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

WBL-24-006

February 29, 2024

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 391/2023-003-01, Automatic Reactor Trip Due to Loss of Main Feedwater Regulating Valve Control**

Pursuant to the reporting requirements of 10 CFR 50.73, attached is the subject Licensee Event Report supplement concerning the Automatic Reactor Trip and Reactor Protection System Actuation for Watts Bar Nuclear Plant, Unit 2, which occurred on August 4, 2023.

There are no new regulatory commitments contained in this letter. Please direct any questions concerning this matter to Jonathan Johnson, WBN Licensing Manager, at [jtjohnson0@tva.gov](mailto:jtjohnson0@tva.gov).

Respectfully,

  
Anthony L. Williams IV  
Site Vice President  
Watts Bar Nuclear Plant

U.S. Nuclear Regulatory Commission  
WBL-24-006  
Page 2  
February 29, 2024

Enclosure: Tennessee Valley Authority, Watts Bar Nuclear Plant, Unit 2, LER 391/2023-003-01, "Automatic Reactor Trip Due to Loss of Main Feedwater Regulating Valve Control"

cc (w/Enclosure):  
NRC Regional Administrator – Region II  
NRC Senior Resident Inspector – Watts Bar Nuclear Plant  
NRC Project Manager – Region II

**ENCLOSURE**

**Tennessee Valley Authority  
Watts Bar Nuclear Plant  
Unit 2**

**LER 391/2023-003-01, "Automatic Reactor Trip Due to Loss of Main Feedwater Regulating Valve Control"**



### LICENSEE EVENT REPORT (LER)

(See Page 2 for required number of digits/characters for each block)  
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1. Facility Name Watts Bar Nuclear Plant, Unit 2	<input checked="" type="checkbox"/> 050	2. Docket Number 00391	3. Page 1 OF 6
	<input type="checkbox"/> 052		

4. Title  
Automatic Reactor Trip Due to Loss of Main Feedwater Regulating Valve Control

5. Event Date			6. LER Number			7. Report Date			8. Other Facilities Involved	
Month	Day	Year	Year	Sequential Number	Revision No.	Month	Day	Year	Facility Name	Docket Number
08	04	2023	2023	003	01	02	29	2024	N/A	<input type="checkbox"/> 050
									N/A	<input type="checkbox"/> 052

9. Operating Mode 1	10. Power Level 100
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11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: (Check all that apply)

<input type="checkbox"/> 10 CFR Part 20	<input type="checkbox"/> 20.2203(a)(2)(vi)	<input type="checkbox"/> 10 CFR Part 50	<input type="checkbox"/> 50.73(a)(2)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(viii)(A)	<input type="checkbox"/> 73.1200(a)
<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.36(c)(1)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(ii)(B)	<input type="checkbox"/> 50.73(a)(2)(viii)(B)	<input type="checkbox"/> 73.1200(b)
<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.36(c)(1)(ii)(A)	<input type="checkbox"/> 50.73(a)(2)(iii)	<input type="checkbox"/> 50.73(a)(2)(ix)(A)	<input type="checkbox"/> 73.1200(c)
<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.36(c)(2)	<input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)	<input type="checkbox"/> 73.1200(d)
<input type="checkbox"/> 20.2203(a)(2)(i)	<input type="checkbox"/> 10 CFR Part 21	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	<input type="checkbox"/> 10 CFR Part 73	<input type="checkbox"/> 73.1200(e)
<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 21.2(c)	<input type="checkbox"/> 50.69(g)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.77(a)(1)	<input type="checkbox"/> 73.1200(f)
<input type="checkbox"/> 20.2203(a)(2)(iii)		<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.77(a)(2)(i)	<input type="checkbox"/> 73.1200(g)
<input type="checkbox"/> 20.2203(a)(2)(iv)		<input type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(2)(ii)	<input type="checkbox"/> 73.1200(h)
<input type="checkbox"/> 20.2203(a)(2)(v)		<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)		

OTHER (Specify here, in abstract, or NRC 366A).

12. Licensee Contact for this LER

Licensee Contact Kevin Lovell, Licensing Engineer	Phone Number (Include area code) 423-365-8196
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13. Complete One Line for each Component Failure Described in this Report

Cause	System	Component	Manufacturer	Reportable to IRIS	Cause	System	Component	Manufacturer	Reportable to IRIS
X	JB	FC	FOX	Y	N/A	N/A	N/A	N/A	N/A

14. Supplemental Report Expected				15. Expected Submission Date		
<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes (If yes, complete 15. Expected Submission Date)			Month	Day	Year
				N/A	N/A	N/A

16. Abstract (Limit to 1326 spaces, i.e., approximately 13 single-spaced typewritten lines)

On August 4, 2023 at approximately 1746 Eastern Daylight-Saving Time (EDT), while operating at 100 percent rated thermal power, Watts Bar Nuclear Plant (WBN) Unit 2 experienced an automatic reactor trip in response to controls failure of the main feedwater regulating valve to steam generator 2. All control and shutdown bank rods inserted properly in response to the reactor trip. All safety systems, including the Auxiliary Feedwater (AFW) System, performed as designed and there were no complications with the trip.

The root cause of the event was determined to be a vulnerability in the design of the Steam Generator (SG) level Distributed Control System (DCS) that prevented automatic and manual control of SG Feedwater (FW) inlet flow. The investigation, at the time of this report, between Tennessee Valley Authority (TVA), Framatome, and Schneider Electric has not determined the specific reason for the fault seen at WBN. WBN will be implementing a SG level control strategy that prevents the total loss of SG inlet flow control.

This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A), as an automatic actuation of the Reactor Protection System (RPS) and Auxiliary Feedwater System (AFW).



**LICENSEE EVENT REPORT (LER)  
CONTINUATION SHEET**

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1. FACILITY NAME  Watts Bar Nuclear Plant, Unit 2	<input checked="" type="checkbox"/> 050	2. DOCKET NUMBER  00391	3. LER NUMBER		
	<input type="checkbox"/> 052		YEAR	SEQUENTIAL NUMBER	REV NO.
			2023	- 003	- 01

**NARRATIVE**

**I. Plant Operating Conditions before the Event**

Watts Bar Unit 2 was at 100 percent Rated Thermal Power (RTP).

**II. Description of Event**

**A. Event Summary**

On August 4, 2023 at approximately 1746 Eastern Daylight-Saving Time (EDT), while operating at 100 percent rated thermal power, Watts Bar Nuclear Plant (WBN) Unit 2 experienced an automatic reactor trip in response to a loss of feedwater regulating valve [EIS:FCV] control and a subsequent low steam generator (SG)[EIS:SG] No. 2 level signal. All control and shutdown bank rods inserted properly in response to the reactor trip. All safety systems, including the Auxiliary Feedwater (AFW)[EIS:BA] System, performed as designed and there were no complications with the trip. After evaluation of all the field test data and associated field inspections, it was determined that the cause was identified as a failure of Distributed Controls System (DCS)[EIS:JB] field bus module (FBM). This failure caused the main feedwater regulating valve to oscillate open and close resulting in a reactor trip followed by a turbine trip. The master FBM was removed and the demand signal stabilized when the system swapped to the tracker FBM. The master and tracker FBM were replaced and sent to the vendor for failure analysis.

Notification to the NRC of the reactor trip was made by Operations at 2051 EDT (Event Notification number 56660) in accordance with 10 CFR 50.72(b)(2)(iv)(B) and 10.50.72(b)(3)(iv)(A). This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) due to actuation of the Reactor Protection System (RPS) and Auxiliary Feedwater (AFW) System.

**B. Status of structures, components, or systems that were inoperable at the start of the event and that contributed to the event**

There were no safety related inoperable structures, components, or systems that contributed to this event.



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**NARRATIVE**

**C. Dates and approximate times of occurrences**

Dates and Approximate Times	Occurrence
8/04/2023 at 1742 EDT	Received DCS Trouble Alarm with SG flow low alarm in. SG No.2 bypass flow was noted to be high on scale and SG No. 2 level was noted to be approximately 30 percent lowering. Using manual controls, SG No. 2 level was restored to approximately 60 percent. Entered 2-AOI-16, Loss of Normal Feedwater.
8/04/2023 at 1746 EDT	Unit 2 Reactor Tripped on Low Low SG Level. Unit 2 entered Mode 3. Feedwater flow unable to be maintained with SG No. 2 Feedwater Regulating Valve (FRV) in manual. Exited 2-AOI-16
8/04/2023 at 1750 EDT	Entered ES-0.1, Reactor Trip Response
8/04/2023 at 1803 EDT	Entered 2-GO-5, Unit Shutdown from 30 percent Reactor Power to Hot Standby

**D. Manufacturer and model number of each component that failed during the event**

Foxboro, Field bus module, FBM218 (P/N: P0922VW); However, subsequent failure analysis performed by the manufacturer has not identified component failures.

**E. Other systems or secondary functions affected**

None.

**F. Method of discovery of each component or system failure or procedural error**

Initial event troubleshooting identified a field bus module (FBM) within the DCS had potentially failed. Failure analysis performed later by the manufacturer on the specific modules replaced did not identify component failure.



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**NARRATIVE**

**G. The failure mode, mechanism, and effect of each failed component**

A vulnerability in the design of the SG level DCS can prevent automatic and manual control of SG FW inlet flow. The specific vulnerability has not been identified. Based on knowledge of the DCS system, the vulnerability may be hardware or software, so the actual failure mode is presently unknown.

**H. Operator actions**

Operations personnel promptly stabilized the plant following the reactor trip.

**I. Automatically and manually initiated safety system responses**

The automatic reactor trip was followed by an automatic subsequent turbine trip. Safety systems responded as expected.

**III. Cause of the event**

**A. Cause of each component or system failure or personnel error**

The exact cause of the DCS component malfunction is unknown. Manufacturer failure analysis testing has been ongoing with inconclusive results.

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

No human performance issues were attributed to this event.

**IV. Analysis of the event**

While operating at approximately 100 percent power during steady state operation, the Watts Bar Unit 2 reactor experienced an automatic reactor trip at approximately 1746 EDT on August 4, 2023, in response to the failure of the main feedwater regulating valve control to steam generator number 2. The sequence of events associated with the trip were bounded by the FSAR Safety Analysis assumptions. The plant response post-trip was uncomplicated and the plant responded as designed. Operations entered 2-AOI-16, Loss of Normal Feedwater; 2-E-0, Reactor Trip or Safety Injection and subsequently transitioned to ES-0.1, Reactor Trip Response and 2-GO-5, Unit Shutdown from 30 percent Reactor Power to Hot Standby.



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**NARRATIVE**

**V. Assessment of Safety Consequences**

In review of the associated plant system performance data from the key plant parameters and plant response to the transient it was concluded that all safety systems performed as designed. There were no conditions identified where actuation signals were not appropriately generated based on the plant transient. The parameter response for this automatic reactor trip was bounded by the FSAR safety analysis assumptions. Probability Risk Assessments (PRA) performed for this Unit 2 trip event resulted in very small impacts to core damage frequency (CDF) and large early release frequency (LERF) values.

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

Not applicable.

**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, estimate of the elapsed time from discovery of the failure until the train was returned to service**

Not applicable.

**VI. Corrective Actions**

This event was entered into the TVA Corrective Action Program and is being tracked under Condition Report 1872637.

**A. Immediate Corrective Actions**

Operations personnel promptly stabilized the plant in Mode 3. Troubleshooting and field inspections identified a potentially faulty field bus module which was subsequently replaced.





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**NARRATIVE**

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

1. Implement a Steam Generator level control strategy that prevents the total loss of Steam Generator inlet flow control.
2. Implement a pressurizer level control strategy that prevents the total loss of chemical and volume control system charging flow control.
3. Implement a pressurizer pressure control strategy that prevents the total loss of pressurizer heaters and sprays control.

**VII. Previous Similar Events at the Same Site**

LER 391-2023-002, "Automatic Reactor Trip Due to Main Generator Protection Relay Actuation" documents a Unit 2 reactor trip that occurred on June 27, 2023. This event was caused by a loose terminal connection for current input into a generator protection relay.

LER 390-2020-001, "Manual Reactor Trip Due to Lowering Steam Generator Level Caused by a Hand Station Failure" documents a Unit 1 manual reactor trip that occurred on February 2, 2019. This event was caused by a stuck pushbutton on the main feedwater regulating valve controller/hand station which led to a loss of control for steam generator No. 3 level.

The LERs listed above do not share a similar cause to the reactor trip event described in this LER.

**VIII. Additional Information**

None.

**IX. Commitments**

None.