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

August 31, 2012

10 CFR 50.73

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

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

Subject: **Licensee Event Report 50-296/2012-006-01**

Reference: Letter from TVA to NRC, "Licensee Event Report 50-296/2012-006-00," dated July 24, 2012

In the reference letter dated July 24, 2012, the Tennessee Valley Authority (TVA) submitted a Licensee Event Report (LER) containing details of a failure to meet the requirements of Browns Ferry Nuclear Plant, Unit 3, Technical Specification 3.4.3 concerning main steam relief valve operability. This supplement is being submitted to include administrative changes that were inadvertently omitted from the referenced LER. The Tennessee Valley Authority is submitting this report in accordance with 10 CFR 50.73(a)(2)(i)(B), 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. E. Emens, Jr., Nuclear Site Licensing Manager, at (256) 729-2636.

Respectfully,

K. J. Polson
Vice President

Enclosure: Licensee Event Report 50-296/2012-006-01 – Browns Ferry Nuclear Plant, Unit 3, Main Steam Relief Valves' Lift Settings Outside Technical Specifications Required Setpoint

cc: See Page 2

IE22
NRR

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 50-296/2012-006-01

Browns Ferry Nuclear Plant, Unit 3, Main Steam Relief Valves' Lift Settings Outside Technical Specifications Required Setpoint

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See Enclosed

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 10/31/2013

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 FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet 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	2. DOCKET NUMBER	3. PAGE
Browns Ferry Nuclear Plant (BFN), Unit 3	05000296	1 of 7

4. TITLE: Browns Ferry Nuclear Plant, Unit 3, Main Steam Relief Valves' Lift Settings Outside Technical Specifications Required Setpoint

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
									N/A	05000
05	25	2012	2012	- 006 -	01	08	31	2012	FACILITY NAME: N/A	DOCKET NUMBER: 05000

9. OPERATING MODE

2

10. POWER LEVEL

000

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Mark Acker, Licensing Engineer	256-729-7533

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	SB	RV	T020	Y					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
N/A	N/A	N/A

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On May 25, 2012, the Tennessee Valley Authority determined, 2 of 13 Browns Ferry Nuclear Plant (BFN), Unit 3, Main Steam Relief Valves (MSRVs) mechanically actuated at pressures outside the allowed +/- 3 percent tolerance of their Technical Specification (TS) setpoint. The BFN, Unit 3, TS Limiting Condition for Operation 3.4.3 requires the safety function of twelve (12) MSRVs to be operable in reactor Modes 1, 2, and 3. Since 2 of 13 MSRVs actuated outside their TS setpoint allowance by greater than +/- 3 percent, it is probable that BFN, Unit 3, operated with only 11 operable MSRVs for longer than allowed by the TS.

The root cause of this condition was the valve design does not make allowance for corrosion bonding.

Corrective actions to prevent recurrence of this condition are to revise Mechanical Corrective Instruction MCI-0-001-VLV002, Main Steam Relief Valves Target Rock Model 7567 Disassembly, Inspection, Rework and Reassembly, to add steps to verify platinum coating on each pilot valve disc during the refurbishment process and to incorporate criteria for replacing pilot valve springs.

NARRATIVE

I. PLANT CONDITION(S)

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 3, was in Mode 2 at less than 1 percent rated thermal power during a refueling outage.

II. DESCRIPTION OF EVENT

A. Event:

On May 25, 2012, the Tennessee Valley Authority (TVA) determined, 2 of 13 BFN, Unit 3, Main Steam Relief Valves (MSRVs) [SB] mechanically actuated at pressures outside the allowed +/- 3 percent tolerance of their Technical Specification (TS) setpoint. The two out-of-tolerance MSRVs have the same nameplate setpoint of 1155 pounds per square inch gauge (psig). The as-found setpoint for one MSRV was outside the TS setpoint allowance (i.e., +3.98 percent) at 1201 psig and the as-found setpoint of the other MSRV was outside the TS setpoint allowance (i.e., -3.1 percent) at 1119.2 psig. The MSRVs were thus inoperable for an indeterminate period during the previous operating cycle, which started on April 8, 2010, and ended on April 7, 2012.

BFN, Unit 3, TS Limiting Condition for Operation (LCO) 3.4.3 requires the safety function of twelve (12) MSRVs to be operable in reactor Modes 1, 2, and 3. With one or more required MSRVs inoperable, the unit is required to be placed in Mode 3 (Hot Shutdown) within 12 hours and in Mode 4 (Cold Shutdown) within 36 hours. Since 2 of 13 MSRVs actuated outside their TS setpoint allowance of +/- 3 percent, it is probable that BFN, Unit 3, operated with only 11 operable MSRVs for longer than allowed by the TS.

B. Inoperable Structures, Components, or Systems that Contributed to the Event:

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

C. Dates and Approximate Times of Major Occurrences:

April 8, 2010	BFN, Unit 3, exits refueling outage 14 (U3R14) and begins Cycle 15 operations.
April 7, 2012	BFN, Unit 3, ends Cycle 15 operations and begins refueling outage 15 (U3R15).
May 25, 2012	Wyle Laboratories completes testing of MSRVs during refueling outage U3R15 and reports two MSRVs failed the as-found setpoint test.

D. Other Systems or Secondary Functions Affected

There were no other systems or secondary functions affected.

E. Method of Discovery

The out-of-tolerance lift setpoints were identified during the performance of as-found setpoint testing at Wyle Laboratories, located in Huntsville, Alabama.

F. Operator Actions

There were no operator actions.

G. Safety System Responses

There were no safety system responses.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of the MSRV failing below 3 percent of its setpoint was that low spring force inside the valve caused the low opening setpoint failure.

The immediate cause for the MRSV failing above 3 percent of its setpoint was corrosion bonding of the pilot valve disc to the valve seat.

B. Root Cause

The root cause of this condition, for both high lift setting and low lift setting failures, was the valve design does not make allowance for corrosion bonding.

The root cause immediately leads to the immediate cause for the high lift setting failure. This root cause also applies to the low lift setting failure because in the past, as corrosion bonding affected all of the pilot valve discs and seats to some degree, test results that otherwise may have approached the -3 percent end of the allowed range due to spring issues were held positive and therefore masked by corrosion bonding. Therefore, the potential for springs impacting whether individual pilot valves would meet TS lift setting requirements was not recognized and, as a result, only limited spring data was being collected and analyzed.

C. Contributing Factors

There were no contributing factors for this condition.

IV. ANALYSIS OF THE EVENT

TVA is submitting this report in accordance with 10 CFR 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's Technical Specifications.

On Friday May 25, 2012, Wyle Laboratories completed the as-found testing of the 13 MSRV pilot valves which were removed from BFN, Unit 3, during the spring 2012 refueling outage U3R15. Two MSRVs failed the as-found setpoint test. Twelve MSRVs are required for operability, per TS 3.4.3, with operability defined as having an as-found setpoint with +/- 3 percent of the nameplate setpoint. The results of the test are shown below:

As-Found Lift Setpoints (1)					
MSRV Unique Identification Number	Pilot Valve Serial Number	MSRV TS Setpoint	1st Test Deviation	2nd Test Deviation	3rd Test Deviation
3-PCV-001-0004	1029	1155	-0.3	-1.1	-1.2
3-PCV-001-0005	1021	1145	2	0.9	-0.1
3-PCV-001-0018	1030	1145	-1.5	-1.1	-0.2
3-PCV-001-0019	1031	1135	2.5	1.4	1.6
3-PCV-001-0022	1061	1145	0.7	-0.2	0.4
3-PCV-001-0023	1060	1135	-1.3	-2	-1.5
3-PCV-001-0030	1272	1145	0	0.3	0.4
3-PCV-001-0031	1063	1135	-0.6	1	-1.1
3-PCV-001-0034	1273	1135	-1.7	1.7	-0.4
3-PCV-001-0041	1071	1155	0.3	-0.1	-0.3
3-PCV-001-0042	1014	1155	-0.1	0.1	0.3
3-PCV-001-0179	1026	1155	3.98	-1.2	-1.6
3-PCV-001-0180	1073	1155	-3.1	-0.5	0.1

(1) Shaded values indicate test results outside of TS required 3 percent tolerance

The MSRV pilot valves did not receive platinum coating for BFN, Unit 3, Cycle 14 operation. When tested at the end of Cycle 14, the MSRV pilot valve test results were 8 of 13 MSRV pilot valves failed their as-found lift setpoint value due to corrosion bonding. The BFN, Unit 3, Cycle 15 was the first cycle on BFN, Unit 3, to have all 13 MSRV pilot valves with platinum coated discs and test results indicate only one MSRV pilot valve exceeded its as-found lift setpoint value due to corrosion bonding. Based on as-found test data received from other utilities that use this technology, high as-found lift setpoint failures have been reduced to a rate similar to those recently documented at BFN. Continuing the practice of utilizing platinum coated discs in the MSRV pilot valves will reduce the probability of similar events occurring in the future.

In the past, corrosion bonding affected all of the pilot valve discs and seats to some degree, test results that otherwise may have approached the -3 percent TS limit were held positive (i.e. masked) by corrosion bonding. Over the past five fuel cycles, the as-found test data for MSRV pilot valve with the serial number 1073 has experienced a steady downward trend from +11.1 percent to the failure value of -3.1 percent in lift settings. This downward trend indicates possible changes in the characteristics of the pilot spring.

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Extent of Condition

The extent of condition includes all three BFN units' MSRVs and spares because the corrosion bonding characteristic is a fundamental design deficiency with the current pilot valve design. The action to address the extent of condition is to replace the spring for MSRV pilot valve, serial number 1073, due to demonstrated low spring force condition and to replace any MSRV pilot valve springs which demonstrate downward trending spring force (PER 558488). The spring data collected during U3R15 was analyzed and a trend could not be identified for any of other MSRV pilot valves.

Extent of Cause

The extent of cause covers all MSRV pilot valves currently in service and the spares which will replace them because all MSRV pilot valves are subjected to the same conditions and failure mechanisms. To address the extent of cause, the Main Steam System Monitoring Plan will be revised to incorporate MSRV pilot spring data and as-found test data, by serial number, for trending and analysis of MSRV pilot valve performance. The data will be used to predict when a MSRV pilot valve may lift outside the TS allowance of +/- 3 percent so the valve can be refurbished prior to failure (PER 558488).

V. ASSESSMENT OF SAFETY CONSEQUENCES

The two out of tolerance MSRV pilot valves have the same nameplate setpoint of 1155 psig. The as-found setpoint for one MSRV exceeded the TS setpoint by +3.98 percent at 1201 psig and the other MSRV exceeded TS by -3.1 percent at 1119.2 psig.

Low pressure relief value of 1119.2 psig

The lowest pressure for which in-tolerance 1135 psig and 1145 psig group valves are analyzed to open is 1101 psig and 1111 psig, respectively based upon a -3 percent drift. The subject valve opened at 1119.2 psig which is higher than the lowest analyzed 1135 psig and 1145 psig group valves. Therefore, reactor vessel pressure reduction would not occur sooner than previously analyzed, and the overpressure safety/relief function is assured.

The lowest indicated relief pressure for the group of MSRVs is predicted to be approximately 980 psig on a valve with a nominal setpoint of 1155 psig. This value is consistent with the prescribed reactor pressure limits (i.e., between 800 and 1000 psig) when using the MSRVs for manual reactor pressure control. Therefore, excessive reactor coolant blowdown is not expected if the MSRVs opened in response to a reactor pressure transient.

High pressure relief value of 1201 psig

The bounding maximum over-pressurization analyses are performed each fuel cycle to show that the requirements of the American Society of Mechanical Engineers (ASME) code regarding overpressure protection are met. The analyses are performed specifically to show how 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

NARRATIVE

Anticipated Transient Without Scram (ATWS) pressurization analyses are also performed to demonstrate that the 1500 psig peak vessel pressure limit is not exceeded.

In both analyses, one 1135 psig valve is assumed to be out of service. For the ASME over-pressurization analyses, all valves that were assumed operational have an assumed 6 percent drift. Therefore, the valves with 1155 psig setpoints were assumed to relieve at 1224.3 psig, and therefore, the 1201 psig lift point is bounded by the analysis.

For the ATWS over-pressurization analyses, all 1135, 1145 and 1155 psig valves in operation are assumed to lift well above their setpoints at 1179, 1189 and 1199 psig respectively. With all twelve operable relief valves acting in concert and lifting 44 psig above their respective setpoints, the maximum lower plenum pressure is calculated to be 1404 psig and the maximum dome pressure is calculated to be 1384 psig. These values are well below the allowable 1500 psig limit for the ATWS analyses. None of the other valves during any of the three tests lifted within 30 psig of the analyzed ATWS setpoints. Therefore, one relief valve lifting at a 1201 psig (2 psig above ATWS analyzed setpoint) in concert with the worse case as-found values of the other valves would not exceed the analyzed pressures for ATWS.

Summary

The variations in lift setting pressures did not prohibit the ability of the MSRVs to perform their function to open in order to provide over pressure protection. The valve lifting prematurely in concert with the others will not start vessel depressurization sooner than previously analyzed nor will it adversely affect the ability to maintain reactor level inventory. The valve lifting later in concert with the others will not over-pressurize the vessel during any pressure transient.

Additionally, these variations in lift setting pressures have no effect on the remote-manual operation, Automatic Depressurization System (ADS) [SB], or the MSRV Automatic Actuation Logic since these operating modes and functions rely upon an electrical signal to energize the MSRV control air solenoid valve which electrically opens the pilot valve. Based upon the above discussion, the as-found setpoint condition has no adverse affect on the MSRVs capability to satisfy the overpressure safety/relief function.

Therefore, this condition is of low safety significance and posed little risk to public health and safety.

VI. **CORRECTIVE ACTIONS** - The corrective actions are being managed by TVA's corrective action program.

A. **Immediate Corrective Actions**

1) All 13 of the BFN, Unit 3, MSRV pilot valves were replaced during refuel outage U3R15 with refurbished pilot valves certified within 1 percent of name plate setpoint
2) Data on spring free lengths, spring constants, and squareness of the 13 pilot valves removed during U3R15 was collected. This data will be used to determine acceptance criteria for replacing the pilot valve springs.

B. Corrective Actions to Prevent Recurrence (including those to reduce the probability of similar events occurring in the future)

1) Mechanical Corrective Instruction MCI-0-001-VLV002, Main Steam Relief Valves Target Rock Model 7567 Disassembly, Inspection, Rework and Reassembly, will be revised to add steps to verify platinum coating on each pilot valve disc during the refurbishment process.
2) Mechanical Corrective Instruction MCI-0-001-VLV002, Main Steam Relief Valves Target Rock Model 7567 Disassembly, Inspection, Rework and Reassembly, will be revised to incorporate criteria for replacing pilot valve springs.

VII. ADDITIONAL INFORMATION

A. Failed Components

There were no failed components.

B. Previous Similar Events

A search of BFN LERs for Units 1, 2, and 3, for approximately the past five years resulted in five LERs: LER 50-296/2008-002-00, LER 50-259/2008-003-00, LER 50-260/2009-003-01, LER 50-296/2010-001-00, and LER 50-259/2010-005-01. The previous LER for BFN, Unit 3, LER 50-296/2010-001-00, reported probable inoperability of 8 of 13 MSRV pilot valves during Cycle 14 operation.

A search was performed on the BFN corrective action program. Similar PERs 146189, 175990, 159200, 226627, 294506, and 372047 were identified.

C. Additional Information

The corrective action document for this report is PER 558488.

D. Safety System Functional Failure Consideration:

In accordance with NEI 99-02, this issue is not considered a safety system functional failure.

E. Scram With Complications Consideration:

This condition did not include a reactor scram.

VIII. COMMITMENTS

There are no commitments.