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

July 27, 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 391/2016-003-00, Turbine Driven Auxiliary Feedwater Pump Inoperable for Longer than Allowable Outage Time due to Governor Valve Spring Over-Tensioning**

This submittal provides Licensee Event Report (LER) 391/2016-003-00. This LER documents an incident where the Technical Specification Limiting Condition for Operation (LCO) 3.7.5 for the Auxiliary Feedwater System was not met. This report is being submitted in accordance with 10 CFR 50.73(a)(2)(i)(B). A supplement to this LER is expected to be submitted by September 2, 2016

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,

(FOR)

Paul Simmons
Site Vice President
Watts Bar Nuclear Plant

Enclosure
cc: See Page 2

cc (Enclosure):

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

NRC FORM 366 (11-2015) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018

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4. TITLE

Turbine Driven Auxiliary Feedwater Pump Inoperable for Longer than Allowable Outage Time due to Governor Valve Spring Over-Tensioning

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
									N/A	N/A
05	28	2016	2016	- 003	00	07	27	2016	FACILITY NAME N/A	DOCKET NUMBER N/A

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
3	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
0	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER *(Include Area Code)*
Gordon Arent, Director Watts Bar Licensing	423-365-2004

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

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☒ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☐ NO		09	02	2016

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

The Unit 2 Turbine Driven Auxiliary Feedwater (TDAFW) pump auto-started upon a planned Reactor Trip at 0154 Eastern Daylight Time (EDT) on May 28, 2016. At 0157 EDT the Reactor Operator noted that TDAFW forward flow to Steam Generators 1 and 3 were approximately 800 gallons per minute, and placed the associated Level Control Valves in the closed position. At approximately 0203 EDT the Main Control Room received Alarm Window 60-A, TDAFW Pump Electrical Overspeed Trip. Operators walked down the TDAFW pump and determined that the turbine had tripped, by confirming that the Trip and Throttle Valve was no longer latched, and declared the TDAFWP inoperable. The equipment was repaired, the TDAFWP was re-tested successfully and returned to service. Technical Specification (TS) Limiting Condition for Operation 3.7.5 was exited on May 30, 2016.

The plant conditions at the time of the event were Unit 2 in Mode 3 at Normal Operating Temperature/Normal Operating Pressure following manual reactor trip from Mode 1. The reactor trip was unrelated to this event.

On June 29 2016, a past operability evaluation concluded that the TDAFWP had been inoperable from March 30 through May 30, 2016. This is reportable as a condition prohibited by TS.

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APPROVED BY OMB: NO. 3150-0104 EXPIRES: 10/31/2018

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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NARRATIVE

I. PLANT OPERATING CONDITIONS BEFORE THE EVENT

Watts Bar Nuclear Plant (WBN) Unit 2 was in Mode 3 at Normal Operating Temperature/Normal Operating Pressure (NOP/NOT) following a planned manual reactor trip from Mode 1. The reactor trip was unrelated to this event.

II. DESCRIPTION OF EVENT

A. Event

The Unit 2 Turbine Driven Auxiliary Feedwater pump (TDAFWP) {EIIS:P} auto-started upon a planned Reactor Trip at 0154 hours EDT on May 28, 2016. At 0157 hours EDT the Reactor Operator noted that TDAFWP forward flow to Steam Generators (SGs) 1 and 3 were approximately 800 gallons per minute (gpm). To preclude the potential for SG overfill, the Reactor Operator placed the associated Level Control Valves (LCVs) {EIIS:LCV} in the closed position. At approximately 0203 EDT the Main Control Room (MCR) received Alarm Window 60-A, TDAFWP Electrical Overspeed Trip. Auxiliary Unit Operators (AUOs) walked down the TDAFWP and determined that the turbine had tripped, by confirming that the Trip and Throttle Valve (TTV) {EIIS:V} was no longer latched. No other anomalies were identified.

Troubleshooting conducted on May 28, 2016 and May 29, 2016 identified that the Governor Valve (2-FCV-001-0052) stem spring {EIIS:SCV} was over tensioned. The Maintenance Instruction for tensioning the valve stem spring directs the technician to adjust spring compression with the valve fully closed to establish a gap of approximately 1/32 inch (0.031 inches) between coils to ensure coils do not bind. The as-found gap between the coils with the governor valve closed was 0.005 inches or essentially coil bound. This led to the Terry Turbine {EIIS:TRB} controls not being able to respond to the sudden reduction in forward flow to the SGs, resulting in an electrical overspeed trip at 110 percent rated speed.

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

There were no additional structures, components or systems that contributed to this event.

C. Dates and Approximate Times of Occurrences

Date	Time (EDT)	Event
03/30/16	2314	Entered Mode 3 with INOPERABLE TDAFWP
04/02/16	0629	Entered Mode 4
04/08/16	1244	Re-entered Mode 3 with INOPERABLE TDAFWP
04/17/16	0338	Entered Mode 4 for repairs to TDAFWP - steam leaks
05/01/16	1736	Re-entered Mode 3 with INOPERABLE TDAFWP
05/18/16	2358	Entered Mode 4
05/20/16	0415	Entered Mode 3 with INOPERABLE TDAFWP
05/23/16	0104	Entered Mode 2, WBN 2 Initial Critical
05/28/16	0154	Manual Reactor Trip due to steam leak
05/28/16	0154	TDAFWP auto start
05/28/16	~0203	TDAFWP trips on spurious overspeed when forward flow was

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Date	Time (EDT)	Event
		terminated
05/30/16	0334	TDAFWP Surveillance completed successfully
06/29/16		Past OPERABILITY Evaluation determined TDAFWP was INOPERABLE

D. Manufacturer and Model Number of Components that Failed

The component failure was due to maintenance practices when the governor valve spring was over-tensioned.

E. Other Systems or Secondary Functions Affected

No other systems or functions were affected.

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

On May 28, 2016, at 0203 EDT the MCR received the TDAFWP Electrical Overspeed Trip alarm. A subsequent walkdown by AUOs determined that the TDAFWP had tripped, by confirming that the TTV was no longer latched.

G. Failure Mode and Effect of Each Failed Component

As noted in the Description of Event, an over-tensioned governor valve stem spring was discovered during troubleshooting following the overspeed trip of the TDAFWP. A review of Operations procedures did not reveal precautions or warnings to prevent Operators from placing the level control valves in the closed position to prevent potential SG overfill during a safety system actuation. As a result, the over tensioning of the Governor Valve stem spring would lead to the overspeed trip of the Terry Turbine anytime a sudden reduction in forward flow to the SGs were to occur. In accordance with the WBN Unit 2 Final Safety Analysis Report, failure of the TDAFWP from a mechanical failure or spurious control signal would be addressed through the operation of the 2A-A and 2B-B Motor Driven Auxiliary Feedwater Pump (MDAFWP) that provide auxiliary feedwater flow to all 4 Steam Generators.

H. Operator Actions

Due to the overspeed trip of TDAFWP the operators entered Technical Specification (TS) Limiting Condition for Operation (LCO) 3.7.5, Condition B, "One AFW train INOPERABLE in MODE 1, 2, or 3 for reasons other than Condition A."

I. Automatically and Manually Initiated Safety System Responses

The condition described in this report did not result in any automatic or manual safety systems activation.

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III. CAUSE OF THE EVENT

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

The inability of the TDAFWP to continue operating following closure of the level control valves and subsequent electrical overspeed trip was the result of maintenance practices that incorrectly set the TDAFWP governor valve stem spring. A review of the governor valve work order history determined that the stem spring had likely been incorrectly set in November 2015.

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

Troubleshooting conducted on May 28, 2016 and May 29, 2016 identified that the governor valve stem spring was over tensioned. The Maintenance Instruction for tensioning the valve stem spring directs the technician to adjust spring compression with the valve fully closed to establish a gap of approximately 1/32 inch (0.031 inches) between coils to ensure coils do not bind. The as-found gap between the coils with the governor valve closed was 0.005 inches or essentially coil bound. This led to the Terry Turbine controls not being able to respond to the sudden reduction in forward flow to the SGs, resulting in an electrical overspeed trip at 110 percent rated speed.

The procedure should have more clearly indicated the required "set up" of the spring and document an as left measurement for the spring. More detailed instructions were needed for setting the gap and an actual step recording the as-left gap measurement should have been incorporated. In addition, since this single step can adversely impact the operation of the Terry Turbine, the step should have been marked as a Critical Step to ensure that awareness to this potential.

IV. ANALYSIS OF THE EVENT

The Auxiliary Feedwater (AFW) system's {EIIS:BA} function is to supply, in the event of a loss of the main feedwater supply, sufficient feedwater to the steam generators to remove primary system residual heat and core decay heat. It may also be required in some other circumstances such as the evacuation of the MCR, cooldown after a Loss of Coolant Accident (LOCA) for a small break, maintaining a water head in the steam generators following a LOCA, a flood above plant grade, Anticipated Transient Without Scram (ATWS) event, 10 CFR 50, Appendix R, Fires and to support normal cooldown.

The TDAFWP assembly along with the MDAFWP assemblies provide the motive pressure to ensure adequate flow gets to the steam generators for decay heat removal.

The Design Basis Events that establish AFW system safety function requirements are:

Loss of Normal Main Feedwater (LONF) (including Loss of Offsite Power)
Main Feedline or Main Steamline Breaks (MFLB or MSLB)
Loss of offsite power (LOOP)
Large Break Loss of Coolant Accident (LOCA)
Small Break Loss of Coolant Accident (SBLOCA)

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Technical Specification 3.7.5, AFW System requires all three trains of AFW to be OPERABLE in Modes 1, 2, and 3. Additionally, one train of AFW is required OPERABLE in Mode 4 when the Steam Generators are used for Heat Removal. With one of the required AFW trains (pump or flow path) INOPERABLE in MODE 1, 2, or 3 for reasons other than Condition A, action must be taken to restore to OPERABLE status within 72 hours. This Condition includes the loss of two steam supply lines to the turbine driven AFW pump. The 72 hour Completion Time is reasonable, based on redundant capabilities afforded by the AFW System, time needed for repairs, and the low probability of a Design Basis Accident (DBA) occurring during this time period.

During the timeframe that the TDAFWP was INOPERABLE while in Modes 1, 2 and 3, both MDAFWPs were considered OPERABLE and capable of performing their design function. As a result, sufficient AFW system capability was available. Additionally, both MDAFWPs were in-service in Mode 3, during the time that the TDAFWP was INOPERABLE.

While the MDAFWPs were considered OPERABLE and were in operation during the timeframe discussed above, a re-evaluation of the 2A-A MDAFWP is in process. The conclusion of this re-evaluation will be provided in a supplement to this LER.

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.

As discussed previously, during the timeframe that the TDAFWP was INOPERABLE while in Modes 1, 2 and 3, both MDAFWPs were OPERABLE and capable of performing their design function. As a result, sufficient AFW system capability was available. Both MDAFWPs were in-service in Mode 3, during the time that the TDAFWP 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

Prior to 0104 EDT on May 23, 2016, Watts Bar Unit 2 had not achieved initial criticality. With the MDAFWPs in service and no decay heat on Unit 2, the ability to shut down the reactor and maintain a safe shutdown condition was not impacted. With no core decay heat, removal of residual heat is not an issue. With no irradiated fuel in the Unit 2 core, an uncontrolled release of radioactive material is not credible, The inoperability of the TDAFWP would not have adversely impacted the ability to mitigate the consequences of an accident.

A risk evaluation was performed for the period from initial criticality to the TDAFWP electrical overspeed trip. The evaluation conservatively used full power thermal-hydraulic analyses, as opposed to the actual residual heat estimate of 19 Megawatt Thermal provided by Nuclear Fuels group. The risk review showed that with an unavailability of seven days, the core damage frequency associated with the TDAFWP remained below 1E-6.

During the initiating event the turbine started, came to rated speed, and flowed forward to maintain SG levels. The electrical overspeed did not occur until the Operators closed the level control valves to SGs 1 and 3. If needed, the Trip and Throttle Valve (2-FCV-001-0051) could have been

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reset from the MCR and the turbine restarted to maintain SG levels in accordance with the Feedwater and Main Steam Annunciator Response Instruction.

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 following provides the window of TDAFWP unavailability for the timeframe Unit 2 was in Mode 3.

From March 30, 2016 through April 17, 2016. There were two windows of unavailability during this timeframe, one was 2 days, 7 hours and 15 minutes and the second was 7 days, 14 hours and 54 minutes respectively for a total exposure time 9 days, 22 hours and 9 minutes. The unavailability window was exited on April 17, 2016, after successful completion of the TDAFWP surveillance test. Surveillance testing did not uncover the governor stem valve spring tension issue.

On May 1, 2016, at 1736 EDT Watts Bar Unit 2 again entered Mode 3. While not recognized, the TDAFWP was not OPERABLE at this time. On May 18, 2016 at 2358 EDT, Unit 2 was moved back to Mode 4. The time in Mode 3 for this window was 17 days, 6 hours and 22 minutes. Subsequently, on May 20, 2016 at 0415 EDT, Unit 2 reentered Mode 3 and remained there until entry into Mode 2 at 0104 EDT on May 23, 2016. This Mode 3 window lasted 2 days, 20 hours and 49 minutes.

As a result, the total TDAFWP unavailability time with Unit 2 in Mode 3 and prior to initial criticality was 30 days, 1 hour and 20 minutes.

Watts Bar Unit 2 entered Mode 2 (initial criticality) at 0104 EDT on May 23, 2016. Unit 2 remained critical until a manual reactor trip was initiated at 0154 EDT on May 28, 2016. The TDAFWP was restored to OPERABLE status at 0334 EDT on May 30, 2016. Based on the above, with the reactor critical the unavailability window was 7 days and 2 hours and 30 minutes.

VI. CORRECTIVE ACTIONS

This event was entered into the Tennessee Valley Authority Corrective Action Program and is being tracked under condition report (CR) 1175968.

A. Immediate Corrective Actions

The TDAFWP governor valve stem spring was reset to the appropriate acceptance criteria on May 29, 2016. The TDAFWP successfully completed TS surveillance requirements at 0334 EDT on May 30, 2016.

B. Corrective Actions to Prevent Recurrence

Revise the Maintenance Instruction to provide more detailed guidance for adjusting spring compression of governor valves and add blank to record the gap as-left measurement setting.

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VII. ADDITIONAL INFORMATION

A. Previous similar events at the same plant

LER 391/2016-002

On April 14, 2016, during performance of Surveillance Requirement (SR) 3.7.5.2, the TDAFWP failed to achieve required rated speed of 3950 rpm ± 25 rpm due to an equipment failure. The TDAFWP was declared inoperable, and TS LCO 3.7.5, Condition B, was entered. The equipment was repaired, the TDAFWP was re-tested successfully and returned to service. TS LCO 3.7.5 was exited on May 4, 2016.

This event, while similar, was the result of a loose wire and not the over tensioning of the governor valve.

B. Additional Information

None.

C. Safety System Functional Failure Consideration

This condition did not represent a safety system functional failure. During the initiating event the turbine started, came to rated speed, and flowed forward to maintain SG levels. Based on the as-found condition of the governor valve stem spring, the Terry Turbine would have tripped on overspeed anytime a sudden reduction in forward flow to the SGs were to occur. If needed, the Trip and Throttle Valve (2-FCV-001-0051) could have been reset from the Main Control Room and the turbine restarted to maintain SG levels in accordance with the Feedwater and Main Steam Annunciator Response Instruction.

Additionally, during the timeframe that the TDAFWP was INOPERABLE while in Modes 1, 2 and 3, based on the initial conclusion that the 2A-A MDAFWP could perform it design basis function, this condition did not result in a safety system functional failure because two MDAFWPs were capable of supplying AFW to all four steam generators. As discussed previously, confirmation of this position is currently being re-evaluated and a supplement to this report will be provided with the final conclusion.

D. Scrams with Complications Consideration

There was no scram associated with this event.

VIII. COMMITMENTS

None.