Summary Report on Emergency Power System Initiatives

Oconee Nuclear Station

December 12, 1995

(This document does not contain any new regulatory commitments beyond those set forth in previously docketed correspondence to the NRC)

Table Of Contents

Section		Page
1. Executive Summary		1
2. Overview of Oconee AC Power System		4
3. Emergency Power System Reviews		5
a.	Design Basis Documentation Program	5
b.	1989 4kV Power System SITA	6
c.	1992 Emergency Power System SITA	6
d.	NRC Augmented Inspection Team	7
e.	NRC Electrical Distribution System Functional Inspection	8
f.	Summary	9
4. Initiatives		10
a.	Organizational Initiatives	10
b.	Programmatic Initiatives	11
c.	Equipment Initiatives	19
d.	Ongoing Initiatives	20
5. Risk Insights		22
a.	Oconee IPEEE	22
b.	Keowee PRA	22
c.	Oconee IPE	23
d.	Station Blackout	24
6. Summary/Conclusions		25
Figure 1 -	Oconee AC Power System Schematic	
Table 1 -	List of Design Basis Documents on the Emergency Power System	

List Of Attachments

Attachment 1 - Emergency Power System LERs (1988-1995)

Attachment 2 - Findings From the 1992 Emergency Power System SITA

Attachment 3 - Commitments From the Oconee Emergency Power Management Plan

Attachment 4 - Oconee Nuclear Site Directive 8.1.2, "Keowee Hydro Station"

Attachment 5 - Major Accomplishments From the Emergency Power Project

1. Executive Summary

The NRC is currently conducting an internal review of the Oconee emergency power system. As part of this review, NRR, AEOD, and CRGR personnel visited Oconee Nuclear Site on three separate occasions in November of 1995. These visits included tours of Oconee Nuclear Station, Keowee Hydro Station, and Lee Steam Station, reviews of procedures and design documentation, and discussions with station personnel. As a result of these visits, Duke Power felt that the NRC Staff might benefit from a summary report documenting Duke Power's initiatives related to the Oconee emergency power system. This document provides a compilation of past reviews and initiatives that are associated with the emergency power system.

The Oconee AC power distribution system consists of diverse power sources and paths. Any single power source is capable of supplying the emergency loads of all three Oconee units. If all AC power is lost, the Standby Shutdown Facility, as the alternate AC power source, can be used to maintain the plant in a safe shutdown condition.

Several licensee initiated reviews and NRC reviews have been conducted in the last 6 years which confirmed the Oconee emergency power system can perform its intended safety function. These reviews included the Duke Design Basis Documentation (DBD) program, two self initiated technical audits, an inspection by an NRC Augmented Inspection Team and the NRC Electrical Distribution System Functional Inspection (EDSFI). The DBD program established a solid foundation to continuously improve the interpretation and implementation of design basis requirements at Oconee. These reviews and resultant corrective actions identified findings, reportable items, NRC violations, and strengths. A majority of the reportable items have been licensee identified. The vast majority of the corrective actions stemming from these reviews are complete. Oconee is in the process of closing out the few remaining corrective actions.

Over the past few years, Oconee has implemented many significant initiatives which have improved the emergency power system. Some of these initiatives were not associated with an NRC commitment. Therefore, a review of the Oconee docket alone may not give a complete current state of the emergency power system.

The initiatives section in the report outlines some significant organizational, programmatic, and equipment

initiatives that have enhanced the emergency power system. In the area of organizational initiatives, the reorganization of Engineering, reorganization of Keowee Operations, and the transfer of switchyard responsibility to the station positively influenced the integration of Keowee and the switchyard into Oconee programs and processes. A special project team, referred to as the Emergency Power Project, was chartered in late 1994. This project completed outstanding action items and commitments associated with Keowee and the emergency power system and integrated Keowee Hydro Station into Oconee Nuclear Site programs and processes. For example, the site Maintenance, Operations and Work Control Groups now have responsibility for planning, scheduling, and implementing all preventive and corrective maintenance at Keowee.

Programmatic initiatives were undertaken in the areas of training, human performance, the USI A-46 program, the Keowee PRA, testing, procedures, and design basis documentation. Enhanced training, procedures, and engineering support and documentation assure that station personnel understand the design basis and operational features associated with the emergency power system. The report also summarizes significant equipment enhancements that further assure the emergency power system is diverse, reliable, and safely operated in a manner consistent with applicable design basis and licensing basis requirements.

Many initiatives have been recently completed that have positively impacted the emergency power system. Additional initiatives are being implemented to further improve performance at Oconee. Human performance, self assessments, implementation of the Maintenance Rule, and configuration control are examples of initiatives currently in progress. Although these initiatives are focusing on improving the performance of the site as a whole, they will also positively impact the reliability and availability of the emergency power system.

In the area of risk assessment, the Keowee PRA and Oconee Individual Plant Examination (IPE) have been completed. The Oconee Individual Plant Examination of External Events (IPEEE) is scheduled to be submitted to the NRC by December 31, 1995. These risk assessments further confirm that the emergency power system is highly reliable. The probability of a loss of all AC power at Oconee is very low. Finally, the Keowee PRA concludes that the core damage risk of accidents involving a loss of AC power is very low, about one in a million.

In conclusion, the ability of the emergency power system to perform its intended safety function and meet the applicable design and licensing requirements has been verified.

2. Overview of Oconee AC Power System

The Oconee AC power distribution system consists of diverse power sources and paths. During Oconee unit operation, the Oconee generator provides power to the Oconee auxiliary loads through the normal auxiliary transformer. Following a reactor trip or shutdown, the Oconee auxiliary loads are powered from the 230kV switchyard through the startup transformer.

If the 230kV switchyard is unavailable, power can be provided by the emergency onsite power sources. One onsite source consists of one Keowee unit through the overhead emergency power path and Oconee startup transformer. The other onsite source consists of one Keowee unit through the underground power path and transformer CT4. Alignment of the emergency power sources during an event is performed automatically by the emergency power switching logic (EPSL). In addition, manual operation is available to recover power through the use of the loss of power abnormal procedure.

Additional manual alignments are available to power an Oconee unit. Backcharging through the Oconee main transformer from the 230kV switchyard is possible once the Oconee unit's generator links have been removed. The standby buses can be energized through transformer CT5 by a combustion turbine from Lee Steam Station or the Central Switchyard. Another manual path consists of cross tieing the 4160V and 6900V buses between the Oconee units.

In the event that all AC power is lost at Oconee, the Standby Shutdown Facility offers a diverse alternate AC power source. The SSF provides makeup to the RCS and feedwater to the steam generators.

Figure 1 is a schematic of the Oconee AC power distribution system.

3. Emergency Power System Reviews

Several reviews of the emergency power system have been conducted since 1986. They include the reviews by the DBD program, 1989 4kV Power System Self Initiated Technical Audit (SITA), 1992 Emergency Power System SITA, 1992 NRC Augmented Inspection Team, and the NRC EDSFI in 1993. During these reviews, several reportable items were identified. Attachment 1 contains a brief summary of the LERs since 1988 that are related to the emergency power system. Of these items, only two corrective actions which are related to emergency power remain open from the licensee event reports (LERs) in Attachment 1. One corrective action will be completed with the installation of NSM ON-52966 at Keowee. The other corrective action involves modification of the RCP motor protection by NSM ON-1,2,32983. Implementation of the corrective actions from these LERs has improved the quality of the emergency power system.

a. Design Basis Documentation Program

Several design documentation deficiencies were discovered during the 1986 NRC Safety System Functional Inspection (SSFI). These deficiencies included the lack of a calculation for some operating modes of EFW, no Keowee dynamic analysis, and inadequate overpressure protection on one steam relief valve supplying the TDEFW pumps. In response to the findings from the SSFI, Duke initiated several generic reviews. This included a review of calculations to ensure all operating modes for systems are appropriately analyzed and a review of the electrical power distribution system.

At this time, Duke also recognized the need for a formal program to review the design basis for selected plant systems at all three Duke nuclear plants. In order to address this issue, Duke developed the DBD program in January of 1989. Duke met with the NRC on May 5, 1989, and July 28, 1989, to discuss the DBD program. During these meetings, Duke indicated the potential that reportable items may be discovered by the DBD program and Duke agreed to submit a separate LER for each reportable item.

The DBD program reviews design and licensing documentation and documents the design basis for selected plant systems. A DBD for a system includes design requirements, operating modes, system descriptions, and NRC commitments. In addition, the DBD effort reviewed the test acceptance criteria for systems against the design basis requirements.

The DBD program has been a major engineering initiative over the last six years. All DBDs related to the Oconee emergency power system are complete. These DBDs are listed in Table 1. All DBD reviews planned for Oconee Nuclear Station will be completed by December 31, 1995. The DBD program established a solid foundation to continuously improve the interpretation and implementation of design basis requirements at Oconee Nuclear Station.

b. 1989 4kV Power System SITA

Duke initiated a SITA on the 4kV power distribution system in 1989 which included a review of the emergency power switching logic. Duke met with the NRC on July 13, 1989 to discuss the scope of the SITA and the team composition. The SITA reviewed the system design, Technical Specifications, operating procedures, administrative procedures, preventative maintenance, surveillances, and operator training. Twelve findings, eight follow-up items, and eleven document discrepancies resulted from the SITA. All of these items have been closed out.

c. 1992 Emergency Power System SITA

Following several licensee identified problems associated with the emergency power system, a management meeting was held with the NRC on February 5, 1992, to discuss ongoing results from the DBD program, the 1989 4kV Power System SITA, and corrective actions associated with past issues. Plans for a SITA on the emergency power system, scheduled for March of 1992, were also discussed.

The emergency power system SITA was performed from March 23, 1992, to May 8, 1992. This SITA evaluated whether the electrical distribution system could perform its intended safety function as designed, installed, and configured.

Several strengths were identified by the inspection team. The most notable strengths consisted of the following items:

1) the design of the relaying protection schemes for the plant auxiliary systems and the offsite source;

2) the quality and usefulness of the electrical DBDs;

3) the quality of the electrical calculations;

4) the talent and technical supervision of the electrical engineering section and the familiarity with the

details and bases of the calculations and the system's design.

In the inspection report, the inspection team considered the design and implementation of the Oconee electrical distribution system generally acceptable. However, they indicated that additional analyses and documentation were necessary to better address certain design features of the emergency power system.

The results of the 1992 Emergency Power System SITA were discussed with the NRC in a meeting on June 4, 1992. Currently, only 6 corrective actions remain from the 86 items that were identified by the inspection team. Attachment 2 includes a list and status of the findings from the SITA.

d. NRC Augmented Inspection Team

Following an October 19, 1992, loss of offsite power event on Oconee Unit 2, the NRC used an Augmented Inspection Team (AIT) to review the events associated with the loss of offsite power. A key conclusion from the AIT was that the operator's response and recovery to the event was complicated by the lack of appropriate procedural guidance and the overall complexity of various electrical power systems interactions.

In response to these issues, Duke developed the Oconee Emergency Power Management Plan. This plan was discussed with the NRC in a March 22, 1993, management meeting at Region II. The management plan established expectations related to the conduct of operations, training, maintenance, and engineering at Keowee. The management plan has been revised since its initial issuance and is contained in Oconee Site Directive 8.1.2, "Keowee Hydro Station". A copy of the initial management plan was provided to the NRC in a Duke letter dated April 29, 1993.

The April 29, 1993, letter also contains the NRC commitments that were made by Duke following the loss of offsite power event. Only one NRC commitment remains open from the loss of offsite power event. This commitment will be completed when modification NSM ON-52966 is installed on Keowee. This modification, approved by the NRC in an SER dated August 15, 1995, eliminates the overhead path zone overlap single failure vulnerability. The modification also addresses Keowee overspeed and overfrequency vulnerabilities. Attachment 3 contains a list of the NRC

commitments that were submitted with the management plan on April 29, 1993, and their status.

e. NRC Electrical Distribution System Functional Inspection

From January 25, 1993, to March 5, 1993, the NRC conducted an EDSFI at Oconee Nuclear Station. The inspection assessed the ability of the electrical distribution system to perform its intended functions. In addition, Keowee was reviewed to determine the root cause of the deficiencies that were previously identified by Duke and the NRC.

One Notice of Violation, one Notice of Deviation with three parts, and six findings were issued with the EDSFI report. The inspection concluded that there was adequate assurance that the electrical distribution system will perform as intended pending further analysis and testing by the licensee.

The six findings from the inspection report included multiple parts. The major areas for the findings are listed below.

1) Lack of an integrated test of the emergency power source for Oconee and lack of a test to demonstrate design capability.

2) Analyses, study, or calculations not completed or performed.

3) Examples of inadequate control of drawings and setpoint documents.

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

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

6) Design features and mechanical components at Keowee were identified that were not being tested.

Duke responded to the findings in a letter dated July 6, 1993. Only one NRC commitment that was made in this response is open at the site. This commitment, associated with frequency effects on the auxiliary power system at Keowee, will be completed when modification NSM ON-52966 is implemented.

f. Summary

In summary, several reviews of the Oconee emergency power system occurred over the past six years. These reviews identified some design deficiencies and programmatic weaknesses. The majority of the reportable items were self-identified. In addition, the vast majority of all issues that are identified in these reviews have been completed and documented. A high priority has been assigned to the few remaining open items.

4. Initiatives

Initiatives have been implemented to resolve the issues that were identified by the reviews of the Oconee emergency power system. As a result of these initiatives, Keowee Hydro Station is integrated into the operations, maintenance, testing, and engineering programs at Oconee Nuclear Station and the reliability of the Oconee emergency power system has been enhanced. This section highlights various organizational, programmatic and equipment initiatives. Initiatives that improved the emergency power system, but were not driven by a corrective action stemming from an emergency power system issue, are included.

a. Organizational Initiatives

Engineering resources were redeployed to the site in 1992. This initiative combined the corporate design basis engineering resources with the site engineering organization that supported station operation. This reorganization improved communication between engineering and the station and enhanced the station's understanding of design basis requirements.

Keowee personnel were integrated into the Oconee Operations Group shortly after the October 19, 1992 loss of offsite power event. As a result of this initiative, the overall performance of Keowee operators meets the expectations of personnel operating and maintaining a nuclear power plant's emergency power system.

In 1994, engineering resources were reorganized to further integrate the design basis and system engineering functions. This initiative enhanced the system engineering program and streamlined the modification process. System engineers were identified for all key plant systems, including Keowee mechanical and electrical system engineers, a switchyard system engineer and a Standby Shutdown Facility system engineer.

An additional organizational initiative was the transfer of responsibility of switchyard activities from the Power Delivery Department to Oconee Nuclear Station. A Switchyard Oversight Committee was established to share information between Duke's transmission experts and the three nuclear sites. In addition, a switchyard coordinator position was staffed from the Oconee Operations Group to have oversight of all activities affecting the switchyard. The switchyard

coordinator and switchyard system engineer work together to monitor the performance of the Oconee switchyards.

In late 1994, a special project, referred to as the Emergency Power Project, was initiated to aggressively complete outstanding corrective actions related to emergency power. The objectives of the Emergency Power Project were to complete outstanding action items and commitments associated with Keowee and the emergency power system and to integrate Keowee Hydro Station into Oconee site programs and processes. A project team was assembled with a full time project manager. Additional engineering and craft resources were contracted to support this effort.

Duke Power met with the NRC on September 29, 1994, to describe the charter and scope of the Emergency Power Project. The Emergency Power Project focused on four key areas; design and testing; operation and maintenance; modifications; and drawing and documentation initiatives. At the September 29, 1994, management meeting, Duke Power committed to complete design and testing initiatives by June 1, 1995. In addition, Duke Power committed to complete operation and maintenance, modifications, and drawing and documentation initiatives by November 1, 1995.

As a result of the dedicated effort by the Emergency Power Project team, the commitments from the September 29, 1994, management meeting were satisfied. Outstanding issues were resolved and Keowee is integrated into the operations, maintenance, testing, and engineering programs at Oconee Nuclear Site. For example, the site Maintenance, Operations and Work Control Groups now have responsibility for planning, scheduling, and implementing all preventive and corrective maintenance at Keowee.

Some of the major accomplishments from the project are described in the programmatic and equipment initiatives sections of this report and are also listed in Attachment 5.

b. Programmatic Initiatives

This section reviews the major programmatic changes that have enhanced the operational readiness of the emergency power system.

Management Expectations

A major initiative in this area was the development of the Oconee Emergency Power Management Plan. The management plan is now contained in Oconee Site Directive 8.1.2, "Keowee

Hydro Station". This directive provides the management expectations for the conduct of operations at Keowee Hydro Station. An information copy of this directive is included as Attachment 4.

Training

Operator training on the emergency electrical system has been enhanced for both the Oconee and Keowee operators. This training improved the understanding of electrical power system interactions and the emergency start response of the Keowee units.

For Keowee personnel, enhancements were implemented in the initial operator and technician training programs and the requalification program. These programs are conducted in accordance with the Oconee Employee Training and Qualification System (ETQS) manual and are maintained by the Oconee Training Department. A complete Job Task Analysis was performed for Keowee operators and technicians, identifying approximately 75 operator tasks and 24 technician tasks. Keowee operators and Oconee operators are trained on modifications to Keowee. Job Performance Measures (JPMs) covering tasks that relate to supplying emergency power to Oconee Nuclear Station were developed for the Keowee operators. The Keowee operators are tested on these JPMs annually.

The Oconee operators are trained on the Keowee auxiliary power system. All Oconee operators are qualified to the tasks of supplying auxiliary power to Keowee Hydro Station and swapping control of Keowee to the ONS control room. A JPM was created on these tasks and is included on the list of JPMs from which the yearly NLO, RO, and SRO exams are selected. Training is conducted annually on the Keowee Emergency Start Abnormal Procedure. In addition, operators receive annual simulator training on the Loss of Power Abnormal Procedure.

Human Performance

Oconee Nuclear Station continues to focus on improving human performance. This initiative is not specific to the emergency power system. It involves the use of the corrective action program and team skills to facilitate human error prevention. Corrective action initiatives include the following items:

1) the root cause threshold was adjusted in order to perform approximately 50 high quality evaluations per year,

2) a core group of root cause analysts were trained and are utilized,

3) lower tier events are being more consistently coded to improve trending capabilities,

4) programmatic corrective actions are to be avoided when a root cause is not performed,

5) periodic common cause analyses are performed.

The team skills used in the prevention of human errors consist of accountability, pre-job briefing, STAR (Stop-Think-Act-Review), QV&V (Qualification, Verification, and Validation) and supervisory observations. Initiatives in these areas have contributed to a reduction in LERs due to human errors.

Review of NRC, INPO, OEP Items

A commitment from the management meeting with the NRC on March 29, 1993, involved a review of Keowee against past NRC, operational experience, and INPO items. A design study reviewed the 502 items that were identified as possibly being applicable to Keowee and concluded that 133 items were applicable to Keowee. Of the 133 items, only a handful of items remain open at the site.

Design Basis Documentation

An earlier section of this report describes the DBD program. This program is scheduled for completion on December 31, 1995. All of the electrical and mechanical system DBDs have been issued. This program involved a significant engineering effort and has improved the knowledge and documentation of the design basis of Oconee Nuclear Station.

A relatively recent enhancement to the DBDs involves the addition of test matrices. These matrices define the design basis functions for each system. Tests are reviewed against the matrix to ensure that design basis functions are adequately tested. If necessary, new tests are developed or existing tests are upgraded. During the development of the test matrices for the emergency power system, twelve new performance tests were conducted. The additional testing validated the conservatism of design basis calculations.

As part of the DBD program, numerous calculations have been created or revised. These calculations confirm the design basis and address system operation in different operating configurations. For example, dynamic voltage analyses were completed for the underground, overhead, and Lee power paths. In addition, voltage calculations were performed for the Keowee DC, 230 kV DC, and ONS Vital I&C Systems. All emergency power system engineering calculations that were included in the Emergency Power Plan were completed.

Testing

Several special tests were conducted in the recent past to further verify that the emergency power system can perform its intended function. Brief descriptions of significant special tests are provided in the following paragraphs.

As part of the design of modification NSM ON-52966, several Keowee load rejection tests were performed to collect data associated with the response of the Keowee units to a loss of load. These tests were performed at power levels ranging from 60 to 90 MW and consisted of both single and dual unit load rejections. Actual emergency start signals were used to initiate each load rejection.

A Keowee Black Start Test was performed to demonstrate Keowee's ability to emergency start with only DC power (black start) available to its auxiliaries. The black start feature was part of the original Keowee design and was tested as part of the pre-operational startup testing for Keowee. This feature was reverified during a one-time test in December of 1992. Although the black start test is considered a one-time test, this feature is demonstrated on a routine basis. During each Oconee Unit 1 EPSL functional test, the Keowee unit that is connected to the underground path is black started.

A one-time test of the Keowee overhead path with a Reactor Coolant Pump (RCP) Motor Load was performed on May 31, 1993, to collect data for the certification of a computer model. During the test, a 9000 hp RCP motor was block loaded onto an idling Keowee overhead path unit. The Keowee unit accepted this load as expected.

A one-time test of a Lee combustion turbine (CT) with the Auxiliary Service Water (ASW) Pump motor was performed on February 10, 1995, to collect data for the certification of a computer model. During the test, the ASW Pump motor was block loaded onto the standby buses which were powered by an

isolated Lee CT. In addition, other loads at Lee were added and rejected to obtain data for the response of the Lee CT during these transients.

A Keowee Low Power Test was performed during the recently completed Oconee Unit 1 refueling outage as part of the EPSL test. The Keowee underground unit was loaded as it accelerated to rated speed and voltage. When the Keowee unit was at steady-state, blocks of load were added and rejected from the Keowee unit. This test collected data on the Keowee unit during the load transients. During the test, Keowee performed as expected. Evaluation of the test data is currently is progress.

Procedures

As part of the Emergency Power Project, maintenance and testing procedures were upgraded. In some instances, new procedures were created to cover testing and maintenance activities. This initiative resulted in approximately 200 new or revised procedures.

A major effort was initiated to identify instruments that required calibration. At the end of this activity, approximately 300 instruments were calibrated using the new or revised procedures.

Drawings and Documentation

A thorough review of Keowee has been conducted to determine the proper quality assurance (QA) classification of systems and equipment. Keowee was not originally designed or purchased to QA-1 standards. However, replacements parts, testing, and maintenance on QA-1 equipment will meet the QA-1 standards.

In connection with the QA review of the Keowee systems and equipment, an improved process was implemented to facilitate the determination of the QA classification of components. This applies to the entire Oconee site, not just Keowee.

Over 1000 drawings were reviewed for proper QA classification. As a result of this effort, a QA-1 designation was added to approximately 800 drawings. Approximately 200 instruments were added to the plant setpoint documents. Additional flow diagrams were created for Keowee systems, a Keowee valve database was created, and Keowee equipment labeling was expanded and improved.

Seismic

Seismic qualification of the piping and supports for the QA-1 mechanical systems at Keowee is complete. This effort involved field walkdowns, calculations, and field modifications. In addition, sketches were drawn and identification tags placed on each QA-1 or QA-4 pipe support (approximately 80 supports) at Keowee.

Additional work in the seismic qualification area resulted in the inspection of the concrete expansion anchors on QA-1 and QA-4 pipe supports at Keowee. This was done using procedures similar to those used in IEB 79-02 at ONS.

Oconee is one of the USI A-46 plants affected by Generic Letter 87-02. Oconee is using the Seismic Qualification Utilities Group (SQUG) developed methodology employing the experienced based approach of confirming seismic adequacy. The seismic issues of the Individual Plant Examination of External Events (IPEEE) were combined with the SQUG effort wherever possible. Duke plans to submit the Oconee IPEEE response in December of 1995 and the Oconee USI A-46 response by December 31, 1996. A brief description of the current status on the USI A-46 effort is provided below.

In keeping with the guidelines for SQUG implementation, the Generic Implementation Procedure (GIP) is being used as approved by the NRC in the SER dated May 22, 1992. The Keowee Hydro Station and its two independent power paths are included in the SQUG scope. The other two non-grid power sources, Lee combustion turbines and Safe Shutdown Facility (SSF), are primarily being addressed from an IPEEE perspective and not from a SQUG Safe Shutdown Equipment List (SSEL) perspective.

Equipment selection has been comprehensive to meet several needs. The fundamental role of the SSEL is to satisfy the SQUG effort. In addition, the list has been supplemented, as needed, to meet the seismic margins approach described in NUREG-1407. Both system approaches required the identification of all primary and any secondary or supporting systems needed to meet the specific program assumptions. In addition to identifying the primary and support equipment, all the relays, contact devices, power supplies and the necessary monitoring and control devices were identified. Finally, the list was supplemented with Probabilistic Risk Analysis (PRA) items needing a walkdown to confirm fragility values used in the Oconee IPEEE.

Walkdown preparation of the SSEL began in April 1993. A consultant was used to assess some of the equipment in the emergency power system that did not fall into equipment classes specifically defined by the GIP. This consultant also walked cable trays and raceways throughout the plant per the GIP guidance. Duke Power employees were certified through extensive SQUG training and performed the majority of the equipment walkdowns. To date, essentially all equipment walkdowns in the plant, including Keowee and the switchyard, have been completed with the exception of some later additions to the SSEL. These additions are the result of further evaluations into secondary support systems and their roles within the GIP assumptions.

To date, walkdowns, evaluations and investigations have revealed no issues to challenge the licensing basis of Oconee. Essentially, this intensive seismic review effort has revealed issues that are common to many of the older nuclear plants. These issues include potential seismic interaction, potential vibration of relays, documentation issues or lack of documentation, etc. To date, the SQUG effort confirms the seismic adequacy of Oconee and the emergency power paths.

Duke is currently evaluating potential interactions and anchorage capacities of items that were walked down in the field. We are also intensively evaluating relays through capacity verses demand comparisons and individual circuit analysis. Program documentation is in progress as well as evaluation of potential options for outlier resolution as addressed with the GIP.

The SQUG effort has identified 4283 contact devices for evaluation within Oconee. Currently, 3115 passed the GIP evaluation methods as acceptable. The balance, 1168, are still under review. The SQUG effort identified 1260 contact devices for evaluation at Keowee and the switchyard. Currently, 1034 have passed the GIP evaluation methods as acceptable. The balance, 226, are still under review. This review includes circuit analysis for low ruggedness relays and other low seismic capacity relays, refinement and tailoring capacity verses demand comparisons for more specific screening, evaluation of test reports, and potential customizing of in-cabinet amplification values.

Equipment and cabinet walkdown items incorporate the "rule of the box". Therefore, each item represents an individual Seismic Evaluation Worksheet (SEW). For example, an entire bank of switchgear, a turbine/generator, or a motor control center each would be evaluated on a single SEW form.

The SQUG effort identified 1532 items (or SEWs forms) at Oconee for evaluation. The evaluation addresses overall seismic adequacy, including anchorage, seismic interaction, and individual structural integrity. Of these, 1130 are SQUG acceptable as they currently exist in the field. The 216 remaining items do not meet SQUG screening requirements and are being subjected to more rigorous SQUG approved methods of demonstrating seismic adequacy. The balance, 186, are currently under review to determine conformance with SQUG screening requirements.

For Keowee and the switchyard, the SQUG effort identified 276 items (or SEWs forms) for evaluation of overall seismic adequacy, including anchorage, seismic interaction and individual structural integrity. Of these, 169 are SQUG acceptable as they currently exist in the field. Rigorous SQUG approved methods of demonstrating seismic adequacy qualified 44 items that did not pass the initial screening criteria. Recommended enhancements for the remaining 63 items will bring them into conformance with SQUG screening requirements.

Keowee PRA

An extensive probabilistic analysis of the Keowee emergency power functions was completed using methods comparable to those of a nuclear power plant PRA. Recommendations from this analysis were implemented. The objectives of the recommendations were to assure the continued high reliability of the system and to maintain the necessary sensitivity of the importance of the system for the overall nuclear safety of the Oconee units.

Maintenance Rule

The final programmatic initiative to be included in this report covers the implementation of the Maintenance Rule. When the Maintenance Rule is implemented, Oconee, Keowee, the switchyard and the Lee power source will be incorporated in the program. Oconee, Keowee and the switchyard will be monitored in accordance with the guidelines for plant systems under the Maintenance Rule. Lee will be monitored as a power source at CT-5.

As part of the Maintenance Rule, a risk matrix was developed that allows Oconee to evaluate the risk significance of having different systems unavailable. This risk matrix is used by Operations and Work Control personnel in scheduling maintenance activities. Implementation of the risk matrix

into work practices has improved the operator's understanding of system interactions and the risk associated with different system configurations.

c. Equipment Initiatives

Equipment enhancements have been completed on the emergency power system in recent years. Some of the equipment initiatives associated with Keowee, the switchyard, and the SSF are highlighted below.

Keowee

1. The control room statalarm panels, events recorder, and computer were placed on an uninterruptible power source. This ensures that the control room instrumentation will be available if the Keowee auxiliary power is lost.

2. The automatic transfer circuitry for the Keowee auxiliary power system has been modified. This ensures that the Keowee auxiliary power will not be lost during an emergency start of Keowee.

3. The battery chargers and inverters have been replaced. This replacement was necessary due to equipment obsolescence.

4. The Keowee main stepup transformer was reblocked to prevent possible faults. This was initiated due to inspection of another similar Duke transformer on the generation system.

5. The events recorder was replaced due to obsolescence.

6. A modification is being implemented to eliminate a postulated zone overlap single failure vulnerability. In addition, this modification eliminates a postulated single failure which could result in excessive overspeed and overfrequency conditions at Keowee following a load rejection. Currently, administrative controls preclude these failures from occurring.

7. Using SQUG and IPEEE walkdowns, the seismic adequacy of Keowee Hydro Station was verified.

Switchyard

1. The overhead power path insulators have been inspected.

2. A modification that is awaiting implementation enhances the degraded grid protection logic.

3. The switchyard battery chargers have been replaced due to obsolescence.

4. Using the SQUG and IPEEE walkdowns, the seismic adequacy of the switchyard was verified.

Standby Shutdown Facility

1. For conditions when forced CCW flow and siphon flow are lost, a submersible pump was added to the SSF. This pump replenishes water to the underground portion of the CCW inlet pipe to maintain the water supply to the SSF service water system.

2. A modification of the SSF RC makeup pump installed a larger plunger in the pump. This increased the pump capacity from 26 gallons per minute (GPM) to 29 GPM.

3. The SSF auxiliary service water control valve on each Oconee unit has been replaced. These valves were changed from manual to motor operated valves that can be manipulated from the SSF Control Room. This modification enhances the ability of the operators to control feedwater to the steam generators from the SSF.

4. The SSF activation time has been decreased by modifying the SSF breaker configuration. Also, the activation procedures have been streamlined and operator training has been improved.

d. Ongoing Initiatives

With the completion of a majority of the items outlined above and the Emergency Power Project, Oconee has integrated the switchyard and Keowee into site programs and processes. However, there are several activities that are still in progress. The remaining initiatives are designed to further improve site programs and processes. Several examples and brief descriptions of initiatives that are in progress are listed below:

1) Human performance improvement - This initiative is designed to improve procedure adherence, attention to detail, and quality of work practices.

2) Configuration control - This effort focuses on adherence to equipment tagging processes and improving

work practices that could affect mispositioned components.

3) Control and power batteries - Oconee is carefully evaluating capacity of the control and power batteries and has an initiative to increase the capacity of these batteries.

4) DC grounds - This activity was initiated to highlight the importance of DC grounds and the need to locate grounds in a timely manner.

5) Testing - In order to ensure a comprehensive program of periodic, post-maintenance, and post modification testing, a management focus item was originated to develop a Nuclear System Directive on testing.

The above examples are some of the management focus issues for Oconee Nuclear Station in 1996. These initiatives should also positively impact the emergency power system.

5. Risk Insights

a. Oconee IPEEE

The Oconee IPEEE will be submitted by December 31, 1995. The IPEEE submittal assesses the risk associated with external events. A complete analysis of external events is also included in the Oconee IPE, which was submitted to the NRC Staff in December of 1990. The predicted Core Damage Frequency (CDF) from external events is lower in the IPEEE than in the IPE. The IPEEE evaluation concludes that there are no unduly significant sequences from external events. Seismic events are the most significant external event contributors to core melt risk. The risk associated with seismic events is dominated by ground accelerations greater than the design basis values given in the Oconee FSAR.

b. Keowee PRA

In January 1994, Duke began work on the Keowee reliability analysis, commonly called the Keowee PRA. This PRA analysis created an integrated reliability model of Keowee. This model was used to obtain an analytical solution for the reliability of Keowee. The predicted reliability of Keowee was compared to operating experience data. In addition, the results were reviewed to provide insights into enhancements of Keowee performance. The final part of the analysis coupled the Keowee model with the existing Oconee AC power model to generate new results for the Oconee AC power reliability and the core damage sequences resulting from a postulated loss of AC power.

Excellent agreement exists between the predicted reliability values from the Keowee PRA and operating experience data. The reliability of the Keowee underground power source is calculated to be 97.8%. The overhead power source has a reliability of 93.5%. These reliability percentages do not include the effects of common cause and dual unit maintenance. The overall unavailability for Keowee is 7.4E-03 with the main contributor to the unavailability being dual unit maintenance (5.0E-03).

When the model is coupled with the Oconee AC power model, the overall failure probability for the Oconee AC power is determined to be 6.4E-05. This includes the frequency of losing off-site power, the probability of Keowee emergency power failure, and the failure probability of backup power from CT-5. However, the recovery of offsite power is not

included. Therefore, the annual probability of a station blackout for an Oconee unit is estimated to be 6.4E-05.

Using the model to calculate the loss of AC power core damage sequences results in a core damage frequency of 1.0E-06 per reactor year. This includes integration of the Oconee AC power model, SSF model, turbine driven emergency feedwater model, and offsite power recovery models. The loss of AC power core damage frequency which was developed in the Oconee IPE program was 3.0E-06. The 1990 Oconee IPE result(3.6E-06) is comparable to the 1995 Keowee PRA result(1.0E-06) for the loss of offsite power initiated core damage frequencies.

The following are the major conclusions from the Keowee PRA:

1. Keowee is a reliable source of emergency power for Oconee for conditions involving the loss of onsite power and offsite power.

2. As expected, Keowee power through the underground path is the more assured source of emergency power for Oconee.

3. The failure probabilities of a Keowee unit to start and run for the mission time estimated from a detailed system model are in close agreement with those derived from the Keowee operational data.

4. Overall, the probability of incurring a sustained loss of AC power for Oconee is very low. The Oconee AC power system is more vulnerable to a loss of AC power condition during damaging severe weather conditions compared to conditions involving a random loss of offsite power.

5. The core damage risk of accidents involving the loss of AC power is very low, about one in a million.

Recommendations from the Keowee PRA have been implemented.

c. Oconee IPE

The 1990 Oconee IPE evaluated the effects of internal events and external events on the core melt frequency. For a loss of offsite power, the calculated annual core melt frequency is 3.6E-06. This is approximately 3 percent of the total core melt frequency for Oconee. The 1990 Oconee IPE result (3.6E-06) is comparable to the 1995 Keowee PRA result

(1.0E-06) for the loss of offsite power initiated core damage frequencies.

d. Station Blackout

The diverse and redundant design of the Oconee AC power system results in a fairly low probability of losing all AC power. Probabilistic analyses in the Oconee IPE, Keowee PRA, and Oconee IPEEE support this assertion. In addition, the operating, maintenance, and testing programs for the Keowee units and the SSF ensure that the probability does not increase significantly.

If a Station Blackout (SBO) were to occur, the SSF provides an additional, alternate AC power source to mitigate this event. The SSF is considered an alternate AC power source under the SBO Rule. The SSF is capable of bringing all three Oconee units to hot shutdown and maintaining hot shutdown. The coping duration for the SBO event is 4 hours for Oconee.

The Oconee control rooms will maintain command and control during the event. In addition, the Oconee control rooms will be in communication with the SSF. This allows the Oconee control rooms to facilitate recovery actions as soon as AC power is restored.

Even though the plant takes credit for the SSF auxiliary service water system to mitigate the SBO event, the emergency feedwater system is available for approximately two hours following the initiation of the SBO event. The turbine driven emergency feedwater pumps supply feedwater through valves that are supplied by a backup nitrogen source.

In conclusion, the SSF provides a diverse source of alternate AC power and can maintain the plant in a safe shutdown condition in the event of a station blackout.

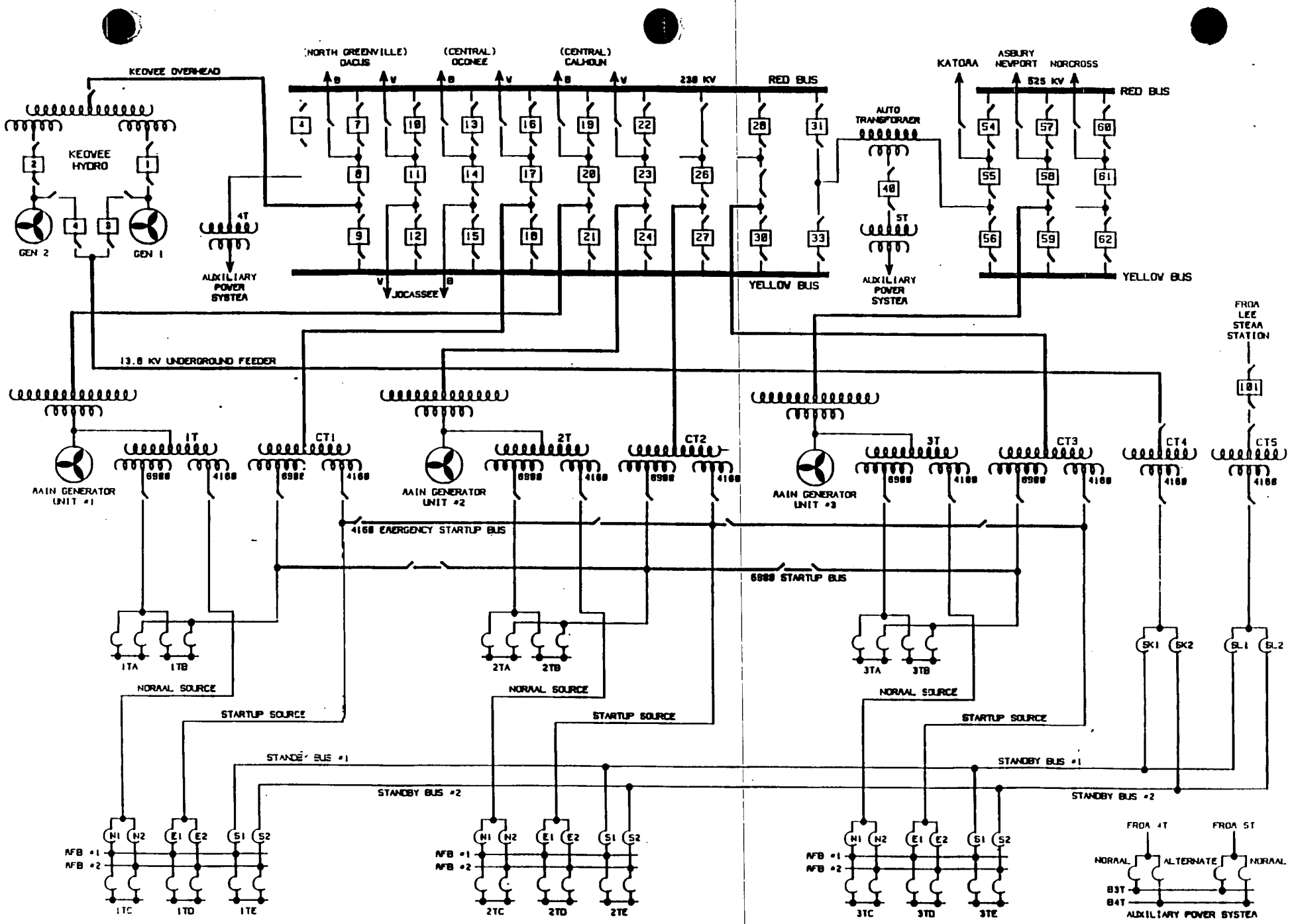
6. Summary/Conclusions

The emergency power system at Oconee Nuclear Station has been thoroughly reviewed over the past six years by both Duke Power and the NRC. The DBD effort, Duke Power audits and assessments, and NRC inspections identified several issues. Duke Power invested significant resources during this time period to resolve these issues.

The organizational, programmatic, and equipment initiatives described in this report provide some perspective on the magnitude of this effort. The vast majority of the corrective actions stemming from these reviews are complete. Oconee is in the process of closing out the few remaining corrective actions. In addition, Keowee and the switchyard are integrated into the operations, maintenance, testing, and engineering programs at Oconee Nuclear Station.

Plant operating experience, extensive reviews of the design basis, and several comprehensive probabilistic risk analyses continue to confirm that the Oconee emergency power system is diverse and reliable. Enhanced training, procedures, and engineering support and documentation assure that station personnel understand the design basis and operational features associated with the emergency power system.

Duke Power will continue to devote the resources necessary to assure that Keowee Hydro Station and the emergency power paths are a reliable source of onsite emergency power for Oconee Nuclear Station.



EPSLOIST
5-5-92

VHIZ

REFERENCES
OEE-117 SERIES

EMERGENCY POWER DISTRIBUTION

Figure 1

Table 1

List of Design Basis Documents on the Emergency Power System

Plant Design Basis

1) Single Failure
2) Design Basis Events
3) Fire Protection
4) Seismic
5) Flooding from External Sources
6) Cable Tray Supports
7) Missile Protection
8) Selected Plant Design Requirements and Programs

Civil Structures

1) Auxiliary Building
2) CT4 Transformer and 4kV Switchgear Enclosures
3) 230kV Switchyard Structures
4) Keowee Structures
5) ~~Turbine Building~~

Electrical Systems

1) 120VAC Vital Instrumentation and Control Power
2) 125VDC SSF Auxiliary Power
3) 125VDC Vital Instrumentation and Control Power
4) 230kV Switchyard 125VDC Power System
5) 230kV Switchyard
6) 4kV Essential Auxiliary Power System
7) 4160/600/120V SSF Essential AC Power System
8) 600/208V Safety Related Auxiliary Power System
9) Keowee Emergency Power
10) 100kV Alternate Power Supply
11) Keowee 125VDC Power Systems
12) 250VDC Auxiliary Power System

Mechanical Systems

1) SSF Reactor Coolant Makeup
2) SSF Auxiliary Service Water
3) SSF Diesel Support System
4) SSF HVAC
5) Keowee Turbine Guide Bearing Oil System
6) Keowee Governor Air System
7) Keowee Governor Oil System
8) Keowee Turbine Generator Cooling Water System
9) Keowee Turbine Sump Pump System
10) Keowee Air Circuit Breaker System

Attachment 1

Emergency Power System LERs (1988-1995)

This attachment briefly describes the reportable events that have been associated with the Oconee emergency power system over the past seven years. A vast majority of the reportable events have been self-identified. In addition, the remaining corrective actions from these events are scheduled for implementation by NSM ON-52966 and NSM ON-1,2,32983. It should be noted that no new LERs have been associated with the emergency power system over the past two years. A supplement to LER 269/93-01 in June of 1994 and March of 1995 was the only LER activity during the 1994 and 1995 timeframe. The resultant corrective actions from these LERs have positively impacted the emergency power system.

LER 270/88-01

During performance of preventive maintenance on the inverter, an I & E technician noticed that a seismic brace was missing. After evaluation, the inverter was declared inoperable. A brace was installed on the inverter and all other vital inverters were inspected to ensure proper installation of the seismic brace.

LER 269/88-04

A design review resulted in the discovery of problems with the removal of control power fuses from out of service SK breakers. This identified a scenario where the EPSL retransfer to startup logic could be defeated. A design study of the impact of maintenance practices on the emergency power system was completed following the discovery of this problem. In addition, a SITA on the emergency power systems, including the EPSL system, was initiated as a result of this LER.

LER 270/88-02

A design review of a switchyard breaker replacement identified potential problems in the EPSL system due to noise induced by the replacement breakers. A design study of the EPSL system was completed and the checklist that is used by engineering when evaluating design input considerations was revised.

LER 287/88-04

An event occurred which resulted in the load shed of Unit 3 loads and a Keowee emergency start. A deficiency in a modification procedure resulted in the deenergization of main feeder bus #2 when main feeder bus #1 was already out of service. Training on the event was provided to the electrical and mechanical technical support personnel.

LER 287/88-05

During the Oconee Unit 3 refueling outage in 1988, a loss of power event occurred on Unit 3 which resulted in the loss of decay heat removal capability. This loss of power occurred during a test and lasted for approximately 15 minutes. Following the event, operations and scheduling personnel reviewed the event to ensure that the need to schedule performance tests during optimum times in the refueling outage was understood. In addition, the importance of communication and pre-job planning was emphasized to the operations personnel. A review of other applicable procedures was performed to ensure that there are adequate steps for breaker racking. Although not a direct result of this LER, Oconee now has a comprehensive shutdown protection plan.

LER 269/88-13

As a followup from the SSFI, the Lee transmission circuit transient capability was reviewed for adequacy. This review resulted in the discovery of potential problems with the voltage margin due to the addition of loads to Oconee. In order to prevent future problems, a review of the impact of electrical load addition was included as a part of the modification process.

LER 270/89-01

A Technical Specification violation resulted from a missed operability surveillance of the emergency power system. The underground path was rendered inoperable by an operations procedure and the overload path was not tested as required by the Technical Specifications. The 100Kv power supply procedure was revised to include guidance on Technical Specification requirements when using CT5 to power the standby buses. In addition, a modification was performed to ensure that adequate voltage levels are maintained on the standby buses when powered by the Lee gas turbines.

LER 269/89-04

Two sets of redundant control cables for the main feeder bus were discovered to be routed in deviation with FSAR requirements. An inspection of a sample of safety-related cables and cable trays containing safety-related cables was conducted to determine if any other safety significant deviations existed. Based on the sample review, no additional problems were identified. However, enhancements were made to the tagging of cable trays to ensure physical verification of cable routes. In addition, the Unit 1 and Unit 2 cable sheets were added to a computer database similar to Unit 3. Engineering conducted a search and evaluation of sample cable sheets.

LER 270/89-02

While completing a modification of the EPSL system, Unit 2 tripped due to a loss of 125 VDC to the Electric Hydraulic Control System (EHC). Part of the EPSL circuitry that was installed by the modification was wired incorrectly. The modification personnel were formally trained on the expectations within the directive on independent verification.

LER 269/89-06

As a result of a cable sheet search and evaluation, a potential single failure vulnerability was discovered in the EPSL system. In addition to the completion of a modification to correct the vulnerability, engineering developed a model of the EPSL system to simulate various failures. Reference to the planned SITA on the emergency power system was included as part of the planned corrective action.

LER 269/89-09

As a result of the DBD effort, a potential single failure of the EPSL system was discovered. In addition, a procedure deficiency was discovered that would have prevented EPSL from swapping to the standby buses if they were powered by Lee. Oconee revised the procedure to prevent the problem from reoccurring. Additional corrective actions included submittal of a Technical Specification change to correct this problem and a review by engineering of operating procedures which remove buses from service.

LER 269/89-10

While performing a follow up review of the use of the Lee gas turbines to power the standby buses, engineering analyzed the use of the Central switchyard as an offsite source. This analysis indicated that adequate protective relaying for degraded grid conditions did not exist on Central. In response to the analysis results, Oconee removed Central as a source of power from the 100Kv power supply procedure. Additional corrective action included revision, as appropriate, of procedures that are used to energize the standby buses. In addition, the LER was reviewed by engineering and operations to emphasize the importance of good communication to engineering and station personnel. Degraded grid protection has been added to the standby buses and Central is now available as an offsite source.

LER 269/89-11

Both emergency power paths were unintentionally removed from service during the EPSL test. The inoperability lasted for approximately 20 minutes. The EPSL test procedures were revised as necessary to ensure that emergency power paths are not rendered inoperable during testing evolutions. In addition, all emergency power procedures were reviewed to ensure compliance with Section 3.7 of the Technical Specifications.

LER 269/89-12

An emergency start of both Keowee units occurred during an Oconee Unit 2 refueling outage. The emergency start was initiated by Channel B of the Oconee Unit 2 Keowee emergency start circuitry due to unknown reasons. This incident was investigated by I&E personnel and no evidence of activation of Engineered Safeguards (ES) Channel 2 was discovered. This ES channel provides input to Channel B of the Keowee emergency start circuit. No planned corrective actions were taken since the cause was unknown.

LER 270/89-06

The DBD for the 4kV electrical system identified an insufficient protective relay setting on the Oconee 2B reactor building spray pump motor. As a result of this deficiency, all safety-related motors, including spare motors, were examined to ensure the overcurrent protective relay settings were adequate. Also, appropriate ONS

maintenance procedures were revised as necessary to address relay coordination when a safety-related motor is replaced. Engineering pursued methods to tag spare safety-related motors on future purchases to ensure that an assessment of relay coordination is performed prior to installing spare motors.

LER 269/89-14

The overhead power path is inoperable when certain 230 kV switchyard power circuit breakers (PCBs) are out of service. This inoperability results from the inability of the Keowee overhead air circuit breakers (ACBs) to close on the yellow bus without the switchyard isolation complete signal. The switchyard isolation complete signal is inhibited by removing certain PCBs from service. Corrective actions revised the affected procedure and provided training to the operators.

LER 269/90-04

A potential degraded grid voltage condition was identified while performing the 230 kV Switchyard DBD. Operational guidance was implemented to monitor the switchyard voltage every two hours and perform appropriate actions if the voltage degraded. Nuclear Station Modification (NSM) 52850 installed degraded grid protection on the 230 kV switchyard. Also, Technical Specifications for the degraded grid circuitry were included as part of the rewrite of Section 3.7 of the Technical Specifications.

LER 269/90-05

Additional review by Duke of the degraded grid switchyard condition discovered the potential of the startup breakers closing into a degraded switchyard. Duke implemented a program to ensure that proper controls are placed on relay setpoints.

LER 269/90-12

During the development of the Keowee emergency power system DBD, Duke identified the possibility of overloading the Keowee units. This results from the loading of the reactor coolant pumps on the Keowee units. The timing circuits for switchyard breaker PCB-9 and the Keowee overhead path ACBs were modified by NSM ON-52855 to prevent the possibility of overloading a Keowee unit with the RCPs.

LER 269/91-01

The Keowee emergency power system DBD identified a possible scenario where both Keowee underground path ACBs close simultaneously and tie the Keowee units together, potentially out of phase. This issue was resolved by modifying the Keowee generator breaker control circuits.

LER 269/91-03

As part of the Duke review of breaker trip setpoints, potential breaker coordination problems were discovered. The corrective actions from this LER included a modification to correct the breaker coordination. Also, the safety-related breaker trip setpoints were reviewed.

LER 269/91-04

Further review of the relay and breaker trip setpoints resulted in the discovery of a potential inadvertent lockout of the yellow bus or startup transformer. In order to prevent these lockouts, the setpoints of the associated relays were changed to the manufacturer's recommendations. The setpoints of the affected relays were revised to eliminate this concern.

LER 269/91-07

Duke identified a breaker coordination concern associated with motor control centers 1XS2, 2XS2, and 3XS2. This problem was eliminated by modifying the loads on the motor control centers.

LER 269/92-01

During the EPSL performance test, the standby buses were energized by the Lee Steam Station substation rather than the Lee gas turbines. The Lee Steam Station substation is not considered a viable source of offsite power due to the lack of degraded grid protection. The affected procedure was revised to include cautions about aligning offsite power sources other than the Lee gas turbines to the standby bus. In addition, training was included in the 1992 requalification schedule for all licensed personnel to stress the importance of properly aligning a Lee gas turbine to the standby bus.

LER 269/92-02

An equipment failure was reported concerning the breaker anti-pump "X" relays on the field and field flashing breakers. This failure resulted in the inoperability of Keowee Unit 1 and was discovered during a normal startup. As an interim measure, the Keowee operators inspected the "X" relays each time the units were shut down. A modification was implemented to replace the "X" relays.

LER 269/92-08

A blown fuse resulted in the inoperability of Keowee Unit 2. At the time of the failure, Keowee Unit 1 was out of service for maintenance. Communication problems resulted in the failure to meet the Technical Specification requirements for powering the standby buses from Lee. As a result of this event, a formal rounds and turnover procedure was initiated to enhance the monitoring of Keowee equipment. In addition, revisions were made to the Oconee procedure which aligns a Lee gas turbine to the standby buses.

LER 269/92-10

An Operating Experience Program (OEP) evaluation of a discriminator feature in DS type Westinghouse breakers discovered the possibility that a fault on a non-safety load could remove power to safety-related equipment on the affected Keowee unit. This problem was corrected by modifying the breaker to bypass the discriminator feature. In addition, the technical bulletin from Westinghouse was included in the vendor manual for the breakers.

LER 269/92-11

While performing a single failure analysis associated with dual unit Keowee operation, Duke identified a scenario that could result in the loss of both onsite emergency power sources. The scenario consisted of a failure of the Keowee underground ACB and the alignment of potentially out of phase Keowee units. The Keowee ACB control logic was modified to prevent this failure.

LER 269/92-14

During post-modification testing of the Keowee ACB control logic, ACB2 failed to close immediately after opening Keowee ACB1. The ACB2 failure was caused by a defective MG-6 relay that was not affected by the modification. The relay had a contact gap larger than the manufacturer's specifications

and a broken armature stop nut. All MG-6 type relays at Oconee and Keowee were inspected and repaired as necessary.

LER 269/92-16

As the single failure analysis of dual unit Keowee operation continued, a potential failure was identified with the zone overlap of protective relays at Keowee. This scenario could lock out the overhead path and the underground Keowee unit if the failure occurs while the unit aligned to the underground path is generating to the grid. The immediate corrective action was to open the disconnects for the overhead ACB on the Keowee unit that is aligned to the underground path. The open disconnects prevent the Keowee underground unit from generating to the grid. The modification to correct this problem was approved by the NRC in an SER dated August 15, 1995 and is being implemented by NSM ON-52966.

LER 270/92-04

On October 19, 1992, Oconee Unit 2 experienced a loss of offsite power during a modification to replace the switchyard batteries. A special inspection by an NRC Augmented Inspection Team (AIT) followed this event. Corrective actions from the Unit 2 loss of offsite power event are described in Attachment 3.

LER 269/92-17

The Unit 2 and Unit 3 batteries were determined to be inoperable due to the lack of adequate seismic bracing. The as built drawings and vendor specifications indicated that the bracing was installed. The batteries were modified to add the missing braces.

LER 269/92-18

During the annual Keowee emergency start test, the Keowee Unit 2 auxiliary power feeder breaker (ACB-8) would not manually close. This failure was attributed to inadequate voltage on the closing coil of a Westinghouse DB relay in the control circuitry for ACB-8. The control circuitry on all Westinghouse DB relays was modified to ensure proper voltage on the closing coil. In addition, the 125 VDC Keowee power system DBD was completed.

LER 269/92-19

As a result of continuing single failure analyses by Duke, a postulated failure that could isolate the overhead path and cause the loss of auxiliary power to the Keowee underground unit was identified. This failure could result in the inoperability of both emergency power paths. The Keowee control circuitry was modified to eliminate this failure mode.

LER 269/93-01

Two related scenarios that could impact the operability of the emergency power system are identified in this LER. The first scenario was identified on January 11, 1993. It involves the possibility of locking out an operating Keowee unit that load rejects from the system grid following an emergency start signal. The lockout could occur due to overspeed conditions following the load rejection. The second scenario was identified on May 16, 1994 as a result of completing design calculations associated with the DBD program. This scenario involves overfrequency conditions following a load rejection that could prevent Keowee from performing its intended safety function. Restrictions on the maximum allowable Keowee power level were implemented to prevent the above scenarios.

LER 269/93-08

A reactor trip resulted from a pair of rolled leads on the supply breaker for the alternate power path of one of the units vital power panelboards. The wiring deficiency was corrected. An additional corrective action remains open which will enhance the RCP motor protection by NSM ON-1,2,32983.

LER 269/93-09

This LER describes an EPSL load shed logic single failure vulnerability caused by the logic being connected to common DC power sources. Corrective actions included correcting the wiring and completing an inspection of the electrical cabinets.

Attachment 2

Findings From the 1992 Emergency
Power System SITA

This emergency power system SITA resulted in 73 findings, 11 followup items, and 2 document discrepancies. Of these items, 20 were completed based on the information provided by the response to the items. Another 25 items involved revisions to documents such as calculations, FSAR sections, and procedures. Further evaluations, reviews, and studies were required to determine the appropriate action to resolve 25 items. Station modifications or program changes were necessary to complete 16 items. As of December 12, 1995, 6 items remain open from the 1992 EDSFI SITA. Currently, the item with the latest completion date is a modification that is scheduled for the Oconee Unit 2 refueling outage EOC16 (fourth quarter of 1997).

Closed at the site

1. Transmission grid stability

2. Medium voltage and high voltage system surge protection/insulation coordination

3. Short circuit rating

4. Differential protection CT accuracy

5. Settings for motor overload protection

6. Electrical independence of separate divisions

7. Non safety loads connected to safety buses

8. Short circuit rating of low voltage systems

9. 600V equipment continuous voltage ratings

10. Short circuit rating of buses and cables

11. Calculation for EHGs grounding equipment

12. 13.8kV cable ampacity calculations

13. 13.8kV cable shield ampacity calculations

14. Inadequate justification for minimum acceptable inverter input voltage

15. Adequacy of corrective action and configuration control of charger overvoltage trip and subsequent bypass or removal of overvoltage protection (all battery chargers)

16. QA Condition 1 calculation not completed for switchyard DC voltage analysis

17. Electrical components required for Keowee emergency power incorrectly classified as non-safety related

18. Keowee safety-related instruments not included in calibration and surveillance program

19. No retrievable analysis of minimum DC voltage to safety related components at Keowee station

20. Keowee 125Vdc coordination analysis did not address more limiting case of fault at common output diode assemblies

21. Observed water leakage into junction box for Keowee turbine sump pump and oil pumps circuits

22. Identification and control of nonlinear loads on vital I&C inverters

23. Potential for coupling of interference to underground runs of I&C cable

24. Inadequate documentation for Turbine-Generator seismic qualification

25. There is limited documentation for the seismic qualification of the Turbine-Generator support systems or that they have been reviewed per Bulletins 79-02 and 79-14

26. Vulnerability of both Keowee units to failure of the turbine-generator cooling water line

27. The failure of the Keowee cranes has not been addressed

28. Information on seismic qualification of selected control room cabinets at Keowee, which had been modified, was inconclusive

29. Inservice testing has not as yet been implemented at Keowee

30. Thermal-hydraulic design and performance of the turbine-generator support systems is not adequately documented

31. Equipment in the Keowee powerhouse cannot withstand tornado loads

32. Vulnerability of both Keowee units to failure of the intake structure

33. Documentation for the seismic qualification of the Jocassee Dam does not exist

34. The Keowee station has not been analyzed for flooding

35. The Keowee station HVAC is not safety-related

36. HVAC in the 230kV relay house is not safety-related

37. Documentation for the seismic qualification of the underground cable is not available

38. Underground cable is vulnerable to turbine missiles and possibly tornado missiles

39. The Oconee turbine building HVAC is not safety-related

40. Inconsistent component/structure classifications

41. There is no comprehensive list of Oconee (and Keowee) equipment to which the commercial grade dedication program applies

42. Problems associated with the integrated systems analysis (ISA) report 81-04

43. The specification of the seismic design criteria contains unsubstantiated statements

44. Unrestrained equipment near Class 1E devices

45. Safe Shutdown Facility battery rack grounding

46. Broken instrument ground insulators

47. Flash-over on a conductor in switchyard relay house

48. Ground bus not connected in 525kV switchyard

49. Control of spare fuses

50. Overhead transmission line connectors

51. AP/1/A/1700/11, Loss of power procedure

52. Cable support criteria

53. Cable separation criteria

54. Cable tray fill

55. Cable Installation

56. Unterminated cable

57. Cable terminators

58. Seismic qualification for selected Oconee cabinets has not been provided

59. Station labeling

60. Bus maintenance

61. Terminal board sliding links

62. Use of incorrect fuses

63. Relay covers

64. Red safety tag violation

65. Device missing from drawings

66. Keowee stereo system inside class 1E control panel

67. Unlabeled plastic bottle

68. Tagging control inside termination cabinets

69. Cables routed on the floor

70. Technical Specification electrical surveillance program

71. Circuit breaker maintenance

72. Molded case circuit breaker curves

73. Testing Class 1E relays, leaving setting outside limits

74. Protective Relaying

75. PT/610/19 100kV power supply prior to extended Keowee outages

76. Keowee penstock inspection

77. Failure to initiate corrective action documents

78. Inadequate corrective action for disposition of inverter failure apparently resulting from blown fuse in recorder

79. Failure to adequately resolve corrective action document

80. No single failure analysis for other that T=0

Open

1. Settings for motor locked rotor protection

2. Nonconformance to FSAR requirement that shorted 125Vdc vital I&C power cables are isolated by feeder breakers

3. As-built discrepancy for Keowee 125Vdc control circuit protection shown on elementary diagram

4. Electrical distribution system cleanliness

5. 4160V switchgear in the turbine building is not protected for the impact of jet impingement of a non-seismic line break

6. The Oconee control battery room HVAC is not safety-related

Attachment 3

Commitments From the Oconee Emergency Power Management Plan

1.	Evaluation of NRC communications applicable to Keowee with schedule for resolution	Completed 2/28/94
	<u>Switchyard Equipment, Design and Testing Commitments:</u>	
2.	Switchyard battery charger testing	Completed 6/93
3.	Switchyard breaker failure relay modifications	Completed prior to Oconee 2 restart
4.	Switchyard synchroscope repair	Completed 2/24/93, Tested 3/16/93
5.	Overhead emergency power path integrated test	Completed 5/93
	<u>Keowee Auxiliary Power System Equipment, Design, and Testing Commitments:</u>	
6.	Westinghouse DB breaker modifications to provide electrical anti-pump logic	Completed 7/92 (Keowee Unit 1) Completed 11/92 (Keowee Unit 2)
7.	Westinghouse DB breaker modifications to add time delay in breaker closing circuit (allows closing with reduced DC voltage)	Completed 12/92
8.	MG-6 relay review for repair and PM program	Review completed: 7/93 (Keowee) 2/93 (Oconee Unit 1) 6/93 (Oconee Unit 2) 1/94 (Oconee Unit 3)
9.	MG-6 relay replacement in Keowee auxiliary transfer circuits	Completed September 1993

10. Keowee auxiliary bus transfer logic modification	Completed September 1993
11. Keowee auxiliary bus transfer logic timing circuitry testing	Completed September 1993
12. Keowee black start test	Completed December 1992

Keowee Unit Protection Equipment, Design and Testing Commitments:

13. Trip function on low voltage at main step-up transformer modification not to affect operating Keowee Unit	Completed November 2, 1992
14. Deletion of speed switch from field circuits	Completed July 1992 (Keowee Unit 1) Completed November 1992 (Keowee Unit 2)
15. Keowee load rejection test while aligned to grid	Completed October 25, 1992
16. Keowee zone relay protection single failure vulnerability	Implementation of NSM ON-52966 (currently administratively controlled)

Other Keowee support items Equipment, Design and Testing Commitments:

17. Keowee computer typer connection to computer power supply inverter	Completed prior to Oconee 2 restart
18. Keowee statalarm modification to power from uninterruptible source	Completed January 29, 1993
19. Events recorder replacement - Switchyard - Keowee - Oconee	Completed December 1993 Completed September 1994 Completed September 1994
20. Review of IEB 79-27 related power supplies	Completed January 28, 1993

Communications Equipment:

21. Facility telephone system cable and battery backup	Completed March 1993
22. Base radio system from Keowee control room to Oconee control room	Completed November 1992
23. Hand held radios capable of transmitting from the Keowee generator floor to the Oconee control room	Completed November 1992

Keowee Operator Training Upgrade Plan

24. Keowee personnel training on requirements of Operations Management Procedure 5-2, "Duties and Responsibilities of Keowee Station Personnel"	Completed November 1992
25. Task Qualification of Keowee operators to all Keowee operating, testing and maintenance procedures relating to the emergency operation of Keowee	Completed November 1992
26. Job Analysis	Completed May 1993
27. Task Analysis (includes lesson plan development and/or training and qualification guide)	Completed August, 1993
28. Individual operator knowledge and skills assessment and upgrade	Completed December 1993

Keowee Emergency Response Procedure

29. "Emergency Start Actuated" indicating light added to Keowee control boards.	Completed October 1992
30. Keowee EOP	Completed October 1992

Keowee Emergency Response Training

31.	Job Performance Measures (JPMs) developed to verify loss of auxiliary power or supply of power to Oconee from Keowee scenarios	Completed November 1992
32.	All Keowee personnel trained and qualified to all 5 JPMs	Completed November 1992
33.	Oconee licensed operators given walk-through training on these JPMs	Since October 1992
34.	Refresher training for Oconee operators to perform remote startup and operation of Keowee from the Oconee control room	Completed June 1993
35.	All Oconee shift operators (licensed and non-licensed) to be qualified to task OO1745801, "Perform Required Actions for an Emergency Start of the Keowee Hydro Units"	Completed August 1993

Oconee Loss of Offsite Power Procedure

36.	Revised to include all steps necessary to recover offsite power to Oconee	Completed December 1992
37.	Revised to include both dead bus and live bus transfer options	Completed December 1992
38.	Live bus transfer functionally tested and verified	Completed March 1993

Attachment 4

FOR INFORMATION ONLY

FOR INFORMATION ONLY

Oconee Nuclear Site Directive 8.1.2 (OP)

Approval

Original Date September 28, 1994

Revised Date

DUKE POWER COMPANY

OCONEE NUCLEAR SITE

KEOWEE HYDRO STATION

1.0 Introduction

The Keowee Hydro Station (KHS) is a two unit hydro-electric generating station utilizing the impoundment of Lake Keowee to operate the turbines for the production of electrical power. The primary function of the KHS is to supply emergency power for Oconee Nuclear Station (ONS). The electrical power generated by the station may be used to supply the commercial grid of Duke Power Company (DPC) when output from the station is not required by ONS.

ONS contains Emergency Power Switching Logic (EPSL) to sense a failure of normal electrical power supply(s). During a loss of power, the EPSL circuitry initiates an Emergency Start signal to KHS which will start both Keowee units, if previously shutdown, or separate the units from the DPC grid, if previously generating for commercial purposes. The Keowee units are then placed in a standby mode to enable them to immediately supply emergency power to ONS.

It is expected that personnel at all levels, who are involved in the operation, maintenance, design and modification of Oconee's emergency power supply, implement the management expectations included in this directive. Conditions may arise where it may be necessary and prudent to vary from these standards. The expectation is, however, that through management awareness and involvement, priority attention will be directed to such times and their impact on safety.

2.0 Purpose

The purpose of this directive is to outline the management, operation, maintenance, design, and modification of the KHS.

3.0 References

3.1 ONS Technical Specifications (TS)

- 3.1.1 TS 3.7, Auxiliary Electrical Systems
- 3.1.2 TS 4.6, Emergency Power Periodic Testing

3.2 ONS Final Safety Analysis Report (FSAR)

- 3.2.1 FSAR Chapter 8.0, Electric Power
- 3.2.2 FSAR Chapter 16.0, Selected Licensee Commitments

3.3 ONS Emergency Power Management Plan, Rev. #3

3.4 ONS Operations Manual

3.5 DPC Work Process Manual

3.6 Keowee Security Documents

- 3.6.1 ONS Physical Security Plan
- 3.6.2 ONS Safeguards Contingency Plan
- 3.6.3 ONS Security Procedures

3.7 ONS ETQS Manual

3.8 ONS Maintenance Manual

3.9 ONS Site Directives

3.10 DPC Nuclear System Directives

3.11 ONS Engineering Document Manual

3.12 ONS Systems Engineering Manual

3.13 ONS Design Basis Documents

3.14 OTG-008, Conduct of Keowee Hydro Operator and Technician Training Program

3.15 Keowee Hydro Station - Emergency Action Plan (EAP)

4.0 Responsibilities

The responsibility for the operation and direction of the Keowee Station has been assigned to the ONS Superintendent of Operations. Management interface is assigned to the Support Operations Manager. Duties and Responsibilities of the Keowee personnel are outlined in Operations Management Procedure (OMP) 5-2 (Duties and Responsibilities of Keowee Personnel). Additional information for operation of the KHS is described in OMP 5-3 (Emergency Power System).

5.0 Applicability

5.1 Engineering Program

5.1.1 Philosophy

A well defined engineering program is essential to maintaining a reliable emergency power source. Emergency power source responsibilities are assigned in the Engineering organization. Engineering resources shall be committed to the timely resolution of design, equipment and maintenance issues associated with the ONS emergency power source.

5.1.2 Organization

The Engineering Division for Oconee's Emergency Power Source will be structured to respond as it would for any other safety related system at Oconee. Detailed accountabilities can be found in applicable Site Directives, Nuclear System Directives, Engineering Document Manual, and Systems Engineering Manual.

5.1.3 Nuclear Station Modification (NSM), Minor Modification (MM), and Temporary Station Modification (TSM)

The NSM/MM/TSM programs provide the guidance to allow for modifications of systems, structures, and components. These programs are applicable to all systems, structures, and components in the Keowee Hydro Station, Emergency Power system, and the 230KV switchyard except for the 525KV/230KV auto transformer, bus and disconnects that connect the auto transformer to the 230KV circuit breakers 31 and 33. Circuit breakers 58, 59 and motor operated disconnects 58B and 58A for the 525KV system are also included. The specific details of the NSM/MM/TSM programs are detailed in the Nuclear System Directive 301, Site Directive 2.1.3, Site Directive 2.1.4, and Site Directive 2.2.1.

5.1.4 Calculations/Analyses

A formalized program for preparing and controlling Design calculations and analyses are detailed in section 101 of the Engineering Document Manual. This guidance is applicable to all calculations and analyses for the Emergency Power system.

5.1.5 Operating Experience Program (OEP)

A detailed program for the collection, evaluation, and assimilation of operating experience information is detailed in Nuclear System Directive 204 Operating Experience Program. This program is applied to the Emergency Power systems for the review of applicable OEP information.

Reviews of OEP items associated with the emergency power source will be performed to ensure they are appropriately evaluated. Lessons learned will be identified and included in KHS operation.

5.1.6 Establishing Design Criteria/Design Basis Document

Design Criteria have been developed for Keowee and the Emergency Power system based on guidance provided under section 170 of the Engineering Document Manual. These Design Criteria are then included in a more detailed document called a Design Basis Document (DBD). This document details the design basis and system functionality for each system based on a review of existing licensing, design, and plant operational documents.

The DBD program is ongoing. As design and engineering criteria for the emergency power source are evaluated or changed, associated DBDs will be revised to reflect any changes.

5.1.7 Seismic Qualification Utility Group (SQUG)

SQUG is a nuclear industry effort to assist the NRC in the resolution of Unresolved Safety Issue A-46, "Seismic Qualification of Equipment in Operating Plants", for older vintage nuclear stations. The resolution of A-46 led to the development of the Generic Implementation Procedure (GIP). The GIP methodology determines equipment adequacy following a Design Basis Seismic Event based on experience data, test, analysis, and trial plant walkdowns. The focus of A-46 is equipment required to bring the plant to and maintain hot shutdown for 72 hours following a Design Basis Seismic Event. The Emergency Power system falls under these guidelines for evaluation.

Mechanical/Civil Equipment Engineering will evaluate any new modifications and will determine any additional methods required to conform to the standards established for A-46.

5.1.8 Reliability/Availability

Reliability/availability evaluations for Keowee are performed based on guidance provided in the Keowee Emergency Power Source Reliability Program directive in the Systems Engineering Manual. The methodology to perform this analysis is based on the current industry accepted INPO standards for Reliability/Availability analysis.

System Engineering currently tracks Keowee start reliability and Keowee unavailable hours. Availability and reliability is reported in the monthly Keowee System Report.

5.1.9 Design Studies

This is a formalized program used to evaluate a technical problem/issue to determine what modifications may be needed to resolve the problem/issue. This program is also used to evaluate alternative solutions when more than one viable option exists. The results of the Design Study are presented in a Technical Report format. Design Studies are utilized in evaluating technical problems/issues with the Emergency Power System and providing technical input for the origination of modifications to correct the technical problem/issue.

5.1.10 Component/Equipment Classification

The methodology for determining and identifying the safety related classification of components, systems, and structures is detailed in the Quality Standards Manual which is part of NSD 307. The classification of components, systems, and structures for the Emergency Power system is outlined in this manual. Review and evaluation of the safety related classifications for Keowee Hydro and the Emergency Power source components, systems, and structures, are performed as modifications warrant.

5.1.11 Testing

The corporate criteria for developing and implementing testing for ONS components/systems is outlined in NSD 703. Specific procedures are written for testing components/systems. Detailed component/system test acceptance criteria is detailed in the Test Acceptance Criteria Document and DBD. Testing for Keowee and the Emergency Power system are developed and implemented following the guidance provided in these documents.

Additional testing requirements for ISI components are detailed in the Inservice Inspection Program Manual. Emergency Power system components are included in the ISI testing program.

5.1.12 Configuration Control

The NSM, MM, TSM, and Editorial Change programs, which are outlined in NSD 301 and ONS SDs 2.1.3, 2.1.4, 2.1.5, and 2.2.1, are the programmatic mechanisms used for configuration control management for the Oconee Nuclear Station. Configuration control for the Emergency Power system fall under the requirements of these programs.

5.2 Training Programs

5.2.1 Initial Operator and Technician Training Program

Initial Operator/Technician Training consists mainly of On-The-Job-Training, augmented with some specialty classroom formal training. The program is based upon guidance found in the ONS ETQS Manual. Specific details for administration and maintenance of the program is contained within Oconee Training Guide 008. OTG-008 is maintained at the Oconee Training Center by the Instructor in charge of the KHS Training Program.

5.2.2 Keowee Hydro Requalification Program

The KHRQ program is conducted in accordance with guidance found in the ONS ETQS Manual. Specific details for administration and maintenance of the program is contained within Oconee Training Guide 008. OTG-008 is maintained at the Oconee Training Center by the Instructor in charge of the KHS Training Programs.

5.3 Federal Energy Regulatory Commission (FERC)

5.3.1

The responsibility for the KHS is aligned under the ONS organization however, the regulatory agency which continues to regulate the license of KHS is the FERC. The following is a list of requirements which are mandated by the FERC in order to operate this facility.

5.3.2

Annual Operation Inspection - This scheduled inspection is conducted by the Atlanta Regional Office (ARO) engineer. The FERC may conduct "unannounced" or "drop by" inspections at their discretion. During these inspections, the following DPC personnel may be in attendance: Hydro Support Services (HSS) engineering; General Office engineering; System Hydro Engineer for Fossil/Hydro Generation Department (FHGD); Keowee-Toxaway Hydro Area engineering; Keowee-Toxaway Hydro Area utility personnel; and Mechanical/Civil Engineering from ONS. The inspections consist of walkdowns of the Keowee Dam, Oconee Intake Dike, Little River Dam, Little River Dikes A, B, C, and D.

Inspections are performed for the Keowee Intake Structure, Keowee Spillway Structure, and the entire Keowee Powerhouse. A portion of the inspection consists of opening one Keowee spillway gate using an emergency power source which consists of a portable self-contained air compressor and an air motor.

The ARO engineer will review the Keowee Station Log and may question the shift operator(s) concerning their responsibility with regards to Emergency Action Plan (EAP) requirements. KHS personnel must have a written list of outages (in excess of 24 hours) - noting planned vs. forced - duration, unit, and the reason for the outage. Critiques from the inspection, notes, and any recommendations are recorded in the Keowee Station Log and signed by the ARO engineer. A written letter follows from the ARO with a suspense for corrections noted.

Reporting requirements, as specified by the FERC, are contained in the EAP. The EAP is updated annually with reporting requirements coordinated between the FHGD and ONS Emergency Planning. A copy of the Keowee EAP is maintained in the Keowee control room.

5.3.3

Prior to the FERC Annual Inspection - the Annual Civil Inspection team schedules their inspection to ensure everything is ready for the FERC Annual Operation Inspection. This team consists of Hydro Support Services engineering; General Office engineering; System Hydro Engineer for Fossil/Hydro Generation Department (FHGD); Keowee-Toxaway Hydro Area engineering and utility personnel; and Mechanical/Civil Engineering for ONS. A report of problems and recommended modifications is completed by the Hydro Support Services engineers.

5.3.4

Every five (5) years, FERC requires DPC to hire an independent consultant - approved by FERC - to conduct an inspection of the facility. This inspection requires the consultant to conduct a review of the design, construction, modifications, inspection reports, monitoring programs, etc., for the facility. The consultant will conduct an on-site inspection with the HSS engineer and the System Hydro Engineer and will file a written report with the FERC concerning their review. HSS budgets the funding for this inspection, contracts for the consultant and obtains the FERC approval for the inspector. HSS also reviews the consultant's report prior to filing it with the FERC.

Should any problems occur with the civil structures (dams, dikes, intake, spillway, intake tunnels and/or powerhouse structures, engineers from HSS and ONS Mechanical/Civil Engineering will inspect the situation and make recommendations for modifications.

5.3.5

Coordination with the FERC ARO is handled by the System Hydro Engineer of the FHGD and the FERC coordinator of the Electric System Support Department (ESSD) in the DPC General Office.

5.3.6

The System Hydro Engineer in conjunction with the ONS Emergency Planning section have responsibility of updating and issuing the Emergency Action Plan (EAP) for KHS. This plan covers the notification of civil authorities, DPC and regulatory agencies in the event of a potential or actual emergency of the KHS. This responsibility entails an annual review, test and update of the plan in addition to a table top and functional exercise of the plan at least every five (5) years. KHS is due to be tested in 1995 and each five years thereafter. Scheduling of required tests will be a coordinated effort between KHS planning and scheduling personnel, ONS Emergency Planning, and FHGD Engineering. The FERC requires testing to be performed by specified dates. The actual date of tests are coordinated to prevent conflicts with ONS outage schedules. Testing dates are flexible within time frames specified by the FERC.

5.4 Work Control

Implementation of the Maintenance Program at KHS is a joint effort between the Keowee Planner, Work Control, and Maintenance execution teams. The Keowee Planner is part of the KHS organization under the station operations organizations. Maintenance requiring outage of TS related equipment or use of ONS station personnel is coordinated by the Keowee Planner and the WCC. KHS work control will be administered as described in the DPC Work Process Manual. All Work Management System (WMS) functions requiring either preventive or corrective maintenance at KHS will be generated by the work control functions assigned to Keowee.

5.4.1 Preventive/Predictive Maintenance:

The Keowee Planner is responsible for identifying all material needs and the generation of the WMS work package. The Keowee Planner will coordinate all work activities with the WCC which is to be performed by appropriate group/groups (OPS, I&E, M.M., ESSD, etc.). The Keowee Planner will contact the WCC to have resources scheduled.

5.4.2 Corrective Maintenance:

The Keowee Planner is responsible for identifying the item/items that require corrective action. If possible, the Keowee Planner will identify all material needs and development of a WMS work package. Assistance will be provided by a Work Control Planner, as requested. Once package development is complete the Keowee Planner will notify the WCC.

5.4.3 ONS Maintenance

Due to the location of KHS, many routine maintenance functions are performed by the Keowee personnel. ONS Maintenance has designated an individual, whose responsibilities are assigned in the WCC, to serve as a contact for interfacing with KHS. When situations arise which require support of ONS personnel, initial contact is made to the individual assigned as the contact for KHS. Support may be required from the Instrument and Electrical (I&E) section and/or Mechanical Maintenance (MM) section. Resources will be allocated on an "as-needed" basis and based upon the operability or in-operability of the KHS equipment requiring attention.

5.4.4 Electric System Support Department (ESSD)

5.4.4.1

Hydro Maintenance (ESSD/HM) - The KHS incorporates unique equipment which requires specialized skills and knowledge to service. When equipment of this type requires either routine maintenance, corrective maintenance, or routine surveillance, planning at the ESSD/HM offices in Great Falls, SC, will be contacted and the required personnel will be dispatched based upon the operability or in-operability of the KHS equipment requiring attention. A satellite crew assigned to ESSD/HM is stationed at the Bad Creek Pumped-Storage Station and is in position to give timely response when required.

5.4.4.2

Generation Services (ESSD/GS) - The KHS generators and associated voltage regulators require specialized skills and knowledge to service. When equipment of this type requires either routine maintenance, corrective maintenance, or routine surveillance, planning at the ESSD/GS offices in Charlotte, NC, will be contacted and the required personnel will be dispatched based upon the operability or in-operability of the KHS equipment requiring attention. Maintenance activities will be conducted as described in NSDs 407, 409, and 502.

5.4.5 Information Technology (IT)

The KHS contains two different computer systems. The Keowee OAC has been incorporated into the station as a means to monitor various station parameters. This system is maintained by ONS I&E computer personnel.

The personal computers (PCs used for WMS, word processing, DMACS, etc.) are maintained through the corporate computer SPOC system. Additions or upgrades to these PCs are coordinated through the ONS Operations IT contact person.

5.4.6 Communications Equipment

KHS contains a variety of communications devices. The installed systems include: local bell telephone circuits; DPC microwave circuits; DPC 800 Mhz two-way radios; DPC system coordinators (System Operating Center - SOC and Transmission Control Center - TCC) auto-ring-down (ARD); and a site ARD phone circuit which connects the Keowee control room to the ONS Unit 2 control room. Upgrades, modifications, and corrective maintenance is performed by ONS site communications personnel.

5.5 Security Program

The Keowee Hydro Station security program is divided into two (2) protection strategies which are dependent upon the operability status of the Standby Shutdown Facility (SSF).

1) During periods of SSF Operability, an "Industrial" Security Program is in effect at Keowee. However, no regulatory requirement exists for a security program at Keowee during an SSF operable.

2) During periods of SSF Inoperability, an "SSF Degrade" Security Program is in effect at Keowee based on regulatory requirements specified in the ONS Security Plan.

The Keowee Hydro Station Security Program is delineated in the (1) Physical Security Plan, (2) Safeguards Contingency Plan, and (3) ONS Security Procedures. These documents are considered "Safeguards" information and, therefore, in-depth discussion of the Security Program is not contained herein. For further information regarding the Keowee Hydro Station Security Program, contact the Site Security Manager or a member of the Security Staff.

Attachment 5

MAJOR ACCOMPLISHMENTS FROM THE
EMERGENCY POWER PROJECT

CATEGORY 1: DESIGN BASIS DOCUMENTATION

Calculations/Analyses/Studies

A significant number of calculations, analyses, and studies were performed during the Emergency Power Project to enhance the station's design basis documentation, including:

Keowee Probabilistic Risk Assessment (PRA) - NEW

Keowee SQUG Seismic Analysis - NEW

Dynamic Voltage Analysis for Oconee Auxiliary Power Systems When Fed From Keowee Via the Emergency Underground Power Path - NEW

(NOTE: This calculation complements the Dynamic Voltage Analysis for Oconee Auxiliary Power Systems When Fed From Keowee Via the Emergency Overhead Power Path, which was completed prior to project start).

Keowee Relay Zone & Frequency Protection Nuclear Station Modification Design Inputs Calculation - NEW

Keowee AC Auxiliary System Voltage Adequacy & Load Analysis - NEW

Keowee DC Auxiliary System Voltage Adequacy & Overvoltage Analysis - NEW

Keowee Voltage Regulator Settings Calculation - NEW

Keowee Normal/Emergency Lockout Study - NEW

Dynamic Voltage Analysis for Oconee Auxiliary Power Systems When Fed From Lee Combustion Turbines Via CT5 Transformer - NEW

Oconee 230KV Switchyard PCB Contact & Coupling Capacitance Study - REVISION

Oconee Transformer Voltage & Switchyard Capacitance Study - REVISION

Calculations/Analysis/Studies (Continued)

Oconee 230KV Switchyard DC System Overvoltage Study - NEW

Oconee, Keowee, & Switchyard Breaker Coordination Calculation - COMPLETE REVIEW & REWRITE

Oconee Electrical Penetration Overcurrent Protection Calculation - COMPLETE REVIEW & REWRITE

Oconee, Keowee, Standby Shutdown Facility, Switchyard Protective Relay & Breaker Setting Calculation - COMPLETE REVIEW & REWRITE

Oconee, Keowee, & Switchyard Power Cable Separation Study - NEW

Oconee Unit Auxiliary System Contactor Voltage, Load, & Fuse Analysis - NEW

Oconee Auxiliary Systems Fast/Slow Transfer Analysis - NEW

Oconee 120VAC Vital I&C & 240/120 VAC Regulated Power Supply Voltage Adequacy & Fault Duty Analysis - NEW

(NOTE: This calculation complements the Oconee 125VDC Vital I&C Power Voltage Adequacy Analysis, which was completed prior to project start).

Oconee 120VAC Vital I&C Power System Harmonic Analysis - NEW

Oconee 208/120VAC Safety Power System Voltage Adequacy Analysis - NEW

Oconee 250/125VDC Power System Voltage Adequacy Analysis - NEW

Oconee 250/125VDC Power System Fault Duty Analysis - NEW

Standby Shutdown Facility AC Auxiliary Power System Load Flow, Voltage Adequacy, & Fault Study - NEW

Standby Shutdown Facility DC Power System Voltage Adequacy Study - NEW

Calculations/Analysis/Studies (Continued)

HVAC Analysis Of Keowee - NEW

Keowee Turbine Generator Cooling Water System Water Hammer Evaluation - NEW

Keowee Turbine Generator Cooling Water System Hydraulic Model - NEW

Keowee Pipe Stress Qualification of Turbine Generator Cooling Water System - NEW

Qualification of Pipe Supports on the Keowee Turbine Generator Cooling Water System - NEW

Keowee Governor Air System Safety Relief Valve Sizing Calculation - NEW

Keowee Governor Air System Recovery Time Analysis - NEW

Keowee Pipe Stress Qualification of Governor Air System - NEW

Qualification of Pipe Supports on the Keowee Governor Air System - NEW

Keowee Turbine Guide Bearing Oil System Analysis - NEW

Keowee Pipe Stress Qualification of Turbine Guide Bearing Oil System - NEW

Qualification of Pipe Supports on the Turbine Guide Bearing Oil System - NEW

Keowee Generator Thrust Bearings Oil System Analysis - NEW

Keowee Turbine Sump Pump Flow Calculation - NEW

Keowee Pipe Stress Qualification of Turbine Sump Pump System - NEW

Qualification of Pipe Supports on the Turbine Sump Pump System - NEW

Keowee Air Circuit Breaker Air System Recovery Time Analysis - NEW

Calculations/Analysis/Studies (Continued)

Keowee Mechanical Systems Single Failure Analysis - NEW

Hydraulic Calculation for Keowee Deluge System - REVISION

Keowee Heat Exchanger Calculations - NEW

Keowee Pipe Stress Qualification of Governor Oil System - NEW

Qualification of Pipe Supports on the Governor Oil System - NEW

Keowee Pipe Stress Qualification of High Pressure Oil System - NEW

Qualification of Pipe Supports on the High Pressure Oil System - NEW

Design Basis Documents

Design Basis Documents that were originated during the project included:

Keowee Turbine Guide Bearing Oil (GBO) System
Keowee Governor Air (AG) System
Keowee Governor Oil (OG) System
Keowee Turbine Generator Cooling Water (WL) System
Keowee Turbine Sump Pump (TS) System
Keowee Air Circuit Breaker (AB) System
Oconee 250/125VDC Power System
Standby Shutdown Facility (SSF) DC Power System

Existing power system design basis documents, as listed below, were revised to include a matrix cross-referencing the design basis against calculations, emergency/abnormal operating procedures, and test procedures.

4160VAC Essential Power System
230KV Switchyard Power System
230KV Switchyard 125VDC Power System
Keowee Emergency Power System
Keowee 125VDC Essential Power System
125VDC Vital I&C Power System
120VAC Vital I&C Power System

Design Basis Documents (Continued)

600/208VAC Essential Power System
Lee/Central 100KV Alternate Power System
250VDC Auxiliary Power System
SSF 4160/600/208VAC Power System
SSF 125VDC Power System

Inspections/Tests

The Emergency Power Project included performance of tests and inspections, including:

Loss of Keowee HVAC Tests

Keowee Governor Oil Pump Performance Test

Keowee Turbine Sump Pump Performance Test

Miscellaneous Valve Stroke Tests

Approximately 15 Keowee Load Rejection Tests from Emergency Start

Miscellaneous Component Low Voltage DC Operating Tests

Switchyard DC System Auctioneering Diode Tests

Keowee Emergency Lighting Assessment

Keowee Motor Control Center Wire Inspection

Inspection of Concrete Expansion Anchors on Keowee QA Condition 1 and 4 Pipe Supports

Keowee Overhead and Lee Power Path Insulator Inspections

CATEGORY 2: OPERATIONS & MAINTENANCE ENHANCEMENTS

Approximately 50 Keowee instrument procedures were created or revised to calibrate approximately 300 instruments. Instruments at Keowee are now periodically calibrated as part of the Oconee Preventive Maintenance (PM) Program.

CATEGORY 2: OPERATIONS & MAINTENANCE ENHANCEMENTS (Continued)

Approximately 160 electrical maintenance and testing procedures were created and revised as part of an ongoing procedure upgrade program for a wide variety of Oconee, Keowee, and Switchyard electrical equipment.

4 generator inspection, maintenance, and testing procedures, including voltage regulator calibration procedures for the Keowee and SSF generators

8 small and large motor inspection, maintenance, and testing procedures

5 transformer inspection and maintenance procedures, including switchyard current transformers

16 breaker inspection and maintenance procedures, including procedures related to the Keowee Air Circuit Breakers, Switchyard Power Circuit Breakers, 600VAC metal clad breakers, and low voltage molded case breakers

4 power distribution bus inspection and maintenance procedures, including procedures related to overhead power path insulators, switchgear buses, and load center buses

2 gang switch inspection and maintenance procedures

3 cable inspection and maintenance procedures

16 low voltage AC and DC system (battery, battery charger, and inverter) maintenance and testing procedures

70 protective and auxiliary relay inspection, testing, and calibration procedures

26 meter procedures, including Keowee generator output metering

1 Keowee supervisory (Keowee status input to Oconee Control Room) maintenance and testing procedure

2 doble test procedures

4 miscellaneous electrical maintenance procedures

CATEGORY 2: OPERATIONS & MAINTENANCE ENHANCEMENTS (Continued)

The Keowee main (overhead power path) transformer was reblocked.

The decision was made to develop electrical load lists with loss of power impact statements and restoration of power precautions. Funding for this project has been approved.

CATEGORY 3: STATION MODIFICATIONS (NSMS) & MINOR MODIFICATIONS (MM)

NSMs have been implemented, including:

NSM ON-52881, Replaced Keowee Battery Chargers and Inverters

NSM ON-52881, Replaced Switchyard Battery Chargers

NSM ON-52904, Replaced Keowee Events Recorder

Initial Scope Documents were completed for other NSMs, that have not been implemented, including:

NSM ON-52966, Keowee Modification to Eliminate Relay Zone Overlap Single Failure Vulnerability

NSM ON-52966, Keowee Modification to Protect Against Overspeed and Overfrequency

NSM ON-52950, Modification to Enhance Degraded Grid Protection Logic

NSMs ON-1/2/32983, 7KV Switchgear Control Circuit Modification

NSM ON-52985, Keowee DC System THKM Breaker Replacement

NSM ON-52991, SSF DC System THKM Breaker Replacement

CATEGORY 3: STATION MODIFICATIONS (NSMS) & MINOR MODIFICATIONS (MM) (Continued)

22 Keowee instrumentation related minor modifications requiring field work and 8 editorial minor modifications have been written. These minor modifications included:

10 minor modifications to upgrade Keowee instrument tubing according to QA Condition

2 minor modifications to replace existing instruments with new QA Condition 1 instruments and to upgrade the instrument tubing on the Keowee CO2 system

2 minor modifications to modify the seal-in circuit for the Keowee governor oil pump during float valve failure

2 minor modifications to delete or abandon in place instrumentation that is not used

8 editorial minor modifications on various Keowee drawings

6 minor modifications to provide test points for inservice testing

Electrical equipment related minor modification packages were prepared, including:

17 equipment upgrade minor modifications, including Keowee isolation transducer replacements, 600VAC breaker trip device replacements, and 9 breaker replacements and setting changes

5 power system control circuit modifications

3 cable reroute minor modifications

Keowee emergency lighting addition minor modification

Keowee main (overhead power path) transformer bushings replacement

CATEGORY 4: CONFIGURATION CONTROL ENHANCEMENTS

Reviewed systems and equipment at Keowee for proper QA classification and revised approximately 800 drawings to reflect correct QA Condition

The Oconee Quality Standards Manual was updated to include a more detailed listing of Keowee QA Condition 1 equipment and a roadmap to aid in determining the QA Condition of other equipment.

Results of Keowee cabinet wiring inspections were reviewed and resolution processes were initiated.

Keowee equipment was added to the EQDB.

More than 200 instrument and relay setpoints were reviewed and added to the Oconee alarm and setpoint document.

Additional flow diagrams and instrument details for Keowee systems were created.