CATEGORY 1

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

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SUBJECT: LER 97-001-04:on 970320,control rod drive sys short circuited resulting in reactor trip due to mfg deficiency. Repaired electrical short & revised CRD breaker trip time test procedure.W/970417 ltr.

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DUKE POWER

April 17, 1997

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 287/97-01
Problem Investigation Process No.: 3-097-1006

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a) (1) and (d), attached is Licensee Event Report 287/97-01, concerning a manufacturing deficiency in the Control Rod Drive electrical circuitry that resulted in a Reactor trip.

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,

J. W. Hampton, Vice President
Oconee Nuclear Site

IE22/1

/fts

Attachment

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Oconee Nuclear Station

NRC FORM 366 (4-95)

U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

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.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Oconee Nuclear Station, Unit Three	05000 287	1 OF 7

TITLE (4)
Control Rod Drive System Short Circuit Results In A Reactor Trip Due To A Manufacturing Deficiency

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
03	20	97	97	- 01	- 00	04	17	97		05000

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR (*Check one or more of the following*) (11)							
POWER LEVEL (10)	73		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	
R. T. Bond, Safety Review Manager	(864)	885-3043

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 March 20, 1997, Unit 3 was operating at 73% full power, following a refueling outage. Maintenance and Operations personnel were performing a monthly "Control Rod Drive Breaker Trip and Event Recorder Timing Test." At approximately 0913 hours, while testing one breaker, the Reactor tripped due to an electrical short in the redundant Control Rod Drive trip confirm breaker circuitry. The trip response was routine with no significant occurrences. The unit was stabilized at Hot Shutdown conditions. The root cause of the event is a manufacturing fabrication deficiency. Corrective actions include repairing the electrical short and revising the CRD breaker trip time test procedure.

BACKGROUND:

The Control Rod Drive (CRD) [EIIS:AA] System utilizes two separate power supplies to energize the CRD mechanisms. If one supply is lost, the other supply will maintain uninterrupted power to the CRD system. There is one AC circuit breaker (10 or 11), two DC circuit breakers (CB-1 and 2 or CB-3 and 4), and electronic trips (contactors) in each circuit. Within the CRD system, two redundant trip confirm circuits exist that monitor the status of the reactor trip devices. The outputs of these two circuits provide "Reactor Trip Confirm A" and "Reactor Trip Confirm B" signals if the logic of the circuits is satisfied so as to indicate a fault condition. A fault condition means that the right combination of reactor trip devices has been detected to be in the tripped state that would indicate a reactor trip. The reactor trip confirm circuitry then sends signals to the turbine/generator circuitry to indicate that the reactor has tripped.

In each of the trip confirm circuits there are four relays, K1 through K4, which provide the combined logic circuit to relay K5. Relay K1 monitors the status of one AC circuit breaker, K2 monitors the other AC circuit breaker, K3 monitors two DC circuit breakers and the E contactors, and K4 monitors the other two DC breakers and the F contactors. Contacts from K1 through K4 are wired to the coil of relay K5. If the logic is satisfied such that K5 de-energizes, a reactor trip confirm signal is sent to the turbine/generator control.

The Reactor Protective System (RPS) [EIIS:JC] consists of four identical protective channels designated as Channel A, B, C, and D. Each RPS channel has a Reactor Trip Module containing tripping relays that will de-energize (trip) the CRD power supply breakers whenever a protective action function is needed.

The Integrated Control System [EIIS:JA] provides fully automatic control of reactor power, steam generation rate, and generated load by processing selected signals of measured plant parameters.

EVENT DESCRIPTION:

On March 20, 1997, at 0850 hours, Unit 3 was at 73% full power and holding for Integrated Control System (ICS) testing. Unit 3 had recently been in a refueling outage that included major modifications to the ICS. At various stages in the return to 100% full power the power escalation was stopped for testing the ICS modification. Prior to the ICS testing at 73% full power, the monthly Control Rod Drive (CRD) breaker testing per procedure IP/0/A/305/14-1 was initiated. Various ICS control stations were in manual for testing. A section of the procedure removes Reactor Protective System (RPS) channel A from service followed by tripping CRD AC breaker 10. RPS channel A and the breaker were placed back in service, at approximately 0905 hours, after the data was recorded for breaker 10. At approximately 0910 hours, RPS channel B was removed from service in preparation for testing CRD AC breaker number 11. At 0913 hours, breaker 11 was manually tripped by test signal per procedure. When breaker 11 opened, a false Reactor Trip Confirm A signal was initiated. A backup generator [EIIS:TB] lockout relay initiated, which tripped the electrical switchyard breakers and transferred auxiliary power to the start-up source after a built-in time delay. The transfer of power interrupted the AC supply to CRD Breaker 10, dropping the control rods and satisfying the Reactor Trip Confirm B logic.

Several immediate automatic actions occurred. All full length control rods inserted into the core, shutting down the Reactor. The Main Steam (MS) [EIIS:SB] Relief Valves and Turbine Bypass Valves opened.

The Operators also took manual action per the Emergency Operating Procedure (EOP). They confirmed that the Reactor [EIIS:RCT] and Main Turbine [EIIS:TA] had tripped and verified that Main Feedwater [EIIS:SJ] was supplying the Steam Generators. They opened valve 3HP-26, as directed by the EOP, to avoid the Pressurizer (PZR) [EIIS:PZR] level dropping below the PZR heaters. This pre-planned, normal action automatically started a second High Pressure Injection (HPI) [EIIS:BG] pump at approximately 0913 hours. At approximately 0917 hours, the operators stopped the second HPI pump and closed valve 3HP-26 when the PZR level reached the normal post-trip setpoint. They also entered procedure AP/3/A/1700/11, Loss of Power, to recover power to two electrical load centers (3X1 and 3X3).

Post-trip response was as expected. Pressurizer inventory remained on scale between a high of 222 inches prior to the trip, to a low of 86 inches post trip before increasing and stabilizing at approximately 106 inches. Reactor Coolant System (RCS) [EIIS:AB] pressure dropped to 1867 psig, then increased and controlled at 2151 psig. RCS Hot and Cold Leg temperatures converged and stabilized at approximately 550 F. Immediately following the trip, the 1A and 1B Steam Generator pressures reached a post trip high of approximately 1090 psig, then pressure was reduced to approximately 979 psig to close the MS Relief Valves.

Unit 3 was stabilized at Hot Shutdown condition. The Post Trip Review procedure and the investigation into the cause of the Unit 3 trip were initiated. The CRD and RPS equipment was quarantined and trouble shooting of the circuitry was performed by maintenance technicians and engineers. At approximately 1630 hours, maintenance technicians found an electrical short to ground in the circuit associated with relay K3 in the Reactor Trip Confirm A logic. The short was found at an electrical connector in a CRD power supply cabinet. The wiring plug connector has a number of individual wires inserted into the back of the plug. The wires are bundled together with a two piece metal clip device that is screwed together on each end. This clip keeps the individual wires from being pulled from the back of the plug connector. The connector is plugged into an electronic trip component. Threads on a screw that secure a clamp at the back of the electrical connector most likely had cut into the insulation of one of the wires entering the connector. The results of the investigation suggested that this condition had occurred over a long period of time.

Previous to this event, sufficient insulating material must have existed to prevent the short to ground. The remaining wire insulation likely deteriorated due to a combination of vibration within the cabinet, thermal stresses, and stresses from the cable movement associated with the other end of this cable. This movement occurs with the removal and installation of the Programmers associated with the CRD system.

When the electrical short to ground finally occurred, sufficient fault current existed to open fuse F3. This fuse provides branch circuit protection for the K3 relay circuit. When the fault occurred, the fuse performed its intended function by opening to isolate this fault. The result was that relay K3 de-energized which provided a tripped signal to the Reactor Trip Confirm A logic circuit.

During the investigation of the CRD circuitry, maintenance technicians discovered that the F3 fuse opening and relay K3 de-energization are not alarmed to any type of remote indication. The only indication of this condition is a blown fuse indicator on the F3 fuse holder. The indicator is designed to illuminate if the fuse is blown. These fuses are located inside a cubicle located above the AC Reactor Trip Breaker cabinets. The indicator associated with the F3 fuse was burned out and could not illuminate. Additionally, it was noted that two manufacturers' drawings showing these fuses were contradictory in specifying the fuse ratings for the F1 through F4 fuses. A Problem Investigation Process report was initiated for resolution of this problem.

Two electrical load centers lost power during the power transfer. This situation had no adverse affect on the transient. However, Operations personnel entered the Abnormal Procedure for a loss of power to restore the load centers. An investigation into why the two load centers de-energized was conducted and concluded the loss was associated with the time delay in the power transfer. This sequence of events occurred as designed and no significant affects on the transient were noted. However, a Problem Investigation Process report was initiated to determine if this time delay should be removed from this circuit.

After the investigation and post-trip review were completed the permission to re-start was granted on March 20, 1997, at 2212 hours. On March 21, 1997, at 0644 hours, the Reactor was made critical.

CONCLUSIONS:

There were no indications of the wiring plug connector being removed or the individual wires replaced. Records of modifications and work orders associated with the Control Rod Drive (CRD) cabinets were researched. However, none were found that specifically addressed the wiring plug connector. Therefore, it is concluded that one of the screws was installed, by the manufacturer, in a manner that pinched the insulation. Over a period of years the insulation was stressed to the point where the wire contacted the screw. Therefore, the root cause of this event is a manufacturing fabrication deficiency.

There have been events involving components associated with the CRD system in the past. However, none were associated with the Reactor Trip Confirm circuitry. Wiring problems have been identified with the CRD programmer circuits but were associated with insufficient wire strands attached to crimp lugs. Therefore, this event is considered non-recurring.

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

CORRECTIVE ACTIONS:

Immediate:

1. Operations personnel took appropriate actions in accordance with the Emergency Operating Procedure to bring the unit to stable conditions following the Reactor trip.

Subsequent:

1. The damaged wire that caused the electrical short to ground was re-insulated and re-installed properly.

2. The circuit integrity was verified and Reactor Trip Breaker testing completed satisfactorily.

3. Fuses F1 through F4 in Reactor Trip Confirm A and B circuits were replaced with the proper size fuses.

4. The fuse indicator for the F3 fuse was replaced.

Planned:

1. Revise the procedure for Reactor Trip Breaker Testing (IP/0/A/305/14-1) to ensure that visual inspections for blown fuses in the Reactor Trip Confirm circuitry will be made prior to initiating any breaker trips.

Planned corrective action number 1 is considered to be an NRC Commitment Item. This is the only NRC Commitment item contained in this LER.

SAFETY ANALYSIS:

A Reactor trip was induced due to a wiring short to ground in the Reactor Trip Confirm logic circuitry. When one Control Rod Drive (CRD) AC power breaker was opened for testing with a short to ground in the other circuit, the closed CRD breaker opened and all full length rods inserted into the core shutting down the Reactor. Loss of power to the CRD's results in roller nuts disengaging from the lead screw on the control rods. This disengagement allows a gravity trip of the control rod assembly. The plant response to this event was normal and as expected. No Engineered Safeguards system or Emergency Feedwater actuations were either required or received.

There were no personnel injuries, releases of radioactive materials, or overexposures associated with this event. The health and safety of the public were not affected due to this event.