



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

December 9, 2016

10 CFR 50.73

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

Watts Bar Nuclear Plant, Unit 1  
Facility Operating License No. NPF-90  
NRC Docket No. 50-390

Subject: **Licensee Event Report 390/2016-011-01, Loss of Centrifugal Charging Pump Due to Repeat Failure of Associated Room Cooler**

This submittal provides Licensee Event Report (LER) 390/2016-011-01. This LER provides details concerning maintenance performed on a safety related room cooler which resulted in a reportable condition. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(i)(B). This supplement documents the cause of the failure and concludes that a loss of safety function did not occur.

There are no new commitments in this letter. Please direct any questions concerning this matter to Gordon Arent, WBN Licensing Director, at (423) 365-2004.

Respectfully,

A handwritten signature in blue ink, appearing to read 'Paul Simmons', written over a light blue horizontal line.

Paul Simmons  
Site Vice President  
Watts Bar Nuclear Plant

Enclosure  
cc: See Page 2

U.S. Nuclear Regulatory Commission  
Page 2  
December 9, 2016

cc (Enclosure):

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

U.S. Nuclear Regulatory Commission  
Page 3  
December 9, 2016

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**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.

<b>1. FACILITY NAME</b> Watts Bar Nuclear Plant, Unit 1	<b>2. DOCKET NUMBER</b> 05000390	<b>3. PAGE</b> 1 OF 6
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**4. TITLE**  
Loss of Centrifugal Charging Pump Due to Repeat Failure of Associated Room Cooler

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
08	03	2016	2016	011	01	12	09	2016	N/A	N/A
									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 type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
100	<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 checked="" 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
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**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	VF	FAN	ELLIS	Y					

**14. SUPPLEMENTAL REPORT EXPECTED**      **15. EXPECTED SUBMISSION DATE**

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

MONTH	DAY	YEAR

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

On August 3, 2016, Watts Bar Nuclear Plant Unit 1 (WBN1) determined that a condition prohibited by Technical Specifications (TS) had occurred. During maintenance of the 1B-B centrifugal charging pump (CCP) room cooler, the bearing was found in a degraded condition requiring repair. This fan is required to support Operability of the 1B-B CCP. Based on the inability of the CCP to meet its calculated mission time of 10 days, the 1B-B CCP was considered to be inoperable from July 24, 2016 until restoration of the 1B-B CCP room cooler on August 5, 2016. This represents a condition prohibited by Technical Specifications due to the 1B-B CCP being inoperable for greater than its allowed outage time. This event is being reported pursuant to 10 CFR 50.73(a)(2)(i)(B).

The cause of the bearing degradation and fan failure was over tensioning the fan belts due to a 2011 revision to a maintenance procedure which improperly removed the established method for belt tensioning. This method had been added to the procedure in 1995 as an action to prevent recurrence of a similar over tensioning event.

The 1B-B CCP room cooler had been rebuilt in December 2015 after a similar bearing failure had occurred as reported in LER 390/2016-006.

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(11-2015)

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## LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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		YEAR	SEQUENTIAL NUMBER	REV NO.
Watts Bar Nuclear Plant, Unit 1	05000390	2016	- 011	- 01

### NARRATIVE

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

Watts Bar Nuclear Plant (WBN) Unit 1 was in Mode 1 at 100 percent rated thermal power (RTP).

#### II. DESCRIPTION OF EVENT

##### A. Event

On August 3, 2016, Watts Bar Nuclear Plant Unit 1 (WBN1) determined that a condition prohibited by Technical Specifications (TS) had occurred. During maintenance of the 1B-B centrifugal charging pump (CCP) {EIS:P} room cooler {EIS:FAN}, the bearing was found in a degraded condition requiring repair. This fan is required to support Operability of the 1B-B CCP. The CCPs are part of the Emergency Core Cooling System (ECCS) {EIS:BQ}, and are required to be Operable by TS 3.5.2. An INOPERABLE CCP is required to be restored to service in 72 hours or a plant shutdown is required. Based on the inability of the CCP to meet its calculated mission time of 10 days, the 1B-B CCP was considered to be inoperable from July 24, 2016 until the 1B-B CCP room cooler was returned to service on August 5, 2016. This represents a condition prohibited by TS 3.5.2.

This event is being reported pursuant to 10 CFR 50.73(a)(2)(i)(B) as a condition prohibited by TS 3.5.2, Emergency Core Cooling Systems.

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

There were no additional structures, components or systems other than the 1B-B CCP room cooler that contributed to this event.

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

Date	Time (EST)	Event
9/27/15	N/A	Preventative maintenance performed on the 1B-B CCP room cooler.
10/07/15		1B-B CCP room cooler returned to service
12/04/15	1042	1B-B CCP room cooler found not cooling and belts thrown
12/04/15		Condition Report (CR) 1111791 generated to evaluate fan failure and correct.
12/06/15	0322	Repairs completed on 1B-B CCP room cooler and fan returned to service.
1/26/16		A past operability evaluation associated with the 1B-B CCP room cooler determines the fan was operable up until failure.
3/07/16		CR 1146474 generated to perform an equipment apparent cause evaluation (EACE) on the 1B-B CCP room cooler failure.
4/21/16		CR 1146474 EACE Approved
5/13/16		CR 1165380 determines this issue to be reportable to NRC.
6/23/16		Revised Past Operability Evaluation associated with the 1B-B CCP and 1A-A CCP approved which determined that the 1B-B cooler was inoperable from October 7, 2015 to December 6, 2015.
6/30/16		LER 390/2016-006 submitted to NRC
7/13/16		CR 1191552 initiated for vibration in alarm status on 1B-B room cooler.

NRC FORM 366A  
(11-2015)

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Watts Bar Nuclear Plant, Unit 1	05000390	2016	- 011	- 01

### NARRATIVE

Date	Time (EST)	Event
7/20/16		1B-B CCP placed in service and operated until August 3, 2016
7/24/16		1B-B CCP determined INOPERABLE based on inability to meet 10 day mission time (10 days prior to fan found in failed condition).
8/3/2016		1B-B CCP room cooler found in a failed condition during maintenance. Documentation after the fact shows fan operating acceptably up until August 3, 2016
8/5/2016		1B-B CCP room cooler returned to service

#### D. Manufacturer and Model Number of Components that Failed

Ellis & Watts fan cooler, Model ACH101.

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

Other than the 1B-B CCP, no other systems or functions were affected.

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

The failure of the fan was discovered during maintenance.

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

The direct cause of the fan failure was the fan belts were over tensioned to 10 pounds, which caused the fan inboard bearing to be overloaded and the fan shaft to operate in a bowed condition.

#### H. Operator Actions

No operator actions were required, as the fan was already out of service for maintenance.

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

There were no automatic or manual safety systems responses required.

### III. CAUSE OF THE EVENT

#### A. The cause of each component or system failure or personnel error, if known.

The direct cause of the fan failure was the fan belts were over tensioned to 10 pounds, which caused the fan inboard bearing to be overloaded and the fan shaft to operate in a bowed condition as documented in Condition Report (CR) 1199024. Maintenance Instruction 0-MI-0.16 provides the process for belt tensioning. A 2011 revision to this procedure had improperly removed the established method (shaft deflection) for belt tensioning, resulting in over tensioning the fan belts.

NRC FORM 366A  
(11-2015)

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### NARRATIVE

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

The root cause was determined to be the procedure revision process lacked requirements to control source notes requiring regulatory/design protection, which led to the removal of a Corrective Action to Prevent Recurrence (CAPR) type action from a historic (1995) Root Cause Analysis (formerly Incident Investigation) related to fan belt tensioning.

#### IV. ANALYSIS OF THE EVENT

The CCPs are a component of the Emergency Core Cooling System (ECCS), providing high head injection into the Reactor Coolant System (RCS). The Specified Safety Function of the ECCS is to cool the reactor core as well as to provide additional shutdown capability following initiation of an accident. TS 3.5.2, "ECCS - Operating," requires two trains to be OPERABLE in Modes 1, 2, 3 and 4. Limiting Condition of Operation (LCO) 3.5.2.A allows one train to be INOPERABLE for 72 hours before a plant shutdown is required. The specified design mission time for the CCPs is 100 days. However, a Westinghouse evaluation determined the minimum operability time that the CCPs are actually required post-accident is approximately 7.5 days. A conservative 10 days is used for CCP mission time in this LER.

On August 3, 2016, WBN1 personnel, while performing maintenance on the 1B-B CCP room cooler, determined that the inboard fan bearing had failed. A maintenance team was formed, including the bearing manufacturer, and the fan was rebuilt. The rebuilt fan considered the most probable causes of the failure, including shaft to bearing tolerance, belt tension, shaft deflection and alignment, and eccentric locking collar installation.

The 1B-B CCP room cooler had been recently rebuilt in December 2015 after a similar bearing failure had occurred from maintenance performed in October 2015. Based on a calculated CCP mission time of 10 days, the 1B-B CCP is considered to have been inoperable from July 24, 2016 until the cooler was repaired on August 5, 2016. This represents a condition prohibited by Technical Specifications for the 1B-B CCP being inoperable for greater than its allowed outage time.

#### V. ASSESSMENT OF SAFETY CONSEQUENCES

A loss of the CCP room cooler will result in the loss of function of its associated CCP in about 74 hours due to loss of qualified motor life. Therefore, while the CCP could not have met its mission time, the fan was functional until it was taken out of service on August 3, 2016, based on normal pump motor winding temperatures. It was returned to service on August 5, 2016. The risk significance of this event was determined to be low.

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

The redundant train 1A-A CCP was OPERABLE and capable of performing its safety function during the time period that the 1B-B CCP was inoperable.

##### 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

NRC FORM 366A  
(11-2015)

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Watts Bar Nuclear Plant, Unit 1	05000390	2016	- 011	- 01

### NARRATIVE

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

The 1B-B CCP room cooler was found in a failed state on August 3, 2016 and was returned to service on August 5, 2016. Based on a 10 day calculated mission time, the 1B-B CCP was inoperable from July 24, 2016 until the cooler was restored to service on August 5, 2016.

### VI. CORRECTIVE ACTIONS

This event was entered into the Tennessee Valley Authority (TVA) Corrective Action Program and is being tracked under Root Cause CR 1199024.

#### A. Immediate Corrective Actions

The failed CCP room cooler was repaired and returned to service. This repair encompassed all of the possible failure mechanisms (shaft to bearing tolerance, belt tension, shaft deflection and alignment, and eccentric locking collar installation) associated with this fan design.

An Extent of Condition (EOC) assessment of safety related coolers was initiated to review shaft clearance and belt tensions, adverse vibration trends, and any other adverse conditions. Coolers which had their fan belts retensioned using the 2011 revision to 0-MI-16 were reviewed and work orders generated. The fan most significantly affected by over tensioning has been corrected.

#### B. Corrective Actions to Prevent Recurrence

The direct cause was determined to be the result of fan belt over tensioning. The procedure used to establish belt tensioning for plant equipment was revised to address this issue.

The root cause performed under CR 1199024 determined that the procedure revision process lacked requirements to control source notes requiring design protection in procedures. The procedures governing procedure development and revision will be revised to ensure controls are in place related to CAPR actions.

The direct cause of the fan failure was the fan belts were over tensioned to 10 pounds, which caused the fan inboard bearing to be overloaded and the fan shaft to operate in a bowed condition as documented in CR 1199024. A work order to address the over tensioned condition on the 1B-B CCP room cooler had been previously generated, but was not worked prior to the fan failure.

### VII. ADDITIONAL INFORMATION

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

On June 30, 2016, WBN Unit 1 reported essentially the same failure in LER 390/2016-006. A failure of the 1B-B CCP room cooler occurred on December 4, 2015 due to an undersized fan shaft resulting in excess shaft to bearing clearance which caused the bearing inner ring to loosen from the eccentric locking collar. These excessive clearances allowed the fan bearing inner ring to



NRC FORM 366A  
(11-2015)

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### NARRATIVE

slide on the shaft. The sliding rotation of the inner ring on the shaft resulted in excessive heat being generated within the bearing leading to catastrophic failure. A contributing cause to the failure was determined to be over tensioning of the fan belts. The failure reported in this LER is essentially the same as that reported in LER 390/2016-006.

On November 3, 1995, WBN Unit 1 reported a construction deficiency related to cooler fan shaft damage under 10 CFR 50.55(e). A final report was completed by TVA on December 4, 1995. The cause of the fan shaft damage was over tensioning of the fan belts. Contributing causes were (1) loose bearing to shaft fit, (2) improper alignment of shafts, (3) flexible bearing support mounts, and (4) shaft material susceptible to deflection and grooving with harder materials. To correct the belt over tensioning issue, a shaft deflection tensioning method was added to Maintenance Instruction MI-0.16. Implementing this method, which was later improperly removed from the procedure in 2011, would have prevented the failure reported in this LER.

#### B. Additional Information

None.

#### C. Safety System Functional Failure Consideration

There was no safety system functional failure.

#### D. Scrams with Complications Consideration

There was no scram associated with this event.

### VIII. COMMITMENTS

None.