



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

June 21, 2016

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. 50-296

Subject: **Licensee Event Report 50-259/2016-001-00**

The enclosed Licensee Event Report provides details of the failure of the 4kV Shutdown Bus Normal Feeder Breaker, the resulting actuation of C and D Emergency Diesel Generators, and the resulting actuation of multiple Containment Isolation Valves. The Tennessee Valley Authority is submitting this report in accordance with Title 10 of the Code of Federal Regulations 50.73(a)(2)(iv)(A), as any event or condition that results in manual or automatic actuation of any of the systems listed in paragraph (b)(3)(iv)(B) Emergency AC Electrical Power Systems including Emergency Diesel Generators, and Containment Isolation Valves.

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 black ink, appearing to read 'S. M. Bono', written over a circular scribble.

S. M. Bono  
Site Vice President

Enclosure: Licensee Event Report 50-259/2016-001-00 – Failure of 4kV Shutdown Board Normal Feeder Breaker Results in Actuations of Emergency Diesel Generators and Containment Isolation Valves

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 50-259/2016-001-00**

**Failure of 4kV Shutdown Board Normal Feeder Breaker Results in Actuations of Emergency Diesel  
Generators and Containment Isolation Valves**

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**See Enclosed**

<b>1. FACILITY NAME</b> Browns Ferry Nuclear Plant (BFN), Unit 1	<b>2. DOCKET NUMBER</b> 05000259	<b>3. PAGE</b> 1 OF 6
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**4. TITLE**  
Failure of 4kV Shutdown Board Normal Feeder Breaker Results in Actuations of Emergency Diesel Generators and Containment Isolation Valves

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
04	22	2016	2016	- 001	- 00	06	21	2016	N/A	N/A
									FACILITY NAME	DOCKET NUMBER
									N/A	N/A

<b>9. OPERATING MODE</b>	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)</b>			
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 checked="" type="checkbox"/> 50.73(a)(2)(iv)(A)	<input type="checkbox"/> 50.73(a)(2)(x)
<b>10. POWER LEVEL</b>  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 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	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

<b>14. SUPPLEMENTAL REPORT EXPECTED</b> <input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO	<b>15. EXPECTED SUBMISSION DATE</b>		
	MONTH	DAY	YEAR
	N/A	N/A	N/A

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

On April 22, 2016, at 1358 Central Daylight Time (CDT), during transfer of the 4160 V (4kV) Shutdown Bus from Alternate to Normal, the Normal Feeder Breaker (BKR 1722) failed to close when the Alternate Feeder Breaker was manually tripped. 4kV SD Bus 2 de-energized, resulting in the loss of 1B and 2B Reactor Protection System (RPS) as well as Steam Jet Air Ejector 1B. Emergency Diesel Generators (EDG) C and D started, but did not tie to the 4kV Shutdown Boards due to Operations personnel immediately re-closing the Alternate breaker and re-energizing 4kV Shutdown Bus 2. Invalid actuations of several Containment Isolation Valves also occurred during this event due to the loss of RPS. At 1530 CDT, EDG C and D were shut down. BFN, Unit 1, was returned to normal operating conditions.

The cause of this event was loose wires in the closing control circuit for BKR 1722 due to work in the vicinity of the control circuit termination points. Corrective actions were to terminate loose wires, using a ring type lug instead of a forked spade type lug, in the closing control circuit for BKR 1722; and to verify Shutdown Bus 2 transferred successfully to BKR 1722. A briefing was provided to Electrical personnel who perform modifications to discuss the potential consequences of installing tie wraps and performing other activities that could adversely affect existing wiring.

(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 1	05000259	2016	- 001	- 00

### NARRATIVE

#### I. Plant Operating Conditions Before the Event

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

##### A. Event:

On April 22, 2016, at 1358 Central Daylight Time (CDT), during transfer of the 4160 V (4kV) Shutdown Bus [BU](SD Bus) from Alternate to Normal, the Normal Feeder Breaker BFN-0-BKR-211-000C/026 [BKR](BKR 1722) failed to close when the Alternate Feeder Breaker (BKR 1712) was manually tripped. 4kV SD Bus 2 de-energized, resulting in the loss of 1B and 2B Reactor Protection System [JC](RPS) as well as Steam Jet Air Ejector [EJR][SH](SJAE) 1B. Emergency Diesel Generators (EDG)[DG] C and D started, but did not tie to the 4kV Shutdown Boards (SD BD) due to Operations personnel immediately closing BKR 1712 and re-energizing 4kV SD Bus 2.

Upon loss of 4kV SD Bus 2, Primary Containment Isolation System [JM](PCIS) Group 2 outboard valves [ISV] isolated and BFN, Unit 1, entered Technical Requirement Manual (TRM) Limiting Condition for Operation (LCO) 3.4.1 which requires sampling of reactor coolant conductivity every four hours. PCIS Group 3 Reactor Water Cleanup [CE](RWCU) and PCIS Group 6 isolated; BFN, Unit 1, entered Technical Specification (TS) LCO 3.4.5 Condition D and TRM LCO 3.3.10 with required action to enter TS LCO 3.0.3 immediately. Operations personnel entered Abnormal Operating Instructions 1-AOI-99-1 (Loss of Power to One RPS Bus), 1-AOI-57-5B (Loss of I&C Bus B), and 1-AOI-47-3 (Loss of Condenser Vacuum) [COND].

On April 22, 2016, at 1436 CDT, Operations personnel noted that Drywell to Suppression Chamber differential pressure was reading 0.95 pounds per square inch differential (psid). BFN, Unit 1, entered TS LCO 3.6.2.6 Condition A.1 which requires Drywell to Suppression Chamber differential pressure to be restored to greater than 1.1 psid within eight hours.

Operations personnel returned BFN, Unit 1, to normal operating conditions and exited all TS LCOs, TRM LCOs, and AOIs. On April 22, 2016, at 1530 CDT, EDG C and D were shut down.

On April 22, 2015, at 1722 CDT, Event Notification (EN) 51878 was made to the NRC in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.72(b)(3)(iv)(A).

#### 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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Browns Ferry Nuclear Plant, Unit 1	05000259	2016	- 001	- 00

**NARRATIVE**

**C. Dates and approximate times of occurrences:**

April 22, 2016, at 1358 CDT	Alternate Feeder Breaker 1712 placed in TRIP, Normal Feeder Breaker 1722 failed to close.  4kV SD Bus 2, 1A and 1B RPS de-energized. EDG C and D started.  Operations personnel re-closed Alternate Feeder Breaker 1712.
April 22, 2016, at 1359 CDT	PCIS Group 2 outboard valves, Group 3 RWCU, and Group 6 isolated.  Loss of SJAE 1B.  BFN, Unit 1, entered AOI-99-1, AOI-57-5B, and AOI-47-3.  BFN, Unit 1, entered TS LCOs 3.0.3 and 3.4.5 Condition D; entered TRM LCOs 3.4.1 and 3.3.10.
April 22, 2016, at 1410 CDT	SJAE 1B returned to service.  Operations personnel exited 1-AOI-47-3.
April 22, 2016, at 1436 CDT	BFN, Unit 1, entered TS LCO 3.6.2.6 Condition A.1.
April 22, 2016, at 1441 CDT	Drywell to Suppression Chamber differential pressure restored to 1.1 psid.  BFN, Unit 1, exited TS LCO 3.6.2.6 Condition A.1
April 22, 2016, at 1444 CDT	BFN, Unit 1, exited TS LCOs 3.0.3 and 3.4.5 Condition D; exited TRM LCOs 3.4.1 and 3.3.10.
April 22, 2016, at 1530 CDT	EDG C and D shut down.
April 22, 2016, at 1540 CDT	RWCU returned to service.  BFN, Unit 1, exited TRM LCO 3.4.1.
April 22, 2016, at 1722 CDT	Provided eight-hour EN #51878 to the NRC.

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

No component failures were identified that occurred during the event.

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**NARRATIVE**

**E. Other systems or secondary functions affected:**

- 4kV SD Bus 2 de-energized
- Loss of SJAE 1B, resulting in lowering vacuum on Unit 1 Main Condenser.
- Loss of 1B and 2B RPS
- PCIS Group 2 outboard valves, Group 3 RWCU, Group 6 isolated
- Lowering Drywell to Suppression Chamber differential pressure

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

This event immediately resulted in multiple indications in the Unit 1 Main Control Room.

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

No component failures were identified that occurred during the event.

**H. Operator actions:**

- Re-closed Alternate Feeder Breaker
- Re-energized 4kV SD Bus 2
- Restored all inoperable equipment to service
- Shut down EDG C and D

**I. Automatically and manually initiated safety system responses:**

EDG C and D started automatically when the BKR 1722 failed to close.

**III. Cause of the event**

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

The Apparent Cause for this event was loose wires in the closing control circuit for BKR1722 due to work in the vicinity of the control circuit termination points. This included movement of nearby wiring and the installation of a tie wrap which exacerbated the situation by providing a pulling force on the termination points.

A contributing cause for this event was the use of forked spade terminal instead of a ring lug, which would have been less susceptible to pulling loose when the tie wrap was installed.

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

No human performance related root cause was identified.

**IV. Analysis of the event:**

The Tennessee Valley Authority is submitting this report in accordance with 10 CFR 50.73(a)(2)(iv)(A), as any event or condition that resulted in manual or automatic actuation of any

(11-2015)



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**NARRATIVE**

of the systems listed in paragraph (a)(2)(iv)(B) of 10 CFR 50.73, except when:

1. The actuation resulted from, and was part of, a pre-planned sequence during testing or reactor operation
2. The actuation was invalid and occurred while the system was properly removed from service, or was invalid and occurred after the safety function had been already completed.

Because this event resulted in a valid, unplanned actuation of EDG C and D, it is reportable according to 10 CFR 50.73(a)(2)(iv)(B)(8). Additionally, this event resulted in the invalid actuations of BFN, Unit 1, Primary Containment Isolation Valves in Groups 2, 3 and 6. These actuations did not occur while the system was properly removed from service or after their safety function had been already completed, and are therefore reportable according to 10 CFR 50.73(a)(2)(iv)(B)(2).

The safety objective of the Standby Alternating Current Power System is to provide a self-contained, highly reliable source of power, as required for the Engineered Safeguards System, so that no single credible event can disable the core standby cooling functions or their supporting auxiliaries. The EDGs are designed to support the electrical load of a 4kV SD BD upon loss of supply from a 4.16 kV shutdown bus. During this event, EDG C and D performed their safety function of automatically starting in order to potentially assume the load of C and D 4kV SD BDs upon a loss of supply to the boards. The EDGs did not tie to the 4kV SD BDs due to Operations personnel immediately closing BKR 1712 and re-energizing 4kV SD Bus 2.

Troubleshooting determined that the failure mechanism for this event was loose wires in the closing control circuit for BKR 1722 due to ongoing work in the vicinity of the control circuit termination points. The closing circuit for BKR 1722 had an open circuit due to a loose wire on terminal block ZW-8. The loose wire and lug were observed to have pulled loose from the terminal block due to a tie wrap that had been installed to secure the wire to an adjacent wire bundle. The installation of the tie wrap to the adjacent control wiring exerted a pulling tension on the control wire terminated at the terminal block. The wire and lug were susceptible to being pulled loose from the terminal block when the control wiring was moved because a spade type lug was installed instead of a ring lug, and because the terminal block screw had been loosened during previous maintenance or modifications work in the panel.

**V. Assessment of Safety Consequences**

This event resulted in an unplanned automatic start of EDG C and D. The EDGs are designed to automatically start upon a loss of offsite power. EDG C and D successfully performed their safety functions during this event; therefore, TVA has concluded there was no significant increase in risk to the health and safety of the public or plant personnel due to this event.

(11-2015)



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CONTINUATION SHEET**

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**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, all four Unit 1 and 2 EDGs remained available, and all four Unit 1 and 2 4kV SD BDs were operable.

**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:**

No safety systems were rendered inoperable as a result of this event.

**VI. Corrective Actions:**

Corrective Actions (CA) are being managed by TVA's Corrective Action Program (CAP) under Condition Report (CR) 1163613. The CAs described below address this condition:

1. Terminate loose wires, using a ring type lug instead of a forked spade type lug, in the closing control circuit for BFN-0-BKR-211-000C/026.
2. Verify Shutdown Bus 2 transfers to normal feed breaker in accordance with 0-OI-57A.

A briefing was provided to Electrical personnel that perform modifications to discuss the potential consequences of performing activities that could adversely affect existing wiring.

**VII. Additional Information:**

**A. Previous Similar Events:**

A review of the BFN CAP and Licensee Event Reports for Units 1, 2, and 3 revealed no events over the last three years where a loose wire resulted in actuation of an EDG.

**B. Additional Information:**

There is no additional information.

**C. Safety System Functional Failure Consideration:**

No safety systems were rendered inoperable as a result of this event. Therefore, this event is not considered to be a Safety System Functional Failure in accordance with NUREG-1022.

**D. Scram with Complications Consideration:**

This event did not result in a reactor scram.

**VIII. COMMITMENTS**

There are no new commitments.