



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

December 2, 2019

10 CFR 50.73
10 CFR 50.4(a)

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

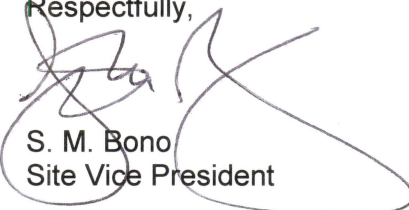
Browns Ferry Nuclear Plant, Unit 2
Renewed Facility Operating License No. DPR-52
NRC Docket No. 50-260

Subject: **Licensee Event Report 50-260/2019-003-00**

The enclosed Licensee Event Report provides details of an automatic reactor scram due to Intermediate Range Monitor noise. 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 an event that resulted in an 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 J. L. Paul, Nuclear Site Licensing Manager, at (256) 729-2636.

Respectfully,



S. M. Bono
Site Vice President

Enclosure: Licensee Event Report 50-260/2019-003-00 – Automatic Reactor Scram during Startup due to Intermediate Range Monitor Noise.

cc (w/ Enclosure):

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

ENCLOSURE

**Browns Ferry Nuclear Plant
Unit 2**

Licensee Event Report 50-260/2019-003-00

Automatic Reactor Scram during Startup due to Intermediate Range Monitor Noise

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 Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by 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 2

2. Docket Number

05000260

3. Page

1 OF 6

4. Title

Automatic Reactor Scram during Startup due to Intermediate Range Monitor Noise.

| 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 |
| 10 | 01 | 2019 | 2019 | - 003 | - 00 | 12 | 02 | 2019 | N/A | N/A |
| 9. Operating Mode | | | 11. This Report is Submitted Pursuant to the Requirements of 10 CFR §: (Check all that apply) | | | | | | | |
| 2 | | | <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) | | |
| 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) | |
| 0 | | | <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

13. Complete One Line for each Component Failure Described in this Report

| Cause | System | Component | Manufacturer | Reportable to ICES | Cause | System | Component | Manufacturer | Reportable to ICES |
|-------|--------|-----------|--------------|--------------------|-------|--------|-----------|--------------|--------------------|
| E | IG | CBL | GEH | 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 14 single-spaced typewritten lines)

On October 1, 2019, at approximately 0307 Central Daylight Time (CDT), Browns Ferry Nuclear Plant (BFN) Unit 2 received a reactor scram signal from less than 1% power that originated from the Neutron Monitoring System. There were no complications associated with this scram. All required safety systems functioned as designed. The initiating condition was discovered to be a scram signal due to electrical noise induced when the pushbutton was depressed for driving Source Range Monitors (SRMs) C and D out concurrently.

On October 1, 2019, at approximately 0605 CDT, Operations personnel completed Event Notification 54302 to the NRC.

The root cause of this event was that BFN engineering and leadership demonstrated weaknesses in risk perception related to the failure to advocate for and implement a permanent solution to the long standing Intermediate Range Monitor (IRM) noise susceptibility issue. Specifically, the IRM system design is not robust enough to mitigate the effects of noise intrusion. Corrective actions which will reduce or mitigate the probability of recurrence are to implement a process to manage the risk of identified equipment vulnerabilities; to implement time constant modifications to BFN Units 1, 2, and 3 which will make the system more robust against noise spiking; and to revise the Bridging and Mitigation Strategy Development procedure to explicitly require review of OE during bridging or mitigation strategy development.

**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 Information Services Branch (T-2 F43), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by 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 2 | 05000260 | 2019 | - 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 approximately 0 percent power.

II. Description of Event**A. Event Summary**

On October 1, 2019, at approximately 0307 Central Daylight Time (CDT), BFN Unit 2 received a reactor scram signal from less than 1% power that originated from the Neutron Monitoring System (NMS) [EIS IG]. There were no complications associated with this scram. At approximately 0315 CDT, Operations personnel ceased reactor start-up, and placed the reactor in MODE 4 at approximately 0606 CDT. BFN Unit 2 began complex troubleshooting, with Maintenance personnel performing cable [EIS CBL] characterization (CHAR) testing of Intermediate Range Monitor (IRM) [EIS RR] cables as well as Source Range Monitor (SRM) drive [EIS DRIV] motor [EIS MO] testing. The initiating condition was discovered to be an invalid scram signal due to electrical noise induced when the pushbutton was depressed for driving SRMs C and D out concurrently.

On October 1, 2019, at approximately 0605 CDT, Operations personnel completed Event Notification (EN) 54302 to the NRC.

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 an event that resulted in an automatic actuation of the Reactor Protection System (RPS).

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 30, 2019, at 2356 CDT | Unit 2 entered MODE 2. |
| October 1, 2019, at 0255 CDT | Unit 2 critical. |
| October 1, 2019, at 0307 CDT | Unit 2 received an automatic reactor scram. |
| October 1, 2019, at 0605 CDT | Completed EN# 54302 to the NRC. |
| October 1, 2019, at 0606 CDT | Unit 2 entered MODE 4. |

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

The components found to be degraded during the event were under-vessel extension cables for IRMs D, E, G, and H. BFN replaced General Electric (GE) Reuter Stokes IRM cables, part number RS-E2-0067-002; and GE cable connectors, part number RS-E3-0048.

E. Other systems or secondary functions affected

This event was an uncomplicated scram, and did not affect any other systems or functions.

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

Troubleshooting identified that the IRM had sent an invalid scram signal due to electrical noise induced when the pushbutton was depressed for driving SRMs C and D out concurrently.

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

The initiation of SRM drive motor movement created noise that was picked up by the IRMs under-vessel at degraded connectors.

H. Operator actions

Operations personnel ceased reactor start-up and placed the reactor in MODE 4.

I. Automatically and manually initiated safety system responses

Unit 2 RPS automatically actuated on a signal from the Neutron Monitoring System.

III. Cause of the event

The root cause of this event was that BFN engineering & leadership demonstrated weaknesses in risk perception related to the failure to advocate for and implement a permanent solution to the long standing IRM noise susceptibility issue.

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

1. The cause of the unexpected scram signal from the IRM system was that IRM system design is not robust enough to mitigate the effects of noise intrusion.
2. The cause of the failure to advocate for and implement a permanent solution to the long standing IRM noise susceptibility issue was that internal and external operating experience (OE) which could have prevented this event was not recognized or implemented:

**LICENSEE EVENT REPORT (LER)
CONTINUATION SHEET**

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NARRATIVE

- Previous scrams due to IRM noise spiking in 2010, 2012, and 2017 were missed opportunities to evaluate the aggregate impact of the IRM noise susceptibility.
- Significant Operating Experience Report (SOER) 10-2, 'Engaged, Thinking Organization', concluded that repetitive and long-standing issues in the industry were being tolerated, consequences of not addressing those issues were not being recognized, and significant OE was not being used effectively to prevent events.
- Industry OE from Hatch Nuclear Plant and Industry Event Report L3-12-17, "Manual Reactor Scram Because of Erratic Intermediate Range Monitor Indications During Startup" discussed the time constant modification that, if implemented, could have prevented this event.

B. 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 safety objective of the RPS is to provide timely protection against the onset and consequences of conditions that threaten the integrity of the fuel barrier. During this event, the RPS functioned as designed, initiating a scram upon receipt of HIGH-HIGH signals from IRMs D, F, G, and H.

The safety objective of the NMS is to detect conditions in the core that threaten the overall integrity of the fuel barrier due to excessive power generation and to provide signals to the RPS, so that the release of radioactive material from the fuel barrier is limited.

The IRM subsystem monitors neutron flux from the upper portion of the SRM range to the lower portion of the power range monitoring subsystems. The IRM subsystem has eight IRM channels, each of which includes one detector that can be physically positioned in the core by remote control. The detectors are inserted into the core for a reactor startup (MODE 2) and are withdrawn after the reactor mode selector switch is turned to RUN (MODE 1).

During this event the IRM subsystem sent an unexpected scram signal after picking up electrical noise from the withdrawal of SRMs. The NMS system design introduces noise source paths under-vessel at the SRM/IRM detector and extension cable interface, at the inboard penetration where the extension cable connects, at the outboard penetration connector, in the junction boxes that house the preamplifier circuitry, and at the connectors at the SRM/IRM drawers in the main control room. The system is designed to amplify the small signals that are generated from neutron detection. The design of the system also has the effect of amplifying the electrical noise from these various sources. The combination of signal and noise during this event was higher than the HIGH-HIGH IRM trip set-point, which resulted in a trip of the IRMs and which generated a full scram signal in the RPS.

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NARRATIVE**V. Assessment of Safety Consequences**

This event was an uncomplicated actuation of the RPS in which all systems other than the NMS functioned as designed to shut down the reactor and maintain safe shutdown conditions. This event did not result in the inoperability or unavailability of any system to provide their required safety functions. No Emergency Core Cooling Systems [EIS BC] [EIS BJ] [EIS BO] or Reactor Core Isolation Cooling [EIS BN] reactor water level initiation set points were reached. No impact to the health and safety of the public occurred from this event.

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

There were no systems or components needed to shut down the reactor and maintain safe shutdown conditions that failed during the event.

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

This event did not occur while the reactor was shut down.

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

This event did not result in the inoperability of any safety system train.

VI. Corrective Actions

Corrective actions for this event are being managed by the BFN Corrective Action Program under Condition Report 1553492.

A. Immediate Corrective Actions

1. Operations personnel ceased reactor start-up and placed the reactor in MODE 4.
2. Entered Complex Troubleshooting.
3. Vendor (AMS) performed CHAR testing of IRM cables.
4. Performed SRM drive motor testing to validate the initiating condition.

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NARRATIVE**B. Interim Corrective Actions**

1. Replaced D, E, G, and H under-vessel extension cables based on CHAR testing results.
2. Implemented U2 IRM mean square analog module signal filter circuit change modification, to change the time constant in the IRM Mean Square Analog card [EIIS RM].
3. Revised procedure for Unit Startup and Power Operation to note that SRM withdrawal has resulted in IRM spiking resulting in RPS actuations, and to recommend individual withdrawal of SRMs (rather than withdrawing multiple SRMs simultaneously).
4. Initiated Work Orders (WOs) for CHAR testing of IRM cables at the next outages (WOs 120834816, 120834817, and 120834819).

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

1. Implement a process to manage the risk of identified equipment vulnerabilities.
2. Implement U1 and U3 IRM mean square analog module signal filter circuit change modification, to change the time constant in the IRM Mean Square Analog card.
3. Revise Bridging and Mitigation Strategy Development procedure to explicitly require review of OE during bridging or mitigation strategy development.

VII. Previous Similar Events at the Same Site

This event is an example of a repeat issue that was determined to have been OE preventable. A search of LERs and the BFN Corrective Action Program revealed multiple instances of reactor scram signals at BFN which were attributed to IRM noise. The most recent event, and the only one to have occurred in the past five years, was an IRM-related manual scram occurring on March 29, 2017. This event was reported as LER 260/2017-003-00. Identified events include the following:

- LER 260/2017-003-00 – Manual Reactor Scram Initiated During Startup Due to Multiple Rods Inserting
- LER 296/2012-004-01 – Manual Reactor Scram During Startup Due to Multiple Control Rod Insertion
- LER 260/2010-003-00 – Reactor Scram Due to Closure of the Main Steam Isolation Valves and Subsequent Invalid RPS Scram From The Intermediate Range Monitoring System
- LER 260/2004-002-00 – Automatic Reactor Scram During Startup Due To Spurious Upscale Trip On The Intermediate Range Monitors

VIII. Additional Information

There is no additional information.

IX. Commitments

There are no new commitments.