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

August 17, 2015

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 50-260/2015-001-00**

The enclosed Licensee Event Report provides details of the inoperability of the 2A Residual Heat Removal Pump for longer than allowed by the Technical Specifications. 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)(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,

S. M. Bono
Site Vice President

Enclosure: Licensee Event Report 50-260/2015-001-00 – Failure of the 2A RHR Pump To Manually Start from the Control Room Due To A Loose Fastener

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 50-260/2015-001-00

Failure of the 2A RHR Pump To Manually Start from the Control Room Due To A Loose Fastener

See Enclosed

NRC FORM 366 (02-2014) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 01/31/2017

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.

LICENSEE EVENT REPORT (LER)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Browns Ferry Nuclear Plant, Unit 2	05000260	1 of 8

4. TITLE:
Failure of the 2A RHR Pump To Manually Start from the Control Room Due To A Loose Fastener

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	N/A	N/A
06	17	2015	2015	001	00	08	17	2015	N/A	N/A

9. OPERATING MODE
1

10. POWER LEVEL
100

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

Licensee Contact	TELEPHONE NUMBER *(Include Area Code)*
Eric Bates, Licensing Engineer	(256) 614-7180

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
N/A	N/A	N/A	N/A	N/A	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 June 17, 2015, at approximately 1015 Central Daylight Time (CDT), Browns Ferry Nuclear Plant (BFN) Operations personnel attempted to place BFN, Unit 2, Residual Heat Removal (RHR) Loop 1 into Suppression Pool Cooling (SPC). Upon actuating Hand Switch 2-HS-74-5A from the Control Room, Operations personnel observed that 2A RHR pump failed to start, and declared RHR Loop I inoperable. On June 18, 2015, at 1710 CDT, the pump was started and stopped after completion of troubleshooting, and the RHR Loop I was declared operable.

Troubleshooting discovered a loose terminal wire which intermittently prevented 2A RHR from being manually started from the Control Room. An investigation determined the cause to be human performance errors. RHR Loop 1 was inoperable from March 20, 2015, to June 18, 2015, longer than allowed by BFN, Unit 2, Technical Specifications. This loose terminal wire made the pump vulnerable to failure during a seismic event and, therefore, not in compliance with the design basis for the RHR system. This event did not prevent the 2A RHR Pump from manually starting, from the pump breaker, for SPC in the event of an emergency. Both the SPC manual start and the automatic start response to an Emergency Core Cooling System initiation signal were unaffected by this condition.

Corrective Actions for this event were to discipline the individuals responsible, to tighten the loose fastener, and to revise maintenance instructions to reduce the probability of recurrence.

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.

II. Description of Events

A. Event:

On June 17, 2015, at approximately 1015 Central Daylight Time (CDT), BFN Operations personnel attempted to place BFN, Unit 2, Residual Heat Removal (RHR)[BO] Loop 1 into Suppression Pool Cooling (SPC). Upon actuating Hand Switch (HS)[HS] 2-HS-74-5A from the Control Room, Operations personnel observed that 2A RHR pump [P] failed to start, the motor overload/tripout light was illuminated, and pump trip annunciators [ANN] were audible. Operations personnel declared RHR Loop I inoperable.

On June 17, 2015, at approximately 2012 CDT, Maintenance personnel completed troubleshooting and cleaning 2A RHR Pump Breaker [BKR]. Operations personnel successfully started and stopped 2A RHR Pump per 2-OI-74, Residual Heat Removal System, and declared RHR Loop I operable.

On June 18, 2015, at approximately 0903 CDT, BFN Operations personnel attempted to place BFN, Unit 2, RHR Loop I into SPC. Upon actuating 2-HS-74-5A from the Control Room, Operations personnel observed that 2A RHR pump failed to start, that the motor overload/tripout light was illuminated, and that pump trip annunciators were audible. Operations personnel declared RHR Loop I inoperable.

On June 18, 2015, at approximately 1710 CDT, Maintenance personnel completed troubleshooting. A loose lead in the 2A RHR Pump Breaker was found and tightened. Operations personnel successfully started and stopped 2A RHR Pump per 2-OI-74, and declared RHR Loop I operable.

A Past Operability Evaluation (POE) was performed for the 2A RHR Pump. The POE concluded that the 2A RHR Pump was inoperable from March 20, 2015, to June 18, 2015.

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 (SSCs) contributed to this event.

1. FACILITY NAME	2. DOCKET	6. LER NUMBER			3. PAGE
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant, Unit 2	05000260	2015	001	00	3 of 8

NARRATIVE

C. Dates and approximate times of occurrences:

March 20, 2015	During a BFN, Unit 2, refueling outage, Electrical Maintenance contractors began work on the 2A RHR Pump, and while performing work, un-tightened a terminal screw at Terminal Point (TP) ZW-15.
June 17, 2015, at 1015 CDT	Operations personnel attempted to place RHR Loop I into SPC. The 2A RHR Pump failed to start when manually actuated. Operations personnel declared RHR Loop I inoperable.
June 17, 2015, at 2012 CDT	Maintenance personnel completed troubleshooting and cleaning 2A RHR Pump Breaker. Operations personnel started and stopped 2A RHR Pump per 2-OI-74, and declared RHR Loop I operable.
June 18, 2015, at 0903 CDT	Operations personnel attempted to place RHR Loop I into SPC. 2A RHR Pump failed to start when manually actuated. Operations personnel declared RHR Loop I inoperable.
June 18, 2015, at 1710 CDT	Troubleshooting identified and corrected a loose terminal wire. Operations personnel started and stopped 2A RHR Pump per 2-OI-74, and declared RHR Loop I operable.

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

No failed components contributed to this event.

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:

On June 17 and 18, 2015, the 2A RHR Pump failed to start when Operations personnel attempted to place RHR Loop I in service for SPC. Troubleshooting revealed the terminal fastener used to secure a wire to the terminal strip to be backed out by approximately 3/16 of an inch, which indicated the fastener was not tightened according to procedure during previous work.

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

No failed components contributed to this event.

NARRATIVE

H. Operator actions:

In response to both failures of the 2A RHR pump to manually start, Operations personnel took the following actions:

- Declared RHR Loop I inoperable
- Entered Technical Specifications (TS) Limiting Conditions for Operability (LCO)
- Declared RHR Loop I operable following troubleshooting by Electrical Maintenance Personnel, and exited TS LCOs

I. Automatically and manually initiated safety system responses:

No safety system responses resulted from this event.

III. Cause of the event

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

The cause of 2A RHR failing to start when manually operated was a loose terminal screw in the pump breaker which caused an intermittent loss of continuity in the affected circuit. The terminal screw was most likely tightened improperly during work performed on March 20, 2015.

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

The cause of this event was lack of procedural adherence. Electrical Maintenance contractors, by leaving the terminal screw backed out 3/16 of an inch, did not effectively utilize human performance tools when performing or when verifying work performed on the 2A RHR Pump during the BFN, Unit 2, refueling outage.

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)(i)(B), as any event or condition which was prohibited by the plant's TS.

This event was most likely the result of lack of procedural adherence, where during the course of work performed on 2A RHR Pump Breaker, the terminal fastener for the wire connecting the 2A RHR pump Control Room 2 manual start HS to the terminal was not properly tightened. This led to a situation where the wire could lose contact with the terminal, preventing 2A RHR from being manually started from the Control Room.

A Past Operability Evaluation determined that 2A RHR Pump was inoperable from March 20, 2015 until June 18, 2015 at 1710 CDT. A loss of continuity in the affected electrical circuit occurred on June 17, 2015, and again on June 18, 2015, due to the loose terminal screw. It is possible that the movement associated with a postulated seismic event could have resulted in the same loss of continuity during the time period of March 20, 2015 until June 18, 2015. Therefore, during this period of time, the manual start circuit was vulnerable to failure due to a seismic event and was not in compliance with the design basis for the RHR System.

NARRATIVE

Due to this period of inoperability, BFN, Unit 2, should have entered the following TS LCOs:

- 3.4.8 RHR Shutdown Cooling System - Cold Shutdown
- 3.5.1 ECCS - Operating
- 3.5.2 ECCS - Shutdown
- 3.6.2.3 RHR Suppression Pool Cooling
- 3.6.2.4 RHR Suppression Pool Spray
- 3.6.2.5 RHR Drywell Spray

Additionally, because several of the above LCOs do not permit continued operation in a Mode higher than Mode 4, BFN, Unit 2, violated TS LCO 3.0.4 when Unit 2 entered Mode 2 on April 9, 2015.

TS LCO 3.5.2 requires that, in Mode 4 and in Mode 5, except with the spent fuel storage pool gates removed and water level greater than or equal to 22 feet over the top of the reactor pressure vessel (RPV) flange, two low pressure Emergency Core Cooling System (ECCS) injection/spray subsystems shall be operable. Unit 2 was in Mode 5 with spent fuel storage pool gates installed from April 1, 2015, at approximately 1500, to April 3, 2015, at approximately 0306, and was in Mode 4 from April 3, 2015, at approximately 0306, to April 9, 2015, at approximately 1429. During this time 2A RHR pump, which was credited as a required RHR shutdown cooling system, was inoperable. Therefore, BFN, Unit 2, was in violation of Required Action A.1, which requires, with one required ECCS injection/spray subsystem inoperable, restoration of required ECCS injection/spray subsystem to operable status within four hours, and Required Action B.1 which requires initiation of action to suspend OPDRVs immediately if Condition A is not met.

TS LCO 3.4.8 requires that, in Mode 4, two RHR shutdown cooling subsystems shall be operable, and, with no recirculation pump in operation, at least one RHR shutdown cooling subsystem shall be in operation. Unit 2 was in Mode 4 from April 3, 2015, at approximately 0306, to April 9, 2015, at approximately 1429. During this time the 2A RHR pump, which was credited as a required RHR shutdown cooling system, was inoperable. Therefore, BFN, Unit 2, was in violation of Required Actions, which require, with one or two required RHR shutdown cooling subsystems inoperable, verification that an alternate method of decay heat removal is available for each inoperable required RHR shutdown cooling subsystem within one hour and once every twenty-four hours afterward.

TS LCO 3.5.1 requires that, in Modes 1, 2, and 3, except High Pressure Coolant Injection (HPCI)[BJ] and Automatic Depressurization System (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), each Emergency Core Cooling System (ECCS) injection/spray subsystem and the Automatic Depressurization System (ADS) function of six safety/relief valves shall be operable. Unit 2 was in Modes 1 or 2 starting April 9, 2015, at approximately 1429 CDT, to the time the failure was corrected on June 18, 2015, at 1710 CDT. During this time the 2A RHR pump, credited as a required low pressure ECCS injection/spray subsystem, was inoperable. Therefore, BFN, Unit 2,

was in violation of Required Action A.1, which requires, with one required ECCS injection/spray subsystem inoperable, restoration of required ECCS injection/spray subsystem to operable status within seven days. BFN, Unit 2, was also in violation of Required Actions, which require Unit 2 to be in Mode 3 within twelve hours and Mode 4 within thirty-six hours if Required Actions and associated Completion Times of Condition A are not met.

TS LCO 3.6.2.3 requires that, in Modes 1, 2, and 3, four RHR suppression pool cooling subsystems shall be operable. Unit 2 was in Modes 1 or 2 from April 9, 2015, at approximately 1429 CDT, to the time the failure was corrected on June 18, 2015, at 1710 CDT. During this time 2A RHR pump, which was credited as a required RHR suppression pool cooling subsystem, was inoperable. Therefore, BFN, Unit 2, was in violation of Required Actions, which require, with one RHR suppression pool cooling subsystem inoperable, to restore the RHR suppression pool cooling subsystem to operable status within 30 days, or be in Mode 3 within twelve hours and Mode 4 within thirty-six hours if the required action and associated completion time are not met.

TS LCO 3.6.2.4 requires that, in Modes 1, 2, and 3, four RHR suppression pool spray subsystems shall be operable. Unit 2 was in Modes 1 or 2 from April 9, 2015, at approximately 1429 CDT, to the time the failure was corrected on June 18, 2015, at 1710 CDT. During this time the 2A RHR pump, which was credited as a required RHR suppression pool spray subsystem, was inoperable. Therefore, BFN, Unit 2, was in violation of Required Actions, which require, with one RHR suppression pool spray subsystem inoperable, to restore the RHR suppression pool spray subsystem to operable status within 30 days, or be in Mode 3 within twelve hours and Mode 4 within thirty-six hours if the required action and associated completion time are not met.

TS LCO 3.6.2.5 requires that, in Modes 1, 2, and 3, four RHR drywell spray subsystems shall be operable. Unit 2 was in Modes 1 or 2 from April 9, 2015, at approximately 1429 CDT, to the time the failure was corrected on June 18, 2015, at 1710 CDT. During this time 2A RHR pump, which was credited as a required RHR drywell spray subsystem, was inoperable. Therefore, BFN, Unit 2, was in violation of Required Actions, which require, with one RHR drywell spray subsystem inoperable, to restore the RHR drywell spray subsystem to operable status within 30 days, or be in Mode 3 within twelve hours and Mode 4 within thirty-six hours if the required action and associated completion time are not met.

V. Assessment of Safety Consequences

This event resulted in BFN, Unit 2, RHR Loop I being inoperable for longer than allowed by the TS. The ability of the system to respond as expected, when Emergency Operating Instructions require a manual start from the control room of the 2A RHR Pump for SPC, was affected. It is also possible that the movement associated with a postulated seismic event could have resulted in a loss of continuity in the affected electrical circuit during the time period of March 20, 2015 until June 18, 2015. Therefore, during this period of time, the manual start circuit was vulnerable to failure due to a seismic event and was not in compliance with the design basis for the RHR System. At no time was the system known to have lost the capability to respond to an automatic or local manual start signal.

NARRATIVE

The safety objectives of the RHRS are as follows:

a. To restore and maintain the coolant inventory in the reactor vessel so that the core is adequately cooled after a loss-of-coolant accident. The RHRS also ensures cooling for the pressure suppression pool for condensation of steam resulting from the blowdown due to a design basis loss-of-coolant accident.

b. The RHRS further extends the redundancy of the Core Standby Cooling Systems by providing for containment cooling.

During a nuclear system shutdown and cooldown, any one of the four RHR shutdown cooling subsystems can provide the required decay heat removal function and maintain or reduce the reactor coolant temperature as required.

The Low Pressure Coolant Injection function of the RHRS is designed to reflood the reactor vessel to at least two-thirds core height and to maintain this level. After the core has been flooded, the capacity of one RHR pump is sufficient to maintain this level.

A Probabilistic Risk Assessment was performed due to the RHR Loop I inoperability, and found that the change in Incremental Core Damage Probability (ICDP) and the change in Incremental Large Early Release Probability (ILERP) for the time period that the system was inoperable corresponds to a negligible increase in risk.

U2 ΔICDP	U2 ΔILERP
6.14E-07	5.21E-08

Based on the above, TVA has concluded that, during the time period that RHR Loop I was inoperable, there was no significant risk to the health and safety of the public or plant personnel for this event.

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, 2A RHR Pump retained the ability to automatically start, or manually start from the pump motor breaker, 2-BKR-74-5, in 4KV Shutdown Board Room A. Additionally, all required ADS valves, at least one Core Spray (CS)[BG] Loop and at least one Unit 2 RHR Pump remained operable at all times.

B. For events that occurred when the reactor was shut down, availability of systems or components needed to shut down the reactor and maintain safe shutdown conditions, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident:

During a portion of the period when 2A RHR pump was inoperable, BFN, Unit 2 was in a refueling outage. While the reactor was shut down, 2A RHR Pump retained the ability to automatically start, or manually start from the pump motor breaker, 2-BKR-74-5, in 4KV Shutdown Board Room A. At least one Core Spray (CS)[BG] Loop and at least one Unit 2 RHR Pump remained operable at all times.

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:

This event resulted in inoperability of the RHR pump for approximately ninety-one days from the time work was completed on the pump breaker on March 20, 2015, until the time the pump was returned to service on June 18, 2015.

VI. Corrective Actions:

Corrective actions (CA) are being managed by TVA's Corrective Action Program (CAP) under Condition Report (CR) 1040950. The CAs addressing this condition are described below:

1. Verified that the termination point ZW-15 is tightened.
2. Provided accountability to contractors performing and verifying the work.
3. MAI-3.3, Cable Terminating and Splicing for Cables Rated up to 15000 Volts, will be revised to provide consistency of the Quality Control hold-points for tightness.

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 one similar event over the last three years:

LER 296/2014-003-00 describes a RHR SDC Inboard Suction Valve Isolation Relay [RLY] which was rendered inoperable for longer than allowed by TS due to improper landing of leads during PM. The event is similar because an improperly connected wire resulted in a long period of inoperability for a safety system. CAs were to develop and deliver a case study to the Maintenance, Modifications, and Operations departments based on the details of this event, and to inspect HFA relay terminations.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

At least one RHR Pump remained operable throughout the duration of this condition. Therefore, in accordance with NUREG-1022, this event is not 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.