



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

April 22, 2016

10 CFR 50.73

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

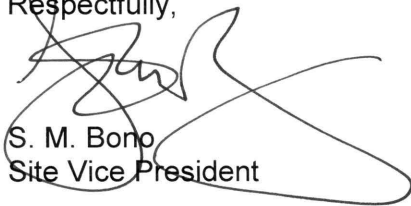
Browns Ferry Nuclear Plant, Unit 3
Renewed Facility Operating License No. DPR-68
NRC Docket No. 50-296

Subject: **Licensee Event Report 50-296/2016-002-00**

The enclosed Licensee Event Report provides details of the inoperability of the 3B and 3D Core Spray (CS) pumps, 3D Residual Heat Removal (RHR) pump, D1 Residual Heat Removal Service Water (RHRSW) pump for longer than allowed by plant Technical Specifications (TS). 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 TS.

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 50-296/2016-002-00 – Improperly Installed Switch Results in Condition Prohibited by Technical Specifications.

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 50-296/2016-002-00

Improperly Installed Switch Results in Condition Prohibited by Technical Specifications.

See Enclosed



LICENSEE EVENT REPORT (LER)

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 Browns Ferry Nuclear Plant, Unit 3	2. DOCKET NUMBER 05000296	3. PAGE 1 OF 8
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4. TITLE
Improperly Installed Switch Results in Condition Prohibited by 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
2	22	16	2016	- 002	- 00	4	22	2015	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)			
5	<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	<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 checked="" 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 Ryan Coons, Licensing Engineer	TELEPHONE NUMBER (Include Area Code) 256-729-2070
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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
D	BO	IS	S125	Y	N/A	N/A	N/A	N/A	N/A

14. SUPPLEMENTAL REPORT EXPECTED <input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> 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 February 22, 2016, during routine maintenance of the Browns Ferry Nuclear, Unit 3 Core Spray (CS) system, relays on the 3ED 4kV Shutdown Board were found de-energized. This resulted in loss of the automatic start function of the 3B and 3D CS Pumps, the 3D Residual Heat Removal (RHR) pump, and the D1 Residual Heat Removal Service Water (RHRSW) pump, with normal power to the 3ED 4kV Shutdown Board. Troubleshooting determined the breaker was de-energized due to a failure of the 6-6C contacts on the MJ(52STA) switch associated with the 3ED 4kV Shutdown Board, and a binding of the 52STA Cam Linkage. This was caused by a misalignment of the switch to linkage interface, due to improper installation. The switch was subsequently replaced. Alignment verification instructions will be added to switch replacement procedures.

The duration of inoperability the 3B and 3D CS pumps, 3D RHR pump, and D1 RHRSW pump, was determined to be from the last successful actuation of the switch on October 28, 2015, until February 20, 2016, when Unit 3 was placed in Mode 4. Manual start of these pumps remained available. Automatic start capability of the other Unit 3 CS, RHR, and RHRSW pumps was unaffected by this condition, and the required safety functions of the impacted systems continued to be met.

NRC FORM 366A
(11-2015)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104

EXPIRES: 10/31/2018



LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Browns Ferry Nuclear Plant, Unit 3	05000296	2016	- 002	- 00

NARRATIVE

I. Plant Operating Conditions Before the Event

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 3, was in Mode 5 at 0 percent power. BFN, Units 1 and 2, were unaffected by this event.

II. Description of Events

A. Event:

On February 22, 2016, at 1445 Central Standard Time (CST), during routine maintenance of the Browns Ferry Nuclear (BFN), Unit 3 Core Spray (CS) system [BM], Operations personnel were unable to verify that the Division II CS 3B Pump Automatic Start Signal (3-RLY-075-14A-K25B) and Valve Automatic Initiation Permissive Signal (3-RLY-075-14A-K13B) relays [RLY] were energized. This was due to a breaker [BKR] on the 3ED 4kV Shutdown (SD) Board (BD), BFN-3-BKR-211-03ED/008, which was found de-energized, preventing the normal automatic startup of the 3B and 3D CS Pumps [P], the 3D Residual Heat Removal (RHR) [BO] pump, and the D1 Residual Heat Removal Service Water (RHRSW) [BI] pump.

Troubleshooting determined that the NVA relays were de-energized due to a failure of the 6-6C contacts on the MJ(52STA) switch associated with the 3ED 4kV SD BD breaker and a binding of the 52STA Cam Linkage. This was caused by a misalignment of the switch to linkage interface, due to improper installation.

On February 23, 2016, at 1520 CST, the 52STA switch and the 52STA CAM linkage associated with the 3ED 4kV SD BD breaker was declared operable following an inspection, cleaning, and adjustment.

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, systems, or components (SSCs) whose inoperability contributed to this event.



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C. Dates and approximate times of occurrences:

<u>Dates & Approximate Times</u>	<u>Occurrence</u>
October 28, 2015 at 2000 CDT	Operations satisfactorily completed the Common Accident Signal Logic surveillance (SAT 3-SR-3.8.1.6).
February 20, 2016 at 0518 CST	Unit 3 entered Mode 4.
February 22, 2016 at 1445 CST	Relays 3-RLY-211-NVA-D1 and 3-RLY-211-NVA-D2 on the 3ED 4kV SD BD found to be de-energized when normal power was available during the performance of 3-SR-3.8.1.9(3C), Diesel Generator 3C Emergency Load Acceptance Test.
February 23, 2016 at 1520 CST	Operations declared the 3ED 4kV SD BD to be operable following the completion of breaker inspection, cleaning, and adjustment.
March 1, 2016 at 0704 CST	The 52STA switch for the 4KV Shutdown Board 3ED/8 was replaced.

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

The failed component was a 52STA switch in the MJ position of Breaker 3-BKR-211-03ED/008, model number 5-3AF-GEH-250-1200-58.

E. Other systems or secondary functions affected:

No other systems or secondary functions were affected by this event.

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

Failure was discovered during performance of 3-SR-3.8.1.9 (3C), when the NVA-D1 and NVA-D2 relays on the 3ED 4kV SD BD were found to be de-energized.

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

Troubleshooting determined that relay 3-RLY-075-14A-K13B was de-energized due to a binding of the 52STA switch and the 52STA Cam Linkage. This binding was due to a misalignment of the 52STA switch and the 52STA Cam Linkage as a result of improper installation.

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H. Operator actions:

There were no operator actions associated with this event.

I. Automatically and manually initiated safety system responses:

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

III. Cause of the event

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

Troubleshooting determined switch failure was caused by a failure of the 6-6C contacts on the 52STA switch, from and a binding of the 52STA Cam Linkage. This binding was caused by a misalignment of the switch to linkage interface, due to improper installation.

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

A review of procedure ECI-0-000-SWZ001, Replacement of Type SB switches, which was used to install the 52STA switch found there were no procedural steps for verifying proper alignment between the 52STA switch and the Breaker 52STA Switch Cam.

IV. Analysis of the event:

The Tennessee Valley Authority 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 (TSs). It was determined that the auto-start function for the 3B and 3D CS pumps, 3D RHR pump, and the D1 RHRSW pump was inoperable from October 28, 2015 until February 20, 2016 when Unit 3 entered Mode 4.

BFN, Unit 3, TS 3.3.5.1 requires Emergency Core Cooling System (ECCS) instrumentation for each function in Table 3.3.5.1-1, to be Operable as specified by Table 3.3.5.1-1. When BFN, Unit 3, time delay relay for the CS B and D pumps and the time delay relay for the Low Pressure Coolant Injection (LPCI) RHR pump D is declared inoperable, TS 3.3.5.1 Required Action C.1 requires the supported ECCS features to be declared inoperable when the redundant ECCS initiation capability is inoperable within 1 hour of discovering the loss of initiation capability for features in both divisions when in Modes 1, 2, or 3. Required Action C.2 requires that the inoperable channel be restored to Operable status within 24 hours. If the inoperable channel cannot be restored to Operable status in the required time period, TS 3.3.5.1 Required Action H.1 requires that the supported ECCS features be declared inoperable immediately. BFN, Unit 3, TS 3.5.1 requires each ECCS injection/spray subsystem and the Automatic Depressurization System (ADS) function of six safety/relief valves to be Operable in Mode 1, and in Modes 2 and 3, except High Pressure Coolant Injection (HPCI) and ADS valves are not required to be operable with reactor steam pressure less than or equal to 150 pounds per square

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inch gauge (psig). When the auto-start functions for the 3B and 3D CS pumps and the 3D LPCI RHR pump were disabled, two low pressure ECCS injection or spray subsystems were inoperable. With two or more low pressure ECCS injection or spray subsystems inoperable, TS 3.5.1 Required Action H.1 requires that BFN, Unit 3, immediately enter TS LCO 3.0.3. The auto-start functions for the BFN, Unit 3, 3B and 3D CS pumps, and the 3D LPCI RHR pump were inoperable from October 28, 2015 until February 20, 2016, which was longer than allowed by TS.

BFN, Unit 3, TS LCO 3.7.1 requires eight Operable RHRSW pumps whenever three units are fueled during Modes 1, 2, and 3. With one RHRSW pump inoperable, Required Action A.2 requires the pump be restored to Operable status within 30 days. If the required Completion Times for Condition A is not met, Required Action G.1 requires BFN, Unit 3, to enter Mode 3 within 12 hours, and Required Action G.2 requires entering Mode 4 within 36 hours. The auto-start function for the D1 RHRSW pump was inoperable from October 28, 2015 until February 20, 2016. Based on this evaluation, BFN, Unit 3, operated with one inoperable RHRSW pump for longer than allowed by TS.

During investigation, Operations discovered NVA-D1 and NVA-D2 relays on the 3ED 4kV SD BD were de-energized. Further investigation revealed this was caused by a failure of the 6-6C contacts on the MJ(52STA) switch associated with breaker BFN-3-BKR-211-03ED/008, which de-energized the NVA-D1 and NVA-D2 relays.

The last exercising of the 3ED 4kV SD BD breaker and successful actuation of the switch occurred on October 28, 2015, at 2000 Central Daylight Time (CDT), during Common Accident Signal Logic testing. The Past Operability Evaluation concluded that the auto-start function for the 3B and 3D CS pumps, 3D RHR pump, and the D1 RHRSW pump was inoperable from October 28, 2015 to February 20, 2016, when Unit 3 entered Mode 4. The duration of system inoperability was longer than allowed by plant TS 3.3.5.1, TS 3.5.1, and TS 3.7.1.

V. Assessment of Safety Consequences

This event resulted in BFN, Unit 3, auto-start function for the 3B and 3D CS pumps, 3D RHR pump, and the D1 RHRSW pump being inoperable for longer than allowed by plant TS. The manual start functions were not affected by MJ(52STA) switch failure, and Control Room operators could have manually started these pumps when their failure to automatically start was identified.

The automatic starting capability of these pumps when the 4kV Shutdown Board 3ED is energized from other than normal sources remained available. In addition, automatic start capability of the other Unit 3 CS, RHR, and RHRSW pumps was unaffected by this condition. The Probabilistic Risk Analysis concluded there was negligible increase in risk due to this condition.



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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:

System availability was not impacted by this event. The operability of the 3A and 3C CS pumps; the 3A, 3B, and 3C RHR pumps; and the A1, B1, and C1 RHRSW pumps was not affected by this event. Each of these pumps were capable of automatically performing their required safety functions.

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 the time the reactor was shutdown, all affected systems remained available to perform their required safety functions.

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:

Inoperability of the MJ(52STA) switch on relay 3-RLY-075-14A-K13B was discovered to be inoperable on February 22, 2016 at 1445 hours CST. Operability of the switch was restored on February 23, 2016 at 1520 CST. Because of the failure of the switch, the 3B and 3D CS pumps, the 3D RHR pump and the D1 RHRSW pumps were considered inoperable from October 28, 2015 until February 20, 2016.

VI. Corrective Actions:

Corrective Actions are being managed by TVA's corrective action program under Condition Reports (CRs) 1140776 and 803629.

A. Immediate Corrective Actions

The MJ(52STA) switch on the 3ED 4kV SD BD breaker was replaced, in accordance with Work Order 116560300.

B. Corrective Actions to Prevent Recurrence

Instructions to verify proper 52STA switch alignment will be developed. Procedure ECI-0-000-SWZ001, Replacement of Type SB switches, will be revised to add steps to verify the proper alignments of the 52STA switch and the Breaker 52STA Switch Cam. This will address the apparent cause, and prevent failures of this type during future 52STA switch installations.



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VII. Additional Information:

A. Previous Similar Events:

A search of the Corrective Action Program for BFN, Units 1, 2, and 3, identified seven MJ(52STA) switch failure events since 2010. These failures were captured by CRs 230836, 328038, 672598, 752488, 792179, 801449, and 980227. These individual failures were collectively evaluated by CR 803629 described below. CR 803629 was written in June 2014 to document the trend of 4 kV breaker's (MJ)52STA stationary contact failures, the same failure that resulted in this event. The cause evaluation for CR 803629 identified two apparent causes.

1. The appropriate preventative maintenance (PM) or pre-emptive replacements were not implemented. The maintenance program only inspected switches for failure, and only took action if the MJ(52STA) switch had failed. This strategy is inadequate with respect to PM, as the associated vendor manuals require contact inspection for wear and burning at regular intervals. Because the existing plant configuration and outage constraints prohibit the performance of a complete cleaning and inspection of Breaker Compartment stationary switches, switch replacement is being implemented on a 24 year frequency to satisfy PM requirements. The 24 year frequency interval was chosen based on engineering judgment and a corrective action review of other similar switches at BFN with component lifetimes of less than 10,000 cycles. An engineering evaluation concluded that this replacement strategy was more conservative than the recommended cleaning and inspection strategy.
2. BFN's elected and documented PM strategy for Medium Voltage Breakers includes the associated switchgear, but the Breaker Program excludes the associated switchgear components. This allows the breaker support components to be overlooked with respect to reliability despite being a vital component to the reliability of the breaker.

The extent of condition review, performed during the causal analysis for CR 803629, identified the 3ED 4kV SD BD breaker in the population of breakers containing MJ(52STA) switches are subject to failure due to age-related degradation. Work orders were created to replace the MJ(52STA) switches in each breaker identified during the extent of condition review.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

In accordance with NUREG-1022, this event is not a safety system functional failure. System availability was impacted by this event. Although the 3B and 3D CS pumps, 3D RHR pump, and the D1 RHRSW pump were considered inoperable during this event, the operability of the 3A and 3C CS pumps, the 3C RHR pump, and the C1 RHRSW pump was not affected. These pumps



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were capable of automatically performing the required safety functions for each of the affected systems.

Additionally, the 3A and 3B RHR pumps, and the A1 and B1 RHRSW pumps were operable throughout the event, except for the following times:

- The A1 RHRSW pump was unavailable for approximately 10.5 hours on November 23, 2015 due to an impeller adjustment.
- The B1 RHRSW pump was unavailable for approximately 3.5 hours on November 18, 2015 for performance of 3-SR-3.8.1.8, 480V Load Shedding Logic System Functional Test.
- The 3A RHR pump was inoperable between November 13, 2015 and November 19, 2015 due to a finding failure of the 3A RHR Pump Motor Breaker Transfer Switch (BFN-3-43-074-0005).
- The 3B RHR train was unavailable for approximately 19 hours between November 20, 2015 and November 21, 2015 due to a motor pinion key falling out of a flow control valve (3-FCV-074-0073) rendering it unable to open and close, which could have impacted its Suppression Pool and Containment Cooling functions, which both require the valve to open. Additionally, the RHR Loop II Shutdown Cooling suction valves can not open if this valve is not fully closed.

These systems were restored to operability within their required LCO completion times. Since one redundant train of each affected system remained operable for the duration of the event, this is not 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.