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

April 20, 2015

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 50-296/2015-002-00**

The enclosed Licensee Event Report provides details of a breaker switch failure that rendered the automatic startup function of Core Spray, Residual Heat Removal, and Residual Heat Removal Service Water Systems inoperable for longer than allowed by Technical Specifications. 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 prohibited by 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,

K. J. Polson
Site Vice President

Enclosure: Licensee Event Report 50-296/2015-002-00 - Switch Failure Rendered Automatic Startup of Some Emergency Core Cooling System Pumps Inoperable Longer Than Allowed by Technical Specifications

cc (w/ Enclosure):

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

ENCLOSURE

Browns Ferry Nuclear Plant
Unit 3

Licensee Event Report 50-296/2015-002-00

Switch Failure Rendered Automatic Startup of Some Emergency Core Cooling System Pumps Inoperable Longer Than Allowed by Technical Specifications

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 3	05000296	1 of 7

4. TITLE: Switch Failure Rendered Automatic Startup of Some Emergency Core Cooling System Pumps Inoperable Longer Than Allowed 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
									N/A	
02	18	2015	2015	- 02 -	00	4	20	2015	FACILITY NAME: N/A	DOCKET NUMBER

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)*
Mark Acker, Licensing Engineer	256-729-7533

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	BO	VACB	S125	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 January 22, 2015, the Browns Ferry Nuclear Plant (BFN), Unit 3, the 3D Core Spray Pump normal power relay (3-RLY-075-14A-K31B) was found de-energized when it should have been energized during performance of a surveillance. Troubleshooting determined the cause of the relay being de-energized was failure of the MJ(52STA) switch in the associated breaker. The relay is an emergency start permissive for the 3B and 3D Core Spray pumps, the 3D Residual Heat Removal pump, and the D1 Residual Heat Removal Service Water pump. This condition prevented those systems from automatically performing their safety functions under normal power, rendering them inoperable for longer than allowed by Technical Specifications. However, these systems were available and the affected pumps could be manually started to perform their safety functions in the event of an accident. The failed switch only serviced the normal power feed, and automatic starting function was unaffected under emergency power. On February 18, 2015, an engineering evaluation determined the switch had apparently failed on September 17, 2014. On January 24, 2015, the relay and switch were replaced, and the automatic startup function was restored.

Apparent causes of the event are failure to implement all appropriate preventive maintenance or pre-emptive replacement allowing MJ(52STA) switches to fail, and the BFN Breaker Program excluding the associated switchgear components allowing support components to be overlooked with respect to reliability.

Corrective actions include replacing MJ switches in non-spare breakers and revising associated preventive maintenance, and revising the Breaker Program to include essential switchgear components.

I. Plant Operating Conditions Before the Event

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 3, was in Mode 1 at approximately 100 percent power.

II. Description of Event

A. Event:

On January 21, 2015 at 0005 Central Standard Time (CST), BFN, Unit 3, 3B and 3D Core Spray [BM] pumps [P] were removed from service for planned maintenance. BFN, Unit 3, entered Technical Specifications (TS) Limiting Condition of Operation (LCO) 3.5.1, ECCS - Operating, Condition A, for one low pressure Emergency Core Cooling System (ECCS) injection/spray subsystem inoperable.

On January 22, 2015, at 2045 CST, the 3D Core Spray (CS) pump normal power relay [RLY], 3-RLY-075-14A-K31B, was found to be de-energized during normal surveillance activities. This relay is an emergency start permissive for the 3B and 3D CS pumps, the 3D Residual Heat Removal (RHR) [BO] pump, and the D1 Residual Heat Removal Service Water (RHRSW) [BI] pump. This relay is energized when the normal feeder breaker [BKR] BFN-3-BKR-211-03ED/008 to the 4 kilovolt (kV) shutdown board [BD] 3ED is closed. BFN, Unit 3, entered TS LCO 3.3.5.1, ECCS Instrumentation, as a result of the inoperability of 3-RLY-075-14A-K31B. TS LCO 3.5.1 was already entered for planned maintenance.

On January 23, 2015, at 0615 CST, troubleshooting determined that 3-RLY-075-14A-K31B was de-energized from the failure of the 6-6C contacts on the MJ(52STA) switch associated with 3-BKR-211-03ED/008. The MJ(52STA) switch provides contacts to indicate breaker state and to cause or prevent other actions, such as alternate feeder breaker closure, or valve [V] operation. When the MJ(52STA) switch contacts fail to operate (open/close), interlocked equipment will subsequently fail to start or stop. Operators exited TS LCO 3.3.5.1 and entered the more restrictive TS LCOs 3.8.7 and 3.8.1 for the 4 kV 3ED shutdown board and 3ED Emergency Diesel Generator (EDG) being removed from service.

On January 24, 2015, at 2015 CST, the 4 kV 3ED shutdown board and 3ED EDG were declared operable following switch replacement and post-maintenance testing (PMT). BFN, Unit 3, exited LCOs 3.8.7 and 3.8.1.

The last exercising of breaker 3-BKR-211-03ED/008 occurred on September 17, 2014, at 1608 Central Daylight Time (CDT), during testing of the EDG paralleling capability. The switch is assumed to have failed at this time. The Past Operability Evaluation (POE), competed on February 18, 2015, concluded that the auto-start function for the 3B and 3D CS pumps, 3D RHR pump, and the D1 RHRSW pump was inoperable from September 17, 2014 to January 24, 2015, which is longer than allowed by plant TS 3.3.5.1, TS 3.5.1, and TS 3.7.1, Residual Heat Removal Service Water (RHRSW) System and Ultimate Heat Sink (UHS).

NARRATIVE

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.

C. Dates and approximate times of occurrences:

Dates & Approximate Times	Occurrence
September 17, 2014, at 1608 hours CDT	Breaker 3-BKR-211-03ED/008, was exercised during testing EDG paralleling capability. Switch failure likely occurred at this time.
January 22, 2015, at 2045 hours CST	Relay 3-RLY-075-14A-K31B was found de-energized when it should have been energized during performance of 3-SR-3.3.5.1.5(CS II), CSS Logic Time Delay Relay Calibration (Loop II). BFN, Unit 3, entered TS LCO 3.3.5.1. TS LCO 3.5.1 was already entered for planned maintenance.
January 23, 2015, at 0615 hours CST	Troubleshooting identified that the cause of 3-RLY-075-14A-K31B being de-energized was the failure of the MJ(52STA) switch associated with breaker BFN-3-BKR-211-03ED/008. BFN, Unit 3, exited TS LCO 3.3.5.1, and entered TS LCO 3.8.7 and 3.8.1.
January 24, 2015 at 2015 hours CST	The relay and switch were replaced and all post-maintenance testing was completed. BFN, Unit 3, exited TS LCO 3.8.7 and 3.8.1.

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 Siemens Horizontal Vacuum 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 procedure error:

Failure was discovered during performance of 3-SR-3.3.5.1.5(CS II), when relay 3-RLY-075-14A-K31B was found de-energized.

NARRATIVE

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

Troubleshooting determined that the cause of relay 3-RLY-075-14A-K31B being de-energized was the failure of the 6-6C contacts on the MJ(52STA) switch associated with breaker BFN-3-BKR-211-03ED/008. The switch fingers were loose and actuating intermittently.

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 / Problem Statement

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

There are two apparent causes associated with this event.

First, was a failure to implement all appropriate Preventive Maintenance (PM) or pre-emptive replacement of MJ(52STA) switches, allowing the switches to fail. During the associated breakers PM, no maintenance action is taken unless the 52STA switch is already failed. This strategy is inadequate with respect to PM, as the associated vendor manuals require contact inspection for wear and burning at regular intervals.

Second, BFN's elected and documented PM strategy for Medium Voltage Breakers includes the associated switchgear, but the Breaker Program excludes the associated switchgear components, allowing the breaker support components to be overlooked with respect to reliability although they are a vital component to the reliability of the breaker.

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

No Human Performance related causes were identified.

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. 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 September 17, 2014 to January 24, 2015.

BFN, Unit 3, TS 3.3.5.1 requires 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 RHR pump D is declared inoperable, TS 3.3.5.1 Required Action C.1 requires that 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 inch gauge (psig). When the auto-start function for the 3B and 3D CS pumps and the 3D LPCI RHR pump is disabled, two low pressure ECCS injection or spray subsystems are inoperable. With two or more low pressure ECCS injection or spray subsystems inoperable, TS 3.5.1 Required Action H.1 requires BFN, Unit 3, immediately enter TS LCO 3.0.3.

The auto-start function for the BFN, Unit 3, 3B and 3D CS pumps, and the 3D LPCI RHR pump was inoperable from September 17, 2014, until January 24, 2015, which is longer than allowed by TS 3.3.5.1 and TS 3.5.1 Actions.

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 September 17, 2014, until January 24, 2015. Based on this evaluation, BFN, Unit 3, operated with one inoperable RHRSW pump for longer than allowed by TS 3.7.1 Actions.

V. Assessment of Safety Consequences

The 3B and 3D CS pumps, the 3D RHR pump, and the D1 RHRSW pump would not have automatically started with normal power available to shutdown board 3ED as a result of this event. However, there was not a significant impact to plant safety because manual starting of the 3B and 3D CS pumps and the 3D RHR pump was not affected. Control room operators could have manually started these pumps when their failure to automatically start was identified. The failed switch only serviced the normal power feed, and automatic starting function was unaffected under emergency power. To address any periods when associated trains were unavailable, a Probabilistic Risk Assessment evaluation was performed to assess the increase in risk. The results of the evaluation, which factored in every entry where an associated train was unavailable, concluded that increased risk was negligible.

Based on the discussion above, the safety significance of this condition is minimal and did not pose a threat to the health and safety of the public or plant personnel.

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 3B and 3D CS pumps, the 3D RHR pump, and the D1 RHRSW pump would not have automatically started with

normal power available to shutdown board 3ED. While this rendered these systems inoperable, they were available, since each pump could be manually started to fulfill their safety functions. Automatic starting of the pumps was unaffected under emergency power.

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 reactor was not shutdown during this time period.

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-K31B was determined to have begun on September 17, 2014, at 1608 CDT, during a EDG paralleling capability test. Operability was restored on January 24, 2015 at 2015 CST following the replacement of the relay and switch.

VI. Corrective Actions

Corrective Actions are being managed by TVA's corrective action program under PERs 980277 and 803629.

A. Immediate Corrective Actions

- Replaced the MJ(52STA) switch on breaker BFN-BKR-211-03ED/008.

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

There are three corrective actions to reduce the probability of similar events from occurring in the future.

- The PMs for the affected breakers have been revised to replace MJ switches on a 24 year frequency.
- The remaining MJ switches in non-spare breakers will be replaced.
- The Breaker Program was revised to include essential switchgear components.

VII. Additional Information:

A. Previous similar events at the same plant:

A search of the Corrective Action Program for BFN, Units 1, 2, and 3, identified six MJ(52STA) switch failure events since 2010. These failures were captured by PERs 230836, 328038, 672598, 752488, 792179, and 801449. These individual failures were collectively evaluated by PER 803629 described below.

PER 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 PER 803629 identified two apparent causes.

NARRATIVE

First, the appropriate 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. Engineering concluded that this replacement strategy was more conservative than the recommended cleaning and inspection strategy.

Second, BFN's elected and documented PM strategy for Medium Voltage Breakers includes the associated switchgear, but the Breaker Program excludes the associated switchgear components, allowing the breaker support components to be overlooked with respect to reliability although they are a vital component to the reliability of the breaker.

The extent of condition review, performed during the causal analysis for PER 803629 identified breaker BFN-3-BKR-211-03-ED/008 in the population of breakers containing MJ(52STA) switches that are subject to failure. Work Orders (WO) were created to replace the MJ(52STA) switches in each breaker identified during the extent of condition review. The failed MJ(52STA) switch in BFN-3-BKR-211-03-ED/008 was scheduled to be replaced during the next BFN, Unit 3, refueling outage in March 2016. However, the switch failed prior to replacement.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

In accordance with NUREG-1022, this event is not considered a safety system functional failure because the 3B and 3D CS pumps, the 3D RHR pump, and the D1 RHRSW pump remained available and could be manually started to perform their safety functions in the event of an accident.

D. Scram with Complications Consideration:

This event did not result in a reactor scram.

VIII. Commitments

There are no commitments.