



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

March 21, 2014

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 390/2014-001, Loss of Air to Train A Motor Driven  
Auxiliary Feedwater Pump Level Control Valves**

This submittal provides Licensee Event Report (LER) 390/2014-001. This LER provides details concerning Motor Driven Auxiliary Feedwater Pump Level Control Valves failing open due to loss of air. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(i)(B).

There are no regulatory 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 black ink, appearing to read "Chris. Church", is written over a horizontal line.

Christopher R. Church  
Site Vice President  
Watts Bar Nuclear Plant

Enclosure  
cc: See Page 2

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Enclosure  
cc (Enclosure):

NRC Regional Administrator - Region II

NRC Senior Resident Inspector - Watts Bar Nuclear Plant

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digits/characters for each block)

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.

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**2. DOCKET NUMBER**

05000390

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**4. TITLE**

Loss of Air to Train A Motor Driven Auxiliary Feedwater Pump Level Control Valves

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
01	24	2014	2014	001	00	03	20	2014	FACILITY NAME	DOCKET NUMBER
										05000
									FACILITY NAME	DOCKET NUMBER
										05000

**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)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)
	<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)
	<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)
	<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)
10. POWER LEVEL  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)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
	<input type="checkbox"/> 20.2203(a)(2)(iii)	<input type="checkbox"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 73.71(a)(4)
	<input type="checkbox"/> 20.2203(a)(2)(iv)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(5)
	<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)(C)	<input type="checkbox"/> OTHER
	<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)(v)(D)	Specify in Abstract below or in NRC Form 366A

**12. LICENSEE CONTACT FOR THIS LER**

## LICENSEE CONTACT

Ernest Thomas Metzler, Watts Bar Site Licensing Engineer

## TELEPHONE NUMBER (Include Area Code)

423-365-7754

**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
A	BA	LCV							

**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 January 24, 2014, 1525 Eastern Standard Time (EST) with Watts Bar Nuclear (WBN) Unit 1 at 100 percent rated thermal power, two Train A Motor Driven Auxiliary Feedwater (AFW) Pump Level Control Valves (LCV) failed open due to loss of air. The valves 1-LCV-3-156-A and 1-LCV-3-164-A failed open following removal of the backup nitrogen control system. Upon investigation two essential air isolation valves 0-ISV-32-371 and 0-ISV-32-373, which are normally open to supply essential air from the Auxiliary Compressed Air System (ACAS) to motor driven AFW LCVs, were found closed.

Valves 0-ISV-32-371 and 0-ISV-32-373 were immediately opened which restored essential air to 1-LCV-3-156-A and 1-LCV-3-164-A. Technical Specification (TS) Limiting Condition for Operation (LCO) 3.7.5 was entered at 1525 on January 24, 2014 when Train A Motor Driven AFW was declared inoperable. Upon restoration of air to LCVs, TS LCO 3.7.5 was exited at 1612 on January, 24, 2014.

The cause of this event was that valves 0-ISV-32-371 and 0-ISV-32-373 were closed as part of work order activities and Operations personnel failed to restore the valves to their normal open position.

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**NARRATIVE****I. PLANT OPERATING CONDITIONS BEFORE THE EVENT**

At the time of discovery, Watts Bar Nuclear Plant (WBN) Unit 1 was in Mode 1 at approximately 100 percent rated thermal power.

**II. DESCRIPTION OF EVENTS****A. Event**

At 1525 on January 24, 2014, Operations personnel vented the nitrogen header as part of a routine nitrogen trailer exchange. Appendix R backup motive force for Auxiliary Feedwater (AFW) (Energy Industry Identification System (EIIIS): BA) air operated level control valves (EIIIS: LCV) is supplied by this nitrogen header. At this time, Main Control Room personnel discovered valves 1-LCV-3-156-A and 1-LCV-3-164-A failed open due to loss of control air. These valves provide Steam Generator (EIIIS: SG) 2 and SG 1 (respectively) Level Control when the Train A Motor Driven AFW Pump supplies feedwater to the steam generators. Upon investigation it was discovered that isolation valves (EIIIS: ISV) 0-ISV-32-371 and 0-ISV-32-373 were in the closed position. These isolation valves are normally open to supply essential air from the Auxiliary Compressed Air System (ACAS) (EIIIS: LE) to Motor Driven AFW Pump Level Control Valves 1-LCV-3-156-A and 1-LCV-3-164-A, as well as 1-LCV-3-156A-A, SG 2 Motor Driven AFW Pump Bypass Level Control Valve, and 1-LCV-3-164A-A, SG 1 Motor Driven AFW Pump Bypass Level Control Valve.

During the previous Unit 1 Refueling Outage, Hold Orders 1-3-0730C and 1-3-0730D were issued on October 20, 2012 to repair leaks associated with the installation of nitrogen backup supplies to Train A Motor Driven AFW Pump LCVs in accordance with Design Change Notice (DCN) 58387. The Hold Orders were released on October 22, 2012. Following Post Maintenance Testing (PMT) activities configuration control was lost with the ACAS supply valves (0-ISV-32-371 and 0-ISV-32-373) in the CLOSED position, inadvertently isolating the ACAS supply to the Train A Motor Driven AFW Pump LCVs. As the date of the actual isolation is known with no indication that the supply has been re-aligned in the time since the mis-positioning, the latter time of the hold order release and PMT activities has been used in lieu of the time of discovery.

DCN 58387 installed a nitrogen backup to the ACAS supply and was being implemented during the Unit 1 Refueling Outage at the time of the mis-position of the ACAS supply valves to the Train A Motor Driven AFW Pump LCVs. This nitrogen backup is a passive non-safety system that provides nitrogen to AFW air operated valves in the event of a loss of ACAS due to an Appendix R fire. Because nitrogen was supplied since October of 2012 Train A Motor Driven AFW Pump LCVs 1-LCV-3-156-A and 1-LCV-3-164-A did not fail in the open state.

This event is reportable under 10 CFR 50.73(a)(2)(i)(B), as an operation or condition which was prohibited by the plant's Technical Specifications (TS). TS 3.7.5 Condition B requires restoration of one inoperable AFW train to operable status in a completion time of 72 hours.

**B. Status of Structures, Components, or Systems that were Inoperable at the start of the event and that contributed to the event.**

None.

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

Date	Time (EDT)	Event
October 20, 2012	N/A	Unit 1 Refueling Outage Hold Orders 1-3-0730C and 1-3-0730D were issued to repair leaks associated with the installation of nitrogen backup supplies to Train A Motor Driven AFW Pump LCVs in accordance with DCN 58387.
October 22, 2012	N/A	Hold Orders were released with the ACAS supply valves to the Train A Motor Driven AFW Pump LCVs (0-ISV-32-371 and 0-ISV-32-373) in the CLOSED position, inadvertently isolating the ACAS supply to the AFW valves.
October 24, 2012	0419	WBN Unit 1 entered Mode 3 and the three trains of AFW are required to be operable according to Technical Specification Limiting Condition for Operation (LCO) 3.7.5.
January 24, 2014	1525	Operations personnel vented the nitrogen header that supplies backup nitrogen to AFW air operated valves for Appendix R backup motive force for the valves. Valve 1-LCV-3-156-A and valve 1-LCV-3-164-A failed open due to loss of control air. Technical Specification LCO 3.7.5 was entered.
January 24, 2014	1612	Valves 0-ISV-32-371 and 0-ISV-32-373 were opened, restoring control air to 1-LCV-3-156-A and 1-LCV-3-164-A. Technical Specification LCO 3.7.5 was exited.

**D. Manufacturer and Model Number (or other identification) of each component that failed during the event**

None

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

None

**F. Method of Discovery of Each Component or System Failure or Procedural Error**

Main Control Room personnel discovered 1-LCV-3-156-A and 1-LCV-3-164-A failed open due to loss of control air. Valves failed open following removal of the backup nitrogen control system.

**G. The Failure Mode, Mechanism, and Effect of Each Failed Component**

With the safety related ACAS supply isolated to the Train A Motor Driven AFW Pump LCVs, 1-LCV-3-156-A and 1-LCV-3-164-A cannot be considered operable due to the fact that the Main LCVs fail in the open state and thus are incapable of modulating AFW flow to control steam generator level.

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**H. Operator Actions**

Upon discovery Operators promptly opened valves 0-ISV-32-371 and 0-ISV-32-373, restoring control air to 1-LCV-3-156-A, 1-LCV-3-164-A, 1-LCV-3-156A-A and 1-LCV-3-164A-A. The operators verified that ACAS was properly aligned to the other AFW Train LCVs.

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

There were no safety system responses and none were required.

**III. CAUSE OF THE EVENT**

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

The direct cause of this event was that valves 0-ISV-32-371 and 0-ISV-32-373 were closed as part of work order activities and Operations personnel failed to restore the valves to their normal open position.

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

The apparent cause of this event was Supervision has not effectively monitored personnel to ensure they properly value their signature.

Contributing cause was that contrary to management expectations, the drawing was not used during Pre Job Briefing.

**IV. ANALYSIS OF THE EVENT**

Each Motor Driven Auxiliary Feedwater pump is capable of supplying two steam generators and there are two Motor Driven AFW pumps. The Turbine Driven (TD) AFW pump is capable of supplying four SGs. One train of AFW (flow to two steam generators) is capable of removing decay heat and cool the unit until residual heat removal (RHR) entry conditions. The flow from the Motor Driven AFW Pump is automatically controlled by a four inch LCV and a parallel two inch LCV. The LCVs are controlled to maintain the required level in their respective SG. The LCVs have split range control such that the two inch LCV is fully open before the four inch LCV begins to throttle open. The two inch LCV is used for low flow demand and the four inch LCV is utilized when flow demand increases beyond the capabilities of the two inch LCV. During cool down, as the pressure in the SG is reduced the LCVs will throttle down to maintain the required flow. A pressure switch (PS) downstream of the LCVs closes the four inch LCV prior to low pressure conditions that could result in significant valve cavitation occurring. The main four inch LCVs fail open on loss of air while the two inch bypass LCVs fail closed on loss of air. DCN 58387 installed a backup, non-safety source of nitrogen to each AFW air operated valve (AOV) to help mitigate the effects of an Appendix R fire.

Absent the Appendix R Nitrogen supply, a loss of ACAS supply to the Motor Driven AFW Pump LCVs results in bypass valves 1-LCV-3-156A-A and 1-LCV-3-164A-A failing in the closed state, while main valves 1-LCV-3-156-A and 1-LCV-3-164-A fail in the open state. With the safety related ACAS supply isolated to the Train A Motor Driven AFW Pump LCVs, 1-LCV-3-156-A, 1-LCV-3-164-A, 1-LCV-3-156A-A and 1-LCV-3-164A-A cannot be considered operable due to the fact that the main LCVs fail in the open state and thus be incapable modulating AFW flow to control SG level. Absent the Appendix R Nitrogen supply, the valves would be incapable of fulfilling their required safety function.

Surveillances were conducted during the period of time that ACAS was isolated. The Motor Driven AFW Pump LCVs performed within the In Service Testing (IST) required stroke times in both the open and closed directions. While the nitrogen supply is not safety-related, TVA completed a seismic evaluation that demonstrates components of the nitrogen supply system located outside the Auxiliary Building (AB) are

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**IV. ANALYSIS OF THE EVENT (continued)**

sufficiently seismically rugged to withstand a Safe Shutdown Earthquake (SSE). Calculations performed demonstrate that the minimum required nitrogen pressure to meet the pressure and flow requirements for the Motor Driven AFW Pump LCVs is 74 psig. A review of the nitrogen tank pressure taken during operator rounds each shift shows that 96 percent of the time the nitrogen available was at or above the required 74 psig when the valves were considered inoperable.

Additionally, in the case of SG overfill event the operator has the ability to secure the Train A Motor Driven Auxiliary Feedwater Pump to prevent overfill. In this instance, the Train B Motor Driven Auxiliary Feedwater Pump and the Turbine Driven Auxiliary Feedwater Pump can be used to mitigate an accident, to remove decay heat and cool the unit to the point that RHR can be placed in service.

Furthermore, in the event of Main Steam Line Break, Main Feedwater Line Break, SG tube rupture, or a faulted SG, the Train A Motor Driven AFW Pump can be secured, or manual action can be taken to close the manual isolation valves upstream and downstream of the LCVs. This will allow for AFW isolation to the impacted SGs. Specifically, procedure for Faulted Steam Generator Isolation, directs the operator to isolate AFW flow to the faulted SG. Additionally, the procedure for Steam Generator Tube Rupture, directs the operator to isolate AFW flow to the ruptured SG.

The Probabilistic Risk Assessment evaluation of risk documented demonstrates the isolation of essential air (for the period in question) from the ACAS to Train A Motor Driven AFW Pump LCVs 1-LCV-3-156-A and 1-LCV-3-164-A, as well as 1-LCV-3-156A-A, SG 2 Motor Driven AFW Pump Bypass Level Control Valve, and 1-LCV-3-164A-A, SG 1 Motor Driven AFW Pump Bypass Level Control Valve is not risk significant. Risk as determined by the internal events model remains very small, even if unavailability of control air throughout an entire year is assumed. External events can be shown by qualitative reasoning to be minor risk contributors. Fire risk need not be considered for loss of control air. Therefore the risk associated with unavailability of control air to Train A Motor Driven AFW Pump LCVs is evaluated to be very small.

**V. ASSESSMENT OF SAFETY CONSEQUENCES**

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

Each Motor Driven AFW pump is capable of supplying two steam generators and there are two Motor Driven AFW pumps. The Turbine Driven AFW pump is capable of supplying four SGs. One train of AFW (flow to two steam generators) is capable of removing decay heat and cool the unit until RHR entry conditions. Operator logs were reviewed during the time that Train A Motor Driven AFW Pump LCVs were considered inoperable. During this time period either the Train B Motor Driven AFW Pump or the Turbine Driven AFW Pump was operable or both of these trains were operable except for one day at 0702 on January 10, 2014. Because of an inoperable Diesel Generator (DG) and TS 3.8.1 Condition B.2 required action (Declare required feature(s) supported by the inoperable DG inoperable when its required redundant feature(s) is inoperable), the three trains of AFW were declared inoperable when the A-A Auxiliary Air Compressor was declared inoperable. Technical Specification LCO 3.7.5 Condition D was entered at 0703 on January 10, 2014 and Technical Specification LCO 3.7.5 was exited at 1022 on January 10, 2014 after the A-A Auxiliary Air Compressor was successfully operated for fifteen minutes and declared operable.

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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 discovery of the failure until the train was returned to service:

One AFW train (Train A Motor Driven AFW Pump) was inoperable from October 24, 2012 at 0419 to January 24, 2014 at 1612.

VI. **CORRECTIVE ACTIONS** - Corrective actions are being managed by TVA's corrective action program under Problem Evaluation Report 838494.

A. Immediate Corrective Actions.

Operators opened valves 0-ISV-32-371 and 0-ISV-32-373 to the correct position that restored air supply to valves 1-LCV-3-156-A and 1-LCV-3-164-A.

B. Corrective Actions to Prevent Recurrence or to reduce probability of similar events occurring in the future.

Implement more robust and intrusive management expectations in the existing observation program which contains a broader range of monitored activities to increase management observation time in the field. The program will require all Senior Reactor Operators to complete four observations with at least one paired observation. Of the four observations one each must be documented for Assistant Unit Operator Rounds, Fire Operations, and Unit 2 activities.

VII. **ADDITIONAL INFORMATION**

A. Previous Similar Events at the Same Plant

The Apparent Cause Evaluation (ACE) for this event included Problem Evaluation Report (PER) 814253 information. PER 814253 was a result of the 2013 World Association for Nuclear Operators (WANO) Assessment Area for Improvement. The ACE for this PER 814253 included review of Watts Bar PERs initiated from October of 2012 until October of 2013. The Apparent Cause was similar to this event. Personnel do not respect and lack accountability for the importance of their signature in the performance of verification. Corrective action was similar to this event for five organizations including Operations. First Line Supervisors were to perform one observation of employee's performance on proper verification over the next quarter with a due date of March 20, 2014. This PER 814253 action was not in progress until January 8, 2014. The completions of this action and other PER actions were still in progress when this LER event occurred.

B. Additional Information

None.

C. Safety System Functional Failure Consideration

In accordance with Nuclear Energy Institute (NEI) 99-02, this condition did not result in a safety system functional failure.



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D. Scram with Complications Consideration

This event did not include a scram.

**VIII. COMMITMENTS**

There are no commitments.