

LICENSEE EVENT REPORT (LER)

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

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.

FACILITY NAME (1) Oconee Nuclear Station, Unit One										DOCKET NUMBER (2) 05000 269		PAGE (3) 1 OF 6		
TITLE (4) A Postulated Single Failure During A LOCA/LOOP May Result In The Loss Of Post Accident Cooling 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			
04	08	93	93	04	00	05	10	93	Oconee, Unit Two		05000 270			
									FACILITY NAME		DOCKET NUMBER			
									Oconee, Unit Three		05000 287			
OPERATING MODE (9)		N		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5: (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)			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 S. G. Benesole, Safety Review Manager										TELEPHONE NUMBER (Include Area Code) (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 April 5, 1993 during an inspection of the Emergency Condenser Cooling Water System, a NRC resident discovered that the control logic associated with the Condenser Cooling Water (CCW) Pump discharge valves may not be single failure proof. An evaluation by Oconee Engineering revealed that a single failure could close all CCW Pump Discharge Valves on a single unit following a LOCA/LOOP. This would isolate the primary suction flow path for the Low Pressure Service Water (LPSW) Pumps. At 1730 hours, on April 8, 1993, with all three Oconee Units at 100% Full Power, a 24 hour action statement for Technical Specification 3.3.7 was entered due to the inability of the LPSW System to withstand a design basis accident and a single failure in the CCW System. The root cause of this event is Design Deficiency: Unanticipated Interaction of Systems, (Design Oversight). Corrective action was to cross connect the CCW System of all three Oconee Units to overcome the single failure vulnerability of the LPSW suction. In addition, a modification is planned to ensure that at least one CCW Pump discharge valve will remain open when all CCW Pumps trip, even with a single failure in the control circuitry.

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BACKGROUND

The Condenser Cooling Water (CCW) System [EIIS:BS] supplies the Low Pressure Service Water System (LPSW) [EIIS:BI] through the CCW crossover header. The CCW System also supplies other systems and components. The Emergency Condenser Cooling 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. The second function is an unassisted siphon. This siphon has two distinct purposes; one supplies suction for the LPSW System and the other provides cooling water flow through the condenser. The CCW System includes four CCW Pumps per unit and 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, its 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 System [EIIS:BP] and Reactor Building Coolers) is cooled by the LPSW System. The LPSW System is required to be operable per Technical Specification 3.3.7.

The Final Safety Analysis Report states that the cooling water systems are designed so no single component failure will curtail normal station operation or impair emergency safeguards operation.

EVENT DESCRIPTION

A Probabilistic Risk Assessment (PRA) for Internal and External Events was published in June 1984 for Oconee Nuclear Station (ONS) Unit 3. In 1982, preliminary results of the study indicated that flooding of the Turbine Building (TB) was a dominant accident sequence with respect to degraded core accidents. To reduce the impact of a major TB flood, interim actions were taken. Actions included closing the Condenser Cooling Water (CCW) crossover valves (1-CCW-40 Unit 1 Crossover Tie and 3-CCW-42 Unit 3 Crossover Tie) to improve the effectiveness of flood isolation. On November 12, 1982, Operations closed 1-CCW-40 and 3-CCW-42.

On April 5, 1993, at approximately 1500 hours, a NRC resident inspector was performing a review of the Emergency Condenser Cooling Water (ECCW) System's electrical drawings. During this review, it was discovered that a failure of relay 2POX3 in conjunction with a LOOP, may have the potential to prevent the operation of the ECCW siphon flow, therefore isolating the

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primary suction flow path for the Low Pressure Service Water (LPSW) Pumps. The NRC resident immediately notified Oconee Engineering (OE) of his finding. OE began evaluating the finding.

On April 6 and 7, 1993, OE continued evaluating the finding. As part of this evaluation, an alternate suction flow path was identified. However, a review of a calculation performed on this flow path revealed that it would result in insufficient Net Positive Suction Head (NPSH) for the LPSW Pumps during a Loss of Coolant Accident (LOCA) / Loss of Offsite Power (LOOP). It was also noted as part of the evaluation that other relays in the control circuitry associated with the CCW Pump Discharge Valves also represented potential single failures.

It was noted during the evaluation that the CCW Design Basis Document for the CCW System did not require the system to be single failure proof.

On April 8, 1993, at approximately 1730 hours, all three units entered the 24 hour action statement for Technical Specification 3.3.7 due to the inability of the LPSW system to withstand a design basis accident and a single failure in the CCW System.

On April 9, 1993, OE performed an operability evaluation to address the concern with water supply from the CCW System to the LPSW System if a single failure of the relay associated with CCW Pump discharge valves occurs. This evaluation determined that the LPSW System is conditionally operable. The condition of operability is that the position of the CCW crossover valves (1-CCW-40 and 3-CCW-42) be changed from closed to open, and this change would be acceptable for thirty days. OE calculated that sufficient NPSH to LPSW Pumps would be provided when taking suction through the cross-connect from any unit's CCW intake. These valves were opened and the 24 hour action statement was exited.

On May 4, 1993, OE determined that it would be acceptable to operate with the crossover valves (1-CCW-40 and 3-CCW-42) open. Calculations revealed that operating with these valves in the open position results in an insignificant increase in the probability of Turbine Building flooding, leading to core melt.

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CONCLUSIONS

The root cause of this event is a Design Deficiency, Unanticipated Interaction of Systems, Design Oversight. Prior to 1982 the Emergency Condenser Cooling Water (ECCW) System was not subject to single failure vulnerability due to the ability to cross connect any of the three Oconee Units through the Condenser Cooling Water (CCW) cross connect lines to feed the Low Pressure Service Water (LPSW) System. In 1982 as a result of the Probabilistic Risk Assessment (PRA), the CCW crossover valves were closed. The closing of these valves inadvertently compromised the ability of the ECCW system to provide adequate NPSH to the LPSW Pumps, during a Design Basis Accident with a single failure of the control circuitry.

The Design Basis Document (DBD) for the CCW System was completed December 1990 and revised in 1992. The DBD process includes extensive research and comment on all the design criteria for a system, including requirements related to single failure. This represented an opportunity to detect the current issue. Review of internal correspondence on the development of the CCW DBD indicates the author and reviewers concluded that because the CCW System was a support system and not strictly part of the LPSW, the Oconee Licensing Basis did not require it to be single failure proof and that this was consistent with the original design. However, it now appears this interpretation was too narrow. It also conflicts with Section 9.2.2 of the Final Safety Analysis Report which contains a broad statement that the system is single failure proof. Properly interpreting and reflecting this criterion in the DBD would not have prevented the current problem but would have detected it sooner. This specific case of a judgement error in preparation of the CCW DBD was not process related, therefore is not considered to be recurring.

A review of the past LERs, within the last two years, revealed two (LER 269/92-11 and LER 269/92-16) events which involved design deficiencies from a failure to anticipate interaction of systems, design oversight. LER 269/92-11 involved a single failure which could cause the overhead path Air Circuit Breaker 1 or 2, for the Keowee unit aligned to the underground, to close. LER 269/92-16 involved a potential single failure that could cause the loss of both Keowee emergency power paths. This problem is therefore considered to be recurring. The corrective actions for the events identified above included modifications and the completion of the single failure analysis of Keowee Hydro Station's power system. These corrective actions could not have prevented this event.

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.

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CORRECTIVE ACTIONS

Immediate

1. All three Oconee Units entered the 24 hour action statement for Technical Specification 3.3.7.

Subsequent

1. Opened Condenser Cooling Water (CCW) cross connect valves 1-CCW-40 and 3-CCW-42.
2. Performed an evaluation of operating continuously with the cross-over valves in the open position in the event of a Turbine Flood.
3. Performed a calculation to verify that the LPSW Pumps would have sufficient NPSH with the cross-over valves open and if the CCW Pump discharge valves were to go closed.
4. Change Operations procedures to document opening of 1-CCW-40 and 3-CCW-42.

Planned

1. Design and implement a modification of the control circuitry for the CCW Pump discharge valves to ensure that one valve will remain open when all CCW Pumps are tripped.
2. Changed the CCW Design Basis Document to state that ECCW supply to the LPSW system is required to be single failure proof.
3. Perform single failure analyses on ECCW supply to LPSW.

SAFETY ANALYSIS

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

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In the event of a LOCA, off-site power is available and any operating CCW pump would continue to operate, providing adequate flow rate and NPSH to the LPSW pump suction header.

In the event of a LOCA/LOOP, off-site power would be lost. Under certain scenarios, the CCW pumps would either trip directly due to undervoltage or would be tripped by the Emergency Power Switching Logic "Load Shed" feature. In either case, the intent of the system design is that at least one of the CCW pump discharge valves would remain open to provide a path for gravity/siphon flow, which would be adequate for all emergency functions.

However, the potential exists for a single failure to defeat the control logic of the CCW pump discharge valves. Such a single failure could allow all four CCW pump discharge valves to close and prevent gravity/siphon flow.

Therefore, if one of these restrictive scenarios had occurred, the CCW system could not have supported proper operation of the LPSW system. As a result, long term core cooling and RB cooling could have been adversely affected.

These consequences should be minimized by procedural guidance in Emergency Operating Procedures which instructs the operators to restore power to, and restart, at least one CCW pump as soon as practical for each unit affected by the LOOP.

LPSW does not provide any significant contribution to core cooling until the water inventory in the Borated Water Storage Tank is depleted and the Low Pressure Injection 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.

If, for some reason, a CCW pump cannot be restarted on the affected unit, isolation valves could have been opened to connect the affected unit to the CCW system of one of the other Oconee units. Even if the other two Oconee Units were affected by the LOOP, the gravity/siphon CCW flow for one unit would be adequate to provide required flow and NPSH for the LPSW system on the LOCA unit.

In conclusion, the probability of a LOCA/LOOP occurring is very low. Therefore, the inoperability of the Emergency CCW System did not adversely affect the health and safety of the public.