



Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

July 7, 2020

10 CFR 50.73  
10 CFR 50.4(a)

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

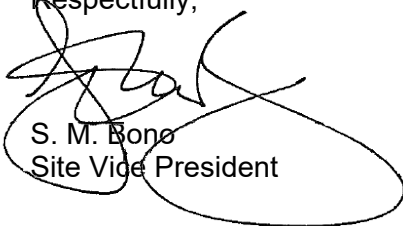
Browns Ferry Nuclear Plant, Unit 3  
Renewed Facility Operating License No. DPR-68  
NRC Docket No. 50-296

Subject: **Licensee Event Report 50-296/2020-002-00 – Main Steam Relief Valves Lift Settings Outside of Technical Specifications Required Setpoints**

The enclosed Licensee Event Report provides details of the inoperability of Main Steam Relief Valves for longer than allowed by plant Technical Specifications. The Tennessee Valley Authority is submitting this report in accordance with Title 10 of the Code of Federal Regulations 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's Technical Specifications.

There are no new regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact J. L. Paul, Site Licensing Manager, at (256) 729-2636.

Respectfully,



S. M. Bono  
Site Vice President

Enclosure: Licensee Event Report 50-296/2020-002-00 – Main Steam Relief Valves Lift Settings Outside of Technical Specifications Required Setpoints

cc (w/ Enclosure):

NRC Regional Administrator - Region II  
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant  
NRC Project Manager - Browns Ferry 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 Information Services Branch (T-6 A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0104), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503; e-mail: oira\_submission@omb.eop.gov. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

<b>1. Facility Name</b> Browns Ferry Nuclear Plant, Unit 3	<b>2. Docket Number</b> 05000296	<b>3. Page</b> 1 OF 7
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**4. Title**  
Main Steam Relief Valves Lift Settings Outside of Technical Specifications Required Setpoints

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
05	08	2020	2020	002	00	07	07	2020	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 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 Ryan Coons, Licensing Engineer	Telephone Number (Include Area Code) 256-729-2070
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**13. Complete One Line for each Component Failure Described in this Report**

Cause	System	Component	Manufacturer	Reportable to ICES	Cause	System	Component	Manufacturer	Reportable to ICES
B	SB	RV	T020	N	N/A	N/A	N/A	N/A	N/A

<b>14. Supplemental Report Expected</b> <input type="checkbox"/> Yes (If yes, complete 15. Expected Submission Date) <input checked="" type="checkbox"/> No	<b>15. Expected Submission Date</b>	<b>Month</b> N/A	<b>Day</b> N/A	<b>Year</b> N/A
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**Abstract** (Limit to 1400 spaces, i.e., approximately 14 single-spaced typewritten lines)

On May 8, 2020, the Tennessee Valley Authority was notified of as-found testing results that two Main Steam Relief Valves (MSRVs) from Unit 3 were outside the +/- 3 percent setpoint band required for operability.

More than the one allowed MSRV was considered to be inoperable during the entire operating cycle and longer than permitted by Technical Specifications. Additionally during this time, BFN, Unit 3 entered a Mode of operation which was not allowed under this condition. The affected valves remained capable of maintaining reactor pressure within American Society of Mechanical Engineers code limits.

It was determined that these MSRVs failed due to corrosion bonding between the pilot valve disc and seat. As a corrective action for this condition, all thirteen of the MSRV pilot valves were replaced during the Unit 3 Spring 2020, refueling outage with pilot discs coated in platinum utilizing the Plasma Enhanced Magnetron Sputtering (PEMS) Deposition method. PEMS provides a more consistent and forgiving finish on the pilot valve seating surface and gives the platinum more inherent ductility than what the previous disposition method provided. BFN began using the PEMS method in 2019, so the valves involved in this event did not receive PEMS deposited platinum coatings during their last rebuild. The PEMS method was used for the pilot discs of the rebuilt valves installed during the Unit 3 Spring 2020 refueling outage, and will be used for all pilot discs going forward.



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

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 Information Services Branch (T-6 A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollects.Resource@nrc.gov, and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0104), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street NW, Washington, DC 20503; e-mail: oira\_submission@omb.eop.gov. The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Browns Ferry Nuclear Plant, Unit 3	05000296	2020	- 002	- 00

**NARRATIVE**

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

At the time of discovery, Browns Ferry Nuclear Plant (BFN) Unit 3 was in Mode 1 at approximately 100 percent power.

**II. Description of Event**

**A. Event Summary**

On May 8, 2020, NWS Technologies notified the Tennessee Valley Authority (TVA) with the as-found testing results of the thirteen Main Steam Relief Valves (MSRVs) [RV], which were removed during the Spring 2020 Unit 3 Refueling Outage 19 (U3R19). Two MSRVs (BFN-3PCV-001-0023 and BFN-3-PCV-001-0034) had as-found lift settings which were outside of the +/- 3 percent band of their setpoints required for operability.

Technical Specification (TS) 3.4.3, Safety/Relief Valves (S/RVs), requires twelve of the thirteen S/RVs to be operable for S/RV system [SB] operability. The two MSRVs were found to have been inoperable for an indeterminate period of time during the entire operating cycle between April 5, 2018, and February 22, 2020, and longer than permitted by TS 3.4.3.

Throughout this event, the two-stage MSRV pilot valves remained capable of maintaining the reactor pressure below 1375 pounds per square inch gauge (psig), which is the American Society of Mechanical Engineers (ASME) code limit of 110 percent of the vessel design pressure. The valves remained capable of performing their required safety function.

The TVA is submitting this report in accordance with Title 10 of the Code of Federal Regulations 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's TS.

**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 structures, systems, or components (SSCs) whose inoperability contributed to this event.



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**NARRATIVE**

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

<u>Dates</u>	<u>Occurrence</u>
April 5, 2018	Unit 3 entered Mode 2, beginning Fuel Cycle 19 (U3C19).
February 22, 2020	Unit 3 entered Mode 4 for U3R19.
May 8, 2020	NWS Technologies notified the TVA with as-found testing results of the thirteen Unit 3 MSR/V pilot valves removed during U3R19.

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

The failed components were all Target Rock Corporation two-stage pressure control valves, model number 7567F.

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

No other systems or secondary functions were affected by this event.

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

Failure of MSR/Vs BFN-3-PCV-001-0023 and BFN-3-PCV-001-0034 was discovered at NWS Technologies during their as-found testing of the thirteen MSR/V two-stage pilot valves which were removed during U3R19.

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

MSR/Vs BFN-3-PCV-001-0023 and BFN-3-PCV-001-0034 failed due to corrosion bonding to the valve seats. Two additional test lifts on each valve were within the acceptance criteria of +/- 3 percent of the required setpoint, indicating corrosion bonding caused each pilot valve to initially lift high.

**H. Operator actions**

There were no operator actions associated with this event.

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

There were no automatic or manual safety system responses associated with this event.



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**III. Cause of the event**

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

MSRVs BFN-3-PCV-001-0023 and BFN-3-PCV-001-0034 failed above their setpoint band due to valve disc corrosion bonding to the valve seat.

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

No human performance related root causes were identified.

**IV. Analysis of the event**

BFN, Unit 3 TS Limiting Condition for Operation (LCO) 3.4.3 requires twelve Operable S/RVs during Modes 1, 2, and 3. If one or more required S/RVs become inoperable, Required Action A.1 requires entering Mode 3 within 12 hours and Required Action A.2 requires entering Mode 4 within 36 hours. S/RV Operability requires that S/RVs be within a +/- 3 percent band of their setpoint values in accordance with Surveillance Requirement (SR) 3.4.3.1. BFN Unit 3 has thirteen MSRVs to satisfy this requirement with margin.

When tested, the following two S/RVs were outside the allowable +/- 3 percent band.

<u>S/RV Number</u>	<u>Setpoint</u>	<u>Test Result</u>	<u>Difference</u>
BFN-3-PCV-001-0023	1135	1210	+6.6%
BFN-3-PCV-001-0034	1135	1194	+5.2%

Prior to startup from U3R19, all thirteen MSRV pilot valves were replaced with refurbished valves which were certified to lift within +/- 1 percent of their setpoint. Operating Experience has shown that Target Rock two-stage MSRV setpoint drift is not a uniform, linear process. The corrosion bonding increases at a random rate. Without an accurate and reliable model for predicting or estimating the setpoint drift development, the point in time where the setpoint exceeded the +/- 3 percent limit cannot be reliably determined. Since this drift occurred during the operating cycle when the MSRVs were installed, MSRVs BFN-3-PCV-001-0023, and BFN-3-PCV-001-0034 are conservatively considered to be inoperable for an indeterminate period of time between April 5, 2018, and February 22, 2020. More than one MSRV was considered to be inoperable during the entire operating cycle and longer than permitted by TS 3.4.3.

TS LCO 3.0.4 states that when an LCO is not met, entry into a Mode or other specified condition in the Applicability shall only be made when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. On November 25, 2019, following the completion of a forced outage to repair an



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unrelated steam leak on a Steam Jet Air Injector, BFN, Unit 3 entered a TS 3.4.3 Applicable Mode when LCO TS 3.4.3 Required Actions were not met. Therefore, Unit 3 was in violation of TS 3.0.4.

**V. Assessment of Safety Consequences**

System availability was not impacted by this event. The failure of the MSRV pilot valves to meet their TS 3.4.3 specified mechanical setpoints did not impact their remote-manual operation or activation through the MSRV Automatic Actuation Logic, since these operating modes and functions rely upon electrically signaled control air solenoids to open the MSRV pilot valves.

The bounding maximum over-pressurization analyses are performed each fuel cycle to show that the requirements of the ASME code regarding overpressure protection are met. The analyses are performed specifically to show that the dome pressure TS limit of 1325 psig is not exceeded and that the vessel pressure does not exceed the limit of 1375 psig. In addition, the Anticipated Transient Without Scram (ATWS) pressurization analyses are also performed to demonstrate that the 1500 psig peak vessel pressure limit is not exceeded.

For the ASME analysis, the existing analysis setpoint groupings conservatively bound the eleven lowest as-found MSRV opening setpoints; however, the highest as-found valve opening setpoint fell outside the bounds of the existing analysis valve groupings. Therefore, the limiting ASME overpressurization event, identified as the ASME with main steam isolation valve closure at 102 percent rated power / 105 percent rated flow at coastdown, was re-analyzed based on the as-found lift settings. The re-analysis determined a maximum dome pressure of 1299 psig and maximum vessel pressure of 1331 psig, which are within the ASME limits.

For the ATWS analysis, the existing analysis valve setpoint groupings conservatively bound the eight lowest as-found MSRV opening setpoints; however, the highest valve setpoints fell outside the existing analysis valve groupings. Therefore, the limiting ATWS overpressurization event, identified as the ATWS pressure regulator failed open at 100 percent rated power / 99 percent rated flow at beginning of cycle, was re-analyzed based on the as-found lift settings. The re-analysis determined a maximum vessel pressure of 1463 psig, which is within the ATWS limit.

TS Bases 3.4.3 states that the overpressure protection system must accommodate the most severe pressurization transient. The MSRVs remained capable of maintaining the reactor pressure below 1375 psig, which is the ASME code limit (110 percent of the vessel design pressure). The valves remained capable of performing their required safety function.

Based on the above, the TVA has concluded that sufficient systems were available to provide the required safety functions needed to protect the health and safety of the public.



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

Each BFN operating unit has a non-safety related, electrical logic system (MSRV Actuation Logic) installed, which provides defense-in-depth against MSRV setpoint drift by electrically opening MSRV groups based upon setpoints at 1135 psig, 1145 psig, and 1155 psig. Therefore, during a reactor pressure transient event, the four 1135 psig group MSRVs, followed by the four 1145 psig group MSRVs, and finally the five 1155 psig group MSRVs would receive an electrical open signal, providing a defense-in-depth function to allow the valves to perform their safety function.

**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**

This event did not occur when the reactor was shutdown.

**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**

TS 3.4.3 require twelve of the thirteen S/RVs to be operable for S/RV system operability. It is conservatively assumed that less than twelve S/RVs were operable for the duration of the fuel cycle, from April 5, 2018, to February 22, 2020.

**VI. Corrective Actions**

Corrective Actions are being managed by the TVA's corrective action program under Condition Reports (CRs) 962223, 1286467, 1410577, 1521190, and 1606785.

**A. Immediate Corrective Actions**

All thirteen of the BFN, Unit 3 MSRV pilot valves were replaced with refurbished valves during U3R19. As-left testing verified that these refurbished pilot valves were within +/- 1 percent of their setpoints.

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

As most recently discussed in LER 50-260/2019-002-00, a flaking issue has been noted with the platinum coated pilot discs. The Boiling Water Reactor Owners' Group (BWROG) is currently working toward a solution to improve the quality and adhesion of the platinum coating on the discs. These improvements include changing the method of applying the



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platinum to the pilot discs from Ion Beam Assisted Deposition (IBAD) to Plasma Enhanced Magnetron Sputtering (PEMS) Deposition, which data shows provides a more consistent and forgiving finish on the pilot valve seating surface and gives the platinum more inherent ductility. Use of the PEMS method began in 2019, so the valves involved did not receive PEMS deposited platinum coatings during their rebuilds. The PEMS method was used for the pilot discs of the rebuilt valves installed during the U3R19 refueling outage, and will be used for all pilot discs going forward.

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

A search of BFN Units 1, 2, and 3 LERs for the last five years identified six LERs associated with MSR/V lift settings outside of TS required setpoints:

- LER 50-260/2019-002-00, for Unit 2 Cycle 20
- LER 50-259/2018-007-00, for Unit 1 Cycle 12
- LER 50-296/2018-004-00, for Unit 3 Cycle 18
- LER 50-260/2017-004-00, for Unit 2 Cycle 19
- LER 50-259/2016-005-00, for Unit 1 Cycle 11
- LER 50-296/2016-004-00, for Unit 3 Cycle 17

**VIII. Additional Information**

There is no additional information.

**IX. Commitments**

There are no new commitments.