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

April 16, 2014

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 50-259/2013-006-02**

Reference:
1. Letter from TVA to NRC, "Licensee Event Report: 50-259/2013-006-00," dated December 3, 2013
2. Letter from TVA to NRC, "Licensee Event Report: 50-259/2013-006-01," dated February 25, 2014

In the reference 1 letter dated December 3, 2013, the Tennessee Valley Authority (TVA) submitted Revision 0 to Licensee Event Report (LER) 50-259/2013-006. After further review of the condition, it was determined that this event resulted in a Safety System Functional Failure and the causal analysis was revised. The TVA submitted Revision 1 to LER 50-259/2013-006-01, on February 25, 2014 (Reference 2). Subsequently, it was determined that the root cause was not adequately identified and the causal analysis was revised again. These changes are detailed in the enclosed LER revision. The TVA is submitting this supplemented report in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(v)(A), 10 CFR 50.73(a)(2)(v)(C) and 10 CFR 50.73(a)(2)(v)(D).

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. BONO FOR

K. J. Polson
Vice President

IE22
MRR

Enclosure: Licensee Event Report 50-259/2013-006-02 – 1B Standby Liquid Control Pump Inoperable For Longer Than Allowed By The Technical Specifications

cc (w/ Enclosure):

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

ENCLOSURE

Browns Ferry Nuclear Plant
Unit 1

Licensee Event Report 50-259/2013-006-02

1B Standby Liquid Control Pump Inoperable For Longer Than Allowed By The Technical Specifications

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See Enclosed

NRC FORM 366 (01-2014) 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 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 1	05000259	1 of 8

4. TITLE: 1B Standby Liquid Control Pump Inoperable For Longer Than Allowed By The Technical Specifications

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
10	04	2013	2013	006	02	04	16	2014	FACILITY NAME: N/A	DOCKET NUMBER: 05000

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

FACILITY NAME	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
X	BR	BKR	G080	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 October 4, 2013, Browns Ferry Nuclear Plant (BFN) discovered, by performing a past operability evaluation, that the 1B Standby Liquid Control (SLC) pump was inoperable from December 1, 2012, at approximately 0145 hours Central Standard Time (CST) to February 14, 2013 at approximately 0625 hours CST. It was subsequently determined that there was a Safety System Functional Failure since the 1A SLC Pump was unavailable during a portion of this time.

On February 13, 2013, during performance of surveillance instruction 1-SI-4.4.A.1, Standby Liquid Control Pump Functional Test, an Assistant Unit Operator manually tripped the 1B SLC pump motor breaker when no water was observed flowing through the 1B SLC pump and the 1B SLC pump motor was producing a loud humming noise.

The root cause was determined to be a crack in the breaker's arc chute caused during transport due to a human performance error. The 1B SLC pump was considered inoperable when the plant entered the mode of applicability on December 1, 2012, at approximately 0145 hours CST.

The corrective action to prevent recurrence requires the revision of procedures to include an additional arc chute inspection to ensure sustainability.

NRC FORM 366A (01-2014) 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 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)
CONTINUATION SHEET

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant, Unit 1	05000259	2013	- 006	- 02	2 of 8

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 100 percent power.

II. Description of Events

A. Event:

On February 13, 2013, during the performance of 1-SI-4.4.A.1, Standby Liquid Control Pump Functional Test, the 1B SLC pump ran for approximately 25 seconds before water flow stopped. An Assistant Unit Operator (AUO) then turned the 1B SLC pump off in the field by tripping the pump breaker [BKR]. Operations personnel had previously declared the 1B SLC inoperable for the performance of surveillance instruction 1-SI-4.4.A.1.

On February 14, 2013, at approximately 0625 hours CST, after successful repair and performance of surveillance instruction 1-SI-4.4.A.1, Operations personnel declared 1B SLC pump Operable and exited Technical Specifications (TS) Limiting Conditions for Operation (LCO) 3.1.7 Condition A, one SLC subsystem inoperable.

On October 4, 2013, BFN discovered, by performing a past operability evaluation, that the 1B Standby Liquid Control (SLC) [BR] pump [P] was inoperable from December 1, 2012, at approximately 0145 hours Central Standard Time (CST) to February 14, 2013 at approximately 0625 hours CST.

It was determined from the past operability evaluation that the last successful performance of the functional test of the 1B SLC pump was on November 20, 2012, during a refueling outage. BFN, Unit 1, entered the applicability of TS LCO 3.1.7, Standby Liquid Control (SLC) System, on December 1, 2012, without the required SLC subsystem being Operable contrary to the requirements of TS LCO 3.0.4. TS LCO 3.0.4 prohibits entering the mode of applicability when a LCO is not met, except when certain conditions exist that were not applicable to this event.

In addition, during the period from December 1, 2012 to February 14, 2013, when the 1B SLC pump was inoperable, the 1A SLC pump was also inoperable for a portion of this time. From February 12, 2013, to February 13, 2013, the 1A SLC pump was inoperable and TS 3.1.7 Condition B was entered. The associated TS 3.1.7 Required Action B.1, that requires one of the two SLC subsystems to be restored to Operable status within 8 hours, was not satisfied within the required 8 hour Completion Time.

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

C. Dates and approximate times of occurrences:

November 20, 2012	Operations personnel successfully completed 1-SI-4.4.A.1.
December 1, 2012, at 0145 hours CST	BFN, Unit 1, entered Mode 2.
February 12, 2013, at 1109 hours CST	During the performance of surveillance instruction 1-SI-4.4.A1, after charging the 1A SLC pump accumulator there was leakage observed from the air valve and the 1A SLC Pump was declared inoperable.
February 13, 2013, at 1550 hours CST	During the performance of surveillance instruction 1-SI-4.4.A1, the water flow stopped from the 1B SLC pump.
February 13, 2013, at 1820 hours CST	After successful performance of surveillance instruction 1-SI-4.4.A.1, Operations personnel declared 1A SLC pump Operable and exited TS LCO 3.1.7 Condition B.
February 14, 2013, at 0625 hours CST	After successful repair and performance of surveillance instruction 1-SI-4.4.A.1, Operations personnel declared 1B SLC pump Operable and exited TS LCO 3.1.7 Condition A.
October 4, 2013	Operations personnel accepted the past operability evaluation.

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

The component that failed was a General Electric (GE) Type 480V AK breaker 1-BKR-063-0006B.

E. Other systems or secondary functions affected:

There were no other systems or secondary functions affected.

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

During performance of surveillance instruction 1-SI-4.4.A.1, the 1B SLC pump failed.

NARRATIVE

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

The 1B SLC pump motor [MO] breaker 'A' phase arc chute was found to be discolored with a piece broken off. The broken section of the arc chute fell into the 'A' phase contacts. This prevented contact closure between the contacts for one phase on the 1B SLC pump motor breaker and its matching contacts on the 1B SLC pump motor breaker cubicle.

H. Operator actions:

The 1B SLC pump motor breaker was manually tripped by an AUO.

I. Automatically and manually initiated safety system responses:

There were no automatically or manually initiated safety system responses for this event.

III. Cause of the event

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

Direct Cause

The direct cause of the 1B SLC pump motor breaker requiring to be manually tripped during surveillance instruction 1-SI-4.4.A.1 was a piece of nonconductive foreign material. The nonconductive foreign material prevented contact closure between the contacts for one phase on the 1B SLC pump motor breaker and its matching contacts on the 1B SLC pump motor breaker cubicle.

Root Cause

The root cause was determined to be a crack in the 1B SLC pump motor breaker's 'A' phase arc chute caused during transport due to a human performance error.

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

TVA identified one root cause for this condition having human performance related aspects:

A crack in the 1B SLC pump motor breaker's 'A' phase arc chute caused during transport due to a human performance error.

The investigation identified that the breaker inspection procedures did not adequately inspect the arc chutes. These procedures have been revised to include enhanced inspection guidance.

IV. Analysis of the event:

The Tennessee Valley Authority (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 TS, as well as 10 CFR 50.73(a)(2)(v)(A), 10 CFR 50.73(a)(2)(v)(C) and 10 CFR 50.73(a)(2)(v)(D), any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to: (A) Shut down the reactor and maintain it in a safe shutdown condition; (C) Control the release of radioactive material; or (D) Mitigate the consequences of an accident.

After inspection of the 1B SLC pump breaker, the 'A' phase arc chute revealed it was discolored and damaged. The broken section of the 'A' phase arc chute was removed, breaker cleaned, and the 'A' phase arc chute replaced. The 1B SLC pump motor breaker was reinstalled and the performance of surveillance instruction 1-SI-4.4.A.1 was completed satisfactorily on February 14, 2013. Prior to the 1B SLC pump motor breaker failure, the last successful performance of surveillance instruction 1-SI-4.4.A.1 was performed on November 20, 2012.

The root cause analysis for the 1B SLC pump motor breaker failure determined that the direct cause was nonconductive material prevented contact closure between the contacts for one phase on the breaker and its matching contacts on the breaker cubicle. This nonconductive material prohibited the 1B SLC Pump Motor from being supplied by three phase power, as it requires. Once the arc chute broke, its dislocated fragments wedged themselves between the breaker contacts and the contacts of the breaker cubicle. This prohibited one phase of current from conducting across the set of inadvertently insulated contacts leading to the need to manually trip the breaker.

Although the 1B SLC pump motor breaker had been refurbished in 2004 and inspected in 2009, the phase arc chutes are only visually inspected, i.e., inspection for corona, cracks, chips, broke fins, and extensive burning or corrosion in the arc chutes. The phase arc chutes are not replaced during the refurbishment process unless a defect is identified. The last activity performed prior to the ultimate breaker failure was installation.

The vendor stated that visual inspections were adequate to detect a crack and there was no need to conduct inspections using any form of magnification. The arc chutes are visually inspected through the preventive maintenance program. The initial visual inspection occurred on September 1, 2004. The last visual inspection was completed in August 2009. It did not reveal any issues. Applying deductive reasoning to evidence gathered from interviews, documentation, walk-downs and trend data, all the potential causes were eliminated with the exception of the following: ceramic arc chute damage due to human performance error during handling after arc chute inspection. It was determined that the arc chute was damaged during transport and the damage went

undetected and propagated over time during quarterly operation of the breaker during SLC pump testing.

V. Assessment of Safety Consequences

The SLC System is a standby system designed to bring the reactor from full power to a cold, Xenon free, shutdown condition, assuming none of the withdrawn control rods can be inserted. It operates by injecting a Boron-10 solution into the Reactor Coolant System. The SLC System may also be manually aligned as an alternate source of high-pressure makeup water to the reactor. The SLC System is not intended to be a backup for the reactor scram function, i.e., it is not designed to rapidly insert negative reactivity when a safety setpoint is exceeded. The SLC System is used to control Suppression Pool pH in the event of a Loss of Coolant Accident combined with High Radiation in the Drywell or Suppression Chamber.

Based on the presence of the nonconductive foreign material, the 1B SLC pump would not have been able to perform its design function. The 1B SLC subsystem is assumed to have been inoperable from the last surveillance on the 1B SLC pump motor breaker, which was successfully performed on November 20, 2012.

In addition, during the period from December 1, 2012, to February 14, 2013, when the 1B SLC pump was inoperable, the 1A SLC pump was also concurrently inoperable. From February 12, 2013, to February 13, 2013, the 1A SLC pump was inoperable and TS 3.1.7 Condition B was entered. The associated TS 3.1.7 Required Action B.1, that requires one of the two SLC subsystems to be restored to Operable status within 8 hours, was not satisfied within the required 8 hour Completion Time.

This condition resulted in a safety system functional failure for the SLC system. The SLC would not have been able to perform its safe shutdown function of injecting a Boron-10 solution into the Reactor Coolant System or control Suppression Pool pH in the event of a Loss of Coolant Accident combined with High Radiation in the Drywell or Suppression Chamber.

A probabilistic risk assessment (PRA) evaluation was performed to assess the safety significance of the 1B SLC pump being inoperable from December 1, 2012, at approximately 0145 hours CST to February 14, 2013, at approximately 0625 hours CST. The PRA evaluation also determined that both subsystems of SLC were unavailable from February 13, 2013, at approximately 0632 hours CST until February 13, 2013, at approximately 1318 hours CST. The analysis evaluated the cumulative risk when the SLC subsystem(s) were considered unavailable. The PRA evaluation concluded that the incremental Conditional Core Damage Probability (ICCDP) was 4.73E-7 and the Incremental Conditional Large Early Release Probability (ICLERP) was 3.10E-8, which concludes that this event had low safety significance.

NARRATIVE

A. Availability of systems or components that could have performed the same function as the components and systems that failed during the event:

The SLC system consists of two 100 percent capacity positive displacement pumps. With the loss of one pump, the alternate pump would fulfill the design function of the SLC system for the required mission time. There was one period of time when the 1A SLC pump was unavailable from February 13, 2013, at approximately 0632 hours CST until February 13, 2013, at approximately 1318 hours CST.

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:

The BFN, Unit 1, was not shut down during this event.

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 1B SLC pump was determined to be inoperable from December 1, 2012, at approximately 0145 hours to February 14, 2013, at approximately 0625 hours. This period of inoperability started when BFN, Unit 1, was placed into Mode 2 after refueling outage 9 to February 14, 2013, at approximately 0625 hours when Operations personnel declared 1B SLC pump Operable and exited TS LCO 3.1.7 Condition A.

VI. Corrective Actions

Corrective Actions are being managed by TVA's corrective action program under Problem Evaluation Reports 681667 and 791685.

Immediate Corrective Actions

The 1B SLC pump motor breaker was racked out and disassembled for troubleshooting. During the troubleshooting of the 1B SLC pump motor breaker, the 'A' phase arc chute was found to be discolored with a piece broken off. The broken pieces were removed, breaker cleaned, the 'A' phase arc chute replaced, and the 1B SLC pump motor breaker was returned to service.

Corrective Actions to Prevent Recurrence or to Reduce Probability of Similar Events Occurring in the Future

1. Revise the breaker inspection procedures to include additional breaker arc chute inspections to ensure sustainability.

VII. Additional Information:

A. Previous similar events at the same plant:

A search of BFN Licensee Event Reports (LERs) for Units 1, 2, and 3 for the last five years identified LER 50-296/2010-002-00, A Subsystem of the Standby Liquid Control System was Inoperable Longer than Allowed by the Plant's Technical Specifications. This LER identified a similar condition concerning the inoperability of the 3B SLC pump motor breaker that was discovered when the pump failed to start. The reason for the breaker failure and the corrective actions reported in LER 50-296/2010-002-00 do not directly relate to this event and would not have prevented this event from occurring.

A search was performed on the BFN corrective action program. There were no corrective action program documents that were similar to this event.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

In accordance with NUREG-1022, this event is considered a safety system functional failure. NUREG-1022, Revision 3, dated January 2013, clarified the events that are reportable under 10 CFR 50.72(b)(3)(v) to include any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to: shut down the reactor and maintain it in a safe shutdown condition; control the release of radioactive material; or mitigate the consequences of an accident.

With both the 1A SLC pump and 1B SLC pump inoperable from February 13, 2013, at approximately 0632 hours CST until February 13, 2013, at approximately 1318 hours CST, the SLC system would not have been able to perform its safe shutdown function of injecting a Boron-10 solution into the Reactor Coolant System or control Suppression Pool pH in the event of a Loss of Coolant Accident combined with High Radiation in the Drywell or Suppression Chamber.

D. Scram with Complications Consideration:

This event did not result in an unplanned scram with complications.

VIII. COMMITMENTS

There are no commitments.