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

May 30, 2017

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 50-260/2017-003-00**

The enclosed Licensee Event Report provides details of a manual reactor scram initiated during startup due to multiple rods inserting. 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), any event or condition that resulted in a manual or automatic actuation of the Reactor Protection System.

There are no new regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact M. W. Oliver, Nuclear Site Licensing Manager, at (256) 729-2636.

Respectfully,

S. M. Bono
Site Vice President

Enclosure: Licensee Event Report 50-260/2017-003-00 – Manual Reactor Scram Initiated During Startup Due to Multiple Rods Inserting

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 50-260/2017-003-00

Manual Reactor Scram Initiated During Startup Due to Multiple Rods Inserting

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See Enclosed

NRC FORM 366 (04-2017) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 03/31/2020

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Browns Ferry Nuclear Plant, Unit 2	05000260	1 OF 5

4. TITLE

Manual Reactor Scram Initiated During Startup Due to Multiple Rods Inserting

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	N/A
03	29	2017	2017	- 003	- 00	05	30	2017	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)*			
2	☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
	☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
	☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
	☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☒ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
10. POWER LEVEL	☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
	☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
000	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
	☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(D)	☐ 73.77(a)(2)(i)
	☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☐ 50.73(a)(2)(vii)	☐ 73.77(a)(2)(ii)
		☐ 50.73(a)(2)(i)(C)	☐ OTHER Specify in Abstract below or in NRC Form 366A	

12. LICENSEE CONTACT FOR THIS LER

LICENSEE CONTACT	TELEPHONE NUMBER *(Include Area Code)*
Ryan Coons, Licensing Engineer	256-729-2070

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
B	JC	AMP	G080	Y	B	JC	57	G080	Y

14. SUPPLEMENTAL REPORT EXPECTED	15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO		N/A	N/A	N/A

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

On March 29, 2017, at 1842 Central Daylight Time (CDT), during Unit 2 start-up, Operations personnel received annunciators for an Intermediate Range Monitor (IRM) Downscale and a Control Rod Withdrawal Block. Operations personnel noticed that IRM 'G' was reading downscale and adjusted the range down one position with no immediate reaction. At 1844 CDT, an upscale spike on IRM 'G' caused a half scram on Reactor Protection System (RPS) 'A' trip system. After verifying that the IRM 'G' High-High trip signal was cleared, Operations personnel reset the half scram on RPS 'A'. An immediate, concurrent trip signal from IRM 'F' was then received on the RPS 'B' trip system, resulting in multiple rods inserting into the core. When Operations personnel identified multiple rods inserting, a manual reactor scram was inserted at 1844 CDT.

The root cause was determined to be a lack of performing electromagnetic and radio-frequency interference noise testing to detect nuclear instrumentation abnormalities.

Corrective Action to Prevent Recurrence is to perform routine pre-outage and outage-related preventive maintenance tasks for noise-induced cable tests to verify the noise has been removed.

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Browns Ferry Nuclear Plant, Unit 2	05000-260	2017	- 003	- 00

NARRATIVE

I. Plant Operating Conditions Before the Event

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 2, was in Mode 2 at zero percent power, after completing a refueling outage.

II. Description of Event

A. Event Summary

On March 29, 2017, at 1842 Central Daylight Time (CDT), during Unit 2 start-up, Operations personnel received annunciators for an Intermediate Range Monitor (IRM) Downscale and a Control Rod Withdrawal Block. Operations personnel noticed that IRM 'G' was reading downscale and adjusted the range down one position with no immediate reaction. At 1844 CDT, an upscale spike on IRM 'G' caused a half scram on Reactor Protection System (RPS) 'A' trip system. After verifying that the IRM 'G' High-High trip signal was cleared, Operations personnel reset the half scram on RPS 'A'. An immediate, concurrent trip signal from IRM 'F' was then received on the RPS 'B' trip system, resulting in multiple rods inserting into the core. When Operations personnel identified multiple rods inserting, a manual reactor scram was inserted at 1844 CDT.

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 whose inoperability contributed to this event.

C. Dates and approximate times of occurrences

Dates & Approximate Times	Occurrence
March 29, 2017, at 1651 CDT	BFN, Unit 2, achieved criticality, as part of startup activities.
March 29, 2017, at 1842 CDT	Operations personnel received annunciators for an IRM Downscale and a Control Rod Block for IRM 'G' and adjusted the range down one position for IRM 'G'.
March 29, 2017, at 1844 CDT	IRM 'G' read upscale when ranged down, resulting in an unexpected half scram on RPS 'A'. The IRM reading stabilized at this higher value. Operations personnel reset the half scram on RPS 'A' and a trip signal from IRM 'F' was received on the RPS 'B' trip system, resulting in multiple rods inserting into the core. When Operations personnel identified multiple rods inserting, a manual reactor scram was inserted.

D. Manufacturer and model number of each component that failed during the event

The failed component was a General Electric pre-amplifier, manufacturer part number 112C2218G001.

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

Operations personnel received annunciators, IRM Downscale and Control Rod Withdrawal Block, for IRM 'G'. Additionally, when Operations personnel were directed to reset RPS 'A', multiple rods were inserting into the core.

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

A faulty pre-amplifier [AMP] gave the IRM 'G' the appearance of a low signal. When the IRM 'G' experienced a spike on this new setting, it caused a half scram.

The faulty high-voltage connector [57] and degraded grounding inside of the IRM 'F' drawer allowed for spurious signals induction from adjacent and/or overlapping cables.

H. Operator actions

After a spike on IRM 'G' caused a half scram on the RPS 'A' trip system, Operations personnel verified that no trip condition was present, and manipulated the RPS 'A' scram reset switch. When resetting RPS 'A', a spurious IRM 'F' signal caused a half scram on RPS 'B' system. This caused multiple rods to insert into the core, requiring Operations personnel to manually scram the reactor.

I. Automatically and manually initiated safety system responses

Operations personnel inserted a manual reactor scram upon noticing multiple rods inserting into the reactor.

III. Cause of the event

A. Cause of each component or system failure or personnel error

The root cause was determined to be a lack of performing electromagnetic and radio-frequency interference noise testing to detect abnormalities in nuclear instrumentation.

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

There were no human performance related root causes associated with this event.

IV. Analysis of the event

The Tennessee Valley Authority (TVA) is submitting this event in accordance with Title 10 of the Code of Federal Regulations 50.73(a)(2)(iv)(A), any event or condition that resulted in a manual or automatic actuation of the RPS. The condition was discovered on March 29, 2017, when IRM 'G' appeared to have a downscale signal, from what was later determined to be a result of a pre-amplifier failure. Upscaling the IRM 'G' caused an RPS 'A' half scram. Signal noise from the RPS 'A' scram reset switch inadvertently induced a current through a faulty high voltage connector on IRM 'F'. This spurious current spike on IRM 'F' tripped a RPS 'B' half-scram signal, before the 'A' signal had cleared. Upon noticing control rod motion, Operations personnel were procedurally required to insert a manual reactor scram, which constitutes a reportable event.

V. Assessment of Safety Consequences

This event resulted in the manual actuation of a safety system. This event did not result in the inoperability or unavailability of any system to provide their required safety functions. No Emergency Core Cooling Systems [BG] [BJ] [BO] or Reactor Core Isolation Cooling [BN] reactor water level initiation set points were reached. Primary Containment Isolation Systems did not receive an actuation signal and performed as designed. All safety systems remained in standby readiness configuration and were capable of performing their required safety functions. Therefore, this condition had a negligible impact on the health and safety of the public.

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

Each RPS train had three additional IRMs which remained operable throughout this event.

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

Safety system availability was not impacted by this event.

C. For failure that rendered a train of a safety system inoperable, estimate of the elapsed time from discovery of the failure until the train was returned to service

Safety system operability was not impacted by this event.

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VI. Corrective Actions

Corrective Actions are being managed by TVA's corrective action program under Condition Report (CR) 1278595.

A. Immediate Corrective Actions

Troubleshooting was performed prior to re-commencing startup. During that effort, the high voltage connector in the IRM 'F' drawer was replaced, and the IRM 'G' pre-amplifier was replaced and its range switch was correlated.

B. Corrective Actions to Prevent Recurrence or to reduce the probability of similar events occurring in the future

Corrective Action to Prevent Recurrence is to perform routine pre-outage and outage-related preventive maintenance tasks for noise-induced cable tests to verify the noise has been removed.

VII. Previous Similar Events at the Same Site

As described in CR 558437, a similar event occurred on May 24, 2012, at BFN, Unit 3, during startup following a refueling outage. Troubleshooting activities identified that IRM 'A' and Source Range Monitors (SRMs) 'A', 'C' and 'D' received period alarms due to scram reset switch actuation with a half scram signal. The subsequent investigation revealed that a high voltage cable in the IRM 'A' main control room drawer had a broken insulating shield, and that the scram reset switch induced electronic noise on the control room common ground. The high impedance of the ground, acting through this degraded connector, caused an electronic spike on IRM 'A', leading to a RPS 'A' actuation while Operations personnel reset a previous RPS 'B' half-scram signal, resulting in a half scram.

Corrective maintenance involved adding ferrite beads to the SRM ground wires and to the reset switch ground wire. It was determined that the Unit 3 IRM 'A' and SRMs were only vulnerable to scram reset switch noise when actually resetting a valid half scram. To prevent recurrence, a significant number of connectors were repaired or replaced on all three units. However, these efforts did not focus on finding the noise causes, and were insufficient to prevent recurrence. While nuclear instrumentation is largely standardized, there can be unforeseen problems, especially as components degrade or are replaced over time.

VIII. Additional Information

There is no additional information.

IX. Commitments

There are no new commitments.