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SUBJECT: LER 89-006-00:on 890301,single component failure could render emergency power switching logic inoperable.
W/8 ltr.

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U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

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) Single Component Failure Could Render Emergency Power Switching Logic Inoperable Under Certain Design Basis Accident Scenarios

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)
0 3	0 1	8 9	8 9	0 0 6	0 0	0 3	3 1	8 9	Oconee, Unit 2	0 5 0 0 0 2 7 0
									Oconee, Unit 3	0 5 0 0 0 2 8 7

OPERATING MODE (9): N
POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check one or more of the following)* (11)

[ ] 20.402(b)	[ ] 20.405(c)	[ ] 50.73(a)(2)(iv)	[ ] 73.71(b)
[ ] 20.405(a)(1)(i)	[ ] 50.36(c)(1)	[X] 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)	[ ] 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)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER	
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COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFAC-TURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

[ ] YES *(If yes, complete EXPECTED SUBMISSION DATE)* [X] NO

EXPECTED SUBMISSION DATE (15): MONTH | DAY | YEAR

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

On March 1, 1989, at 2000 hours with Unit 1 and 3 at 100% reactor power and Unit 2 at 15% reactor power, it was discovered that the Emergency Power Switching Logic System (EPSL) could be rendered inoperable by a single equipment failure under certain design basis accident scenarios. This discovery was made during a Design Engineering study of electrical circuitry that resulted from a previous problem with cable separation criteria for safety related cables. Subsequently Unit 1 was shutdown for unrelated maintenance, and both Unit 2 and 3 were placed in a 72 hour Limiting Condition of Operation until the circuitry was revised. This revision was implemented, and all three unit EPSL systems were declared operable. The root cause was determined to be Design Deficiency, Electrical Equipment Configuration Deficiency.

IE22
1/1

BACKGROUND

The Emergency Power Switching Logic (EPSL) [EIIS:EK] in conjunction with its associated circuits, provides a means for assuring that power is supplied to the Main Feeder Buses [EIIS:EA] and therefore to the essential plant loads under accident conditions. The EPSL monitors the normal and emergency power sources and upon loss of the normal power source, the EPSL will seek an alternate source of power. The first priority as the alternate power source is the unit startup transformer powered from either the plant 230 kV switchyard or from one of the Keowee hydro units, via the 230 kV overhead feeder. In the event the startup source is not available, the EPSL will select the standby bus as the alternate power source with power provided from an emergency power source, the other Keowee hydro unit, via the 13.8 kV underground feeder. If none of the alternate power sources are available, the EPSL waits until power is available at one of the sources and then selects that source as the emergency power supply.

Technical Specification 3.0 (Limiting Condition For Operation) states "In the event a Limiting Condition for Operation (LCO) and/or associated Action requirements cannot be satisfied because of circumstances in excess of those addressed in the specification, the affected unit will be placed in at least Hot Shutdown within the next 12 hours,and in at least Cold Shutdown within the following 24 hours unless corrective measures are completed that permit operation under the permissible Action statements for the specified time interval as measured from initial discovery or until the reactor is placed in a mode in which the specification is not applicable."

Technical Specification 3.7.2.a states "One of the two independent on-site emergency power paths, as defined in 3.7.1.b, may be inoperable for periods not exceeding 72 hours for test or maintenance, provided the alternate power path is verified operable within one hour of the loss and every eight hours thereafter."

EVENT DESCRIPTION

From 1970 to 1973, the Emergency Power Switching Logic (EPSL) circuitry was designed and issued by Design Engineering and installed in Unit 1, 2, and 3 at Oconee. During this time, relay 86TX was installed per the Design Engineering issued drawings. This relay was wired in series with a contact from the 86CT1 relay in the EPSL and was used to trip and lockout the Startup breakers (E1 and E2) fed from the startup transformer(CT) (See Final Safety Analysis Report figure 8.1-1) in the event of a Startup Transformer Lockout relay actuation. The purpose of this circuitry was to isolate the Startup Transformer in the event of a fault. This wiring configuration resulted in the possibility that a single failure of the 86TX relay or the contact of the 86CT1 relay could result in a failure of the EPSL to swap to an alternate power source. The relay numbering used above is indicative of the Unit 1 numbering. This problem existed on all three unit EPSL systems.

On January 23, 1989, a lack of cable separation for lockout relay control cables for the MFB on all three units was discovered. As a result of corrective actions for this incident Design Engineering was reviewing electrical documentation to determine the need for a Design Study to identify mutually redundant cables which did not meet cable separation criteria. On March 1, 1989, at 2000 hours the consequences of a single failure of the 86TX relay or the 86CT1 relay contact were discovered. One of these relay failures could prevent operation of the startup breakers for that unit without tripping the switchyard breakers for that unit's startup transformer. Under this condition, voltage sensing relays for the EPSL would falsely sense that the startup source was a viable source of power and prevent an automatic swap to the standby power source.

Upon this discovery, Units 1, 2, and 3 entered Technical Specification (TS) 3.0 which placed them in a Limiting Condition of Operation (LCO) requiring the units to be at hot shutdown within 12 hours and at cold shutdown within the following 24 hours. Unit 1 was subsequently shutdown to allow unrelated maintenance. The generator was taken off line at 0100 hours on March 2, and the unit was at cold shutdown at 1745 hours on March 2. Unit 1 exited the LCO upon reaching cold shutdown. At 0631 hours and 0635 hours respectively on March 2, the switchyard breakers for Unit 2 and 3 were opened to deenergize the startup transformers. With the startup transformers deenergized, it was not possible for the failure of the 86TX relay or the 86CT1 contact to prevent EPSL from performing its function since this effectively deenergized the power path which EPSL was monitoring. This lifted the LCO per TS 3.0 and placed unit 2 and 3 in a 72 hour LCO per TS 3.7.2.a.

An urgent Nuclear Station Modification (NSM) 2808, to correct the wiring configuration and correct the single failure concerns, was issued by Design Engineering for Units 1, 2, and 3 and immediately implemented on all three units. NSM 2808 was functionally tested on March 3 at 0117 hours for Unit 3 and Unit 3 exited the TS 3.7.2.a LCO. NSM 2808 was functionally tested on March 3 at 0508 hours for Unit 2 and Unit 2 exited the TS 3.7.2.a LCO. NSM 2808 was functionally tested on March 3 at 1315 hours for Unit 1 and the Unit 1 EPSL circuitry was declared operable at 1315 hours.

CONCLUSION

The circuitry for the Emergency Power Switching Logic (EPSL) was routed and installed per the Design Engineering specifications and drawings. Due to the design, the single failure of the 86TX relay or the 86CT1 contact could have led to a failure of the EPSL to perform its intended function under certain Design basis accidents. Because of this fact, the root cause of this incident is classified as a Design Deficiency due to an electrical equipment configuration deficiency.

A review of incidents during the past year revealed that similar incidents had occurred. Licensee Event Report (LER) 269/89-04 involved Main Feeder Bus cables which had been routed per the Design Engineering routes and did not maintain cable separation as required by the Final Safety Analysis Report. The corrective actions taken as a result of LER 269/89-04 resulted in the discovery of this event. LER 270/88-02 involved an inoperability of the Unit 2 EPSL system due to Design Deficiency when it was discovered that switchyard breakers could prevent proper operation of the EPSL system under certain conditions. The above referenced events occurred after the installation of the EPSL circuitry and therefore could not have prevented this incident. Therefore even though this event is classified as a recurring event it is recognized that corrective actions resulting from these events would not have prevented this incident. It is also recognized that the corrective actions from LER 269/89-04 led to the discovery of this incident. The TOPFORM program that was implemented within Design Engineering in early 1987 should minimize the chance of similar incidents in the future. There were no exposures, radiation releases or injuries associated with this event and it is concluded that the health and safety of the public were not affected by this event.

CORRECTIVE ACTIONS

Immediate

1. Units 1, 2, and 3 entered the Limiting Condition of Operation (LCO) as specified by Technical Specification (TS) 3.0.

Subsequent

1. Unit 1 was placed under LCO of TS 3.0 until it was placed in cold shutdown at which time it exited the LCO.

2. Switchyard breakers for Unit 2 and 3 startup transformers were opened and Unit 2 and 3 exited LCO of TS 3.0 and entered LCO of TS 3.7.2.a.

3. NSM 2808 was implemented on Unit 1, 2, and 3, functionally tested and Unit 2 and 3 exited LCO of TS 3.7.2.a.

Planned

1. Design Engineering will evaluate development of a model of the Emergency Power Switching Logic System to enable simulation of various failures.

2. A Self Initiated Technical Audit will be performed on the Oconee Emergency Power System per the commitment from LER 270/88-02.

SAFETY ANALYSIS

If a failure of the startup source lockout auxiliary relay to the energized state, a failure of a single relay contact of the startup source lockout relay to the closed state, or a failure of a cable, such as a short, had occurred, the result would have been a trip signal to the startup source to main feeder bus (E) breakers without tripping the switchyard breakers for that unit's startup transformer [EIIS:EA]. In order to evaluate the impact of these postulated failures, various scenarios need to be individually assessed.

1. LOSS OF OFF-SITE POWER (LOOP)

In the event of a LOOP, the Oconee units will trip and both Keowee Hydro generators will start. The switchyard will align itself to provide power from Keowee via the overhead path through the startup transformers and the E breakers. If the subject relay failures had preexisted on any LOOP unit, the E breakers for that unit would have been incapable of closing even if power became available to the startup transformer. Under this condition, the voltage sensing relay for the Emergency Power Switching Logic (EPSL) would have falsely sensed that the startup source was a viable source of power and prevented the automatic transfer to the standby bus (powered from the Keowee Hydro via the underground path through the standby transformer and the Keowee breakers (SK) and Standby bus (S) breakers).

While automatic transfer would have been prohibited, two manually initiated options existed. From the control room, the operators could either trip the switchyard breakers to the startup transformer and, therefore, remove voltage from the startup source, or manually close the S breakers. Either action would have allowed the EPSL to complete the transfer to the standby bus. The closing of the S breakers would have been the easiest and most likely action the operators would take upon recognizing the failure of the E breakers to close. The operators would have recognized the inability to get power through the E breakers almost immediately after the expected time period (31 seconds) to get power. The expected response time would have been well below the time period of 23 minutes to fill the pressurizer [EIIS:AB] with reactor coolant when power is unavailable per Final Safety Analysis Report (FSAR) 15.8.

2. LOSS OF COOLANT ACCIDENT (LOCA)

During a LOCA, the Oconee unit will trip and the switchyard will align itself to provide power from the system grid through the startup transformer and E breakers. Simultaneous with this action, the generated Engineered Safeguards [EIIS:JE] (ES) signal starts the Keowee Hydro units in case they are needed. If the subject relay failures were preexisting on the LOCA unit, power would not have been supplied from the startup source due to the E breakers' inability to close and, as previously explained, automatic transfer to the standby bus would have not taken place. As before, operator action was the only alternative.

Accident analyses require that emergency core coolant be delivered to the reactor vessel within 35 seconds after the ES signal (BAW-10103 Rev. 3: ECCS Analysis of B&W's 177-FA Lowered-Loop NSS). Operator action to restore power by manually closing the S breakers from the control room is expected within 2 minutes. This is based on observations and data collected during the simulator training portion of the 1988 Operator Requalification Program. (This same data shows that a certain percentage of crews will respond within 1 minute.) It has been estimated that 1 minute is sufficient time for the necessary valves to open, pumps to start, and lines to fill with water. Therefore, operator action to restore power within 2 minutes would inject water into the reactor vessel within 3 minutes. From a best-estimate perspective, substantial fuel damage is not expected within 3 minutes. Operator action to restore power within 1 minute would inject water into the reactor vessel within 2 minutes. From a best-estimate perspective, fuel damage within 2 minutes is expected to be negligible. There still existed the remote possibility that an operator could have restored power in time to prevent any fuel damage. This possibility existed because, during a LOCA situation and upon loss of power to the main feeder buses, the operator expects automatic power restoration in approximately 11 seconds. When power is not provided in 11 seconds, the operator knows immediate action is required. Operator training has greatly stressed EPSL and the need for prompt action in such situations.

This LOCA scenario also applied to any other design basis accident which would generate an ES signal and require prompt power restoration for accident mitigation. Of the FSAR Chapter 15 accidents, only two were found to be applicable - main steam line break and steam generator [EIIS:AE] tube rupture. The main steam line break analysis assumes the High Pressure Injection system [EIIS:BJ] delivers coolant in 23 seconds, but the LOCA scenario was discussed because, qualitatively, it was judged that the consequences would be more severe if electrical power were delayed for the LOCA than if power were delayed for the main steam line break. The steam generator tube rupture is considered to be another form of a LOCA and bounded by the LOCA scenario.

3. LOCA/LOOP

In the event of a LOCA simultaneous with a LOOP, if the LOCA unit had the subject relay failure, power would indeed have been automatically transferred to the standby bus. This transfer was possible because, after 11 seconds from the ES signal, the EPSL will align the unit to receive power from Keowee Hydro via the underground path through the standby transformer to the standby bus. This action would have taken place before the overhead path from Keowee would re-energize the startup transformer; hence, not allowing the EPSL voltage sensing relay to falsely sense that the startup source was an available source of power.

If the relay failure had occurred on one of the non-LOCA units, that unit would have been in the same situation as described in Scenario 1. The reason for the non-LOCA unit not automatically receiving power is that the EPSL would wait 31 seconds before aligning the unit to the standby bus; by this time, Keowee Hydro would have re-energized the startup transformer and the EPSL voltage sensing relay would have falsely sensed the startup source as an available power source.

4. NORMAL REACTOR TRIP (No Accident Present)

If a unit should have tripped with the relay failure present, the unit would have been in the same situation as Scenario 1. In essence, after the reactor trip, the unit would have found itself in a LOOP event.

5. UNIT BEING SUPPLIED FROM THE STARTUP TRANSFORMER

The units are normally supplied from the startup transformer when the unit is less than 200 MWe. In this case, failure of the relay would have been recognized immediately because the E breakers would have tripped while supplying power from the startup transformer to the main feeder bus. Because of not knowing the cause of the E breakers tripping, the operators would have probably not attempted to re-close the breakers lest a severe fault exists that might cause damage to the breakers. Again, this situation is the same as that in Scenario 1.

Of the above Scenarios, the most limiting was the second which requires the fastest operator response time. While it is stated that there was the remote possibility that the operators could have indeed taken the appropriate actions to prevent fuel damage in the required amount of time, it is admitted that such an estimate is speculation and cannot be predicted with a high degree of accuracy. It needs to be recognized that the accidents described above, particularly Scenario 2, are of extremely low probability, especially when coupled with the low probability event of the relay failure. Since Oconee has been in operation, there has never been a failure of these relays; therefore, the health and safety of the public was not affected by this condition and corrective actions have been taken to ensure that it will not be adversely affected by a single failure of these relays in the future.

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DUKE POWER

March 31, 1989

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

Subject: **Oconee Nuclear Station**
Docket Nos. 50-269, -270, -287
LER 269/89-06

Gentlemen:

Pursuant to 10CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report (LER) 269/89-06 concerning a discovery that under certain design basis accident scenarios the emergency power switching logic could be rendered inoperable by a single component failure.

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

Very truly yours,

J.W. Hampton for

Hal B. Tucker

PJN

Attachment

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