



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

August 2, 2021

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 2
Renewed Facility Operating License No. DPR-52
NRC Docket No. 50-260

Subject: **Licensee Event Report 50-260/2021-002-00 – 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 Michael W. Oliver, Interim Site Licensing Manager, at (256) 337-6803.

Respectfully,

A handwritten signature in black ink, appearing to read 'Matthew Rasmussen', with a stylized flourish at the end.

Matthew Rasmussen
Site Vice President

Enclosure: Licensee Event Report 50-260/2021-002-00 – Main Steam Relief Valves Lift Settings Outside of Technical Specifications Required Setpoints

U.S. Nuclear Regulatory Commission

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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 FOIA, Library, and Information Collections Branch T-6 A10M, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by e-mail to Infocollections.Resource@nrc.gov, and the OMB reviewer at: OMB Office of Information and Regulatory Affairs, (3150-0104), Attn: Desk ail: oir_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 Browns Ferry Nuclear Plant, Unit 2	2. Docket Number 05000260	3. Page 1 OF 8
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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	Revision No.	Month	Day	Year	Facility Name	Docket Number
06	03	2021	2021	- 002	- 00	08	02	2021	N/A	05000 N/A
									Facility Name	Docket Number
									N/A	05000 N/A

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"/> 50.36(c)(2)	<input type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
<input type="checkbox"/> 20.2201(b)	<input type="checkbox"/> 20.2203(a)(3)(i)	<input type="checkbox"/> 50.46(a)(3)(ii)	<input type="checkbox"/> 50.73(a)(2)(v)(A)	10 CFR Part 73
<input type="checkbox"/> 20.2201(d)	<input type="checkbox"/> 20.2203(a)(3)(ii)	<input type="checkbox"/> 50.69(g)	<input type="checkbox"/> 50.73(a)(2)(v)(B)	<input type="checkbox"/> 73.71(a)(4)
<input type="checkbox"/> 20.2203(a)(1)	<input type="checkbox"/> 20.2203(a)(4)	<input type="checkbox"/> 50.73(a)(2)(i)(A)	<input type="checkbox"/> 50.73(a)(2)(v)(C)	<input type="checkbox"/> 73.71(a)(5)
<input type="checkbox"/> 20.2203(a)(2)(i)	10 CFR Part 21	<input checked="" type="checkbox"/> 50.73(a)(2)(i)(B)	<input type="checkbox"/> 50.73(a)(2)(v)(D)	<input type="checkbox"/> 73.77(a)(1)
<input type="checkbox"/> 20.2203(a)(2)(ii)	<input type="checkbox"/> 21.2(c)	<input type="checkbox"/> 50.73(a)(2)(i)(C)	<input type="checkbox"/> 50.73(a)(2)(vii)	<input type="checkbox"/> 73.77(a)(2)(i)
<input type="checkbox"/> 20.2203(a)(2)(iii)	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"/> 73.77(a)(2)(ii)
<input type="checkbox"/> 20.2203(a)(2)(iv)	<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"/> 20.2203(a)(2)(v)	<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)	

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

12. Licensee Contact for this LER

Licensee Contact Robert Moxley, Licensing Engineer	Phone Number (Include area code) 256-729-2551
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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
B	SB	RV	T020	N	N/A	N/A	N/A	N/A	N/A

14. Supplemental Report Expected) <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes (If yes, complete 15. Expected Submission Date)	15. Expected Submission Date Month: N/A Day: N/A Year: N/A
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16. Abstract (Limit to 1560 spaces, i.e., approximately 15 single-spaced typewritten lines)

On June 3, 2021, the Tennessee Valley Authority was notified of As-Found testing results that five Main Steam Relief Valves (MSRVs) from Unit 2 were outside the +/- 3 percent set-point 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. During this time, BFN Unit 2 made entries into Modes of Operation that were not allowed under this condition. The affected valves remained capable of maintaining reactor pressure within the American Society of Mechanical Engineers code limits.

It was determined that one MSRV failed due to corrosion bonding between the pilot valve disc and seat, and the other four failed due to setpoint spring relaxation. As a corrective action, the MSRV maintenance procedure will be revised to include stricter testing and acceptance criteria for pilot setpoint spring parameters based on industry best-practices. This stricter testing criteria will drive spring replacement prior to a point of relaxation which results in as-found setpoint testing failures. Additionally, all thirteen of the MSRV pilot valves were replaced during the Unit 2 Spring 2021, refueling outage with pilot discs coated in platinum utilizing the Plasma Enhanced Magnetron Sputtering (PEMS) deposition method. PEMS provides a more consistent finish on the pilot valve seating surface and gives the platinum more inherent ductility than what the previous deposition 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 2 Spring 2021 refueling outage, and will be used for all pilot discs going forward.



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

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Browns Ferry Nuclear Plant, Unit 2	05000-260	2021	- 002	- 00

NARRATIVE

I. Plant Operating Conditions before the Event

At the time of discovery, Browns Ferry Nuclear Plant (BFN) Unit 2 was in Mode 1 at approximately 100 percent power.

II. Description of Event

A. Event Summary

On June 3, 2021, 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 2021 Unit 2 Refueling Outage 2 (U2R21). Five MSRVs (BFN-2-PCV-001-0018, BFN-2-PCV-001-0005, BFN-2-PCV-001-0023, BFN-2-PCV-001-0034, and BFN-2-PCV-001-0004) 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 five MSRVs were found to have been inoperable for an indeterminate period of time during the entire operating cycle between April 8, 2019, and February 27, 2021, 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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C. Dates and approximate times of occurrences

Dates and Approximate Times (CDT)	Occurrence
April 8, 2019	Unit 2 entered Mode 2, beginning Fuel Cycle 21 (U2C21).
September 21, 2019	U2 inserted a manual Scram to address high conductivity of reactor coolant due to condenser tube leaks.
October 7, 2019	U2 entered Mode 2 and commenced Reactor Startup.
May 19, 2020	U2 inserted a manual Reactor Scram and entered Mode 3 for corrective maintenance on a leaking feedwater system check valve.
May 22, 2020	U2 entered Mode 2 and commenced Reactor Startup.
June 6, 2020	U2 in Mode 4 with Mode Switch in Shutdown to address unexpected Steam bypass of the A Low Pressure Turbine.
June 10, 2020	U2 entered Mode 2 and commenced Reactor Startup.
July 21, 2020	U2 in Mode 4 with Mode Switch in Shutdown due to decreasing condenser vacuum due to eel grass intrusion.
July 27, 2020	U2 entered Mode 2 and commenced Reactor Startup.
February 27, 2021	Unit 2 entered Mode 4 for U2R21.
June 3, 2021	NWS Technologies notified the TVA with as-found testing results of the thirteen Unit 2 MSRV pilot valves removed during U2R21.

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.



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E. Other systems or secondary functions affected

No other systems or secondary functions were affected.

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

The MSR/V failures were discovered at NWS Technologies during their as found testing of the thirteen MSR/V two stage pilot valves which were removed during U2R21.

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

MSR/V BFN-2-PCV-001-0005 failed due to corrosion bonding to the valve seats. As a result, the force required to break the crystal structure of the corrosion bond alters the mechanical setpoint of the pilot valve. This issue is commonly known to the industry as set point drift.

MSR/Vs BFN-2-PCV-001-0004, BFN-2-PCV-001-0018, BFN-2-PCV-001-0023, and BFN-2-PCV-001-0034 failed due to a relaxation of the setpoint spring over time.

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.

III. Cause of the event

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

MSR/V BFN-2-PCV-001-0005 failed above its setpoint band due to valve disc corrosion bonding to the valve seat.

MSR/Vs BFN-2-PCV-001-0004, BFN-2-PCV-001-0018, BFN-2-PCV-001-0023, and BFN-2-PCV-001-0034 failed below their setpoints due to relaxed setpoint springs.

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

No human performance related root causes were identified.



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IV. Analysis of the event

BFN, Unit 2 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 2 has thirteen MSRVs to satisfy this requirement with margin.

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

<u>S/RV ID Number</u>	<u>Setpoint (psig)</u>	<u>Test Result (psig)</u>	<u>Difference (Percent)</u>
BFN-2-PCV-001-0004	1155	1113	-3.6
BFN-2-PCV-001-0005	1145	1211	+5.8
BFN-2-PCV-001-0018	1145	1105	-3.5
BFN-2-PCV-001-0023	1135	1097	-3.3
BFN-2-PCV-001-0034	1135	1097	-3.3

Prior to startup from U2R21, all thirteen MSR/V 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 MSR/V setpoint drift is not a uniform, linear process. The corrosion bonding increases at a random rate. Similarly, industry operating experience does not indicate loss of spring tension occurs in a uniform, linear pattern. 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 MSR/Vs were installed, MSR/Vs BFN-2-PCV-001-0004, BFN-2-PCV-001-0005, BFN-2-PCV-001-0018, BFN-2-PCV-001-0023, and BFN-2-PCV-001-0034 are conservatively considered to be inoperable for an indeterminate period of time between April 8, 2019, and February 27, 2021. More than one MSR/V 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 four separate occasions, (October 7, 2019; May 22, 2020; June 10, 2020; and July 27, 2020), BFN Unit 2 entered a TS 3.4.3 Applicable Mode when LCO TS 3.4.3 Required Actions were not met. Therefore, Unit 2 was in violation of TS 3.0.4.



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V. Assessment of Safety Consequences

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

If an S/RV were to open at a pressure value below that assumed in the analyses of record, it would allow the pressure vessel to depressurize quicker, thus leading to a reduced peak calculated pressure. For the four S/RV's found to have tested to an earlier (lower) lift point, there would be no increased peak pressure calculated. Hence, these four valves test results do not impact (are bounded by) the analyses of record.

For the single S/RV to have opened at a higher pressure value than assumed in the analysis of record, it could in theory increase the peak pressure experienced in the event. However, both the ASME and ATWS overpressure analyses assume one S/RV out-of-service (in the lowest setpoint group to be conservative). Since only one S/RV was determined to fail high, the valve can be assigned as the out-of-service valve in the analyses of record. Consequently, there is no impact to the peak calculated pressure for the ASME and ATWS overpressure events at any time during U2C21 operation.

TS Bases 3.4.3 states that the overpressure protection system must accommodate the most severe pressurization transient. The MSR/Vs 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.

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 (MSR/V Actuation Logic) installed, which provides defense in depth against MSR/V setpoint drift by electrically opening MSR/V groups based upon setpoints at 1135 psig, 1145 psig, and 1155 psig. Therefore, during a reactor pressure transient event, the four 1135 psig group MSR/Vs, followed by the four 1145 psig group MSR/Vs, and finally the five 1155 psig group MSR/Vs would receive an electrical open signal, providing a defense in depth function to allow the valves to perform their safety function.



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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

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 requires 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 8, 2019, and February 27, 2021.

VI. Corrective Actions

Corrective Actions are being managed by the TVA's corrective action program under Condition Reports (CRs), 962223, 1286467, 1410577, 1521190, 1658693, and 1699286.

A. Immediate Corrective Actions

All thirteen of the BFN, Unit 2 MSR/V pilot valves were replaced with refurbished valves during U2R21. 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 50-259/2020-003-01, 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 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 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 U2R21 refueling outage, and will be used for all pilot discs going forward.



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NARRATIVE

Procedure MCI-0-001-VLV002, "Main Steam Relief Valves Target Rock Model 7567 Disassembly, Inspection, Repair and Reassembly," will be revised to include stricter acceptance criteria for pilot setpoint spring parameters based on recommendations provided by the Exelon Corporation Fleet SRV owner via the Target Rock SRV BWROG. The recommendations are based on three primary parameters and four secondary parameters. For the most reliable setpoint performance, all of the primary parameters must be within tolerance and only one secondary parameter can be outside of tolerance. If two secondary parameters are outside of tolerance, only one cycle is allowable before retest. The stricter criteria during testing will drive spring replacement prior to the point of significant relaxation that results in as-found setpoint testing failures.

VII. Previous Similar Events at the Same Site

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

- LER 50-259/2020-003-01, for Unit 1 Cycle 13
- LER 50-296/2020-002-00, for Unit 3 Cycle 19
- 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.