapolation of test data can demonstrate the quality levels achieved through inspection, calibration and testing, which is stated in 4.3 "Quality of components and modules." The LAR provided data through LERs and an S/RV test case and thus supported the proposed change to the surveillance procedures.

- (Regulatory Guide) RG-1.118, "Periodic Testing of Electrical Power and Protection Systems" provides a regulatory position replacement description for a logic system functional test, as noted in Section 6.3.5 of IEEE Std. 338-1987, "IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems." The logic system functional test does not have to include the actuated device, to verify operability. Simultaneous testing of the system from the sensor to the actuated equipment may not be practical, and thus a system design shall provide an overlap testing capability as part of the periodic surveillance testing procedure. Furthermore from Section 5.5 of IEEE Std. 338-1987 the testing an instrument channel and logic circuits separate from the actuator devises is acceptable.

- 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 13, "Instrumentation and control" demonstrates instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems, affecting the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges.

The present Susquehanna methods for the S/RV surveillance have been recognized industry wide as causing unnecessary shifts to the accuracy of the valve and further performance challenges.

## 3.0 TECHNICAL EVALUATION

The staff has reviewed the licensee's proposed TS change and finds the current surveillance requirements can result in additional seat leakage of the ADS valves during power operation. Such leakage would be directed to the primary containment suppression pool, causing a need to increase cooling to the suppression pool water or a plant shutdown to fix the leaking valve. The proposed testing provides for actual stroking of the ADS S/RVs after performing the American Society of Mechanical Engineers (ASME) Code setpoint testing on a sample of valves combined with stroking only the S/RV actuators after the ADS S/RVs have been installed.

At Susquehanna the ADS valves are removed from the plant and setpoint tested during each refueling outage in accordance with SR 3.5.1.11. The setpoint testing program includes the manual actuation of the ADS valves during the bench testing of the valves. The ADS valves are reinstalled in the plant and SR 3.5.1.12 is performed on all of the ADS valves to manually actuate the valves with plant-installed equipment. Prior to start-up, valves will have been cycled with the actuator, which can cause misalignment of the valve internals. The response to staff's request for additional information (EICB RAI #1) demonstrated that further cycling of the valves with the actuator not only misaligns the valve's load bearing parts but also can upset/shift the valve's setpoint from the criteria set forth in the TS. The six listed licensee event reports (LERs) showed a continued pattern and a general lowering of the valve's set pressure.

The phenomena of set pressures being found outside of the acceptance criteria was documented in a Crosby Receipt inspection report for the S/RVs. A valve with a nameplate set pressure of 1205 psig was subjected to a series of actuations and the new set pressure was recorded after each actuation. The final setpoint shifted downward an average of 0.43% on this particular valve. This data is consistent with the industry operating experience, which has produced that the number of S/RV openings needs to be reduced as much as possible and unnecessary challenges to the S/RV should be avoided.

The licensee states that the proposed change to the SR would allow the uncoupling of the ADS valve stem from the plant-installed remote manual actuation equipment prior to performing SR 3.5.1.12, thereby allowing the verification that the plant-installed manual actuation equipment functions without requiring the opening of the ADS valve. The ADS valves that are removed during each refueling outage will continue to be manually actuated during the bench testing of the valves as part of the setpoint testing program. The uncoupling of the ADS valve stem from the plant-installed remote manual actuation equipment will allow increased testing of the manual actuation valve solenoids without cycling the valve.

The LAR states that all of the components necessary to manually actuate the ADS valve will continue to be tested. The proposed changes to SR 3.5.1.12 will result in the testing of the manual actuation of the S/RVs being performed in two overlapping steps in accordance with the requirements of SR 3.5.1.11. The setpoint testing of the ADS valves is performed after the valve and actuator assemblies have been removed from the plant and transported to an approved vendor. The valves are bench tested at the vendor location to verify the safety and relief mode of valve operation. The safety mode is tested by verifying the pressure required below the valve disc to open the valve is consistent with design requirements. The relief mode is tested by providing air to the valve actuator and verifying the performance of the valve actuator, lever, and pivot mechanism to open the valve. The proposed changes to SR 3.5.1.12 would require the testing of the ADS valves manual relief mode after the valves are installed in the plant. The testing would be performed with the actuator uncoupled from the valve stem to allow the testing of the manual actuation electrical circuitry, manual actuation solenoid and air control valve, and the actuator without causing the ADS valve to open.

The staff notes that, with the proposed change to SR 3.5.1.12, all of the ADS S/RV air solenoids will be actuated on a 24-month frequency. This is more frequent that the current SR which requires only that the air solenoids be tested on a staggered basis when the ADS S/RVs are actuated. Therefore, this part of the proposed change exceeds the current TS requirement.

## 6.0 CONCLUSION

Based on its review of the proposed TS change and discussion of the RAI's, the staff finds that the proposed surveillance testing change is acceptable. The only significant difference between the current surveillance testing and the testing proposed by the licensee is the sampling approach to stroke-testing a portion of the total S/RV population each outage, when the S/RVs are setpoint tested, is less than the current testing of all S/RVs each refueling. However, the proposed change logically provides for the stroking of S/RV actuators only when setpoint tests, or maintenance or repair activities, are performed. This approach reduces the unnecessary challenges to the S/RV, and increases the frequency of testing of the ADS S/RV air solenoids loop, and logic system while maintaining the proper overlap of valve testing per six year intervals, when the entire valve is shipped for certified testing and rebuild.

As noted in the regulatory evaluation in RG-1.118, the logic system functional test does not have to include the actuated device, to verify operability. Simultaneous testing of the system from the sensor to the actuated equipment may not be practical, and thus a system design shall provide an overlap testing capability. This proposed detachment of the valve from the actuator under a controlled periodic surveillance testing procedure acceptably falls within the code and thus improves system accuracy required by IEEE Std. 279-1971, 4.4.

The NRC Staff has concluded, that (1) there is reasonable assurance the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance the changes in the post-LAR modified plan configuration for the new system activities will be correctly and accurately documented in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

## 7.0 REFERENCES


- IEEE Std. 279-1971,"Criteria for Protection Systems for Nuclear Power Generating Stations."
- IEEE Std. 338-1987, "IEEE Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems."
- Regulatory Guide 1.118, "Periodic Testing of Electric Power and Protection Systems," Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, 1995.


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