



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

September 13, 2016

10 CFR 50.73

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 50-260/2016-002-00**

The enclosed Licensee Event Report provides details of the inoperability of the Browns Ferry Nuclear Plant, Unit 2, High Pressure Coolant Injection system. The Tennessee Valley Authority (TVA) is submitting this report in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.73(a)(2)(v)(D), as any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident.

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 'S. M. Bono'.

S. M. Bono
Site Vice President

Enclosure: Licensee Event Report 50-260/2016-002-00 – High Pressure Coolant Injection System Failure Due To Stuck Contactor

cc (w/ Enclosure):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

ENCLOSURE

**Browns Ferry Nuclear Plant
Unit 2**

Licensee Event Report 50-260/2016-002-00

High Pressure Coolant Injection System Failure Due To Stuck Contactor

See Enclosed

1. FACILITY NAME Browns Ferry Nuclear Plant (BFN), Unit 2	2. DOCKET NUMBER 05000260	3. PAGE 1 OF 6
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4. TITLE
High Pressure Coolant Injection System Failure Due To Stuck Contactor

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
03	19	2016	2016	002	00	09	13	2016	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

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 checked="" 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 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 Baruch Calkin, Licensing Engineer	TELEPHONE NUMBER (Include Area Code) (256) 614-6713
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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
E	BJ	BKR	G080	Y	N/A	N/A	N/A	N/A	N/A

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 March 19, 2016, at approximately 1024 Central Daylight Time (CDT), the Unit 2 High Pressure Coolant Injection System (HPCI) Steam Admission Valve failed to stroke due to a stuck contactor in the valve motor breaker. This rendered the Unit 2 HPCI inoperable, resulting in a Safety System Functional Failure; however the system had previously been declared inoperable for maintenance and the Unit 2 Reactor Core Isolation Cooling System had been verified as operable in accordance with Technical Specifications Limiting Conditions for Operation 3.5.1. On March 20, 2016, at approximately 1103 CDT, Maintenance personnel commenced work to repair the Unit 2 HPCI steam admission valve motor breaker. On March 21, 2016, at approximately 0245 CDT, Unit 2 HPCI was declared operable following completion of all required PMTs.

The cause of the stuck contactor was accelerated cyclic fatigue due to overheating of the motor starter during packing consolidation and MOVATS testing. Corrective actions were to replace the stuck contactor, to clean contactors in similar HPCI valve motor breakers for Units 1 and 3, to determine an allowable maximum number of valve cycles within a given time period, and to revise plant procedures based on the determined cycle limit in order to prevent contactors from sticking due to accelerated cyclic fatigue.

Subsequent review determined the identified condition to be reportable.

(11-2015)



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 FOIA, Privacy and Information Collections Branch (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.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Browns Ferry Nuclear Plant, Unit 2	05000260	2016	- 002	- 00

NARRATIVE

I. Plant Operating Conditions Before the Event

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 2, was operating in Mode 1 at approximately 100 percent rated thermal power. BFN, Units 1 and 3, were unaffected by this event.

A. Event:

On March 19, 2016, at approximately 0004 Central Daylight Time (CDT), BFN Operations personnel received a 2-EA-57-117 ground alarm [ALM] during performance of valve diagnostic (MOVATS) testing on the Unit 2 High Pressure Coolant Injection System (HPCI)[BJ] Steam Admission Valve 2-FCV-073-0016. The valve motor breaker [BKR] 2-BKR-073-0016 was opened at 250VDC RMOV Board [ECBD] 2A, Compartment 3D, and the alarm cleared. The thermal overload relay was found tripped, resulting in the alarm, and was reset. At 1024 CDT, Operations attempted to stroke the valve from the Control Room for post-maintenance testing (PMT) using hand switch [HS] 2-HS-073-0016A, and the valve failed to stroke due to a stuck contactor [CNTR] in the breaker.

BFN, Unit 2, had previously entered Technical Specifications (TS) Limiting Conditions for Operation (LCO) 3.5.1, Emergency Core Cooling Systems (ECCS) – Operating. Condition C was entered due to HPCI inoperability for repack of the steam admission valve, with required actions to immediately verify Reactor Core Isolation Cooling (RCIC)[BN] operable by administrative means and restore HPCI to operable status within 14 days. LCO 3.5.1 requires each ECCS injection/spray subsystem and the Automatic Depressurization System (ADS)[SB] function of six safety/relief valves to be operable in reactor Modes 1, 2, and 3 except when HPCI and ADS valves are not required to be operable with reactor steam dome pressure less than or equal to 150 pounds per square inch, gauge (psig). RCIC was verified operable by Operations personnel.

On March 20, 2016, at approximately 1103 CDT, Maintenance personnel commenced work to repair the Unit 2 HPCI steam admission valve motor breaker. Both the 1C and 2C contactors were replaced.

On March 21, 2016, at approximately 0245 CDT, Unit 2 HPCI was declared operable following successful completion of all required PMTs.

II. Description of Events

B. Status of structures, components, or systems that were inoperable at the start of the event and that contributed to the event:

No inoperable systems, structures, or components contributed to this event.

(11-2015)



LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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NARRATIVE

C. Dates and approximate times of occurrences:

March 17, 2016, at 2300 CDT	Declared Unit 2 HPCI inoperable for repacking of HPCI steam admission valve.
March 19, 2016, at 1024 CDT	Operations personnel unsuccessfully attempted to stroke open Unit 2 HPCI steam admission valve.
March 20, 2016, at 1103 CDT	Maintenance personnel commenced work to repair a stuck contactor in the Unit 2 HPCI steam admission valve motor breaker.
March 20, 2016, at 2205 CDT	Declared Unit 2 HPCI available. Troubleshooting showed no grounds on Battery Board 2 and the valve opened and closed as expected.
March 21, 2016, at 0245 CDT	Declared Unit 2 HPCI operable following successful completion of all required PMTs

D. Manufacturer and model number (or other identification) of each component that failed during the event:

The breaker containing the failed contactor was manufactured by General Electric Co. The manufacturer's part number is THEF124040.

E. Other systems or secondary functions affected:

There were no other systems or secondary systems affected.

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

The stuck contactor was discovered when the valve failed to open during MOVATS testing.

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

The 2C contactor in 2-BKR-073-0016 failed due to accelerated cyclic fatigue as a result of overheating of the motor starter during packing consolidation and MOVATS testing.

H. Operator actions:

Operations personnel stationed an Assistant Unit Operator to operate the supply breaker for 2-FCV-73-16 to maintain HPCI available while maintenance personnel performed a ground inspection.

I. Automatically and manually initiated safety system responses:

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

(11-2015)



LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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Browns Ferry Nuclear Plant, Unit 2	05000260	2016	- 002	- 00

NARRATIVE

III. Cause of the event

A. The cause of each component or system failure or personnel error, if known:

The cause of the stuck contactor was accelerated cyclic fatigue due to overheating of the motor starter during packing consolidation and MOVATS testing.

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

No human performance related cause has been identified.

IV. Analysis of the event:

The Tennessee Valley Authority (TVA) is submitting this report in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.73(a)(2)(v)(D), as any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident.

This event was the result of accelerated cyclic fatigue due to overheating of the motor starter. The valve had stroked multiple times for packing consolidation and MOVATS testing prior to the failure. Each valve cycle results in arcing between the motor starter contact surfaces, which causes pitting and burning of the contact surface. Excessive pitting of the contact surfaces can lead to stuck contacts.

The safety function of HPCI is to assure that the reactor is adequately cooled to limit fuel cladding temperature in the event of a small break in the nuclear system and loss of coolant which does not result in rapid depressurization of the reactor vessel.

V. Assessment of Safety Consequences

This event resulted in additional, unplanned inoperability and unavailability of the single train of the BFN, Unit 2, HPCI system. This resulted in the inability of the HPCI system to perform its safety functions, for mitigation of the consequences of an accident, longer than the planned system outage duration. In the event of an emergency, the RCIC system remained operable, and all other ECCS and ADS systems were available during this event to facilitate core cooling. Additionally, this event did not result in BFN, Unit 2, exceeding the fourteen-day limit for HPCI inoperability given in TS LCO 3.5.1.C. Therefore, during the time period that the HPCI system was inoperable, sufficient systems were available to provide the required safety functions 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:

During this event, RCIC was verified as operable by Operations personnel. Additionally, all other ECCS and ADS systems remained operable.

(11-2015)



LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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NARRATIVE

B. For events that occurred when the reactor was shut down, availability of safety-related systems or components:

This event did not occur when the reactor was shut down.

C. For failure that rendered a train of a safety system inoperable, an estimate of the elapsed time from discovery of the failure until the train was returned to service:

The Unit 2 HPCI system was inoperable due to failure of the contactor from 0004 on March 19, 2016, when the failure was discovered, to 0245 on March 21, 2016, when the system was declared operable following successful completion of all required PMTs for 2-FCV-73-16 and MOVAT testing. This event did not result in BFN, Unit 2, exceeding the fourteen-day limit for HPCI inoperability given in TS LCO 3.5.1.C.

VI. Corrective Actions:

Corrective actions are being managed by TVA's Corrective Action Program (CAP) under Condition Reports (CR) 1160196 and 1199462.

The following corrective actions have been completed:

1. Replaced the stuck contactor for breaker 2-BKR-73-16.
2. Revised MCI-0-000-PCK001 (Generic Maintenance Instructions for Valve Packing) to add the following note:
"If DC MOVs are cycled electrically for packing consolidation, then the starter contactors are to be inspected and burnished (as necessary) prior to returning the valve to service. (This may be conducted following as-left MOVATS testing.)
EPI-0-000-MCC001 is to be referred to for guidance on starter contactor inspection and burnishing."

The following corrective actions are in progress:

1. Determine an allowable maximum number of cycles within a given time period to prevent cyclic fatigue of Motor Starters.
2. Revise ECI-0-000-MOV009 (Testing of Motor Operated Valves Using Viper 20) to add a step to this procedure to not exceed the maximum allowable number of cycles within a given period.
3. Revise MCI-0-000-PCK001 to add a step to this procedure to not exceed the maximum allowable number of cycles within a given period.
4. Clean the open and close contactors in 1-BKR-73-16 and 3-BKR-73-16 per EPI-0-000-MCC001 (Maintenance and Inspection of 480V AC and 250V DC Motor Control Centers).

(11-2015)



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

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NARRATIVE

VII. Additional Information:

A. Previous Similar Events:

A review of the BFN CAP and Licensee Event Reports (LERs) for Units 1, 2, and 3 revealed no contactor failures resulting in the inoperability of BFN HPCI systems for the last three years.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

The failed contactor was not part of the planned maintenance being performed during the scheduled LCO. Due to the additional, unplanned inoperability of the HPCI system resulting from the failed contactor, this system was unable to perform its safety function while in a mode of applicability for HPCI.

This event resulted in the inability of the BFN, Unit 2, HPCI system to perform its safety function for mitigation of the consequences of an accident. In accordance with NUREG-1022, this event is considered a safety system functional failure.

D. Scram with Complications Consideration:

This event did not result in a reactor scram.

VIII. COMMITMENTS

There are no new commitments.