



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

July 16, 2018

10 CFR 50.73

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 50-296/2018-004-00**

The enclosed Licensee Event Report provides details of the inoperability of three 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, Nuclear Site Licensing Manager, at (256) 729-2636.

Respectfully,

A handwritten signature in blue ink, appearing to read "DLH", written over a light blue circular stamp.

D. L. Hughes
Site Vice President

Enclosure: Licensee Event Report 50-296/2018-004-00 – 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

ENCLOSURE

**Browns Ferry Nuclear Plant
Unit 3**

Licensee Event Report 50-296/2018-004-00

Main Steam Relief Valves Lift Settings Outside of Technical Specifications Required Setpoints

See Enclosed

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reporting burdens learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by 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.



LICENSEE EVENT REPORT (LER)

1. Facility Name Browns Ferry Nuclear Plant, Unit 3	2. Docket Number 05000296	3. Page 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	17	2018	2018	004	00	07	16	2018	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)					
10. Power Level		<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)				
085	<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	Y	N/A	N/A	N/A	N/A	N/A

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

Abstract (Limit to 1400 spaces, i.e., approximately 14 single-spaced typewritten lines)

On May 17, 2018, the Tennessee Valley Authority was presented with as-found testing results indicating that three of the thirteen Main Steam Relief Valves (MSRVs) from Browns Ferry Nuclear Plant, Unit 3, were outside the +/- 3 percent setpoint band required for their operability. Troubleshooting determined that the three MSRV discs failed by corrosion bonding to their valve seats. The valve discs were previously platinum coated to prevent this, and this was the first Unit 3 MSRV service interval to implement an improved surface treatment to prevent coating delamination.

These three MSRVs were found to have been inoperable for an indeterminate period of time between March 26, 2016, and February 17, 2018, which is longer than permitted by Technical Specifications (TS). The affected valves remained capable of maintaining reactor pressure within American Society of Mechanical Engineers code limits. Additionally, the valves' ability to open under remote-manual operation, activation through the Automatic Depressurization System, or MSRV Automatic Actuation Logics were not affected. The valves remained capable of performing their required safety function.

The valves failed to open within their TS required limits due to the valve discs corrosion bonding to their seats, as a result of their platinum anti-corrosion coatings flaking off. The immediate corrective action was to replace all thirteen of the Unit 3 MSRV pilot valves with refurbished valves during the Unit 3 Refueling Outage 18. The corrective action was to ensure pilot discs are prepared for platinum coating in accordance with the revised procedure which requires nitrogen pressure testing to verify valve seal functionality prior to coating.



**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-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by 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.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Browns Ferry Nuclear Plant, Unit 3	05000296	2018	- 004	- 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 85 percent power.

II. Description of Event

A. Event Summary

On May 17, 2018, NWS Technologies provided 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 2018 Unit 3 Refueling Outage 18 (U3R18). Three of the Main Steam Line A and B Relief Valves (BFN-3-PCV-001-0179, BFN-3-PCV-001-0004, and BFN-3-PCV-001-0023) had as-found lift settings which were outside of the +/- 3 percent band of their setpoints required for their operability.

Technical Specification (TS) 3.4.3 requires twelve of the thirteen Safety/Relief Valves (S/RVs) to be operable for S/RV system operability. These three MSRVs were found to have been inoperable for an indeterminate period of time between March 26, 2016, and February 17, 2018, and longer than permitted by TS 3.4.3.

MSRV operability was restored on April 10, 2018, upon completion of post-maintenance testing (PMT) following the biennial scheduled replacement of the MSRV pilot valves with refurbished valves which were certified to lift within +/- 1 percent of their setpoints.

Throughout this event, the two-stage MSRV pilot valves remained capable of maintaining the reactor pressure below 1375 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. It was determined that the MSRV pilot valve inoperability resulted from their setpoints gradually drifting during the course of their operating cycle, which began when Unit 3 entered Mode 2 on March 26, 2016, and February 17, 2018, when Unit 3 entered Mode 4.

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

<u>Dates & Approximate Times</u>	<u>Occurrence</u>
March 26, 2016	Unit 3 entered Mode 2, beginning the cycle.
February 17, 2018	BFN, Unit 3, entered Mode 4, beginning the U3R18.
April 10, 2018	Replacement of MSR/V pilot valves and their associated PMT was completed, as part of the U3R18.
May 17, 2018	NWS Technologies provided TVA with the as-found testing results of the thirteen Unit 3 MSR/V pilot valves removed during the U3R18.

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 was discovered at NWS Technologies, during their as-found testing of the thirteen MSR/V two-stage pilot valves which were removed during the U3R18.

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

The two-stage pilot valves failed due to the corrosion bonding of the valve disc to the valve seat.

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

The two-stage pilot valves failed above their setpoint bands due to their valve discs corrosion bonding to the valve seat, as a result of their platinum anti-corrosion coatings flaking off.

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 becomes inoperable, Required Action A.1 requires BFN, Unit 3, to enter Mode 3 within 12 hours, and Required Action A.2 requires entering Mode 4 within 36 hours. S/RV Operability is defined as being within a +/- 3 percent band of their setpoint values, in accordance with Surveillance Requirement 3.4.3.1. BFN, Unit 3, has thirteen MSRVs to satisfy this requirement with margin.

After the installation of the S/RVs, the as-left lift setpoints for S/RVs, BFN-3-PCV-001-0179 and BFN-3-PCV-001-0004, was 1155 psig (+/- 1 percent), and SR/V, BFN-3-PCV-001-0023, was 1135 psig (+/- 1 percent). However, during as-found testing at NWS Technologies, the Main Steam Line A Relief Valves, BFN-3-PCV-001-0179 and BFN-3-PCV-001-0004, lifted at 1205 psig (+4.33 percent) and 1203 psig (+4.15 percent), respectively; and the Main Steam Line B Relief Valve, BFN-3-PCV-001-0023, lifted at 1173 psig (+3.35 percent). During the fuel cycle, these valve lift setpoints gradually drifted outside of the +/- 3 percent margin which is required for their operability. The valves which exceeded their setpoint bands failed due to corrosion bonding between the valve discs and their seats.

Prior to startup from the Unit 3 Refueling Outage 17, all thirteen BFN, Unit 3, 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. 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 between the beginning of the fuel cycle on March 26, 2016, and February 17, 2018, the MSR/V inoperability was conservatively declared to have been inoperable for an indeterminate period of time between March 26, 2016, and February 17, 2018, and longer than permitted by plant TS 3.4.3.



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V. Assessment of Safety Consequences

System availability was not impacted by this event. The failed MSR/V pilot valves were not a part of the Automatic Depressurization System (ADS). The failure of the MSR/V pilot valves to meet their TS 3.4.3 specified mechanical setpoints does 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.

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.

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 1375 psig is not exceeded and that the vessel pressure does not exceed the limit of 1404 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 ATWS analysis, the setpoint groupings conservatively bound the ten lowest as-found MSR/V opening setpoints; however, the two highest valve setpoints fall outside the bounds of the valve groupings. Therefore, the limiting ATWS overpressurization event, identified as the ATWS pressure regulator failed open at 100% rated power and 81% rated flow at the beginning of cycle exposure, was re-analyzed by Framatome. The results from this analysis indicates that despite that three MSR/V pilot valves were outside their as-found setpoint band, the maximum vessel pressure and maximum dome pressure reaches a maximum of 1404 psig, and therefore does not exceed the ATWS vessel pressure limit of 1500 psig. Therefore, there was no impact on the MSR/Vs to perform their specified safety function.

Based on the above, 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. The three failed MSR/V pilot valves rendered the entire S/RV system inoperable for the duration of the fuel cycle, from March 26, 2016, and February 17, 2018.

VI. Corrective Actions

Corrective Actions are being managed by TVA's corrective action program under Condition Reports (CRs) 962223, 1252419, and 1416743.

A. Immediate Corrective Actions

All thirteen of the Unit 3 MSR/V pilot valves were replaced with refurbished valves during the U3R18. These valves had platinum coatings applied in accordance with the revised procedure. As-left testing verified that these refurbished pilot valves were within +/- 1 percent of their name plate setpoints.

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

This event is one instance of a known industry issue with Target Rock Model 7567F, two-stage safety relief valves. Platinum coated pilot discs have been found to mitigate, but not completely resolve the setpoint drift issues. The Boiling Water Reactor Owner's Group (BWROG) is currently working toward a solution to improve the quality and adhesion of the platinum coating on the discs.

Prior to the U3R18, a flaking issue was noted with the platinum coated pilot discs. Actions included revising the valve's inspection, repair, and reassembly procedure to add nitrogen leak testing of the pilot valves prior to platinum coating. This procedure requirement was added in 2017, and the valves removed from the U3R18 outage did not have this step of nitrogen leak testing prior to platinum coating within the scope of their rebuilds. The valves installed during the U3R18 outage received nitrogen leak testing during their rebuilding.



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VII. Previous Similar Events at the Same Site

A search of BFN LERs for Units 1, 2, and 3, identified four LERs for this same issue within the last five years.

A search of the Corrective Action Program for BFN, Units 1, 2, and 3, identified eighteen MSR/V failure events since 1999. These failures were captured by CRs 37328, 59786, 50084, 61823, 81376, 102298, 124944, 146189, 175990, 159200, 226627, 294506, 372047, 558488, 962223, 1157981, 1237184, and 1294336.

CR 55557 identified that corrosion bonding between the valve discs and their seat surfaces were strong enough to cause significant drifts in their opening pressure and reset setpoints. As a corrective action, a design change was implemented to update/install a safety related pressure switch logic that was endorsed by BWROG to resolve setpoint drift issues.

CR 56793 identifies the corrosion-prone materials used in the construction of Target Rock two-stage S/RVs presented a fundamental design deficiency. An alternate MSR/V design/logic/manufacture was sought, but industry OE demonstrated that the use of platinum coated valve discs provided the best results.

The Corrective Actions for CR 146189 required platinum coated MSR/V discs to be installed in future outages to prevent recurrence. CR 166147 verified that these platinum coatings were in place.

VIII. Additional Information

There is no additional information.

IX. Commitments

There are no new commitments.