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FACIL:50-287 Oconee Nuclear Station, Unit 3, Duke Power Co. 05000287
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RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 94-001-00:on 940301,Unit 3 tripped from 100% full power. Cause was equipment failure.Corrective action:operators brought unit to stable hot shutdown,faulty mercury bulb assembly in level switch replaced.W/940331 ltr.

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DUKE POWER

March 31, 1994

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
LER 287/94-01

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 287/94-01, concerning a reactor trip on false high level indication.

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,

Bryan J. Dolan for J W Hampton

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 3	05000 287	1 OF 7

TITLE (4) REACTOR TRIP ON FALSE HIGH LEVEL INDICATION DUE TO EQUIPMENT FAILURE

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
03	01	94	94	-- 01 --	00	03	31	94	FACILITY NAME	DOCKET NUMBER 05000

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)	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
	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)
L. 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
F	SN	XIS	M322	No						

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)

At 1014:30 hours, March 1, 1994, Unit 3 tripped from 100% Full Power. All systems responded as expected. The response of Operators and automatic systems brought the unit to stable hot shutdown conditions. The initiating signal was an Anticipatory Reactor Trip on Turbine Trip due to a false emergency high level in a Moisture Separator/Reheater (MSR), even though there were no other high level indications or alarms. Troubleshooting personnel identified a defective mercury contact switch assembly in one of four MSR high level instruments. Root cause was Equipment Failure. The defective contact assembly was replaced prior to restart of the unit.

BACKGROUND

Each Oconee unit contains four Moisture Separator/Reheater (MSR) shell and tube heat exchangers [EIIS:HX] which reduce the moisture content and raise the temperature of the steam being passed to the low pressure turbines [EIIS:TRB]. Removing the moisture and reheating the steam reduces erosion and improves the thermal efficiency of the low pressure turbines.

The MSRs receive the main steam discharge [EIIS:SE] from the high pressure turbine. The steam passes through chevron separators which collect moisture droplets contained in the steam. The droplets collected by the chevron separators are passed into a MSR drain tank [EIIS:SN]. In "dump" mode, drain tank level sensors [EIIS:XT] open valves to route the contents of this drain tank to the condenser. In "feed forward" mode, control is switched such that normal flow is routed to the feedwater [EIIS:SJ] system in order to recover more thermal energy and improve unit efficiency. However, even in feed forward mode, a high level in the drain tank will result in an alarm and the dump valves will open.

If the drain tank controls were to malfunction such that the water level was allowed to rise into the MSR, the water could be entrained by the steam flow and could be passed on the low pressure turbine. In severe cases, the low pressure turbines could be significantly damaged. Therefore, the control system will trip the turbine if an emergency high water level is sensed in any of the four moisture separators.

Oconee Nuclear Station had several previous trips due to spurious actuation of these emergency high level trip switches. Previous trips, the last occurring in 1988, have been due to the switch being hit or kicked, wiring being damaged by high temperature, etc. As a result of those incidents, previous corrective actions have included:

A. revision of the logic to require a high level exist for ten seconds prior to initiation of a trip signal;

B. erection of a "cage" around the switch to prevent it from being hit or kicked by passers-by;

C. replacement of wiring with wire rated for higher temperatures;

D. initiation of a visual inspection for signs of deterioration and effects of heat.

EVENT DESCRIPTION

On February 26, 1994, Oconee Unit 3 returned to service following a scheduled refueling outage. Unit 3 reached 100% Full Power (FP) on February 28, following physics and power escalation testing.

On March 1, 1994, the operators were performing routine post-startup activities to optimize unit operation. Between approximately 0945 and 1000 hours, the operators had realigned the flow path of the 3A Moisture Separator/Reheater drains from a "dump to condenser" mode to a "feed forward" mode.

At 1014:30 hours, Unit 3 tripped from 100% FP without any prior indication of a problem. The initiating signal was an Anticipatory Reactor Trip on Turbine Trip. The "first out" circuit indicated that the turbine had tripped due to emergency high moisture separator level, even though there had been no Moisture Separator/Reheater (MSR) Drain Tank high level indications or alarms.

As the turbine tripped, Unit AC power [EIIS:EA] was automatically transferred from the auxiliary transformer to the start-up transformer, powered from the switchyard. The Anticipatory trip actuated the Reactor Protective System [EIIS:JC] which opened the control rod drive breakers [EIIS:BRK] and dropped all control rods [EIIS:ROD] as expected.

The Integrated Control System (ICS) [EIIS:JA] reduced feedwater flow so that Steam generator levels dropped from 183/195 inches (steam generators 3A and 3B, respectively) before the trip to a minimum of 22 inches after the trip. ICS then controlled at approximately 25 inches, the post-trip set point. Main Steam [EIIS:SB] pressures were approximately 895 psig before the trip. After the trip, the turbine by-pass valves and main steam relief valves operated to control steam pressure. Pressures peaked at a high of 1117 psig, which is slightly higher than the maximum expected value of 1115 psig, then controlled at approximately 1005 psig. This condition is being evaluated under a Problem Investigation Process report which was initiated after a previous trip where pressures increased above 1115 psig.

Normal Reactor Coolant System (RCS) [EIIS:AB] operating temperatures are approximately 601F at the hot legs and 557F at the cold legs for an average RCS temperature of 579F. After the trip, the hot leg and cold leg temperatures converged at approximately 550F, rose briefly to 560F, then returned to 555F.

Normal RCS pressure is 2155 psig. Due to routine fluctuations it dropped to 2129 psig prior to the trip. As the RCS temperature dropped, the post-trip pressure dropped to 1793 psig approximately one and a half minutes

after the trip. Pressurizer (PZR) level decreased from about 220 inches prior to the trip to approximately 59 inches as the RCS temperature and pressure dropped. The operator took manual action to increase RCS inventory by closing 3HP-5 (Letdown Isolation Valve), opening 3HP-26 (Loop A Injection emergency flow control valve), and running a second High Pressure Injection (HPI) [EIIS:CB] pump for approximately 2 minutes, 38 seconds. RCS pressure increased to a maximum of 2157 psig before stabilizing at approximately 2132 psig as HPI flow restored PZR level. As the system was being stabilized, PZR level returned to 147 inches before being maintained at approximately 133 inches.

At 1018:37 hours, a Loss of Core Saturation Margin alarm was received. The operators verified that the Inadequate Core Cooling Monitor and Post Accident Monitor instrumentation all indicated that the actual core conditions were satisfactory. At 1019:10 hours, the alarm cleared and did not repeat. Post trip investigation determined that this was due to a momentary spike on a core exit thermocouple indication. The spike was too short to represent a real temperature increase but no problem could be found in the circuit. The duration of the alarm condition was due to the calculation frequency in the computer. No further investigation is planned.

At approximately 1026 hours, the operators lowered the main steam header pressure setpoint to reduce main steam pressure to 968 psig so that the main steam relief valves would reseat.

At 1031 hours, the operators took manual control of the 3B Main Feedwater Pump Turbine, and, at 1034 hours, shut the pump down per procedure, leaving the 3A Main Feedwater Pump in service.

At approximately 1152 hours, the operators recognized that 3RIA-54, Turbine Building Sump Radiation Monitor, [EIIS:IL] had not automatically reset following the transfer of AC power after the trip. Initial examination showed that the sample pump was off. In this situation, 3RIA-54 is supposed to interlock the Unit 3 Turbine Building Sump Pump. The operators restarted the RIA sample pump, which reset a flow fault, and the RIA reset. However, the operators discovered that the sump pump had operated from 1135 to 1136 and from 1148 to 1152 hours while it should have been interlocked. The Operators evaluated the readings on the RIA after it was reset and concluded that the situation did not constitute a release of radioactive materials. They initiated a work request to investigate and repair the immediate problem, and initiated a Problem Investigation Process report. Instrument and Electrical (IAE) technicians investigated the problems with 3RIA-54. When the technicians checked the function of the sump pump interlock, it appeared to function properly. This is still considered an outstanding item and additional troubleshooting is planned.

An investigation began into the cause of the trip. After several hours of troubleshooting and inspection, IAE technicians and Engineering personnel identified a defective mercury switch [EIIS:XIS] in one of the MSR high level instruments. The switch had a spotty residue plated out on the glass inner wall of the bulb. When cycled manually, they observed that the mercury did not flow and break contact properly. The defective contact assembly was replaced prior to restart of the unit. The personnel involved stated that the defect was not obvious and the switch had to be cycled several times before it became apparent.

After the last trip due to a spurious high MSR level, which occurred in 1988, IP/0/B/0280/012A, (Turbine-Generator Trips), was revised to include a step to visually inspect the switch and wiring for signs of deterioration and effects of heat. This procedure also checks the setting of the time delay relay and exercises the switches for 15 seconds to verify that trip signals are received. While it does verify that the trip signals have reset, it does not specifically verify the function of the switch by checking the water level or equivalent position at which the contacts make or break. This procedure had been performed between February 2 and 9, 1994, during the refueling outage, with no defects identified.

It was noted that a Nuclear Station Modification (NSM) had been initiated in 1991 to modify the MSR high level trip circuit on all three Oconee units to a 2-of-3 logic in order to further reduce the potential for spurious trips. At one time, this modification had been scheduled for implementation during 3EOC14, the refueling outage which immediately preceded this trip. However, in August, 1993, implementation of this NSM had been delayed to 3EOC15 and, on February 11, 1994, had been cancelled. Part of the decision making process included an evaluation of operating history after the 1988 trip associated with switches in this application and the apparent success of corrective actions already taken.

While the unit was at hot shutdown, several outstanding work requests were performed to repair unrelated problems. The unit returned to critical at 1049 hours, March 2, 1994.

CONCLUSIONS

The Root Cause of this event is determined to be equipment failure. The glass bulb of the Moisture Separator/Reheater (MSR) level switch had apparently lost its vacuum seal, which allowed degradation of the mercury to occur. A residue formed which apparently allowed contact to be made with less motion (level change) than normal. Apparently, vibrations and pressure surges associated with the system realignments produced enough motion of the switch, and the mercury within it, to establish continuity

across the trip circuit contacts. In addition, the mercury had lost surface tension due to contact with the residue and "wet" the glass bulb rather than maintaining a "bead". Therefore, the mercury did not flow properly to reopen the contact prior to the ten second time delay. This switch and other switches in similar applications on all three Oconee units have been visually inspected during refueling outages since approximately 1988, but no prior failures of this type have been observed. Although this failure was detected by visual inspection after the trip, the degradation was not easily observable and this investigation determined that it was not unreasonable for the degradation to be undetected by technicians performing the periodic inspection during the previous outage.

The defective mercury bulb was part of a Magnetrol model 402 level switch. This failure is not NPRDS reportable.

Over the last two years there have been five reactor trips at Oconee Nuclear Station with root or contributing causes of equipment failure. These were reported as LERs 269/92-03, 270/92-04, 270/93-01, 269/93-10 and 269/94-02. In each of these cases the systems, components, and mode of failure have been different. Therefore, this is not a recurring event.

There were no personnel injuries, radiation overexposures, or releases of radioactive materials associated with this event.

CORRECTIVE ACTIONS

Immediate

1. Operators took actions per procedure to bring unit to stable hot shutdown.

Subsequent

1. The faulty mercury bulb assembly in the level switch was replaced.

2. 3RIA-54 was returned to service, and PIP 3-094-0323 initiated to address the problem.

Planned

1. Appropriate procedures and associated technician task training will be enhanced to improve the periodic inspection, and functional verification of the Moisture Separator Reheater emergency high level switches.

2. Evaluate replacement of the existing mercury bulb assemblies or entire level switches with a model which will be more reliable. Take appropriate action based on evaluation.

3. Re-evaluate the need for the modification to install 2-of-3 logic in the Moisture Separator Reheater emergency high level trip logic. Take appropriate action based on evaluation.

4. Continue to trouble shoot/repair the 3RIA-54 interlock problem.

5. Inspect MSR emergency high level switches on Units 1 and 2 during the next refueling outage (to prevent inadvertant actuation during inspection).

6. Evaluate function of other applications where this model level switch is used. Inspect those switches used in functions where a similar malfunction would affect plant safety or reliability.

SAFETY ANALYSIS

The Moisture Separator/Reheater (MSR) emergency high level trip is a turbine protective trip for economic reasons; high MSR level does not affect nuclear safety.

In this event, although the trip signal was initiated due to a defective component rather than a real signal, the plant systems and operators responded as expected. Automatic system responses and operator actions in accordance with existing procedures were adequate to safely control the reactor following this trip.

There were no Engineered Safeguards or Emergency Feedwater actuations required as a result of this event.

The health and safety of the public were not affected by this event.