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SUBJECT: LER 92-018-00:on 921202,design deficiency reulted in inoperability of Oconee Emergency Electrical Power Source. Aligned to standby bus 24 hour Limiting Condition for Operation entered.W/921231 ltr.

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DUKE POWER

December 31, 1992

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

Subject: Oconee Nuclear Site
Docket Nos. 50-269, -270, -287
LER 269/92-18

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 269/92-18, concerning the inoperability of Oconee emergency electrical power source.

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

Very truly yours,

for J. W. Hampton
Vice President

/ftr

Attachment

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NRC FORM 366 (5-92) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 5/31/95

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNBB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Oconee Nuclear Station, Unit 1	05000 269	1 OF 9

TITLE (4) Design Deficiency Results In The Inoperability of Oconee Emergency Electrical Power Source

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
12	02	92	92	-- 18 --	00	12	31	92	Oconee, Unit 2	05000 270
									Oconee, Unit 3	05000 287

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)					
POWER LEVEL (10)	100%	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
		20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)	(Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iv)	X	50.73(a)(2)(ii) (A)		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 (Include Area Code)
S. G. Benesole, Safety Review Manager	803-885-3518

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

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

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 15 single-spaced typewritten lines) (16)

On December 2, 1992 at 1605 hours, Oconee Nuclear Station Units 1, 2, and 3 were operating at 100% Full Power. While testing the control circuitry for the Auxiliary Power Air Circuit Breakers (5, 6, 7, 8), generator field and field supply breakers for both Keowee Hydro (KH) Units, it was discovered that, during emergency conditions, available DC voltage may be inadequate to close the breakers. These breakers are Westinghouse DB-50 breakers, which had been recently modified to revise the control circuits. As a result, both KH Units, the Emergency Power Generators for Oconee, were declared inoperable and entered Technical Specification 3.7. The root cause of this event is a Design Deficiency (Unanticipated interaction of Systems or Components - Design Oversight). Corrective actions include modifying the control circuitry for all Westinghouse DB type breakers at Keowee. This modification will permit the close coil to remain energized for a longer period to ensure breaker closure during an emergency start without AC power.

BACKGROUND

The Keowee Emergency Power System [EIIS:EK] consists of two hydroelectric generators which provide an emergency onsite power source for the Oconee Nuclear Station via two separate and independent paths, one of which is the underground feeder through transformer CT4 and the standby buses [EIIS:EB] and the second is the overhead path through the 230 KV switchyard [EIIS:FK]. One unit is required to be connected to the underground path at all times.

Each Keowee Hydro (KH) Unit is provided with a separate 125V DC Power System consisting of one battery and charger, which is powered from the 1X or 2X load centers. On a loss of power to the charger, the battery will supply loads necessary for unit starting. The loads on the DC system include the Generator Field and Supply Breakers, which are required to operate on an emergency start.

Each KH Unit is provided with its own automatic start equipment. Both units undergo a simultaneous automatic start and run in standby on a loss of the grid, an engineered safeguards actuation on any of the three Oconee Units, or an extended loss of voltage on any unit's main feeder buses. On an emergency automatic startup, the unit connected to the underground feeder supplies that path while the other unit, remaining in standby, is available to supply the overhead transmission line. If there is a grid disturbance, this unit is automatically connected to the Oconee 230 KV switchyard yellow bus only after the yellow bus is automatically isolated from the grid. Therefore, in the event of a Loss of Coolant Accident and the simultaneous loss or degradation of the grid, emergency power is available from either Keowee Unit through the underground feeder and/or the overhead transmission line.

The field, supply, and field flashing breakers are closed to provide DC to the field, which will allow the generator to produce electricity. The "X" relays are the anti-pump relays used in Westinghouse type DB breakers. The anti-pump circuitry prevents the breaker from cycling back and forth between closed and tripped when a close and trip signal are both present. The "X" relay is operated by a coil which is energized on the close signal.

If power to the Oconee units is not available from the grid or the KH units, power can be made available to the standby power buses from the Central Switchyard or one of the Lee Steam Station combustion turbines (CT). The power is provided through a 100 Kv transmission line from the Lee CT's via the Central switchyard to Oconee's CT-5 transformer. If an emergency occurs that would require the use of this 100 KV line it can be isolated from the balance of the transmission system in order to supply

power to Oconee. One of the Lee CT's can be started and supply power within one hour.

Technical Specification (TS) 3.7.2 allows one Keowee unit to be out of service for 72 hours provided the other unit is verified to be operable within one hour. This is verified by starting the Keowee Unit and energizing the standby power bus.

TS 3.7.3 requires that if certain conditions are not met within the time specified in TS 3.7.2, except as noted in TS 3.7.4 and 3.7.7, the reactor shall be placed in a hot shutdown condition within 12 hours. If these requirements are not met within an additional 48 hours, the reactor shall be placed in the cold shutdown condition within 24 hours.

TS 3.7.4 allows Oconee unit operation for an additional 45 days (beyond the 72 hours provided for in TS 3.7.2) with one KH Unit unavailable, under certain conditions.

TS 3.7.7 requires that if both Keowee 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 100 KV transmission circuit and it shall be separate from the system grid and all offsite non-safety related loads.

EVENT DESCRIPTION

On January 29, 1992 at 2104 hours, Keowee Hydro (KH) Unit 2 failed to start during a routine attempt to supply power to the grid. The failure of KH Unit 2 to start was caused by a mechanical failure of the "X" relay. This event was reported in LER 269/92-02. Corrective actions included a Nuclear Station Modification (NSM) 52917, which replaced the existing electromechanical anti-pump scheme with an electrical anti-pump scheme. The design process of the modification included a review by Westinghouse. Westinghouse identified a concern with keeping the closing coil energized too long, potentially damaging the coil. They did not have a concern with maintaining the coil energized long enough to ensure breaker closure. As a result of Westinghouse's concern every DB breaker was individually time tested before and after the modification to ensure the new anti-pump scheme would maintain the closing coil energized as long as the old anti-pump scheme. This was documented in the calculations.

The NSM for KH Unit 1 was completed and tested successfully on July 19, 1992. The NSM for KH Unit 2 was completed and successfully tested on November 18, 1992.

On November 24, 1992, the annual KH Emergency start test was being performed for both KH units. One feature of this test, which differed from the post modification testing performed earlier, was that it assumed, and simulated, a loss of auxiliary AC power as part of the emergency condition. Therefore, the DC battery charger was not assisting the battery during the test. While attempting to tie KH Unit 2 to the overhead power path, it was discovered that after opening the KH Unit 2 Auxiliary Power Normal Feeder Breaker (ACB-6), the KH Unit 2 Auxiliary Power Alternate Feeder Breaker (ACB-8) could not be manually closed. Engineering Supervisor A suspected this failure was due to a voltage problem in ACB-8's closing coil. The problem was attributed to a possible wiring or connection problem, since the breaker closed in the test position after failing in the operate position. Both KH Units auxiliaries were placed in a dedicated alignment so they would be available if they were needed during an emergency, since they were already in their closed position. Under this alignment the suspect circuit would not have been challenged during a Design Basis Event. It was decided that further testing would be performed.

At 1201 hours on December 1, 1992, KH Unit 1 was generating to the grid when voltage swings and a loss of field alarm occurred due to problems with a voltage regulator. KH Unit 1 was shutdown manually and declared inoperable. An investigation was initiated to find the cause. A 72 hour Limiting Condition for Operation (LCO) was entered under Technical Specification (TS) 3.7.2 and KH Unit 2 was operability tested within one hour and subsequently every eight hours as required by TS.

Since KH Unit 1 was inoperable, no testing of breakers could be performed on KH Unit 2 at this time. Later that day KH Station's spare breakers and KH Unit 1's Auxiliary Power Alternate Feeder Breaker (ACB-7) were tested and a potential problem was identified. This testing showed that KH Unit 1's ACB-7 failed to close at low voltages. The results of the testing raised a question about the test equipments accuracy and speed, since ACB-7 had been known to close at lower voltages than those measured during the test. It was determined that high speed measuring equipment would be required to adequately test the breakers. This equipment was located off-site and would be on-site the next day. Also during this period of time, the investigation into Unit 1's voltage regulator problem continued.

At approximately 1000 hours on December 2, 1992, Engineering Supervisor A met with the NRC Resident and Station Management during a routine weekly meeting to discuss the status of problems at Keowee. During this meeting he notified them of the possibility of breaker problems and the need to do further testing. After this meeting, Station Management decided to take

further compensatory actions by energizing the Standby Buses from a Lee Gas Turbine. This action was taken as a precaution, due to the fact that KH Unit 1 was already inoperable and the breaker problem had the potential for affecting KH Unit 2.

At 1605 hours on December 2, 1992 with KH Unit 1 already inoperable, KH Unit 2 locked out due to an indicated generator ground fault during operability testing as required by TS 3.7.2. An investigation was initiated into the generator ground fault. At approximately this same time testing of the control circuitry for DB-50 breakers utilizing the high speed measuring equipment was completed. Test results indicated that available DC voltage may be inadequate to close the breakers. At this time KH Unit 2 was declared inoperable due to inadequate DC voltage to close the DB-50 breakers. This affected the field and field supply breakers which made the Unit inoperable. At this time, all three Oconee Units were placed in a 24 hour LCO under TS 3.7.7.

An investigation revealed that with reduced DC voltages the closing mechanism moves slower, therefore has less momentum. Under reduced voltage situations the close coil becomes deenergized in the travel such that the available momentum is not adequate to complete the breaker travel. To correct this problem, a Minor Modification was implemented. This modification added a time delay to increase the amount of time the closing coil is energized. This increased time compensates for the effects of decreased voltage, and ensures breaker closure.

On December 2, 1992 at approximately 2121 hours, it was discovered that KH Unit 1's voltage regulator problem was due to a faulty voltage error card. This was repaired but KH Unit 1 remained inoperable due to the breaker problems.

At 0129 hours on December 3, 1992, Oconee Unit 1's Turbine Generator was taken off line in preparation for a scheduled Refueling Outage. The reactor was shutdown, and the Unit entered cold shutdown at 2324 hours on December 4, 1992.

A Minor Modification was completed on KH Unit 1 and the unit was restored to an operable status at 0835 hours on December 3, 1992. At this time TS 3.7.7 was exited and TS 3.7.2 was reentered with approximately 27 hours of the 72 hours remaining.

At 1201 hours on December 4, 1992, Oconee Units 2 and 3 entered TS 3.7.4.d due to one unit of KH being unavailable for more than the 72 hours provided for in TS 3.7.2. The NRC was notified. During the notification it was stated that Oconee Units 2 and 3 would be considered to have been under TS

3.7.3, rather than TS 3.7.4.d, if KH Unit 2 could be repaired and declared operable by 0001 hours on December 5th.

A Minor Modification was completed on KH Unit 2 at approximately 1700 hours on December 4, 1992. The investigation into the cause of KH Unit 2's lockout continued.

At 2100 hours on December 4, 1992, the cause of KH Unit 2's lockout, which occurred on December 2 was discovered. As part of a corrective action for an earlier identified problem, Station Instrument and Electrical (I&E) personnel had implemented a Configuration Control Inspection. The inspection is verifying that safety related cabinets' internal wiring agrees with the as-built drawings. On December 2, at approximately 1100 hours, I&E technicians were replacing a coverplate on the Voltage Regulator Control Cabinet as part of this inspection. Unknowingly, a screw from the coverplate had penetrated the insulation of a wire associated with the Voltage Regulator circuitry, thus creating a ground and causing the unit to lockout. The wire was replaced. An operability test was performed satisfactorily at 2300 hours.

At 2336 hours on December 4, 1992, KH Unit 2 was restored to operable status. The NRC Regional Office was notified at 2348 hours on December 4th. As stated in the earlier notification it was considered that Oconee Units 2 and 3 had been operating under provisions of TS 3.7.3 from 1201 hours until 2336 hours when, KH Unit 2 was declared operable. TS 3.7.4 was never entered.

CONCLUSIONS

A design deficiency in the anti-pump relay scheme on DB-50 breakers associated with Keowee Hydro (KH) Units 1 and 2 Supply and Field Breakers resulted in both KH Units being inoperable. This design problem also affected both KH Unit's Air Circuit Breakers (ACB) 5, 6, 7 and 8. The breaker operation is such that, upon receiving the close signal, the breaker close coil is energized through the "X" relay. As the breaker mechanism travels to the closed position, the "X" relay is deenergized before the breaker is fully closed. This removes power from the breaker's closing coil, but by then the closing mechanism has moved far enough in it's travel, allowing the breaker to travel to it's fully closed position by inertia. Under the original design the "X" relay was opened by a mechanical action associated with the breaker closing mechanism, which mechanically opened the "X" relay as it traveled to the closed position. Under the new design, the "X" relay is opened by breaker auxiliary contacts which operate as the breaker mechanism travels to the closed position. Time testing of the breakers was performed as part of the modification to

ensure the closing coil remained energized in the new design as long as it did under the original design. The results of the testing indicated that the time in which the closing coil remained energized was compatible with the original design. This appeared to indicate that as the closing coil mechanism traveled to the fully closed position, the "X" relay dropped out at relatively the same location on the closing travel range in the new and old design.

Although attempts were made to ensure that the new design allowed the close coil to remain energized to the same point in the breaker mechanism's travel as the original design did, it appears that the threshold of operability at reduced DC voltages was raised. It is not known if the same breakers would have closed with the original design under the worst case DC voltage conditions. It is apparent that the design process did not anticipate that low control circuit voltage could prevent breaker closure. Therefore, the root cause of this event is Design Deficiency (Unanticipated Interaction of System or Components - Design Oversight).

A review of previous events involving KH, that have resulted from a root cause of design deficiency - unanticipated interaction of systems or components, revealed two LERs (269/92-11 and 269/92-16). Neither of these previous events involved DB-50 breakers, therefore this event is considered non-recurring.

This event did not involve actual equipment failure and therefore was not NPRDS reportable. There were no releases, radiation exposures, or injuries associated with this event.

CORRECTIVE ACTIONS

Immediate

1) Both Keowee Hydro units were declared inoperable, a Lee Gas Turbine was in operation, aligned to the standby bus and a 24 hour Limiting Condition for Operation was entered.

Subsequent

1) All Westinghouse DB type breakers at Keowee were modified to permit the closed coil to remain energized for a longer period to ensure breaker closure when operating with a degraded DC system voltage.

Planned

1) Complete the Design Basis Document for Keowee's 125 VDC Power System.

SAFETY ANALYSIS

Keowee Hydro (KH) Station provides an emergency power source to Oconee Nuclear Station for scenarios which involve a Loss of Offsite Power (LOOP). In this event, the design deficiency produced a common mode failure that could have made both KH Units and the associated emergency power paths inoperable. If both KH Units are inoperable an alternate power alignment for emergency offsite power is through the 100 KV transmission line from Lee Steam Station's gas turbines within 60 minutes. An alternate power alignment is from the Duke grid via the Central Switchyard.

Final Safety Analysis Report (FSAR) 15.8.3 addresses a simultaneous LOOP event on all three units. This analysis shows that natural circulation of the reactor coolant system [EIIS:AB], turbine driven emergency feedwater system [EIIS:BA], condenser circulating water gravity induced flow, and gravity insertion of the control rods [EIIS:ROD] are among the design features provided to ensure the removal of decay heat for the reactor coolant system without offsite power being available. Additionally, FSAR Section 15.8.3 states that "Each reactor can sustain a complete electrical power loss without emergency cooling for about 23 minutes before the steam volume in the pressurizer is filled with reactor coolant" and that "beyond this time reactor coolant will boil off, and an additional 83 minutes will elapse before the boil off will start to uncover the core." Therefore, the 106 minutes given in the FSAR for core uncovering is well beyond the 60 minutes required for establishing emergency power from the Lee gas turbines.

The Standby Shutdown Facility (SSF) is a separate seismically qualified building which houses the systems and components necessary to provide an alternate and independent means to achieve and maintain hot shutdown conditions for one or more of the three Oconee Units. The SSF was designed to resolve the safe shutdown requirement for fire protection, turbine building flooding, and physical security. The SSF has the capability of maintaining hot shutdown conditions on all three units for approximately three days following a loss of normal AC power.

In the event that a Loss of Coolant Accident (LOCA) occurs simultaneously with a LOOP and power cannot be restored in a reasonable period of time, the emergency core coolant flow would have been delayed beyond what was assumed in the accident analysis. FSAR 15.14.3.3.6 assumes 48 seconds for

the loss of Transformer CT4. If this happens, fuel damage could occur which will result in a radioactive release to the containment building. The FSAR states that without Reactor Building Spray [EIIS:BE] and Reactor Building Cooling Systems [EIIS:BK] the reactor building pressure would not exceed the design pressure for the containment following the LOCA. Given the 60 minute time frame to restore power, it is expected that the reactor building leak rate would not exceed the LOCA analysis rate, but dose rates may be higher due to a loss of filtered ventilation until power is restored. A design containment response evaluation has shown that equipment qualification conditions would not be exceeded in under two hours for the expected temperature and pressure resulting from this event. Therefore, reactor building equipment would be operable when unit power is restored.

This event did not lead to the release of radioactive material, exposure to radiation, or personnel injury. It did not compromise the health and safety of the public.