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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 91-012-00:on 911014,design deficiency noted re establishing setpoint on relief valve installed in reactor coolant makeup sys.Caused by choosing wrong setpoints for discharge relief valves.Valves changed.W/911126 ltr.

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DUKE POWER

November 26, 1991

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
LER 269/91-12

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 269/91-12 concerning inoperability of the accident mitigating backup Reactor Coolant Makeup System.

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,

H. B. Barron
Station Manager

/ftr

Attachment

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NRC FORM 366 (6-89) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92

ESTIMATED BURDEN PER RESPONSE TO COMPLY WTH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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) Design Deficiency In Establishing Relief Valve Setpoint Results in Technical Inoperability of Alternate Reactor Coolant Makeup System

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 4	9 1	9 1	– 0 1 2	– 0 0	1 1	2 6	9 1	Oconee, Unit 3	0 5 0 0 0 2 8 7

OPERATING MODE (9)	POWER LEVEL (10)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
N	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)	X 50.73(a)(2)(v) (d)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X 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)	50.72(2)(b)(iii)(d)
		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	
	AREA CODE	
Henry R. Lowery, Chairman Oconee Safety Review Group	8 0 3	8 8 5 – 3 0 3 4

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 fifteen single-space typewritten lines) (16)

On October 14, 1991, Duke Power Design Engineering (DE) initiated an investigation into a possible inadequately low actuation setpoint on a relief valve which was installed on the Reactor Coolant Makeup System (RCMU). RCMU is a portion of the Standby Shutdown Facility (SSF) used to establish hot shutdown conditions following a fire, flood, or sabotage event. It injects borated water into the seals of the Reactor Coolant Pumps (RCPs). The RCMU pump is required by a proposed Technical Specification. On October 28, 1991, with all three units at 100 percent full power, an operability evaluation performed by DE declared the RCMU system on all three units inoperable based on the inability to provide adequate RCP seal flow to prevent seal failure and a loss of reactor coolant under certain accident conditions. The RCMU system was technically inoperable since its original design in 1981. Conditional operability for all units was attained on November 4, 1991, by verifying new Test Acceptance Criteria for SSF equipment and by implementing SSF Emergency Operating Procedure changes. The root cause of the event was a functional design deficiency. Properly set relief valves will be installed on each unit.

BACKGROUND

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.

There are two systems used at the SSF to establish hot shutdown conditions. The Reactor Coolant Makeup System (RCMU) uses three positive displacement pumps [EIIS:P], one located in each unit's Reactor Building, which take suction from the Spent Fuel Pool and discharge to the Reactor Coolant Pump (RCP) seals. The purpose of this system is to protect the seals of the RCPs, recover the Reactor Coolant System (RCS) [EIIS:AB] volume, and borate the RCS to cold shutdown conditions.

The SSF Auxiliary Service Water system (SSF-ASW) [EIIS:BA] is used to control steam generator pressure and inventory. It consists of a single pump, located in the SSF, which takes suction from the Unit 2 Condenser Cooling Water piping and discharges to both steam generators on any of the Oconee units.

The Unit 1 RCPs are manufactured by Westinghouse Electric. Unit 2 and 3 use Bingham Company reactor coolant pumps. Both type pumps use three-stage seals.

The requirements for SSF operability are currently not a part of Technical Specifications (TS). However, a proposed Technical Specification 3.18 has been submitted which requires that the RCMU system be operable for each unit when above an RCS temperature of 250 degrees F. Proposed TS 3.18 further states that, if inoperable, the SSF RCMU system will be restored to operable status within seven days or the affected units will be placed in hot shutdown conditions.

EVENT DESCRIPTION

The Standby Shutdown Facility (SSF) was designed and constructed in the years 1978 to 1982 to mitigate the consequences of certain fire, flood, or sabotage events which would require placing the units in hot shutdown conditions from outside the plant control room. The Reactor Coolant Makeup (RCMU) system was completed in 1981.

On September 10, 1991, Design Engineer (DE) A and Operations Engineer A performed some plant response simulations using the Oconee Unit 1 simulator. These simulations involved the loss of all High Pressure Injection (HPI) pumps and all Main [EIIS:SJ] and Emergency Feedwater [EIIS:BA]. Since the Oconee Unit 1 simulator does not directly model the Standby Shutdown Facility (SSF), the response of the plant to SSF Auxiliary

Service Water (SSF-ASW) and Reactor Coolant Makeup (RCMU) were modeled by reintroducing Emergency Feedwater and a small amount of HPI. DE A noted that pressurizer code safety relief valves [EIIS:V] opened prior to the SSF-ASW pump start. Nominal pressurizer code safety relief valve setpoint is 2500 psig.

During the week of September 16, 1991, while Unit 1 was in a scheduled 55 day refueling outage and Units 2 and 3 were at 100 percent full power, Performance Engineer A requested that DE A provide information concerning the appropriate discharge pressure and flow rate for inservice pump testing of the Unit 1 RCMU pump. While researching this question, DE A noted that the relief valves (1,2,3 HP-404) on all three units' RCMU pump discharge lines were set to relieve at 2510 psig.

DE A states that he did not immediately see the significance of the pressurizer code safety relief valve actuations in the simulator scenarios. However, while researching Performance Engineer A's request for inservice pump testing, he realized that the RCMU pump discharge relief valves might be set too low to allow the SSF RCMU pump to provide adequate seal injection flow to the Reactor Coolant Pump (RCP) seals when RCS pressure was at code safety relief setpoint. The problem was that during a plant accident requiring the SSF, in which all HPI makeup, RCP seal injection and cooling, as well as all main and emergency feedwater is lost, the RCMU pump discharge relief valves may open prior to or while the code safety relief valves on the RCS are relieving. This would prevent adequate seal injection flow from reaching the RCP seals, possibly damage the seals, and lead to a small break loss of coolant. A loss of coolant accident is beyond the design basis of the SSF. A Problem Investigation Report (PIR 4-091-0108) was initiated on October 14, 1991.

Following the initiation of the Problem Investigation Report, operability evaluations were begun for Unit 1 and for Units 2 and 3. It was determined from conversations with the RCP manufacturers (Westinghouse and Bingham) that the integrity of the pump seals were in jeopardy if seal injection was not reestablished within 11 minutes following loss of seal injection and seal cooling. The pressure response to the loss of HPI and feedwater event was determined using computer simulations. Calculations of the pressure drop in the RCMU pump discharge line were also performed. New Test Acceptance Criteria (TAC) were developed for the RCMU systems and the SSF-ASW systems to determine whether the equipment could meet the assumptions of the analysis.

Design completed calculations for their operability evaluation and immediately notified the station. These calculations confirmed that the system could not perform its intended function with the relief valves set at 2510 psig. The RCMU systems on all three Oconee units were declared inoperable on October 28, 1991, at 1028 hours. All units were operating at 100 percent full power at this time. All three units entered a Limiting Condition for Operation per proposed Technical Specification 3.18.

Required compensatory actions were instituted following the declaration of inoperability.

Design Engineering provided long term and interim corrective actions which would allow the RCMU system to be declared operable. The long term solution is to replace the relief valves with a properly designed relief valve and requalify the SSF RC makeup system to the higher design pressure.

Until the long term solution could be completed, the Operability Evaluation allowed the RCMU system to be declared operable if the following conditions were met:

1. More strict Test Acceptance Criteria, (ONTC-1,2-101A-0022-001, Rev 0) for the RCMU pump flow performance must be met. This was to ensure that 1,2,3 HP-404 would not relieve below its nominal setpoint of 2510 psig enough to prevent the RCMU pump from providing flow to the RC pump seals at eleven minutes after the loss of seal injection.

2. More strict Test Acceptance Criteria (ONTC-2-133A-0001-001, Rev 2) for the SSF Auxiliary Service Water system to ensure a minimum of 413 gpm to an affected unit during an SSF event must be met. The SSF-ASW system is used to reduce RCS pressure during the hypothesized event. This requirement was set to assure that enough ASW would be available to immediately reduce RCS pressure once the SSF was activated.

3. The SSF emergency operating procedure must be revised to require SSF ASW flow to be established prior to starting RCMU pumps. The SSF RCMU pumps must not be started until RCS pressure is low enough to prevent 1,2,3 HP-404 from opening. These requirements were listed in Engineering Instructions, ONEI-1,2-101A-0001-001 and ONEI-1,2-101A-0001-002.

4. Unit 1 RCP seal leakage must be less than 4.5 gpm. Unit 1 should receive seal flow before any other affected unit if RCS pressure allows. The design of the Westinghouse RCP seals makes them more susceptible to seal failure when seal leakage is high.

On October 28, 1991, the Unit 1 seal leakage was verified to be less than 4.5 gpm. An item was added to the Reactor Operator Turnover Sheet (OP/1/A/1102/20, Enclosure 5.6) to declare the Unit 1 RCMU system out of service if seal leakage exceeds 4.0 gpm. This item is carried over from shift to shift.

AP/0/A/1700/25, Standby Shutdown Facility Emergency Operating Procedure, was issued on October 29, 1991. This procedure had formerly been OP/0/A/1600/11. It was in the process of revision to reflect the format of Abnormal Procedures. The procedure issue incorporated the engineering

instructions required by the Operability Evaluation for conditional operability. Specifically the changes were:

1. Require that SSF-ASW flow be established before providing RCMU flow to the RCS.

2. Initially provide a flow rate of 500 gpm of SSF-ASW flow to each affected unit. If the SSF-ASW pump is unable to provide 500 gpm to each affected unit, the flow rates provided to the affected units should be balanced to maximize flow to all units. Once RCMU flow is established, use RCS parameters to determine the appropriate SSF-ASW flow rate.

3. RCS pressure must be below 2335 psig prior to establishing SSF RC makeup flow and this pressure should not be exceeded once RCMU system flow is established.

4. Since Unit 1 seals are likely to fail more quickly than Units 2 or 3, establish flow to Unit 1 first if it is affected and RCS pressure allows.

5. Monitor the RCMU system flow rate to the RCP seals once seal flow has been established. If seal flow is lost, stop the SSF RCMU pump to reseat relief valve 1,2,3 HP-404. Restart the RCMU pump once RCS pressure is below 2335 psig.

All Operations shifts were trained in the SSF Emergency Operating Procedure changes as they rotated on shift. Personnel who were not scheduled to work when the training was given were required to read a training package on the changes as they returned to their duties. The training was complete on November 4, 1991.

The SSF was declared operable on November 4, 1991, at 1205 hours.

CONCLUSIONS

The root cause of this event is a functional mechanical design deficiency, which occurred during the original design of the Reactor Coolant Makeup (RCMU) system in 1980-1981. The wrong setpoints for the RCMU pump discharge relief valves were chosen. Documentation is not available to determine what aspect of the design process led to the incorrect relief valve setpoint. The design process has changed considerably since the construction of the Standby Shutdown Facility (SSF). Design criteria are now formally specified and reviewed prior to implementation, a practice which was not in place during the original design of the RCMU system. A Design Basis Document is scheduled to be prepared for the SSF which should discover other potential design errors at the SSF.

Several functional design deficiencies have been discovered in the past two years. Most of the events have been discovered through the Design Basis Document program and most have been associated with electrical design problems. This event is considered recurring. Since the design error occurred approximately ten years ago, corrective actions from the recently discovered deficiencies could not prevent the occurrence of this event.

This event did not involve a release of radioactive material, radiation overexposure, or personnel injury. There were no NPRDS reportable equipment failures involved.

CORRECTIVE ACTIONS

Immediate

1. An Operability Evaluation was initiated to determine the effect of the Reactor Coolant Makeup (RCMU) pump discharge relief valve low setpoint on system function.

Subsequent

1. Standby Shutdown Facility (SSF) Auxiliary Service Water (ASW) pump was verified to be within new Test Acceptance Criteria established by the Operability Evaluation.

2. All RCMU systems were verified to be within new Test Acceptance Criteria established by the Operability Evaluation.

3. The SSF Emergency Operating Procedure was revised to reflect new guidelines established in the Operability Evaluation.

4. Seal leakage was verified to be less than 4.5 gpm per Reactor Coolant Pump on Unit 1 as required by the Operability Evaluation. The requirement to maintain this limit was added to the Unit 1 Reactor Operator Shift Turnover Sheet.

5. Design Engineering performed a review of other SSF systems and the HPI system to determine if other similar problems existed. No other problems were identified.

Planned

1. The RCMU pump discharge relief valves, 1,2,3 HP-404, will be changed to a new valve with a higher actuation setpoint and the system piping will be upgraded accordingly.

SAFETY ANALYSIS

The actuation setpoints of the Reactor Coolant Makeup (RCMU) pump discharge relief valves (1,2,3 HP-404) on all three Oconee units were set too low during the original design of the system. This would have prevented the RCMU pumps from adequately protecting the Reactor Coolant Pump (RCP) seals during accidents requiring the Standby Shutdown Facility (SSF) in which both normal seal injection and emergency feedwater are lost. The loss of coolant accident which would result from the seal failure is beyond the design basis of the SSF.

Although no Technical Specifications (TS) for the SSF has been approved, the inoperability of the SSF RCMU system placed the three Oconee units in an action statement of proposed TS 3.18. This specification requires hot shutdown conditions within seven days if the RCMU system cannot be returned to operability. Operability was restored within this time frame by meeting the interim requirements of the Operability Evaluation.

The RCMU system would have been unable to perform its intended function during certain accidents which would require its use. This situation existed from the original operability of the SSF in 1981 until November 4, 1991. The loss of RCMU system function which could have resulted from the low discharge relief valve actuation setpoint requires: a simultaneous loss of all High Pressure Injection (HPI) to the RCP seals, a loss of Component Cooling to the RCP seals, and a loss of all main and emergency feedwater. Although this accident is considered unlikely, there is a possibility that such an event may occur from either fire, flood or sabotage (for instance, a station blackout with the failure of the Turbine Driven Emergency Feedwater Pump). Had such an event occurred, it is possible that Reactor Coolant System (RCS) pressure would have remained high enough to open and maintain open the relief valve on the RCMU pump discharge. This could have prevented adequate flow from reaching the RCP seals to maintain seal integrity. The extended loss of seal injection could have created a loss of coolant accident from the failed seals.

If the postulated accident had actually occurred and the loss of coolant accident proceeded as outlined above, recovery would have depended on the ability to reestablish RCS makeup from the HPI system or depressurize the RCS using Auxiliary Service Water or restored feedwater. The ability to perform these actions depends on the cause of the accident. Plant equipment exists which is designed to establish temporary power to the HPI pumps if a loss of power to the pumps makes this necessary. Under some circumstances, this equipment could be used to restore HPI pumps.

The postulated accident has not occurred at Oconee. The health and safety of the public have not been compromised by this event. The event did not involve personnel overexposure, release of radioactivity, or personnel injury.

ATTACHMENT A

SSF REACTOR COOLANT MAKEUP SYSTEM