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

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20603.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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Watts Bar Nuclear Plant - Unit 1	05000390	1 OF 8

TITLE (4)

Reactor Trip due to Operation of a Generator Protective Relay

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
										05000
04	20	97	97	010	00	05	20	97	FACILITY NAME	DOCKET NUMBER
										05000

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

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

20.2201(b)	20.2203(a)(2)(v)	50.73(a)(2)(i)	50.73(a)(2)(viii)
20.2203(a)(1)	20.2203(a)(3)(i)	50.73(a)(2)(ii)	50.73(a)(2)(x)
20.2203(a)(2)(i)	20.2203(a)(3)(ii)	50.73(a)(2)(iii)	73.71
20.2203(a)(2)(ii)	20.2203(a)(4)	X 50.73(a)(2)(iv)	OTHER
20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below
20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	or in NRC Form 366A

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Jerry Bushnell, Licensing Engineer	(423)-365-8048

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
X	YES - refer to Section V, Corrective Actions (If yes, complete EXPECTED SUBMISSION DATE).	NO		10	31	97

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

At 0125 EDT on April 20, 1997, the WBN Unit 1 main generator pneumatic circuit breaker (PCB) opened initiating a turbine trip and a subsequent automatic reactor trip. Investigations found that the turbine trip was initiated by operation of the generator backup relay, relay 121GB. Operation of this relay results in the opening of the main generator PCB and closure of the steam supply to the turbine. Meggar testing was performed to establish a possible cause for the operation of the protective relay. For the A phase main transformer high side potential device (PD) circuit, a low meggar reading was found. Additional troubleshooting found evidence that the phase A capacitance tap connector from the 500KV bushing to the PD had experienced arcing. Moisture was also found in the bushing well and the lubricant around the bushing well was blackened indicating a fault on the A phase capacitance tap connector. Once this problem was found, the capacitance tap bushing area was cleaned and new lubricant was applied. In addition, the exposed surfaces of the connector were sealed with an RTV sealant. Resistance tests were subsequently performed with the readings found to be normal. Due to the problems found on the A phase, the B and C phase capacitance tap connectors were inspected even though the PD circuits meggar tested satisfactorily. No problems were found on the B phase. C phase was found to have lost a portion of its lubricant, and the remaining lubricant was blackened but no significant burn odor was noted. The same type of repairs performed on the A phase were made to both the B and the C phases.

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I. PLANT CONDITIONS:

On April 20, 1997, at 0125 EDT, the plant was in Mode 1, Reactor Coolant System (RCS) (EIIS AB) average temperature was 587.9° F , RCS pressure was 2236 psig.

II. DESCRIPTION OF EVENT

A. Event

At 0125 EDT on April 20, 1997, the WBN Unit 1 main generator pneumatic circuit breaker (PCB) opened initiating annunciator window 75-C, "Electrical Trouble." The opening of the breaker generated a turbine trip and subsequent automatic reactor trip. Plant equipment functioned as designed in response to the trip and all rods fully inserted. The auxiliary feedwater (AFW) system operated as designed to maintain feedwater flow to the steam generators. Operations personnel performed as required to control the transient and to stabilize the plant in Mode 3. A four hour report to the NRC was made at 0232 EDT in accordance with 10 CFR 50.72 by the Operations Shift Manager.

The turbine trip was initiated by operation of the generator backup relay, relay 121GB. This relay is connected to a current transformer (CT) and a potential device (PD) on the high voltage bushing side of the 500 KV main transformers and provides backup protection for the generator and the transformer. The operation of the 121GB relay will cause the operation of auxiliary relay 186GB after a time delay of 10 cycles. Operation of the 186GB relay results in opening of the main generator PCB, closure of the steam supply to the turbine, and the performance of additional actions.

Problem Evaluation Report (PER) WBPER970409 was initiated to document this event in the TVA Corrective Action Program.

B. Inoperable Structures, Components, or Systems that Contributed to the Event

There were no structures, components, or systems inoperable at the start of the event that contributed to the event.

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II. DESCRIPTION OF EVENT (continued)

C. Dates and Approximate Times of Major Occurrences

Time (EDT)	Major Occurrence
01:25:53.501	The generator 1 backup and transformer 1 feeder differential relay operates (relay 121GB).
01:25:53.501	Turbine trip due to electrical trouble.
01:25:53.601	The 500 KV PCB operates.
01:25:53.774	Reactor trip breaker B and bypass breaker B operate.
01:25:53.781	Reactor trip breaker A and bypass breaker A operate.
01:25	Licensed unit operators enter emergency procedure E-0, "Reactor Trip or Safety Injection."
01:26	The auxiliary feedwater (AFW) system starts.
01:28	Licensed unit operators transition from emergency procedure E-0 to ES-0.1, "Reactor Trip Response."
01:29	Licensed unit operators take manual control of AFW to limit cooldown.
21:00	TVA's Transmission Power Supply (TPS) organization finds moisture in the A phase bushing for the potential device which feeds the 121GB relay. Evidence of a potential fault included low resistance, arcing, and blackening of the lubricant.

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II. DESCRIPTION OF EVENT (continued)

D. Other Systems or Secondary Functions Affected

No other systems or secondary functions were affected by this event.

E. Method of Discovery

The event was monitored through control room indication by operations personnel as it occurred.

F. Operator Actions

Operations personnel responded correctly in accordance with Emergency Procedure E-0, "Reactor Trip or Safety Injection," and transitioned as required into procedure ES-0.1, "Reactor Trip Response." Operators took manual control of auxiliary feedwater (AFW) level to minimize temperature reduction. Members of the operations staff also took measures to assemble a response team to investigate the cause of the plant trip.

A member of the operations training staff was observing the on-shift operations crew at the time of the event and provided an overview of the of the crew's performance during this transient. In general, he determined crew performance was satisfactory. The response of the operating crew was consistent with that of a training exercise conducted during simulator training. The unit supervisor promptly implemented emergency operating instruction E-0, "Reactor Trip or Safety Injection." The shift technical advisor obtained a backup set of procedures and maintained an overview. The shift manager maintained oversight of the operating crew and plant responses. A formal crew briefing was conducted on the transition from E-0 to ES-0.1, "Reactor Trip Response." All crew members provided plant status input during the briefing. The three unit operators on shift at this time were not normally assigned to this crew, yet functioned well as a crew. The training observer identified that the operators took quick action to avoid unnecessary overcooling of the reactor coolant system per ES-0.1.

G. Automatic and manual safety system responses

The AFW system operated as required. Neither the steam generator power operated relief valves, the pressurizer power operated relief valves, nor the pressurizer safety valves were required to operate.

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III. CAUSE OF EVENT

The cause of the trip was determined to be a fault on the A phase capacitance tap connector as a result of moisture intrusion into the bushing housing. Through investigation, evidence was found that the phase A capacitance tap connector from the 500 KV main transformer bushing to the potential device (PD) had experienced arcing. Moisture was also found in the bushing and the lubricant around the bushing was blackened indicating a fault on the A phase capacitance tap connector. This was established as the principal cause of the trip after evaluation of the operational characteristics of the 121GB relay and other generator protective relays. Measures which will be taken to determine the exact cause of the moisture intrusion are described in Section V, Corrective Actions.

IV. ANALYSIS OF EVENT - ASSESSMENT OF SAFETY CONSEQUENCES

There was no safety significance related to the plant trip that occurred on April 20, 1997. The plant responded as designed to the initiating condition. In general, this event was less challenging than and bounded by the event described in the Section 15.2.7, "Loss of External Electrical Load and/or Turbine Trip" of the Final Safety Analysis Report (FSAR). The following plant conditions are bounded by the event described in the FSAR:

1. Reactor power was less than the FSAR (102%).

2. The anticipatory reactor trip occurred on turbine trip versus the reactor protection system trip setpoint.

3. Reactor control was in automatic versus manual in the FSAR.

4. The steam dump valves operated as designed. The FSAR does not take credit for their use.

Since the reactor trip occurred as designed from a turbine trip and since station power was not lost during the event, the plant response remained within the FSAR boundary analysis. The pressurizer power operated relief valves and safety valves were not required to limit Reactor Coolant System (RCS) pressure. Similarly, the steam dumps and auxiliary feedwater (AFW) system operated as required so that steam generator power operated relief was not required. RCS pressure and loop average temperatures decreased during the transient rather than increasing as predicted by conservative FSAR assumptions. These differences between the FSAR and the plant event are associated with the conservatism of the FSAR analysis and the benign nature of the actual plant event which was quickly brought to a stable condition.

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V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Operations personnel responded correctly in accordance with Emergency Procedure E-0, "Reactor Trip or Safety Injection," and transitioned as required into procedure ES-0.1, "Reactor Trip Response." Operators took manual control of AFW level to minimize temperature reduction. Members of the operations staff also took measures to assemble a response team to investigate the cause of the plant trip.

B. Corrective Actions to Prevent Recurrence

The corrective measures implemented to address the above cause of the trip included the cleaning of the capacitance tap bushing area and the application of new lubricant along with the application of a room temperature vulcanizing (RTV) sealant on exposed surfaces. Additional resistance tests were performed after the repairs with the readings taken at this time being normal (> 999 meg ohms). Since the application of the connector type that experienced the moisture intrusion is limited to the Unit 1 and Unit 2 main transformer and the spare transformer, work order 97-06722-00 was written to inspect and repair the bushing connectors on the Unit 2 main transformer and the spare transformer.

Additional measures were defined to ensure proper action was established to prevent recurrence of this type of problem. These measures included:

1. The preventive maintenance (PM) history for the bushing connectors will be reviewed and provisions implemented or revised to establish controls for the periodic inspection and/or replacement of the bushing connectors.

2. The manufacturer of the 500 KV transformers will be consulted to determine if moisture intrusion problems have been experienced with the bushing connectors in other applications or at other utilities. If problems have occurred, appropriate information will be obtained from the manufacturer to assess the problems that have been encountered. If determined necessary from the assessment of the manufacturers information, additional corrective actions will be developed and a supplemental response for LER 390/97010 will be submitted to NRC.

3. An evaluation to establish the potential for moisture intrusion on other similar connectors in use in switchyard equipment will be performed. Based on the results of this evaluation, preventive maintenance instructions will be initiated or revised to inspect similar switchyard components for moisture intrusion.

B. Corrective Actions to Prevent Recurrence (continued)

4. As a measure to establish the source of the moisture in the connector, the fire protection system test practices and spray nozzle configuration will be evaluated to determine if any changes are required to test methods or nozzle configuration. Should additional corrective actions be required, the scope of the changes will be included in the supplement to LER 390/97010 discussed in Item 2 above.

Implementation of the incomplete corrective actions listed above will occur by October 31, 1997.

VI. ADDITIONAL INFORMATION

A. Failed Components

1. Safety Train Inoperability

The cause for the moisture intrusion into the transformer bushing connector which caused the operation of the generator protective relay is being investigated as part of the measures defined in Section V, Corrective Actions, above. However, the components which initiated this event are not safety-related.

2. Component/System Failure Information

a. Method of Discovery of Each Component or System Failure:

Refer to Item 1, Safety Train Inoperability, above.

b. Failure Mode, Mechanism, and Effect of Each Failed Component:

Refer to Item 1, Safety Train Inoperability, above.

c. Root Cause of Failure:

Refer to Item 1, Safety Train Inoperability, above.

d. For Failed Components With Multiple Functions, List of Systems or Secondary Functions Affected:

Refer to Item 1, Safety Train Inoperability, above.

e. Manufacturer and Model Number of Each Failed Component:

Refer to Item 1, Safety Train Inoperability, above.

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VI. ADDITIONAL INFORMATION (continued)

B. Previous Similar Events

For Watts Bar Nuclear Plant, no events similar to the events described in this report have been previously reported under 10 CFR 50.72 or 10 CFR 50.73.

VII. COMMITMENTS

The actions committed to be implemented in response to this event are tabulated in Section V, Corrective Actions.