

LICENSEE EVENT REPORT (LER)

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

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-8 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.

FACILITY NAME (1)

Watts Bar Nuclear Plant - Unit 1

DOCKET NUMBER (2)

05000390

PAGE (3)

1 OF 10

TITLE (4)

REACTOR TRIP DUE TO TURBINE TRIP

| 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 |
| 03 | 07 | 98 | 98 | 001 | 00 | 04 | 06 | 98 | | 05000 |
| | | | -- | | | | | | | 05000 |

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|--------------------|-----|---|-------------------|-------------------|---------------------|--|--|--|--|--|
| OPERATING MODE (9) | 1 | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11) | | | | | | | | |
| POWER LEVEL (10) | 100 | 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 | | | | | |
| | | 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

Rebecca N. Mays

TELEPHONE NUMBER (Include Area Code)

(423) 365-3855

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO EPIX | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO EPIX |
|-------|--------|-----------|--------------|--------------------|-------|--------|-----------|--------------|--------------------|
| B | IT | PS | UEC | YES | | | | | |
| B | IT | RV | FISHER VALVE | YES | | | | | |

SUPPLEMENTAL REPORT EXPECTED (14)

EXPECTED

MONTH

DAY

YEAR

YES

X NO

SUBMISSION DATE (15)

(If yes, complete EXPECTED SUBMISSION DATE).

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

On March 7, 1998 at 0026 EDT, the reactor was in Mode 1, approximately 100% power of 3411 Mw thermal and 1209 Mw electrical. The unit had been on line for 137 days. The reactor automatically tripped after receiving a turbine trip signal. The turbine tripped due to a low bearing oil pressure signal received during the performance of technical requirements procedure 1-TRI-47-1, "Main Turbine Oil Trip Devices TGOP, SOBP, and EOP Monthly Test." The cause of the event was an upward set point drift (81 psig as found vs 45 psig required) of pressure switch 1-PS-47-72, (pressure switch provides a redundant signal to dump EHC fluid and trip turbine on low auto-stop oil pressure), and a pressure regulator 1-RFV-47-945 failing to maintain oil pressure during the test performance. This loss of pressure condition occurred when in the "Test" position and opening one of the trip device valves. It resulted from failure of one of the two regulator valves in the main supply header for auto-stop oil. The combination of the drop in pressure with the upward setpoint drift resulted in the turbine trip and subsequent reactor trip. Both the pressure switch and the relief valve were replaced. The other pressure switches were calibrated and setpoints adjusted as needed. When the turbine reached 1800 RPM prior to generator synchronization, technical requirement procedure 1-TRI-47-1 was successfully performed.

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I. PLANT CONDITIONS:

On March 7, 1998, at 0026 EDT, the plant was in Mode 1 at approximately 100% power of 3411 Mw thermal and 1209 Mw electrical. The unit had been on line for 137 days.

II. DESCRIPTION OF EVENT

A. EVENT

On March 7, 1998 at 0026 EST, the WBN Unit 1 reactor was in Mode 1, at approximately 100% power of 3411 MW thermal and 1209 MW electrical. The unit had been on line for 137 days. The reactor automatically tripped after receiving a turbine trip signal. The turbine generator (EIS code TRB) tripped due to a auto stop oil (ASO) low pressure signal with a low bearing oil pressure signal present while in "Test." Section 6.3, "Turbine Bearing Oil Pressure Test" of procedure 1-TRI-47-1, "MAIN TURBINE OIL TRIP DEVICES TGOP, SOBP AND EOP MONTHLY TEST" was in progress at the time of the test. Plant systems functioned as designed. Control rods inserted. Auxiliary Feedwater (AFW) initiated due to the reactor trip Lo-T_{avg} signal which isolates normal feedwater during a trip.

Problem Evaluation Report (PER) WBPER980266 was initiated to document this event in the TVA Corrective Action Program.

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

1. Low auto-stop oil pressure switch (1-PS-47-72) (EIS Code PS)
2. Auto-stop oil regulator valve (1-RFV-45-945) (EIS code RG/V)

C. Dates and Approximate Times of Major Occurrences

March 6, 1998

- 2337 Pretest briefing conducted for 1-TRI-47-1.
- 2355-
2358 Began 1-TRI-47-1.

March 7, 1998

- 0019 Completed Section 6.1 and 6.2 overspeed trip device check and vacuum trip device test. During testing overspeed trip test lever held in test position.
- 0024 Began section 6.3 of TRI for Turbine Bearing Oil Pressure Test. Auto stop oil pressure was observed going to 5 pounds (1-PI-47-71A).
- 0026 Automatic reactor trip on turbine trip due to bearing oil pressure low on main turbine.

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II. DESCRIPTION OF EVENT (continued)

C. Dates of Discovery and Reportable Findings (continued)

- 0026 Assistant Unit Operator (AUO) closed TCV-47-0600.
- 0029 Completed first four steps of E-0, transferred to ES-0.1.
- 0031 Took manual control of AFW level control valves, controlling at 100 gpm per steam generator (SG).
- 0045 Transitioned to GO-2.

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 immediately monitored through control room indication as it occurred.

F. Operator Actions

Operations responded to the plant transient in accordance with appropriate plant procedures and placed the reactor in Mode 3.

G. Automatic and manual safety system responses

Following the turbine generator trip on loss of oil pressure, the reactor automatically tripped on the turbine trip signal and AFW automatically initiated due to the reactor trip Lo-T_{avg} signal which isolates normal feedwater. Control rods inserted as required.

III. CAUSE OF EVENT

An analysis was performed to determine the Root Cause of the Event. The cause of the event was the result of two equipment problems which in combination initiated the turbine trip:

An upward setpoint drift of the pressure switch 1-PS-47-72: This pressure switch provides a redundant signal to dump EHC fluid and trip turbine on low ASO pressure. Specifically, the pressure switch setpoint had apparently drifted from its as-left setting of approximately 45 psig during the Unit 1, Cycle 1 (U1C1) refueling outage to an as-found pressure of 81 psig. This pressure switch was replaced during the U1C1 refueling outage. The switch installed during the refueling outage was obtained from WBN Unit 2 and modified per design change notice (DCN) M-16333-A to correct for setpoint drift during cover installation. Although this switch had only been in service for about 4 months, it was over 20 years old. Laboratory analysis will be completed to determine the subcomponent which failed and the failure mechanism.

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III. CAUSE OF EVENT (continued)

- 2) A loss of pressure experienced when performing 1-TRI-47-1: This condition occurred when in the "Test" position while opening one of the trip device valves and resulted from failure of one of the two regulator valves in the main supply header for ASO. The regulator valves, 1-RFV-47-945 and 1-RFV-47-946, are intended to maintain ASO supply pressure at approximately 110 psig. However, upon inspection, regulator valve, 1-RFV-47-945, was found to be leaking and not capable of holding the oil pressure. The pressure regulator setpoint was 110 psig. This regulator had primary control of ASO header pressure. It was in service for about 16 months before failure occurred. The regulator diaphragm apparently failed due to service. Laboratory analysis will be completed to determine the exact cause of failure.

IV. ANALYSIS OF EVENT - ASSESSMENT OF SAFETY CONSEQUENCES

A. Evaluation of Plant Systems/Components

The WBN design includes turbine protection features which serve to trip the turbine during abnormal mechanical operation. One of the trips is for low bearing oil pressure. This feature is tested as part of procedure 1-TRI-47-1. Testing of this component requires holding the overspeed trip test lever in test to prevent the low bearing oil pressure trip from actually tripping the turbine.

Trouble shooting activities initially centered on the turbine front standard to attempt to duplicate the event which caused the plant trip during testing of turbine bearing oil pressure. Troubleshooting was able to replicate the trip, consecutively, three times which showed that there was no personnel error. The cause of the event was the result of two equipment problems: 1) an upward setpoint drift of ASO low pressure switch 1-PS-47-72, which provides a redundant signal to dump EHC fluid and trip the turbine on low ASO pressure, and 2) an excessive loss of ASO pressure experienced when performing 1-TRI-47-1. This loss of pressure condition occurred with the Mechanical Trip Test Device in the "Test" position upon opening the Turbine Bearing Oil Pressure trip device valves. It resulted from failure of one of the two regulator valves in the main supply header for ASO. The combination of the drop in pressure with the upward setpoint drift resulted in a turbine trip and subsequent reactor trip. The first 2 sections of 1-TRI-47-1 were completed successfully which indicates that both component failures were not present until the turbine bearing oil pressure trip test was performed.

The pressure switch, 1-PS-47-72, was calibrated to an as-left setpoint of 45.7 psig in order to reperform the test. Regulator valve 1-RFV-47-945 was bench tested and confirmed to be incapable of maintaining pressure. The ASO orifices (three) were measured and inspected for debris. No problems were identified with these orifices. Valve 1-RFV-47-945 was replaced and the ASO system was aligned for testing per 1-TRI-47-1, using a test pressure transmitter and chart recorder to monitor ASO pressure. The test was successfully performed four times for three of the turbine ASO trips: vacuum, thrust bearing, and low bearing oil pressure trip. In each of these tests, initial ASO pressure with the system aligned in the "Latched" and "To Test" positions was between 110 and 111 psig, with ASO low pressure dropping 13 to 14 psi to 97 psig upon actuation of the trip signal, well above the 45 psig specified trip pressure for the ASO pressure switch 1-PS-47-72. In each case, the post reset pressure was 110 psig. Based on these test results, the system is working satisfactorily.

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IV. ANALYSIS OF EVENT - ASSESSMENT OF SAFETY CONSEQUENCES (continued)

A. Evaluation of Plant Systems/Components (continued)

An evaluation of the Turbine Front Standard pressure switches was performed to identify switches that could initiate a turbine trip in the event of a single failure. The following additional switches were identified: 1-PS-47-76, 1-PS-47-77B, 1-PS-7-12. The remaining pressure switches, 1-PS-47-71, 1-PS-47-73, 1-PS-47-74, and 1-PS-47-75, have a trip alarm function or a 2-out-of-3 trip logic function. The maintenance history was reviewed for these pressure switches to evaluate out of tolerance trends and failures. Each of the switches were calibrated with the exception of 1-PS-7-12, which was found to be defective and subsequently replaced.

Fisher valves 1-RFV-47-945 and 1-RFV-47-946 were installed in February 1996. These valves were replaced as recommended by Westinghouse per Availability Improvement Bulletin (AIB) 9204 as the existing Teledyne Republic relief valves had a history of setpoint drift over time. Both valves control ASO header pressure. Valve 1-RFV-47-945 is set at 110 psig and valve 1-RFV-47-946 is set at 120 psig. There are no other Fisher pressure regulating valves of this model installed at WBN. There is no failure history for these valves at WBN since installation and there are no reported failures of these valves in this application by Westinghouse.

B. Evaluation of Personnel Performance

Test personnel were closely following procedure 1-TRI-47-1. This surveillance had also been selected for management oversight. Part of the Turbine Front Standard troubleshooting was to determine if the auxiliary operator had inadvertently caused the trip by momentarily releasing pressure on the overspeed trip test lever, which would have caused the trip. Based on the troubleshooting, it was determined that there was a mechanical failure and no personnel error. No issues were identified regarding inadequate test personnel performance.

Main Control Room personnel responded appropriately to the plant transient. Upon turbine/reactor trip, Operations entered: 1) Emergency Procedure (EO), Reactor Trip or Safety Injection, 2) ES-0.1, Reactor Trip Response, and 3) General Operating Instruction (GO) 2, Reactor Startup. Emergency and abnormal procedures were correctly followed, and the plant was placed in a stable condition in Mode 3. The required report to the NRC under 10CFR 50.72 was made in a timely manner, and plant management was promptly notified.

C. Safety Significance

The subject plant transient is bounded by the analysis of "Loss of External Load and /or Turbine Trip" given in Section 15.2.7 of the WBN Updated Final Safety Analysis Report (UFSAR). The UFSAR analysis conservatively does not take credit for the reactor trip on turbine trip which was the first trip signal for the transient. The steam dumps and rods operated properly to control the transient without relying on the SG power operated relief valves (PORVs). The UFSAR does not take credit for the operation of the steam dumps or SG PORVs. The UFSAR transient relies on the SG safety valves for pressure relief. Accordingly, the results of the UFSAR analysis are not challenged by the

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IV. ANALYSIS OF EVENT - ASSESSMENT OF SAFETY CONSEQUENCES (continued)

C. Safety Significance (continued)

March 7, 1998 trip. There was no hazard to the integrity of the reactor coolant system (RCS), or the main steam system. The transient was controlled by the steam dumps and there was no challenge to the pressurizer or SG PORVs or SG safeties. The integrity of the core was maintained by operation of the reactor protection system which ensures DNBR is maintained above the limiting value.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

A team was assembled consisting of members of various plant organizations divided into a day and night shift to investigate this event.

B. Corrective Actions to Prevent Recurrence

Prior to Mode 2 Items

Calibrated pressure switches 1-PS-47-72, 1-PS-47-76, 1-PS-47-77B and 1-PS-7-12 which could initiate a turbine trip in the event of a single failure.

Calibrated pressure switches 1-PS-47-71, 1-PS-47-73, 1-PS-47-74, and 1-PS-47-75 which could warn or initiate a turbine trip in an alarm function or 2-out-of-3 logic function.

Replaced pressure switches 1-PS-47-72 and 1-PS-7-12.

Evaluated ASO pressure decrease while in test position and inspected regulator valves, 1-RFV-47-945 and 1-RFV-47-946, and orifices. Replaced regulator valve 1-RFV-47-945.

Prior to Generator Synchronization Items

Removed pressure transmitter and recorder used to monitor ASO pressure during 1-TRI-47-1.

Inspected 1-RFV-47-945 and 1-RFV-47-946 at 1800 RPM prior to generator synchronization.

Performed 1-TRI-47-1 prior to generator synchronization at 1800 RPM with ASO supplied by the main oil pump.

Revised 1-TRI-47-1 to obtain ASO pressure with trip devices tripped to trend degradation of ASO pressure. Added abort criteria to test instruction for low ASO pressure.

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V. CORRECTIVE ACTIONS (continued)

B. Corrective Actions to Prevent Recurrence (continued)

Non Restart Items

Evaluate failure analysis of 1-PS-47-72 and 1-RFV-47-945 upon receipt from TVA's Central Laboratory and perform additional corrective actions if necessary.

Additional Items Tracked by WBPER980266*

Initiate periodic maintenance for 1-PS-7-12 at a refueling outage frequency.

Ensure periodic maintenance frequency for 1-PS-47-71, 1-PS-47-72B, and 1-PS-47-77B is every refueling outage

Identify all sensors in the turbine generator control system which could initiate a turbine trip at full power upon single failure and install REACTOR TRIP HAZARD labels on these devices.

Evaluate component identification change for 1-PS-7-12 from the turbine extraction traps and drains system to the turbine generator control system.

Evaluate changing the performance frequency for 1-TRI-47-1 from monthly to quarterly or greater.

Develop a list of components which may initiate turbine generator trips during maintenance or testing and evaluate relative risk significance.

Identify generation risk significant activities in the Daily Work Schedule, such as 1-TRI-47-1.

VI. ADDITIONAL INFORMATION

A. Failed Components

1. Safety Train Inoperability

There were no safety trains inoperable.

* The additional corrective actions associated with WBPER980266 are considered enhancements which would not have resulted in a turbine/reactor trip. These actions are being tracked under the corrective action program and therefore, are not considered to be regulatory commitments.

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VI. ADDITIONAL INFORMATION (continued)

A. Failed Components (continued)

2. Component/System Failure Information

a. Methods of Discovery of Each Component or System Failure.

The turbine tripped and subsequently tripped the reactor. The Post Trip Investigation Team identified that the pressure switch and the regulator valve were inoperable.

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

The pressure switch which provides a redundant signal to dump EHC fluid and trip the turbine on low ASO pressure, had drifted upward from approximately 45 psig to 81 psig 4 months after installation. This failure alone, would not have initiate a turbine trip during test conditions.

The regulator valve which is intended to maintain ASO supply pressure at approximately 110 psig was found to be leaking and not capable of holding pressure. This failure alone, would not have initiate a turbine trip during test conditions.

c. Root Cause of Failure:

Pressure switch 1-PS-47-72 setpoint had drifted upward from 45 psig to 81 psig which is approximately 34 psig out of tolerance. This switch, which was installed during the refueling outage, was obtained from WBN Unit 2 and modified to correct the setpoint drift during installation. The regulator valve 1-RFV-47-945, was found to be leaking and incapable of maintaining ASO pressure. During testing the pressure had dropped to 81 psig. The combination of the pressure switch setpoint drifting to 81 psig and the regulator valve failure which dropped ASO to 81 psig during mechanical trip testing, initiated the turbine trip.

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

There were no component failures of this type at WBN.

e. Manufacturer and Model Number of Each Failed component:

United Electrical Corporation (UEC) pressure switch model No. J303.

Fisher Valve Co. regulator valve model No. 78H

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VI. ADDITIONAL INFORMATION (continued)

B. Previous Similar Events

Although there have been other turbine trips resulting in reactor trips at WBN, none were attributed to setpoint drift.

C. Additional Information

Additional hardware items that were identified following the transient, which are not corrective actions associated with the reactor trip, are being tracked by TVA's corrective action program under WBPER980266.

VII. COMMITMENTS

Evaluate failure analysis of 1-PS-47-72 and 1-RFV-47-945 upon receipt from TVA's Central Laboratory and perform additional corrective actions if necessary. This action will be complete by June 30, 1998.

