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SUBJECT: LER 94-004-00:on 940727,determined from testing that emergency condenser CWS would not maintain flow following LOOP event,if EWST unavailable & pond below certain level. Caused by design oversight.W/940825 ltr.

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PRIORITY 2 DOCUMENT

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DUKE POWER

August 25, 1994

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
LER 269/94-04

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 269/94-04, concerning post accident core cooling being technically inoperable.

This report is being submitted in accordance with 10 CFR 50.73 (a)(2)(v)(D). 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
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 8

TITLE (4)

POST ACCIDENT CORE COOLING TECHNICALLY INOPERABLE DUE TO A DESIGN DEFICIENCY

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
07	27	94	94	-- 04 --	00	08	25	94	Oconee, Unit 2	05000 270
									Oconee, Unit 3	05000 287

OPERATING MODE (9)	N
POWER LEVEL (10)	100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (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) (D)		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)		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 (Include Area Code)
Lanny V. Wilkie, 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 July 13, 1994, during the planning process for maintenance that would take the Elevated Water Storage Tank (EWST) out of service, System Engineering (SE) was asked to determine the applicable Limiting Conditions for Operations. On July 26, 1994, with all three Oconee Units at 100 % Full Power, SE completed an operability evaluation to determine the affected systems. The evaluation revealed that if lake level is less than 798.13 feet (two feet below full pond), with the EWST unavailable, the Emergency Condenser Circulating Water System could not maintain siphon flow as required following a Loss of Offsite Power event, thus rendering a Post Accident Core Cooling System (Low Pressure Service Water System) inoperable. The evaluation by SE also determined that the Low Pressure System Water System had been past inoperable during 1985 and 1990 when the EWST was out of service while the lake level was less than 798.13 feet. The root cause of this event is a Design Deficiency, Unanticipated Interaction of Components, (Design Oversight). Planned corrective actions included reviewing and revising design basis documents.

BACKGROUND

The Condenser Circulating Water (CCW) System [EIIS:BS] supplies the Low Pressure Service Water System (LPSW) [EIIS:BI] through the CCW crossover header. The Emergency Condenser Circulating Water System (ECCW) is a part of the CCW System and performs two separate functions. One of these functions is to recirculate CCW to the intake canal following the loss of Lake Keowee (Dam Failure). The second function is an unassisted siphon during Loss of Offsite Power (with or without a Loss of Coolant Accident). This siphon has two distinct purposes; one supplies suction for the LPSW System (Post Accident Core Cooling) and the other provides cooling water flow through the condenser. Each units' CCW System includes four CCW Pumps, each with an associated discharge valve. Each CCW Pump has a pump/valve interlock such that when the last CCW Pump is turned off or upon loss of power, the last pump's discharge valve will remain open to ensure siphon flow. All open valves stay open if all pumps stop at the same time.

The LPSW System provides cooling for components in the Turbine Building [EIIS:NM], the Auxiliary Building (AB) [EIIS:JE] and the Reactor Building (RB) [EIIS:NH]. Engineering Safeguards [EIIS:JE] equipment located in the AB and RB (such as the Low Pressure Injection [EIIS:BP] and Reactor Building Coolers [EIIS:BK]) is cooled by the LPSW System. The LPSW System is required to be operable per Technical Specification 3.3.7.

The High Pressure Service Water System (HPSW) [EIIS:KP] provides a source of water for fire protection. In the event of Loss of Offsite Power, the HPSW via the Elevated Water Storage Tank (EWST) automatically supplies cooling water to the Turbine Driven Emergency Feedwater Pump and its associated oil cooler, and maintains CCW pump seal water.

The Continuous Vacuum Priming System (V) [EIIS:SH] maintains the ECCW System operable to initiate ECCW siphon flow from the intake canal, through the main condenser to the discharge. The V System includes two Emergency Steam Air Ejectors, one for Unit 1 and Units 2 and 3 share the other.

EVENT DESCRIPTION

On July 13, 1994, during the planning process to repair a leaking High Pressure Service Water (HPSW) valve (HPSW-25), System Engineering (SE) was asked to determine which Limiting Conditions for Operations (LCO) should be entered if the Elevated Water Storage Tank (EWST) is taken out of service. SE determined that sealing water supplied from the EWST to the Condenser Circulating Water (CCW) pump shaft seals is necessary to prevent the loss of ECCW siphon flow when lake level is less than 798.13 feet (approximately two feet below full pond), during a Loss of Offsite Power (LOOP) event.

The initial response was that a seventy two hour LCO would be applicable for the Low Pressure Service Water (LPSW) since the EWST supports the suction flow of the LPSW pumps. Further discussions led to the conclusion that the 72 hour LCO is for removing one LPSW pump from service. However, the loss of the EWST would result in the loss of suction flow to all LPSW pumps during a LOOP. This concern was entered into the Problem Investigation Process and SE continued the evaluation.

On July 21, 1994, temporary operational guidance was given to Operations on the importance of the EWST and HPSW Pumps to LPSW Pumps suction during a LOOP event.

On July 26, 1994, with all three Oconee Units at 100 % Full Power, SE completed an operability evaluation. The evaluation concluded that, if lake level is equal to or greater than 798.13 feet (approximately two feet below full pond), gravity flow will supply suction to the LPSW pumps during a LOOP event. However, if lake level is less than 798.13 feet, and the EWST is unavailable during a LOOP, the Emergency Condenser Circulating Water System (ECCW) may not maintain siphon flow due to assumed air inleakage through the CCW Pump seals, thus rendering the LPSW pumps inoperable.

The evaluation by SE revealed that the EWST had been taken out of service during 1985 and 1990 while lake level was less than 798.13 feet (approximately two feet below full pond). In 1985, between August and November, the EWST was removed from service to be painted (inside and out) and lake level was eight feet below full pond. In 1990, at various times between July and September, the EWST was removed from service, as a result of maintenance on HPSW-25 (Altitude Valve), with lake level four feet below full pond. The evaluation concluded that the ECCW and LPSW had been technically inoperable during these time periods.

An investigation into the event revealed that in 1985 when the EWST was removed from service, compensatory actions taken were in regard to fire protection and cooling water for the Turbine Driven Emergency Feedwater Pump. During maintenance of the Altitude Valve (HPSW-25) in 1990, the same compensatory actions were taken. No compensatory actions were taken in regard to the loss of suction to the LPSW Pumps. No calculations existed that determined the minimum lake levels required to maintain net positive suction head to the LPSW Pumps. A calculation was performed on May 14, 1993 and revised on March 3, 1994. The purpose of this calculation was to determine the required lake level that maintains siphon flow to the ECCW System.

CONCLUSIONS

Prior to this event it was not understood that the removal of the Elevated Water Storage Tank (EWST) from service could result in the loss of suction to the Low Pressure Service Water Pumps when lake level is low and siphon is required. At the time the EWST was removed from service, the only concern was fire protection and cooling water for the Turbine Driven Emergency Feedwater Pump. Calculations for air inleakage in conjunction with lake levels did not exist at that time. If calculations had existed prior to the EWST being removed from service, this event may have been prevented. Therefore, the root cause of this event is a Design Deficiency, Unanticipated Interaction of Components, (Design Oversight).

A review of LERs, written within the last two years, revealed that two events (LERs 269/93-04 and 269/94-01) involved design deficiencies from a failure to anticipate interaction of systems, design oversight. LER 269/93-04 involved a potential single failure that could close all Condenser Circulating Water Pump Discharge Valves on a single unit following a Loss of Coolant Accident/Loss of Offsite Power. LER 269/94-01 involved a potential seismic interaction that could have resulted in the loss of Emergency Condenser Circulating Water (ECCW). Both of these events involved the loss of ECCW. Therefore, this event is considered to be recurring. The corrective actions for the events identified above included modifications and the completion of the single failure analysis. Because the periods of inoperability reported in this report occurred prior to the discovery of the problems reported by those LERs, the associated corrective actions could not have prevented this event. Enhancements in the design process, since the original design of Oconee Nuclear Station, should prevent this type of design oversight in the future.

This event did not involve equipment failure and therefore was not NPRDS reportable. There were no radiological overexposures, radioactive releases or personnel injuries associated with this event.

CORRECTIVE ACTIONS

Immediate

1. System Engineering verified lake level and Elevated Water Storage Tank availability to assure Emergency Condenser Circulating Water was not currently inoperable.

Subsequent

1. Temporary operational guidance was given to Operations on the importance of the Elevated Water Storage Tank and High Pressure Service Water System to Low Pressure Service Water pump suction during a Loss of Offsite Power event.

Planned

1. Revise the Emergency Condenser Circulating Water to Low Pressure Service Water Single Failure Calculation to include High Pressure Service Water components as they relate to possible failure of the Low Pressure Service Water System.

2. Review the High Pressure Service Water (HPSW) Design Basis Document (DBD) to ensure that it properly indicates the importance of the HPSW Pumps, and the check valves/HPSW-25 following a Loss of Offsite Power event. Revise the HPSW DBD as required to reflect the results of review.

3. Review the Condenser Circulating Water (CCW) Design Basis Document (DBD) to ensure that it properly indicates importance of the Elevated Water Storage Tank in a Loss of Offsite Power event. Revise the CCW DBD as required to reflect the results of review.

4. Revise the appropriate procedures to provide administrative controls of the High Pressure Service Water System and the Elevated Water Storage Tank to Low Pressure Service Water following a Loss of Offsite Power event.

5. Revise Selected Licensee Commitment 16.9 to reflect the required lake levels for taking the Elevated Water Storage Tank out of service and provide proper compensatory measures.

SAFETY ANALYSIS

The emergency function of the Condenser Circulating Water (CCW) system is to provide a source of water to the Low Pressure Service Water (LPSW) system, which, in turn, provides cooling water for the Low Pressure Injection (LPI)(Decay Heat Removal) System, the Reactor Building Coolers (RB Ventilation), and various motor, oil, and auxiliary heat exchangers.

In the event of a Loss of Off-site Power (LOOP), the CCW pumps would be tripped either by undervoltage relays or by the Emergency Power Switching Logic "Load Shed" feature. In either case, the intent of the system design is that the CCW pump discharge valves would remain open to provide a path for gravity/siphon flow, which would be adequate for all emergency functions.

There are several applicable scenarios:

1. In scenarios where the LOOP does not affect all three Oconee units, isolation valves could be opened to cross connect the affected unit to the CCW system of one of the unaffected Oconee units.

2. LOOP on three units, without a Loss of Coolant Accident (LOCA).

   Without a LOCA, the Emergency Feedwater system would be removing decay heat rather than the LPI/LPSW systems. As described in the Final Safety Analysis Report (FSAR), power is restored to the Main Feeder Busses within approximately 48 seconds. With the EWST unavailable, and lake level less than 798.13 feet (two feet below full pond), sealing water would have not been available to the CCW Pumps. Therefore, depending upon the condition of the pump shaft seals, there could have been excessive air inleakage into the system. Siphon flow may have been lost after a short period of time. Manual operator action would be required to start a CCW pump to restore flow. The applicable Emergency Procedure contains steps to perform this action within 1.5 hours. A High Pressure Service Water Pump (for sealing water) must be restarted prior to restarting the CCW pump. Therefore, this scenario should not have any significant effect on decay heat removal.

3. LOOP on three units, with a LOCA on one unit.
   NOTE: The probability of a LOCA/LOOP occurring is very low.

   As described in the FSAR, power is restored to the Main Feeder Busses within approximately 48 seconds. With the EWST unavailable, and lake level less than 798.13 feet (two feet below full pond), sealing water would have not been available to the CCW Pumps; therefore, depending upon the condition of the pump shaft seals, there could have been excessive air inleakage into the system. Siphon flow may have been lost after a short period of time. The Continuous Vacuum Priming System was aligned to take suction on the CCW lines to prevent, or minimize, any effect of air inleakage on siphon flow. During the time periods in question, the Continuous Vacuum

Priming System was considered adequate to handle expected inleakage. Testing performed at low lake levels in 1986 demonstrated that, with seals in poor condition, air inleakage interfered with proper siphon flow. However, with new seals, siphon flow was maintained for four hours without support of either Continuous Vacuum Priming or HPSW seal supply water. Since that time, CCW pump seals have been included in the Preventive Maintenance program for the CCW pumps. Each refueling outage one CCW pump seal is replaced. However, subsequent tests have not verified the ability to maintain siphon flow without seal flow.

Manual operator action would be required to start a High Pressure Service Water Pump (for sealing water) prior to restarting a CCW pump to restore flow. The applicable Emergency Procedure contains steps to perform this action within 1.5 hours. If, for some reason, a CCW pump cannot be restarted on the unit without siphon flow, the operators could cross connect to a unit with siphon flow as described in scenario 1. Siphon CCW flow for one unit would be adequate to provide required flow and Net Positive Suction Head for the LPSW system on the affected unit.

LPSW does not provide any significant contribution to core cooling until the water inventory in the Borated Water Storage Tank is depleted and the LPI system is placed in recirculation mode to take suction from the Reactor Building emergency sump. This is typically several minutes into the LOCA scenario, and should occur after a CCW pump has been restored to service. During this time, Reactor Building temperature would be elevated, and may not remain within the envelope calculated for maintaining environmental qualifications of equipment located inside the reactor building. However, most of the affected active components would have moved to their post-accident positions soon after the LOCA occurred. Therefore, prompt operator action may minimize or prevent any significant effect on decay heat removal capability due to this scenario.

4. "Station Blackout" on three units, without LOCA (e.g. Appendix R event)

Depending upon the exact scenario, the Turbine Driven Emergency Feedwater Pump may be available for decay heat removal to maintain the unit at hot shutdown. Alternatively, 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 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. The SSF takes its water supply from the Unit 2 CCW line, so that it would be affected by this design deficiency only if the air inleakage occurred on Unit 2. A submersible pump is also available and can be employed within 3.5 hours through damage control procedures to add water to the Unit 2 CCW intake piping.

In summary, in the unlikely event of a LOCA/LOOP during the short time periods that the EWST was unavailable, decay heat cooling may have been lost if 1) excessive seal leakage existed, 2) Continuous Vacuum Priming failed, and 3) power could not be restored to a CCW pump prior to loss of siphon flow. This combination, while possible, is not considered probable. Therefore, the potential for loss of decay heat cooling due to this design deficiency is not considered significant. But, if this scenario had occurred, long term core cooling and RB cooling could have been adversely affected. During this period no LOOP events occurred. Therefore, the inoperability of the Emergency CCW System did not adversely affect the health and safety of the public.