



Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

August 4, 2016

10 CFR 50.73

ATTN: Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2  
Facility Operating License No. NPF-96  
NRC Docket No. 50-391

Subject: **Licensee Event Report 391/2016-004-00, Reactor Trip and Safety Injection  
Actuation Caused by Turbine Governor Valve Failure**

This submittal provides Licensee Event Report (LER) 391/2016-004-00. This LER provides details concerning a recent reactor trip with safety injection as a result of a turbine governor valve failure. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A).

Please direct any questions concerning this matter to Gordon Arent, WBN Licensing Director, at (423) 365-2004.

Respectfully,

A handwritten signature in black ink, appearing to read "Paul Simmons", with a long, sweeping horizontal line extending to the right.

Paul Simmons  
Site Vice President  
Watts Bar Nuclear Plant

Enclosure  
cc: See Page 2

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cc (Enclosure):

NRC Regional Administrator - Region II  
NRC Senior Resident Inspector - Watts Bar Nuclear Plant



## LICENSEE EVENT REPORT (LER)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the FOIA, Privacy and Information Collections Branch (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to Infocollects.Resource@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

## 1. FACILITY NAME

Watts Bar Nuclear Plant, Unit 2

## 2. DOCKET NUMBER

05000391

## 3. PAGE

1 OF 5

## 4. TITLE

Reactor Trip and Safety Injection Actuation Caused by Turbine Governor Valve Failure

## 5. EVENT DATE

MONTH	DAY	YEAR
06	05	2016

## 6. LER NUMBER

YEAR	SEQUENTIAL NUMBER	REV NO.
2016	- 004	- 00

## 7. REPORT DATE

MONTH	DAY	YEAR
08	04	2016

## 8. OTHER FACILITIES INVOLVED

FACILITY NAME	DOCKET NUMBER
N/A	N/A
FACILITY NAME	DOCKET NUMBER
N/A	N/A

## 9. OPERATING MODE

## 11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

1

<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)

## 10. POWER LEVEL

12.5

<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.77(a)(1)
<input type="checkbox"/> 20.2203(a)(2)(v)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(2)(i)
<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(ii)
	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> OTHER	Specify in Abstract below or in NRC Form 366A

## 12. LICENSEE CONTACT FOR THIS LER

## LICENSEE CONTACT

Dean Baker, Licensing Engineer

## TELEPHONE NUMBER (Include Area Code)

423-452-4589

## 13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
B	SB	LVDT	SIEMENS	N					

## 14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO

## 15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

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

On June 5, 2016 at 1227 Eastern Daylight Time (EDT), Watts Bar Nuclear Plant Unit 2 was in MODE 1 at approximately 12.5 percent power when a safety injection (SI) actuation occurred, followed by an automatic reactor protection system (RPS) trip. No primary safety barriers (Reactor Coolant System, containment and fuel clad) were challenged and no primary or secondary safety or relief valves actuated during the event. The Unit 2 plant trip was considered a complicated trip due to SI actuation. Safety equipment operated as expected and SI was promptly terminated.

The reactor trip and SI were caused by a turbine governor valve failing open, causing a steam header pressure rate of decrease SI actuation signal.

NRC FORM 366A  
(11-2015)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104

EXPIRES: 10/31/2018



## LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
Watts Bar Nuclear Plant, Unit 2	05000391	YEAR	SEQUENTIAL NUMBER	REV NO.
		2016	- 004	- 00

### NARRATIVE

#### I. PLANT OPERATING CONDITIONS BEFORE THE EVENT

Watts Bar Nuclear Plant (WBN) Unit 2 was in Mode 1 at 12.5 percent rated thermal power (RTP).

#### II. DESCRIPTION OF EVENT

##### A. Event

On June 5, 2016 at 1227 Eastern Daylight Time (EDT), Watts Bar Nuclear Plant (WBN) Unit 2 was in MODE 1 at approximately 12.5 percent power when a safety injection (SI) actuation occurred, followed by an automatic reactor protection system (RPS) trip. The cause of the trip with SI was a failure of the No.1 high pressure turbine governor valve {E1S:XCV} in the open position causing a steam header pressure rate of decrease SI actuation signal. At 1245, Operations personnel secured safety injection and Unit 2 was stabilized in MODE 3 at normal operating pressure and temperature. No primary safety barriers (reactor coolant system, containment and fuel clad) were challenged and no primary or secondary safety or relief valves actuated during the event. The Unit 2 plant trip was considered a complicated trip due to SI actuation. Safety equipment operated as expected and SI was promptly terminated.

This event was reported to the Nuclear Regulatory Commission (NRC) on June 5, 2016 via Event Notification 51982 pursuant to 10 CFR 50.72(b)(2)(iv)(B) and 10 CFR 50.72(b)(3)(iv)(A).

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

A bracket for the No.1 turbine governor valve linear variable differential transmitter (LVDT) failed due to vibration induced fatigue.

##### C. Dates and Approximate Times of Occurrences

Date	Time (EDT)	Event
6/3/16	2038	Power level increases from 0 percent power. Governor valve vibration levels estimated between 2.4 and 4 inches per second (ips). Vibration information obtained during Unit 2 start-up subsequent to this event.
6/4/16	1658	Power level reached 127 Megawatt Electric (MWe). Valve position approximately 9.3 percent open, vibration estimated between 2.5 and 4 ips.
6/5/16	1122	Unit 2 generator synchronized with governor valve 1 between 4 and 5 percent open. Expected vibration 4 ips.
6/5/16	1204	Governor valve 1 7.5 to 8 percent open
6/5/16	1227	Unit 2 trips with SI actuation. Operations enters procedure 2-E-0, Reactor Trip or Safety Injection
6/5/16	1236	Transition to procedure 2-ES-1.1, SI Termination
6/5/16	1245	SI secured.
6/5/16	1320	Plant transitions to 2-GO-5, Unit Shutdown from 30 percent Reactor Power to Hot Standby

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**NARRATIVE****D. Manufacturer and Model Number of Components that Failed**

A bracket that mounted the LVDT to the No. 1 governor valve failed due to vibration related fatigue.

**E. Other Systems or Secondary Functions Affected**

During the event, anomalies were noted with the 2B Motor Driven Auxiliary Feedwater Pump (MDAFWP) and the Turbine Driven Auxiliary Feedwater Pump (TDAFWP). The 2B MDAFWP was shutdown due to smoke coming from the pump packing. After discussion with the vendor, this was determined to be an expected condition for this type of new packing with minimal break-in time and the pump was restarted. During operation of the TDAFWP, no oil was noted in one of the bearing sight glasses and the pump was manually secured. This was determined to be an issue with the sight glass providing inaccurate indication and not a lack of oil. The pump was subsequently returned to service.

**F. Method of discovery of each Component or System Failure or Procedural Error**

The failure became apparent after the plant trip.

**G. Failure Mode and Effect of Each Failed Component**

The No. 1 governor valve mounting bracket failed from vibration related fatigue.

**H. Operator Actions**

This reactor trip was complicated by a concurrent SI. Operations personnel were able to promptly terminate SI in accordance with plant procedures and restore the plant to a normal shutdown alignment.

**I. Automatically and Manually Initiated Safety System Responses**

All automatic and manual safety systems responded as expected.

**III. CAUSE OF THE EVENT****A. The cause of each component or system failure or personnel error, if known.**

The Unit 2 No. 1 governor valve LVDT bracket experienced failure due to short term cyclic fatigue during extended start-up conditions.

**B. The cause(s) and circumstances for each human performance related root cause.**

There were no apparent human performance related root cause.

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#### IV. ANALYSIS OF THE EVENT

The turbine governor valves experience high vibration when operated at low steam flow. This flow induced vibration is inherent to the turbine governor valve design when its position is less than 20 percent open. Vibration is highest with the valve less than 12 percent open. While operating WBN Unit 2 at low power for an extended period, a bracket supporting a position transducer failed, causing an associated failure on the LVDT position rod. During operation, the broken LVDT core rod "walked off" the actuator arm, giving a false low position of the governor valve. The control system, based on the false indication, provided an open demand signal to the No.1 governor valve, which lead to a steam header pressure rate of decrease safety injection actuation signal and an automatic reactor trip.

#### V. ASSESSMENT OF SAFETY CONSEQUENCES

WBN Unit 2 experienced a safety injection with an automatic reactor trip. All safety equipment responded as expected and operations personnel promptly terminated safety injection. The plant was stabilized in Mode 3 without any additional complications. The risk associated this event was determined to be less than 1E-6.

- A. Availability of systems or components that could have performed the same function as the components and systems that failed during the event

The failure that occurred was on a non-safety related turbine component. No safety systems were impacted as a result of this failure.

- B. For events that occurred when the reactor was shut down, availability of systems or components needed to shutdown the reactor and maintain safe shutdown conditions, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident

Not applicable.

- C. For failure that rendered a train of a safety system inoperable, an estimate of the elapsed time from the discovery of the failure until the train was returned to service

Not applicable.

#### VI. CORRECTIVE ACTIONS

This event was entered into the Tennessee Valley Authority (TVA) Corrective Action Program and is being tracked under condition report 1178855.

- A. Immediate Corrective Actions

The plant was placed in a safe condition. The failed turbine governor components were replaced.

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#### B. Corrective Actions to Prevent Recurrence

Plant operating procedures will be revised to minimize governor valve operation when the valve position is less than 12 percent open. TVA will work with the turbine vendor to determine if work can be performed within the existing valve design requirements to reduce flow induced vibration.

#### VII. ADDITIONAL INFORMATION

##### A. Previous similar events at the same plant

No similar events have been identified at the Watts Bar plant .

##### B. Additional Information

None.

##### C. Safety System Functional Failure Consideration

This condition did not result in a safety system functional failure.

##### D. Scrams with Complications Consideration

There was an SI associated with this plant trip. Operations personnel were able to promptly terminate SI in accordance with plant procedures and restore the plant to a normal shutdown alignment.

#### VIII. COMMITMENTS

None.