



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

February 11, 2019

10 CFR 50.73

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

Browns Ferry Nuclear Plant, Unit 1
Renewed Facility Operating License No. DPR-33
NRC Docket No. 50-259

Subject: **Licensee Event Report 50-259/2018-007-00**

The enclosed Licensee Event Report provides details of the inoperability of two 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 M. W. Oliver, Acting Nuclear Site Licensing Manager, at (256) 729-7874.

Respectfully,

A handwritten signature in blue ink, appearing to read "DLH", is positioned above the printed name of the signatory.

D. L. Hughes
Site Vice President

Enclosure: Licensee Event Report 50-259/2018-007-00 – 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-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 Browns Ferry Nuclear Plant, Unit 1 | 2. Docket Number 05000259 | 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 |
| 12 | 12 | 2018 | 2018 | 007 | 00 | 02 | 11 | 2019 | 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) |
| 086 | <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 Mimi King-Patterson, Licensing Engineer | Telephone Number (Include Area Code) 256-614-7225 |

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

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

On December 12, 2018, the Tennessee Valley Authority was presented with as-found testing results indicating that two of the thirteen Main Steam Relief Valves (MSRVs) from Browns Ferry Nuclear Plant, Unit 1, were outside the +/- 3 percent setpoint band required for their operability. MSRV Line B failed 4.37 percent above its setpoint band and MSRV Line C failed 3.96 percent below its setpoint band. Troubleshooting determined that MSRV Line B disc failed above its setpoint band due to corrosion bonding to the valve seat as a result of its platinum anti corrosion coating flaking off. The valve discs were previously platinum coated to prevent this, and this was the first Unit 1 MSRV service interval to implement an improved surface treatment to prevent coating delamination. MSRV Line C failed below its setpoint band due to relaxation of the setpoint spring over time.

These two MSRVs were found to have been inoperable for an indeterminate period of time between November 2, 2016, and October 14, 2018, and longer than permitted by Technical Specifications. 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 was not affected. The valves remained capable of performing their required safety function.

All thirteen of the Unit 1 MSRV pilot valves were replaced with refurbished valves during the Unit 1 Refueling Outage 12. The corrective actions to preclude recurrence were to prepare the pilot discs for platinum coating in accordance with the revised procedure which required nitrogen pressure testing to verify valve seal functionality prior to coating. Additionally, the discs will be platinum coated, the setpoint spring for Pilot 1069 will be replaced, and the remaining springs will be tested and replaced, if necessary.

**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 1 | 05000259 | 2018 | - 007 | - 00 |

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

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 1, was in Mode 1 at approximately 86 percent power.

II. Description of Event**A. Event Summary**

On December 12, 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 Fall 2018 Unit 1 Refueling Outage 12 (1R12). Two Main Steam Relief Valves on lines B and C (BFN-1-PCV-001-0018 and BFN-1-PCV-001-0034) 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, Safety/Relief Valves (S/RVs), requires twelve of the thirteen S/RVs to be operable for S/RV system operability. These two MSRVs were found to have been inoperable for an indeterminate period of time between November 2, 2016, and October 14, 2018, 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 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 1 entered Mode 2 on November 2, 2016, and ended October 14, 2018, when Unit 1 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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NARRATIVE

C. Dates and approximate times of occurrences

Dates & Approximate Times

November 2, 2016

Occurrence

Unit 1 entered Mode 2, beginning the cycle.

October 14, 2018

BFN, Unit 1, entered Mode 4, ending the 1R12 refueling outage.

December 12, 2018

NWS Technologies provided the TVA with the as-found testing results of the thirteen Unit 1 MSRV pilot valves removed during the 1R12 refueling outage.

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 MSRV two-stage pilot valves which were removed during the 1R12 refueling outage.

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

Troubleshooting determined that MSRV Line B failed by corrosion bonding to its valve seat as a result of its platinum anti-corrosion coatings flaking off. It was also determined that the failure of MSRV Line C was most likely caused by 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.

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NARRATIVE**III. Cause of the event****A. Cause of each component or system failure or personnel error**

Main Steam Line B Relief Valve, BFN-1-PCV-001-0018, failed above its setpoint band due to valve disc corrosion bonding to the valve seat, as a result of its platinum anti-corrosion coating flaking off.

Main Steam Line C Relief Valve, BFN-1-PCV-001-0034, failed below its setpoint band due to a faulty valve spring.

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 1, 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 1, to enter Mode 1 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 1, has thirteen MSRVS to satisfy this requirement with margin.

After the installation of the S/RVs, the as-left lift setpoints for S/RV, BFN-1-PCV-001-0018 was 1145 psig (+/- 1 percent), and SR/V, BFN-1-PCV-001-0034, was 1135 psig (+/- 1 percent). However, during as-found testing at NWS Technologies, the Main Steam Line B Relief Valve BFN-1-PCV-001-0018 lifted at 1195 psig (+4.37 percent); and the Main Steam Line C Relief Valve, BFN-1-PCV-001-0034, lifted at 1090 psig (-3.96 percent). During the fuel cycle, these valve lift setpoints gradually drifted outside of the +/- 3 percent margin which is required for their operability. The valve which exceeded its setpoint band failed due to corrosion bonding between the valve disc and its seat. The valve which failed below the setpoint band failed due to a faulty valve spring.

Prior to startup from the Unit 1 Refueling Outage 12, all thirteen BFN, Unit 1, MSRVS 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 MSRVS 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 November 2, 2016, and October 14, 2018, the MSRVS inoperability was conservatively declared to have been inoperable for an indeterminate period of time between November 2, 2016, and October 14, 2018, and longer than permitted by plant TS 3.4.3.

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NARRATIVE**V. Assessment of Safety Consequences**

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

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. Therefore, as defined in NEI 99-02, failure of the MSRV pilot valves was not a safety system functional failure.

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, one valve is assumed to be out of service (OOS), as permitted by Tech Spec 3.4.3. For conservatism, one of the valves with the lowest setpoint is assumed to be OOS. Valves opening at a lower pressure will result in a less severe pressure transient. Main Steam Line C Relief Valve, BFN-1-PCV-001-0034, failed low at 1090 psig which is 3.96 percent below the 1135 setpoint. Therefore, this valve was within the bounds of the analysis assumptions. Since Main Steam Line B Relief Valve, BFN-1-PCV-001-0018, failed high at 1195 psig (+4.37 percent), this valve was considered to be OOS for the analysis. Therefore, 12 out of 13 valves are within the assumptions of the ATWS analysis, and assures the licensee that the ATWS analysis remains valid and peak pressure limits would not have been exceeded for an actual event. Therefore, there was no impact on the MSRVs to perform their specified 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 (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



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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 requires twelve of the thirteen S/RVs to be operable for S/RV system operability. The two failed MSRV pilot valves rendered the entire S/RV system inoperable for the duration of the fuel cycle, from November 2, 2016 to October 14, 2018.

VI. Corrective Actions

Corrective Actions are being managed by the TVA's corrective action program under Condition Reports (CRs) 962223, 1252419, and 1475055.

A. Immediate Corrective Actions

All thirteen of the Unit 1 MSRV pilot valves were replaced with refurbished valves during the 1R12 refueling outage. 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

Prior to the 1R12 refueling outage, 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 1R12 refueling 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 1R12 refueling outage received nitrogen leak testing before and after the platinum coating.

The corrective action to reduce the probability of similar events occurring in the future include preparing the pilot discs for platinum coating in accordance with the revised procedure which required nitrogen pressure testing to verify valve seal functionality prior to coating.

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Additionally, the discs will be platinum coated, the setpoint spring for Pilot 1069 will be replaced, and the remaining springs will be tested and replaced as necessary.

VII. Previous Similar Events at the Same Site

A search of BFN LERs for Units 1, 2, and 3, identified six 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 nineteen MSRV 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, 1294336, and 1416743.

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 MSRV 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 MSRV 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.