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

July 23, 2012

10 CFR 50.73

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

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

Subject: **Licensee Event Report 50-296/2012-004-00**

The enclosed Licensee Event Report provides details of a manual reactor scram during startup due to multiple control rod insertion. 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 of the systems listed in paragraph 10 CFR 50.73(a)(2)(iv)(B), reactor protection system including: reactor scram or reactor trip.

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

Respectfully,

K. J. Polson
Vice President

Enclosure: Licensee Event Report 50-296/2012-004-00 - Manual Reactor Scram During Startup Due to Multiple Control Rod Insertion

cc: See Page 2

IE22
NRR

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 50-296/2012-004-00

Manual Reactor Scram During Startup Due to Multiple Control Rod Insertion

See Attached

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 10/31/2013

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 Section (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: Manual Reactor Scram During Startup Due to Multiple Control Rod Insertion

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
05	24	2012	2012	- 004 -	00	07	23	2012	FACILITY NAME: N/A	DOCKET NUMBER: 05000

9. OPERATING MODE

2

10. POWER LEVEL

001

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☒ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

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
B	JC	CON	A380	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 May 24, 2012, at approximately 0638 Central Daylight Time, Operations personnel inadvertently ranged 3H intermediate range monitor (IRM) down instead of up resulting in a half scram from the 3B reactor protection system (RPS) trip channel. Subsequently, the IRM was properly ranged and Operations personnel responded in accordance with procedures to reset the half scram. Coincident with Operations personnel placing the scram reset switch in the Group 2/3 position, an electrical spike was received on 3A IRM of the 3A RPS trip channel resulting in control rod insertion for the Groups 1 and 4 control rods. Operations personnel identified the unexpected control rod motion and initiated a manual reactor scram in accordance with Browns Ferry Nuclear Plant (BFN) Abnormal Operating Instructions.

The root cause was the design of the IRM high voltage coaxial cable connector allowed the cable to twist at the ferrule, which caused the shield to become ungrounded.

Corrective actions are established to replace the IRM high voltage coaxial cable side connectors and use Raychem shrink wrap on the cable to cover the back shell nut or replace the existing connectors with new design coaxial cable side connectors that eliminate the shield weaknesses of the previous connector design on BFN, Units 1, 2, and 3.

NARRATIVE

I. PLANT CONDITION(S)

At the time of the event, Browns Ferry Nuclear Plant (BFN), Unit 3, was in Mode 2 at approximately 1 percent power following a refueling outage.

II. DESCRIPTION OF EVENT

A. Event

On May 24, 2012, at approximately 0638 Central Daylight Time (CDT), Operations personnel inadvertently ranged 3H intermediate range monitor (IRM) down instead of up resulting in a half scram from the 3B reactor protection system (RPS) [JC] trip channel. Subsequently, the IRM was properly ranged and Operations personnel responded in accordance with procedures to reset the half scram. Coincident with Operations personnel placing the scram reset switch in the Group 2/3 position, an electrical spike was received on 3A IRM of the 3A RPS trip channel resulting in control rod insertion for the Groups 1 and 4 control rods. Operations personnel identified the unexpected control rod motion and initiated a manual reactor scram in accordance with BFN Abnormal Operating Instructions (AOIs).

The plant responded as designed. All safety systems remained in a standby readiness configuration. There were no Emergency Core Cooling System (ECCS) [BJ][BO][BM][SB] or Reactor Core Isolation Cooling (RCIC) [BN] System reactor water level initiation set points reached and no Primary Containment Isolation System (PCIS) [BD] actuation signals were received.

B. Inoperable Structures, Components, or Systems that Contributed to the Event

There were no inoperable structures, components, or systems that contributed to this event.

C. Dates and Approximate Times of Major Occurrences

May 24, 2012, at 0638 CDT	Operations personnel inadvertently ranged 3H IRM downward instead of upward resulting in a half scram from the 3B RPS trip channel.
May 24, 2012, at 0639 CDT	The scram reset switch was placed in the Group 2/3 position. At the same time the switch was taken to the Group 2/3 position, groups 1 and 4 control rods began to insert. Operations personnel immediately identified the unexpected control rod motion and initiated a manual reactor scram in accordance with BFN AOIs.
May 24, 2012, at 1010 CDT	BFN reported event to the NRC.

NARRATIVE

D. Other Systems or Secondary Functions Affected

There were no other systems or secondary functions affected by this event.

E. Method of Discovery

Operations personnel observed the unexpected control rod motion during reset of the half scram.

F. Operator Actions

Operations personnel responded in accordance with procedures to reset the half scram, identified the unexpected control rod motion, and initiated a manual reactor scram in accordance with BFN AOIs.

G. Safety System Responses

The plant responded as designed. All safety systems remained in a standby readiness configuration. There were no ECCS or RCIC System reactor water level initiation set points reached and no PCIS actuation signals were received.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of the event was the scram reset switch induced electromagnetic interference on the control room common ground which, through a degraded connector [CON], caused an electrical spike on the 3A IRM. This electronic spike resulted in a 3A RPS actuation while Operations personnel were resetting a previous half scram signal on the 3B RPS.

B. Root Cause

The root cause was the design of the IRM high voltage coaxial cable connector allowed the cable to twist at the ferrule, which caused the shield to become ungrounded.

C. Contributing Factors

1. Surveillance testing requires manipulation of the cable connections at least quarterly, which increases the potential for connector fatigue. The increased potential for connector fatigue will be addressed by replacing the IRM high voltage coaxial cable side connectors and use Raychem shrink wrap on the cable to cover the back shell nut or by replacing the existing connectors with a new design of coaxial cable side connector.
2. Special instrument instruction SII-0-XX-92-054, IRM/SRM Testing and Temporary Protection Maintenance Instruction, does not include a test for verifying coaxial cable connector shielding integrity. The lack of a test to verify coaxial cable connector shielding integrity will be addressed by developing a mockup and testing of equipment to evaluate the new testing methods. The new testing methods will then be implemented for use in detecting degraded or failed IRM and SRM connector shields.

3. Ineffective use of self-checking by the Operator during ranging of the IRM.

IV. ANALYSIS OF THE EVENT

The Tennessee Valley Authority (TVA) 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 of the systems listed in paragraph 10 CFR 50.73(a)(2)(iv)(B), reactor protection system including: reactor scram or reactor trip.

The design of the IRM high voltage coaxial cable connector allows the twisting of the cable to damage the shielding. The IRM high voltage coaxial cable supplies power to the IRM. The coaxial cable shielding is bent back on a ferrule and mechanically compressed using a back shell nut that is tightened in the clockwise direction. If the nut is tightened excessively, it can damage the shield. Also, if the nut is allowed to loosen, it can also affect the shielding. In this case, the shielding was found degraded as evidenced by the cable turning in the connector for the 3A IRM. Interviews with the engineers and instrument mechanics confirm that when the IRMs have spiking issues, one of the first locations checked is the coaxial cable connections.

During the BFN, Unit 3, startup, a pattern had been established ranging IRMs downward and the error occurred when the first IRM was required to be ranged upward. Additionally, this was the first performance of an actual startup by the Operator that made the error. An error likely situation developed when plant conditions changed and an opposite action was required for the same component. Initially, the ranging IRM directive required moving the switch downward, and when plant conditions changed, the same ranging IRM directive required moving the switch upward. A specific pre-job brief for ranging IRMs was not performed nor was it required. A reactivity brief was performed prior to the Operators assuming the shift. Although there were error precursors and error likely situations, the Operator making the manipulation of the 3H IRM range switch stated the correct action that was to be performed to the peer checker and made the appropriate indication of the range switch direction, but ranged the switch downward instead of upward. Therefore, these error precursors and error likely situations were not considered as contributing causes.

Just in time training (JITT) for reactor shutdown and startup was performed on April 9, 2012. The JITT for the BFN, Unit 3, startup was also performed on May 16, 2012, prior to the first startup from the refueling outage. The JITT is normally used for the Operations crew that is performing the startup which gives the startup Operations crew the opportunity to discuss communications, roles, responsibilities, and practices which make them more familiar and prepared for startup. The Operator that incorrectly ranged the 3H IRM downward instead of upward was trained at the first JITT which occurred on April 9, 2012. A performance analysis worksheet and a training needs analysis was performed in accordance with NPG-SPP-17.2, Analysis Phase, to determine if training was a contributing cause. The analysis determined that training was not a contributing cause. Therefore, the JITT would not have prevented the incorrect operation and was not considered a contributing cause.

NARRATIVE

The Operator making the manipulation of the 3H IRM range switch stated the correct action that was to be performed to the peer checker and made the appropriate indication of the range switch direction, but ranged the switch downward instead of upward. The self check was done in conjunction with a peer check. Both tools were used in accordance with standard human performance tools. The human performance tool that was not used was the act correctly step in the STAR (Stop and focus, Think what will happen with right action, Act correctly, Review that the result is as expected) human performance tool which resulted in a contributing cause of the human performance error.

Extent of Condition

The extent of condition is bounded by the unit being in a startup, with a half scram already present before using the scram reset switch. It was determined that BFN, Unit 3, 3A IRM and three SRMs were vulnerable to noise from the scram reset switch, only when resetting a half scram. The BFN, Units 1 and 2, are not currently in startup and the exact test conditions could not be established.

Extent of Cause

The extent of cause is bounded by SRM and IRM coaxial cable side connectors at BFN and only those connections that are susceptible to shield to ground separation at the ferrule.

V. ASSESSMENT OF SAFETY CONSEQUENCES

The causes of this event resulted in half of the control rods inserting (Groups 1 and 4) in response to a spurious scram signal followed by a manual scram signal initiated by the Operator. The function of the RPS is to initiate a reactor scram when one or more monitored parameters exceed their specified limits to preserve the integrity of the fuel cladding and the Reactor Coolant System and minimize the energy that must be absorbed following a loss of coolant accident. This can be accomplished either automatically or manually. The plant is designed to scram all control rods at the same time, but in this case, only half of the control rods began inserting initially, followed by prompt Operator action to initiate a manual scram which inserted all control rods. This had the potential to reduce the defense in depth to nuclear safety. The human performance error created the half scram condition which reduces the defense in depth to a plant scram and associated plant transient. The degraded equipment condition caused the full scram on half of the control rods.

In response to this condition, Operations personnel identified the unexpected control rod motion and initiated a manual reactor scram in accordance with BFN AOIs. The plant responded as designed. All safety systems remained in a standby readiness configuration. There were no ECCS or RCIC System reactor water level initiation set points reached and no PCIS actuation signals were received.

Therefore, TVA concluded that there was no significant reduction to the health and safety of the public.

NARRATIVE

VI. CORRECTIVE ACTIONS - The corrective actions are being managed by TVA's corrective action program.

A. Immediate Corrective Actions

1. Operator was removed from watch standing duties pending remediation.
2. Cable connectors in degraded IRM drawer were repaired and tested.

B. Corrective Actions

1. Identify the appropriate method of eliminating the shield weaknesses in BFN, Units 1, 2, and 3, IRM and SRM coaxial connectors.
2. Disassemble and perform an as-found inspection on all SRM coaxial cable side connectors on BFN, Units 1, 2, and 3. Replace connectors or improve current connector design to eliminate the shield weaknesses of the previous connector.
3. Develop a mockup and test equipment to evaluate new testing methods for use in detecting degraded or failed IRM and SRM connector shields. Revise SII-0-XX-92-054 to incorporate the new testing method(s) to detect degraded or failed connector shields.

C. Corrective Actions to Prevent Recurrence

1. Replace the IRM high voltage coaxial cable side connectors and use Raychem shrink wrap on the cable to cover the back shell nut or replace the existing connectors with new design coaxial cable side connectors that eliminate the shield weaknesses of the previous connector design on BFN, Units 1, 2, and 3.
2. Disassemble and perform an as-found inspection on the IRM signal coaxial cable side connectors to verify proper assembly on BFN, Units 1, 2, and 3. The IRM signal coaxial cable transmits the signal from the IRM pre-amplifier to the associated RPS IRM channel. Replace connectors or improve current connector design to eliminate the shield weaknesses of the previous connector.

VII. ADDITIONAL INFORMATION

A. Failed Components

The failed component was an IRM high voltage coaxial cable connector. The manufacturer of the connector was Amphenol with a manufacturer part number of 28000.

B. Previous Similar Events

A search of BFN LERs for BFN, Units 1, 2, and 3, was performed and BFN, Unit 2, LER 50-260/2004-002-00, Automatic Reactor Scram During Startup Due To Spurious Upscale Trip On The Intermediate Range Monitors, was found to be similar.

A search in the BFN corrective action program for the past five years was performed. There were several Problem Evaluation Reports (PERs) that documented connector issues. The PER 338613 was directly related to an IRM high voltage coaxial cable connector. The PER 338613 documents that an IRM drawer high voltage connector

needed to be replaced. Actions were implemented to repair the connector. No further action was taken. There were also several PERs that documented IRM half scrams: PERs 135889, 164120, 164325, 362057, 364646, 368256, 371387, 375780, and 439393.

C. Additional Information

The corrective action document for this report is PER 558437.

D. Safety System Functional Failure Consideration

In accordance with NEI 99-02, this condition is not considered a safety system functional failure.

E. Scram With Complications Consideration

This event was not a complicated scram.

VIII. COMMITMENTS

There are no commitments.