CATEGORY 1

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FACIL:50-270 Oconee Nuclear Station, Unit 2, Duke Power Co. 05000270
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SUBJECT: LER 98-007-00:on 981103,RT on loss of main FW pumps due to falsehigh steam generator level.Caused by inadequate procedural guidance.Planned mods to electrical fire barrier penetration repair methodology.With 981203 ltr.

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 10
TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

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December 3, 1998

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Licensee Event Report 50-270/98-07, Revision 0
Problem Investigation Process No.: 2-0-98-5261

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report 50-270/98-07, concerning a reactor trip on a false high steam generator level.

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

Very truly yours,

W. R. McCollum, Jr.

Attachment

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NRC FORM 366 (4-95) — U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMD NO. 3150-0104
EXPIRES: 04/30/98
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)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Oconee Nuclear Station, Unit 2	05000-270	1 of 8

TITLE (4) REACTOR TRIP ON LOSS OF MAIN FEEDWATER PUMPS DUE TO A FALSE HIGH STEAM GENERATOR LEVEL

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 NAME	DOCKET NUMBER(S)
										05000
11	3	98	1998	- 07	- 0	12	3	98		05000

OPERATING MODE (9): 1
POWER LEVEL (10): 100

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)	X 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 (*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 (AREA CODE)	
J.E. Burchfield, Regulatory Compliance Manager	(864)	885-3292

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 (*f yes, complete EXPECTED SUBMISSION DATE*)	X NO				

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

On November 3, 1998, at approximately 1015 hours, Unit 2 tripped from 100 percent power on an anticipatory reactor trip due to a trip of the main turbine-generator (MT) and both main feedwater (MFW) pumps which was initiated by a spurious high steam generator (SG) level. Immediately prior to the reactor trip, vital 125 VDC positive to ground indications had been received. Actual SG levels remained at normal operating levels until after the trip. All three emergency feedwater pumps started and maintained post-trip SG levels per design. The unit was stabilized at Hot Shutdown per procedure. All systems operated as designed to maintain the unit within acceptable limits.

Investigations determined that the MT and MFW pump trip occurred when a metal nail used in repair of fire barrier penetrations grounded the cable for the 125 VDC positive supply conductor. Immediately thereafter, the signal conductor for the MT and MFW pump trip circuit also grounded thereby tripping the MT and MFW pump. Nails are used to hold fiberboard over the outside of fire barrier sealant material for repairs. Corrective actions to prevent recurrence include planned modifications to the electrical fire barrier penetration repair methodology, and improved training and supervision.

This event is considered of no significance to public health and safety.

EVALUATION:

Background

The Reactor Protective System (RPS) [EIIS:JC] monitors several important system parameters and initiates a reactor trip when any trip setpoint is reached using two-of-four channel logic. One reactor trip parameter is a Main Turbine (MT) [EIIS:MT] trip which will initiate a reactor trip when power is greater than 30 percent full power by actuating RPS turbine anticipatory trip channels. The purpose of this trip is to limit Reactor Coolant System (RCS) [EIIS:AB] pressure and to minimize challenges to the Power Operated Relief Valve.

A high level in either Steam Generator (SG) [EIIS:SG] will initiate an automatic trip of both the Main Feedwater (MFW) [EIIS:SJ] pumps and the MT. This trip protects the Reactor Vessel (RPV) [EIIS:RPV] from potential pressurized thermal shock resulting from overfilling the SGs. The SG high level trip circuits are designed to fail safe (i.e., on a loss of power to the circuits, an automatic trip occurs). A SG high level or circuitry failure will trip the MFW pumps and the MT. Selected Licensee Commitment (SLC) 16.7.5, SG Overfill Protection, requires that anytime the RCS temperature is greater than 325 degrees Fahrenheit, and the SG high level trip is inoperable, that the trip be restored to operability within 72 hours.

The Emergency Feedwater system (EFW) [EIIS:BA] is designed to start automatically upon loss of MFW or low level in either SG. The EFW system consists of two motor driven pumps and one turbine driven pump.

The 125 VDC Vital Instrumentation & Control (I&C) electrical power system (subsequently referred to as "Vital DC") [EIIS:EJ] consists of six power sources shared by the three Oconee units. Each unit has its own two power sources with backup sources supplied to the unit's VITAL DC distribution system from another unit using a network of isolating diode assemblies. Each source consists of one 125 VDC battery, a battery charger for each battery, the associated control equipment, isolating transfer diodes and interconnecting cables. The two independent and physically separated DC buses (DCA and DCB) for each unit provide a source of continuous power for I&C during normal operation and shutdown of each unit. During normal operation, like trains of VITAL DC for the three units are interconnected via isolating transfer diodes (e.g., Train "A" for Units 1, 2 and 3 are interconnected).

Description of Event

On November 3, 1998, at approximately 1011 hours, Units 1, 2 and 3 VITAL DC Battery trouble alarms were received for both trains of VITAL DC. Operators observed indication of a ground on the positive side of the VITAL DC batteries.

Four minutes later at approximately 1015 hours, with Unit 2 operating at 100 percent power, the reactor tripped on an anticipatory reactor trip following a high SG level trip signal to the MT and both MFW pumps. It was later determined that the levels of both SGs had remained at normal operating levels and that the trip did not result from actual high SG levels.

All full length control rods [EIIS:ROD] fully inserted into the core shutting down the reactor and the Unit 2 AC power [EIIS:JA] automatically transferred to the start-up transformer. All three EFW pumps started automatically on the loss of MFW pumps and properly controlled secondary side water level in the SGs. Decay heat removal was via the Main Steam Relief valves.

Operators took manual actions per the Emergency Operating Procedure. As normally required after a reactor trip, operators started a second High Pressure Injection (HPI) [EIIS:CB] pump to restore RCS Pressurizer [EIIS:PZR] level. The second HPI pump was stopped when the pressurizer level was stabilized at acceptable levels.

All systems and components which actuated as a result of the false high SG level trip and the subsequent transient operated as designed. Post-trip parameters remained within acceptable limits. Following the reactor trip the average RCS temperature decreased from 579 F to 551 F and the RCS pressure decreased from approximately 2132 psig to 1790 psig. Pressurizer level decreased from 221 inches initially to a minimum of 58 inches. SG "A" pressure increased to a peak of 1097 psig and decreased to a minimum of 982 psig. SG "B" pressure increased to a maximum of 1103 psig and decreased to a minimum of 979 psig. The SG levels decreased to 30 inches and stabilized at that level on each SG. As systems and operators responded to the trip, RCS pressure reached a maximum of 2207 psig and stabilized at approximately 2120 psig. The pressurizer level recovered to a maximum of 154 inches and stabilized at that level.

Following the reactor trip, it was determined that the MFW pump and MT trip had not occurred due to a high SG level since SG levels had remained stable at a normal level until the MFW and MT pump trip at 1015 hours. Initial troubleshooting found the MT and MFW trip relays energized (i.e., in the tripped state) and that both conductors in a cable providing the trip signal to these relays were grounded when only the spiral shield wire around the two conductors should have been grounded. The two conductors consist of: 1) a positive VITAL DC supply to the SG high level MFW pump and MT trip matrix; and 2) a positive signal from the trip matrix to the trip relays. The MFW pump and MT trip relays were being maintained energized in the trip state by the faulted cable which effectively bypassed the SG high level trip matrix.

At 1613 hours on November 3, 1998, SLC 16.7.5, Required Action "A.1" (restore the SG overfill protection system with a Completion Time of 72 hours) was entered to isolate the faulted cable. On isolating the cable, the MFW pump and MT trip relays deenergized, and it was determined that both conductors and the shield were connected together by a low resistance fault.

Review of plant activities prior to the trip revealed that Unit 2 electrical penetration fire barrier repairs had been in progress on November 3, 1998 to correct previously identified deficiencies. The faulted cable causing the trip fed through a fire barrier penetration which was being repaired at the time of the initial battery trouble alarms at 1011 hours and the subsequent reactor trip at 1015 hours. The repair activity in progress immediately prior to the battery trouble alarms and reactor trip consisted of installing one inch thick Cera Form Board (fiberboard) over the fire barrier material.

This particular electrical fire barrier penetration is approximately 10 inches in diameter vertically through a 10 inch concrete floor. The initial fire barrier fill material was approximately 8 inches of Chemtrol Firewall 50 (Firewall 50) which required repair. The repair consisted of filling voids in the Firewall 50 from the underside of the floor with Dow Corning 3-6548 Silicone RTV Foam (foam) and applying an approximately two inch layer of the foam to fill the recess between the bottom of the Firewall 50 and the bottom side of the concrete floor. With the installation of the foam on the underside of the penetration, it was necessary to cover the foam with fiberboard.

The installation used four inch long ribbed nails which were required by procedure to be pushed through the fiberboard into the foam by hand to hold the fiberboard in place over the fill material. The contract worker installing the fiberboard pushed the nails by hand through the fiberboard and foam. When the worker could not seat the nails by hand, he drove the nails into the Firewall 50 with a hammer. One of the nails penetrated the MFW pump and MT trip cable shield to the positive power supply conductor creating a short to ground and triggering the battery trouble alarms. The trip occurred approximately four minutes later when the nail made contact with both of the cable's conductors. The most likely reason for the delayed final contact between the power and signal conductors is that the signal conductor insulation had not been penetrated and resistive heating due to the current flow through the nail generated sufficient heat to melt the insulation. When electrical contact between the two positive conductors occurred, the MFW pump and the MT tripped.

After replacing the damaged SG high level trip cable and satisfactory testing of the trip circuit, the SLC 16.7.5 LCO was exited. While the unit was at Hot Shutdown, several outstanding work requests were performed to repair unrelated problems. The Unit 2 Reactor was returned to critical on November 5, 1998 at 0542 hours.

Conclusion

The root cause of the worker driving the nail into the fire barrier and damaging the cable was inadequate procedural guidance to perform the work. The procedure lacked sufficient technical guidance and clarity to ensure the repair work quality met required specifications. The procedural inadequacy resulted from inadequate engineering and technical information since the fire barrier specification did not address the specific configuration being repaired (i.e., nails can be successfully installed by hand in foam only penetrations). However, guidance is not provided in the procedure for Firewall 50 penetrations being repaired with foam. Contributing causes include: 1) Contract worker technical training was inadequate for the repair of fire barriers having mixed sealants which caused workers to perceive that full compliance with certain procedure provisions was unnecessary; 2) Utility maintenance supervisors and repair technicians did not have sufficient knowledge of the required mixed sealant repair configuration and therefore were unable to assure quality work is accomplished; and 3) Utility maintenance supervisors and repair technicians supporting the contractor repair work did not comply with Duke requirements for procedural compliance.

Review of occurrences for the preceding 48 months did not find instances of reactor protection system or engineered safeguard system actuation resulting from inadequate procedures, work methodology, inadequate training or inadequate supervision. It is therefore concluded that this is a non-recurring problem.

CORRECTIVE ACTION:

Immediate:

1. Operations personnel took appropriate actions to bring the unit to stable conditions per the Emergency Operation Procedures (EOP).

2. Operations personnel verified that the MFW pump and MT trip did not result from an actual high SG Level.

Subsequent:

1. The damaged SG High Level trip cable was replaced.

2. The circuitry of the MFW pump and MT trip on high SG level were tested and found to be operable.

3. The practice of inserting nails into electrical fire barrier penetrations was suspended until the fire barrier installation procedure was modified to include measures to significantly reduce the risk of electrical cable damage. The modifications included specific guidance about the location and position of nails with respect to electrical cables, require the use of blunted nails and to emphasize inserting the nails by hand.

4. Those maintenance supervisors, repair technicians, and job sponsors currently involved with the installation and repair of fire barrier penetrations have received additional training in their roles and responsibilities in assuring quality work is accomplished. These same personnel have also been counseled on the Duke requirements for procedure use and adherence (i.e., need for procedure compliance).

Planned:

1. Modify the installation specification for electrical penetration firestops to improve technical guidance on fire barrier penetration seal repairs and allowed configurations. Barrier repair topics in the specification which will be improved include: 1) allowable combinations of fire barrier materials, 2) acceptable methods for installing fiberboard for each barrier material or combination of materials requiring fiberboard.

2. Modify the maintenance procedures for installation and repair of electrical fire barrier penetrations to incorporate the modifications to the installation specification for electrical penetration firestops described above.

3. Electrical fire barrier penetrations having nails inserted into the sealant will be visually inspected to identify penetrations likely to have damaged cables. Such penetrations will be opened to inspect the cables for damage. In the unlikely event that cable damage is found, the damage will be evaluated to determine if cable repair or replacement is necessary.

4. Maintenance supervisors, repair technicians, and job sponsors who are not currently involved with the installation and repair of fire barrier penetrations will receive additional training in their roles and responsibilities in assuring quality work is accomplished. The same personnel will also be counseled on the Duke requirements for procedure use and adherence (i.e., need for procedure compliance).

Planned corrective actions one through four are considered to be NRC Commitments. These are the only NRC Commitments contained in this LER.

SAFETY ANALYSIS:

Loss of MFW is an anticipated transient and is described in Section 10.4 of the Updated Final Safety Analysis Report. Loss of MFW initiates a reactor trip and starts the EFW System to provide decay heat removal. In this event, all the systems and equipment operated as designed to mitigate the consequences of the loss of MFW. Instrumentation detected the loss of MFW and the MT and initiated the reactor trip and provided the start signal to the EFW system. During this event, the turbine driven EFW pump and both motor driven EFW pumps started and properly controlled SG levels to remove decay heat from the RCS. The unit was stabilized at Hot Shutdown.

If the Unit 2 EFW pumps had not started, the EOPs and Abnormal Procedures (AP) direct operators to align EFW from one of the other two Oconee units (Unit 3 EFW was not available due to being in a refueling outage). The EOP and AP also include the use of high pressure injection forced cooling and/or use of the Standby Shutdown Facility Auxiliary Service Water pump. At the time of this event: 1) both trains of the high pressure injection system were available to provide feed-and-bleed decay and sensible heat removal, 2) Unit 1 was at power and all three EFW pumps were available to provide EFW, and 3) the Standby Shutdown Facility and its Auxiliary Service Water pump were available to provide heat removal via the SGs.

The core damage significance of this event has been evaluated by considering the availability of the EFW system, the SSF and the HPI system to provide SG and feed-and-bleed cooling. The estimated increase in core damage probability associated with this event is approximately 1E-7 and is less than the precursor threshold of 1E-6.

There were no releases of radioactive materials, radiation over-exposures, or personnel injuries associated with this event. The health and safety of the public was not affected by this event.