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FACIL:50-270 Oconee Nuclear Station, Unit 2, Duke Power Co. 05000270

AUTH.NAME	AUTHOR AFFILIATION
WILKIE,L.V.	Duke Power Co.
HAMPTON,J.W.	Duke Power Co.
RECIP.NAME	RECIPIENT AFFILIATION

SUBJECT: LER 94-005-00:on 941209,failed equipment of breaker resulted in reactor trip due to thermal overload.Changed out power supply breaker & reviewed breaker preventive maint program. W/950105 ltr.

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Duke Power Company
Oconee Nuclear Site
P.O. Box 1439
Seneca, SC 29679

J. W. HAMPTON
Vice President
(803)885-3499 Office
(803)885-3564 Fax

DUKE POWER

January 5, 1995

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

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
LER 270/94-05

Gentlemen:

Pursuant to 10 CFR 50.73 Sections (a)(1) and (d), attached is Licensee Event Report (LER) 270/94-05, concerning equipment failure of a breaker which 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,

BWPeele
for J. W. Hampton
Vice President

/ftr

Attachment

xc: Mr. S. D. Ebneter
Regional Administrator, Region II
U.S. Nuclear Regulatory Commission
101 Marietta St., NW, Suite 2900
Atlanta, Georgia 30323

INPO Records Center
700 Galleria Parkway
Atlanta, GA 30339-5957

Mr. L. A. Wiens
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Mr. P. E. Harmon
NRC Resident Inspector
Oconee Nuclear Site

JE22

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 2	05000 270	1 OF 6

TITLE (4)
Equipment Failure of Breaker Results in Reactor Trip

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 05000
12	09	94	94	-- 05 --	00	01	05	95	FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)		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)
POWER LEVEL (10)		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)
Lanny 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	EL	52	I005	Yes						

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 December 8, 1994, at 1425 hours, Unit 2 Reactor tripped from 100% full power. The Reactor tripped when a breaker that supplies "auto" power to the Integrated Control System (ICS) tripped. The loss of "auto" power caused a relay to deenergize (by design) that introduced a false high Steam Generator (S/G) level that tripped the Main Feedwater Pumps and the Main Turbine. The trip of the Main Feedwater Pumps and Main Turbine resulted in an anticipatory trip of the Reactor Protective System. Emergency Feedwater automatically actuated with all three pumps starting and feeding the S/Gs as expected. The Unit was then stabilized at Hot Shutdown condition with decay heat removal via the S/Gs. No major problems were noted as a result of the trip. Investigation revealed a loose lug on the load side of the breaker that generated sufficient heat to trip the breaker on thermal overload. The root cause of the event is equipment failure possibly due to thermal cycling. Corrective actions included the changeout of the power supply breaker and review of breaker preventive maintenance program.

BACKGROUND

The 2KI inverter is a non-safety related power source that supplies essential (non-vital) plant loads. One of the primary loads that it supplies is the Integrated Control System (ICS) [EIIS:JA] and its various components. Instruments and controls that are essential for shutdown are arranged with their power supply independent of the ICS source. If a loss of ICS power occurs, the power supplies are designed to place the Unit in a known safe state. This is accomplished by initiating a trip of both Main Feedwater [EIIS:SJ] pumps (MFDWP) by a fail-safe design of the Once Through Steam Generator (S/G) high level monitoring circuits. These circuits are designed such that upon loss of either "hand" or "auto" power to the ICS, a trip of the MFDWPs and the Main Turbine is initiated. This in turn will trip the reactor by an Anticipatory Reactor trip signal.

EVENT DESCRIPTION

After Operators had completed a routine turbine valve movement periodic test at 1421 hours on December 8, 1994, Unit 2 was at 100% full power, steady state conditions. At 1425:27 hours the reactor tripped without any prior indication of a problem. Reactor Protective Systems [EIIS:JC] Channels A, B, C, and D tripped on an anticipatory trip signal from loss of both Main Feedwater pumps (MFDWPs). The Operators responded to the reactor trip by entering the Emergency Operating Procedure and performing the required actions.

The Operators observed the loss of both MFDWPs and a loss of "auto" power to the Integrated Control System (ICS) from control room alarms and indications. All three Emergency Feedwater (EFDW) [EIIS:BA] pumps started automatically and properly controlled secondary side water level in the Steam Generators (S/Gs) independent of the ICS. Decay heat removal was via the Main Steam Relief Valves. The Turbine Bypass Valves (TBVs) failed closed/manually operable per design as a result of the loss of "auto" power to the ICS. The Unit AC power [EIIS:JA] automatically transferred to the start-up transformer and all full length control rods [EIIS:ROD] fully inserted into the core shutting down the reactor.

In response to the loss of "auto" power, a Non-Licensed Operator (NLO) was dispatched to the 2KI Inverter power panelboard that supplies "auto" power to the ICS. The NLO found breaker 2KI-25 in the 2KI panelboard tripped and reported this back to the control room. He was instructed to close the breaker, which he performed at 1437 hours.

Primary and most secondary post trip plant parameters responded normally and remained within acceptable limits. Reactor Coolant System (RCS) [EIIS:AB] pressure decreased to a minimum of 1845 psig, then rose to approximately 2203 psig shortly after the trip and then decreased and stabilized at approximately 2155 psig. Pressurizer level decreased from 220 inches to a minimum of 76 inches and then stabilized at approximately 150 inches. Operators opened 2HP-26 (Loop A HPI Emergency Injection valve) in response to the decreasing pressurizer level for additional makeup but did not have to start an additional makeup pump. Except for those indications affected by the loss of breaker # 25, RCS hot and cold leg temperatures converged and stabilized at approximately 551 degrees Fahrenheit (F). Steam Generator A and B levels at the start of the transient were 163 and 158 inches respectively. They dropped to respective post-trip minimum of 25 inches and 26 inches. Both stabilized on the Startup Range and were automatically maintained at 30 inches. S/G Pressure response was higher than normal for both A and B S/Gs post trip because of the loss of auto power to the ICS. The TBVs did not open automatically at the time of the trip, thus the pressure in S/G A went from approximately 900 psig pre-trip to a peak of 1137 psig. The pressure then stabilized at 1000 psig. Also, S/G B pressure response was from approximately 900 psig to 1124 psig before stabilizing at 1000 psig post trip. The normal pressure peak is less than 1115 psig. The unit was stabilized at Hot Shutdown conditions.

An investigation began immediately into the cause and problems associated with this trip. The investigation centered toward discovering what caused breaker 2KI-25 to trip. The event recorder, alarm typer and the "first out" circuit indicated the unit had tripped due to the loss of "auto" power to the ICS. The 2KI-25 circuit was reading 17 amps after the breaker was closed. The breaker was rated at 50 amps. The reading was compared with Unit's 1 and 3 and this value was normal.

At 1602 hours, MFDWP A was placed back in service and the EFDW System was shutdown.

At 2317 hours, as Instrument and Electrical (I&E) personnel were troubleshooting breaker 2KI-25, it tripped again. The MFDWP tripped and all EFDWP started as expected. Thermography of the breaker and panelboard revealed that the breaker load side lug was excessively hot (approximately 125 degrees F at the connector and greater than 200 degrees behind it). Also, the connector was discovered to be loose. It was concluded that the high temperature had caused the breaker thermal overloads to trip, thus tripping the breaker.

All breakers in 2KX, 2KI, and 2KU panelboards were examined by thermography and two other loose connections were identified and tightened. It was

decided not to examine Units 1 and 3 similar equipment at this time because of the possibility of tripping the units. This item was added to each Units "Hot" list that identifies items to be worked on at the next shutdown.

A Temporary Modification was implemented to remove breaker 2KI-25 in 2KI panelboard from service and to connect its loads to spare breaker 2KI-26. Breaker 2KI-25 was removed from service because of the potential damage it may have sustained from the excessive thermal loading. The amp reading and temperature of the new supply breaker indicated normal values after it was carrying the load.

At 0221 hours on December 9, 1994, the EFDW system was shutdown after the 2A MFDWP was placed back in service.

At 0451 hours all outstanding items were completed and the plant Manager gave permission for restart.

On December 9, 1994, at 1123 hours the reactor was critical and the Turbine/Generator placed on-line at 1357 hours.

CONCLUSIONS

The root cause of this event was determined to be equipment failure. High resistance caused by a loose electrical terminal generated enough heat such that the thermal overload tripped the breaker. Research of the work history for this breaker reveals that there has been no documented maintenance on it since it was replaced more than ten years ago. Since there has been no work identified on the breaker, Engineering suspects that thermal cycling could cause the connector to come loose over the years. The trip of the breaker caused a loss of "auto" power to the ICS which by design caused the anticipatory trip of the Reactor Protective system.

Response of the primary system to the trip was normal. Reactor Coolant System (RCS) inventory, RCS pressure, and RCS temperature were all maintained within the normal post-trip range. S/Gs peak pressure response was slightly higher than normal due to the Turbine Bypass Valves not opening from the loss of ICS "auto" power. S/Gs level response was normal.

A review of previous reactor trips of the last two years indicates that there were five other events involving reactor trips with root or contributing causes of equipment failure. Four of the events involved different equipment and modes of failure. One of the events (LER 269/93-10) involves a loose/broken electrical lug connector but its mode of failure was attributed to vibration. The corrective action from the events

addressed the failures and other applications where the specific equipment was used. Since the failure in this event did not involve the same mode of failure, the corrective actions from the previous events could not have prevented this event. Therefore, this event is considered to be non-recurring.

The breaker failure of 2KI-25 breaker is NPRDS reportable. The manufacturer is ITE Circuit, Limited and the model number is CE2B50.

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

CORRECTIVE ACTIONS

Immediate

1. Operators took the appropriate actions per procedure to stabilize the Unit at Hot Shutdown conditions.

Subsequent

1. The Operators reclosed 2KI-25 breaker.

2. I&E performed thermography on all the breakers in the power panelboards 2KI, 2KX, and 2KU and tightened all connectors that were found loose.

3. A Temporary Modification was implemented to transfer the loads from breaker 2KI-25 to spare breaker 2KI-26.

Planned

1. A review will be conducted to determine which breakers with similar type lugs are high risk to cause trips and transients.

2. Changes will be made to the thermography program to include the breakers that are identified from corrective action # 1.

3. Implement modification to separate auto and manual power sources to the ICS such that losing one of the sources will not automatically trip the Unit.

SAFETY ANALYSIS

In this event the Integrated Control System (ICS) "auto" power was lost resulting in a reactor trip. Instrument and controls that are essential for Operators to control and monitor for shutdown are arranged with their power supply independent of the ICS source. The response to the event by the Operators was not restrained by the loss of power to the ICS.

Also, as a result of the loss of ICS "auto" power, the Main Feedwater (MFDW) pumps tripped. Loss of MFDW is an anticipated transient and is described in Section 10.4 of the Final Safety Analysis Report. Loss of MFDW initiates a reactor trip and starts the Emergency Feedwater (EFDW) System to provide for the removal of decay heat. In this event, the loss of MFDW was per design to respond to a transient induced by the loss of "auto" power to the ICS. This put the unit in a known safe state condition of a reactor trip to reduce Operator burden. All the systems and equipment operated as designed. The Unit was stabilized at Hot Shutdown conditions.

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