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SUBJECT: LER 88-013-00:on 881017,emergency backup power via lee gas turbines found unacceptable in certain accident scenarios.
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APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/88

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Oconee Nuclear Station, Unit 1	0 5 0 0 0 2 6 9	1 OF 0 8

TITLE (4) Emergency Backup Power Via Lee Gas Turbines Found to Be Unacceptable in Certain Accident Scenarios Due to a Design Deficiency

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
									Oconee Unit 2	0 5 0 0 0 2 7 0
1 0	1 7	8 8	8 8	- 0 1 3	- 0 0	1 1	1 6	8 8	Oconee Unit 3	0 5 0 0 0 2 8 7

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10) 1 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
	20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.405(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
	20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

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SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On October 17, 1988, at 1500 hours, with all three units at 100% power, Oconee Nuclear Station was informed of the results of an electrical transient analysis, regarding emergency backup power. A Design Engineering calculation revealed that for certain conservative LOCA and Loss of Offsite Power scenarios, the voltage on the Standby Bus, when fed from Lee Steam Station gas turbines, is less than adequate for starting the auxiliary shutdown loads. This situation existed since the installation of the Motor Driven Emergency Feedwater Pumps in 1979.

The immediate corrective action was to declare Lee Steam Station gas turbines inoperable. Other significant corrective actions included: issuing operating guidelines to all Operations Shift Supervisors and changing operating procedures to reflect the situation.

The root cause of this event was a design deficiency due to the failure to adequately assess and document the interaction of the MDEFWP's and the emergency power system at Oconee.

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☆ U.S.GPO:1984-0-454-481/18759

Introduction

On October 17, 1988, at 1500 hours, with all three units at 100% power, Oconee Nuclear Station was informed by Design Engineering (DE) of the results of an electrical transient analysis, regarding emergency backup power. A DE calculation concerning the Oconee Standby Bus voltage profile, revealed that for certain conservative Loss of Coolant Accident (LOCA) and Loss of Offsite Power (LOOP) scenarios, the voltage on the Standby Bus, when fed from Lee Steam Station gas turbines, is less than adequate for starting the auxiliary shutdown loads (steady-state voltage is adequate under all scenarios). These calculation results impact the station in situations where the Lee gas turbines are energizing the standby electrical buses through a dedicated transmission line under the provisions of Oconee Technical Specifications 3.7.4 through 3.7.8. This situation was identified as a part of a Duke initiated review of electrical calculations following the Oconee Safety System Functional Inspection conducted by the NRC.

Further investigation by Design Engineering revealed that this unacceptable voltage profile on the Standby Bus, under certain transient emergency conditions, had existed since the installation of the Motor Driven Emergency Feedwater Pumps (MDEFWP) in 1979. The immediate corrective action was to declare Lee Steam Station gas turbines inoperable. Other significant corrective actions included: issuing operating guidelines to all Operations Shift Supervisors and changing operating procedures to reflect the situation.

The root cause of this event was a design deficiency due to the failure of DE to adequately assess and document the interaction of the MDEFWP's and the emergency power system at Oconee. No documentation could be located where DE analyzed the transient voltage profile on the Standby Bus to determine how it would be affected with the addition of the MDEFWP's. DE calculations, performed in October 1988, indicated that the voltage profile on the Standby Bus, when powered via Lee gas turbines, was satisfactory prior to addition of the MDEFWP's in 1979. A contributing cause to this incident was the failure of DE to document the design analysis on the Lee Steam gas turbines, when supplying the standby bus, during original design. No original design documentation could be located to address the voltage profile of the standby bus when powered from the Lee gas turbines.

Background

The Standby Buses (EIIS:BJ) are available to supply 4160 volt power to the Main Feeder Buses in the event that power from the main and/or startup transformers (EIIS:XFMR) is unavailable. The Standby Buses may receive power from transformer CT-4 (via the Keowee Hydro units (EIIS:EK)), or CT-5 (via the Central Switchyard or Lee gas turbines). In the event that Keowee Hydro units are unavailable for the supply of emergency power, gas turbines at the Lee

Steam Station are lined up, via a dedicated transmission line, to supply power to the Standby Buses at Oconee under the provisions of Technical Specifications.

Technical Specification 3.7 delineates the requirements for auxiliary electrical systems (EIIS:EA). Section 3.7.4 states: "Prior to heating the reactor above 200 degrees F or prior to the restart of a shutdown reactor or within 72 hours of the loss of one Keowee unit, the 4160 Volt standby buses shall be energized by a Lee gas turbine through the 100 kV circuit. The Lee gas turbine and 100kV transmission circuit shall be electrically separate from the system grid and offsite non-safety-related loads." Specification 3.7.6 states: "In the event that all conditions of Specification 3.7.1 are met, and planned tests or maintenance are required which will make both Keowee units unavailable, the 4160 volt standby buses shall first be energized by a Lee gas turbine through the 100kV transmission circuit and shall be separate from the grid and offsite non-safety-related loads. The reactor shall then be permitted to remain critical for periods not to exceed 72 hours with both Keowee units unavailable." Specification 3.7.7 states: "In the event that all conditions of Specification 3.7.1 are met except that both Keowee hydro units become unavailable for unplanned reasons, the reactor shall be permitted to remain critical for periods not to exceed 24 hours provided the 4160 volt standby buses are energized within 1 hour by the Lee gas turbine through the 100kV transmission circuit and it shall be separate from the system grid and all offsite non-safety-related loads." Technical Specifications 3.7.5 and 3.7.8 also address the requirements for Lee gas turbine operability.

The Motor Driven Emergency Feedwater Pumps (EIIS:BA) and the Turbine Driven Emergency Feedwater Pumps provide water to both steam generators in the event of a loss of main feedwater (EIIS:SJ).

Description of Incident

In 1967, the Lee gas turbines were committed to the Oconee Nuclear Station as an emergency backup power supply. Normal backup power to the station was provided by two (2) Keowee Hydro units and the Lee gas turbines were redundant to this. In the event of a Loss of Offsite Power (LOOP), the Lee gas turbines could be available to supply the station via a dedicated transmission path from Lee Steam Station to Oconee Nuclear Station (ONS). No documentation could be located to indicate that Design Engineering, at the time of deisgn, performed a transient analysis on the Standby Buses, when supplied from the Lee gas turbines.

In August 1979, Motor Driven Emergency Feedwater Pumps (MDEFWP) were added to each Oconee unit. These pumps supplemented the Turbine Driven Emergency Feedwater Pumps which were already installed. At the time of the installation of the MDEFWP's, no transient analysis was performed by Design Engineering to

determine if the addition of these pumps would adversely affect the Oconee emergency power system with the Lee gas turbines serving as the emergency power supply.

During the time period from May 5 - June 11, 1986 the NRC conducted a Safety System Functional Inspection (SSFI) of the Emergency Feedwater System at ONS. The NRC issued its SSFI report on August 1, 1986, in which deficiencies in the Keowee dynamic analysis were noted. On August 11, 1986, a Design Engineering SSFI action list was compiled and issued internally, including the generation of a Lee transient analysis as an additional action item. On October 1, 1986, Duke Power provided an initial response to the NRC's SSFI finding, including the commitment to review electrical and mechanical system calculation files for completeness.

On October 17, 1988, a Design Engineering preliminary calculation indicated that a less that adequate voltage level at the Standby Bus, when powered from the Lee gas turbines, may exist under the following conditions:

1. All three units transfer to the Standby Bus simultaneously in the event of a LOOP.
2. Loss of Coolant Accident (LOCA) loads of one unit transferring to the Standby Bus followed by the transfer of LOOP load of the other two units in the event of a LOCA/LOOP.

In these situations the loads transferring to the bus simultaneously would decrease voltage on the Standby Bus to the point where some equipment could trip on overcurrent while starting and possibly some equipment damage could occur.

Further calculation, also completed on October 17, indicated that the voltage profile of the Standby Bus was acceptable prior to the addition of the electrical load of the MDEFWP's in 1979. The calculation also indicated that in conditions which require the Standby Buses to be energized via the Lee gas turbine, only two Oconee units can remain operable, based on the capability of the Lee gas turbine to maintain adequate voltage on the Standby Buses with the existing LOCA/LOOP loading sequence. The third Oconee unit must be placed in cold shutdown and its standby breakers opened and blocked from automatically closing in order to prevent the possibility of an undervoltage condition on the Standby Bus. The third unit can be connected manually to the Standby Bus at a later time, approximately thirty (30) seconds.

On October 17, 1988, at 1500 hours, ONS was informed of the results of the calculation. ONS immediately declared the Lee gas turbines inoperable as an emergency power supply and, at 1645 hours, communicated this information to the NRC via a red phone notification persuant to 10 CFR 50.72. Operational guidance was given to the Operations Shift Supervisors and procedure changes were put into place to give guidance in the event of a LOOP or LOCA/LOOP event.

Cause of Occurrence:

The root cause of this incident was determined to be a design deficiency due to the failure of Design Engineering (DE) to adequately analyze the effect of adding the Motor Driven Emergency Feedwater Pumps (MDEFWP) to the emergency power system. DE calculations, performed after the discovery of the Standby Bus voltage degradation problem, indicated that adequate voltage existed on the Standby Buses prior to the addition of the MDEFWP's. After the addition of the MDEFWP's Standby Buses voltage (when powered via the Lee gas turbines), would by analysis degrade to an unacceptable level during certain LOOP and LOCA/LOOP scenarios described earlier in this report. Through interviews with DE personnel, it was learned that no Standby Bus transient voltage profile calculations were performed when the MDEFWP's were added.

A contributing cause to this event was the failure of DE to document analysis of the voltage profile, during original design, of the Standby Buses when powered from Lee gas turbines. No documentation could be located which indicated that DE assessed the voltage drop on the Standby Buses during transient emergency power situations. This voltage drop aspect may have been considered in the original design; however, it was not documented. Had it been documented, it is possible that the additional Standby Bus transient voltage drop resulting from the addition of the MDEFWP loads would have been analyzed. This analysis could have prevented this incident.

It should be noted that the Standby Bus steady-state voltage with the Lee gas turbine as the generation source is adequate under all scenarios via analysis and testing. Also, due to the inherent thermal response differences between units and/or relay setting differences between units it is unlikely that any two units would trip and transfer to the Standby Bus at the same time.

It should also be noted that conservative actions were taken upon discovery of this event. When the station was informed of preliminary calculations which indicated that the emergency power source of the Lee gas turbines may be unacceptable, the station took the conservative action and declared the gas turbines out of service based on the preliminary calculation. In addition, no credit was taken for preliminary calculations, which indicated that operation with two units at power and the third unit in cold shutdown was acceptable when the Standby Buses were energized from Lee gas turbines. The station took the conservative approach of mandating that all three units be brought to cold shutdown in the event that energizing the Standby Buses from the Lee gas turbines was required by Technical Specifications.

The method of discovery for this event, a Duke initiated review of nuclear station modification files for completeness, is itself a corrective action. This review of calculations should ensure that any other similar events are

discovered. Also, the program TOPFORM (the overall plan for organizational review of modifications), currently in place, ensures a periodic review of calculations. TOPFORM also ensures an evaluation of the interaction between systems and components when nuclear station modifications are made.

The corrective actions already taken at Oconee ensure that the overcurrent situation will not occur. Changes in the procedure for Loss of Power and the operating procedure for 100kV Power Supply ensure gradual loading of equipment onto the Standby Bus, whenever manual action is required.

A review of incidents occurring during the past three (3) years revealed two other similar incidents with the same root cause. Therefore, this incident is classified as recurring. The similar incidents were LER 269/87-05 (Potential Tripping of HPI Pumps During Starting) and LER 269/88-06 (Failure to Provide an Adequate Design Analysis of the High Pressure Injection System in the Emergency Core Cooling System Sump Recirculation (Piggyback) Mode). A review of these reports indicated that the resultant corrective actions could not have prevented this event.

No radioactive material releases, radiation exposures or personnel injuries occurred as a result of this incident. The health and safety of the public were not compromised. This incident did not involve any component failure; therefore, it is not NPRDS reportable. This incident is reportable pursuant to 10 CFR 50.73(a)(2)(i)(B).

Corrective Actions :

The immediate corrective action was to declare the Lee gas turbines inoperable.

Subsequent corrective actions were to:

Issue operating instructions to Operations Shift Supervisors regarding Lee gas turbine unavailability;

Revise the Loss of Power and 100kV Power Supply procedures to give guidance for operation when the Standby Buses were required to be energized via Lee gas turbines.

Planned corrective actions are for:

Design Engineering to design and provide post modification test acceptance criteria (PMTAC) for a station modification to ensure that adequate voltage levels are maintained on the Standby Buses, when energized via the Lee gas turbines, during all Loss of Offsite Power and Loss of Coolant Accident/Loss of Offsite Power design scenarios;

The Projects group at Oconee Nuclear Station (ONS) to ensure implementation and testing of the station modification described above;

The Projects group at ONS to distribute a training package on the modification to all affected groups within ONS in accordance with the Project Section Manual Directive 4.12 (NSM Information Package Distribution);

The Projects group at ONS to define the extent and responsibility of testing required on the modification. This information will be included in the modification implementation package.

Analysis of Occurrence:

The safety concern is defined as the potential of tripping one or more safety-related pumps or load centers due to an overcurrent condition occurring during the initial phases of a simultaneous Loss of Offsite Power (LOOP) on all three units or during a Loss of Coolant Accident (LOCA) on one unit with concurrent LOOP on the other two units. The probability of this scenario is extremely low, since the Standby Bus is powered from the 100kV transmission line (Lee Station) and the transfer of loads onto the Standby Bus occurs within approximately thirty (30) seconds.

The potential overcurrent condition has existed since the addition of the Motor Driven Emergency Feedwater Pumps (MDEFWP) in 1979. In the initial phase of starting pumps and operating valves, the high demand for power causes voltage on the Standby Bus to drop and the pump motors compensate by drawing higher currents, which may result in actuating overcurrent protection relays on individual pumps and/or load centers. The exact number of loads that would trip on overcurrent is unknown and unpredictable. As affected loads trip, the demand for power decreases, allowing voltage to recover and the untripped pumps to continue operating normally. Hence, the overcurrent condition would correct itself without operator action and, depending on the number of loads that would trip, may not affect safety functions at all if at least one redundancy of each safety system remains operable. Any tripped pump or load center can be manually reset and restarted within approximately five (5) minutes.

Simultaneous LOOP on all three units would have no impact on nuclear safety, since natural circulation and the Turbine Driven Emergency Feedwater Pump would ensure core cooling until tripped equipment can be restarted, as described above. This situation is covered in Oconee FSAR, Chapter 15.8.3. In general, loss of cooling situations not involving LOCA do not cause core damage within the five (5) minutes required to restart plant equipment.

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		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Oconee Nuclear Station, Unit 1	0 5 0 0 0 2 6 9	8 8	— 0 1 3	— 0 0	0 8 OF 0 8

TEXT (If more space is required, use additional NRC Form 366A's) (17)

LOCA on one unit and concurrent LOOP on two units may cause a loss of all redundancies of the same safety system, such as the Low Pressure Injection system (EIIS:BP). Depending on the size of the break, restarting a pump within five (5) minutes may not prevent damage to the core. In addition, the calculation performed by Design Engineering has determined that the lowest calculated voltage for the above scenario may be beyond the thermal damage curves of the High Pressure Injection (EIIS:BQ) pump motors.

An accident requiring simultaneous transfer of all three units to the Standby Bus, while powered from the Lee gas turbine, has not occurred since the MDEFWP's were added. It is concluded that only a simultaneous LOCA with concurrent LOOP on two units has had the potential for core damage. However, the probability of this scenario is extremely low and the incremental risk is considered negligible. It should be emphasized that the overcurrent scenario would have, in no way, affected the availability of the Standby Bus, the 100kV transmission line, or the Lee gas turbines and would have in no way impeded prompt operator action to restore equipment to service.

Duke Power Company
P.O. Box 33198
Charlotte, N.C. 28242

DUKE POWER

November 16, 1988

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Oconee Nuclear Station
Docket No. 50-269, -270, -287
LER 269/88-13

Gentlemen:

Pursuant to 10CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 269/88-13 concerning emergency backup power via Lee gas turbines.

This report is being submitted in accordance with 10CFR 50.73(a)(2)(i)(B). This event is considered to be of no significance with respect to the health and safety of the public.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

PJN/425/mmf

Attachment

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