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

October 24, 2014

10 CFR 50.73

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

Browns Ferry Nuclear Plant, Unit 1
Renewed Facility Operating License No. DPR-33
NRC Docket No. 50-259

Subject: **Licensee Event Report 50-259/2014-003-00**

The enclosed Licensee Event Report provides details of a turbine trip resulting in an automatic reactor scram. 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)(iv)(A), Any event or condition that resulted in automatic or manual actuation of any systems listed in paragraph (a)(2(iv)(B), reactor protection and containment isolation systems.

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 50-259/2014-003-00 – Turbine Generator Neutral Overvoltage Causes a Reactor Scram

cc (w/ Enclosure):

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

IE22
NRR

ENCLOSURE

Browns Ferry Nuclear Plant
Unit 1

Licensee Event Report 50-259/2014-003-00

Turbine Generator Neutral Over-Voltage Causes a Reactor Scram

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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 1	05000259	1 of 6

4. TITLE: Turbine Generator Neutral Overvoltage Causes a Reactor Scram

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
08	26	2014	2014	- 003 -	00	10	24	2014	FACILITY NAME: N/A	DOCKET NUMBER: 05000

9. OPERATING MODE

1

10. POWER LEVEL

095

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)*
Ron Everett, Licensing Engineer	256-729-2654

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	TB	XPT	B455	N	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 August 26, 2014, at 1730 Central Daylight Time, Browns Ferry Nuclear Plant (BFN), Unit 1, experienced a turbine trip resulting in an automatic reactor scram. The cause of the turbine trip was a control valve fast closure signal that was generated by a turbine trip on generator neutral over voltage signal from the 1A Generator Neutral Overvoltage relay.

The root cause of the event was the failure of an internal fuse to Generator Circuit Breaker Potential Transformer to clear a fault due to improper fuse size. This was the result of insufficient technical rigor during vendor design and in the Tennessee Valley Authority's review of the vendor design.

The corrective action to prevent recurrence is to develop and implement a design change for all three BFN Units to replace the fuses contained within the Main Generator Circuit Breaker Potential Transformers with a fuse that will coordinate with the Generator Neutral Overvoltage Relay and clear prior to the actuation point of the Generator Neutral Overvoltage Relay during any postulated failure of the Potential Transformers.

I. Plant Operating Conditions Before the Event

Browns Ferry Nuclear Plant (BFN), Unit 1, was in Mode 1 at approximately 95 percent power.

II. Description of Event

A. Event:

On August 26, 2014, at 1730 Central Daylight Time (CDT), Browns Ferry Nuclear Plant (BFN), Unit 1, experienced a turbine trip resulting in an automatic reactor scram. The cause of the turbine trip was a control valve [FCV] fast closure signal that was generated by a generator neutral over voltage signal. The Main Steam Isolation Valves (MSIVs) [ISV] remained open with the main turbine bypass valves controlling reactor pressure. The Reactor Feedwater system [SK] pumps remained in service to control reactor water level.

Primary Containment Isolation Systems (PCIS) [JE] Groups 2, 3, 6, and 8 isolation signals were received. Upon receipt of these signals, all required components actuated as required with the exception of Standby Gas Treatment (SBGT) train A, which was under a clearance for planned maintenance. Neither High Pressure Coolant Injection (HPCI) nor Reactor Core Isolation Cooling (RCIC) signals were received. Initially, three Main Steam Relief (MSRVs) opened to control the pressure surge and subsequently reclosed. The plant was placed in its normal shutdown electrical lineup. There were no impacts to BFN Units 2 and 3.

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, components, or systems that were inoperable at the start of the event and that contributed to the event.

C. Dates and approximate times of occurrences:

December 1, 2012	The affected BFN Unit 1 generator circuit breaker potential transformer [XPT] was placed in service following installation by a design change.
June 2014	Preventive Maintenance performed on all three BFN generators and isophase bus systems. No deficiencies related to this failure were identified.
August 26, 2014, at 17:30 CDT	Operations received a turbine trip, automatic reactor scram, and successful PCIS group 2, 3, 6, and 8 isolation.
August 26, 2014, at 17:38CDT	Operations reset the reactor scram and the PCIS isolation.
August 26, 2014, at 20:24 CDT	BFN Operations made Event Notification 50404 to NRC in accordance with Title 10 of the Code of Federal Regulations 10(CFR) 50.72(b)(2)(iv)(B) and 10 CFR 50.72(b)(3)(iv)(A).

NARRATIVE

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

The failed component was the Generator Circuit Breaker A-Phase Potential Transformer manufactured by ABB. The ABB Part Number is 1HC0068399M0011.

E. Other systems or secondary functions affected:

There were no other system or secondary functions affected.

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

Operations received main control room indications of the turbine trip and subsequent automatic reactor scram.

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

The failed component was the BFN Unit 1 Generator Circuit Breaker A-Phase Potential Transformer. The potential transformer failed catastrophically due to an internal fault. The fault energy vaporized some of the transformer internals and the resulting gas pressure exceeded the strength of the polymeric housing. The resulting tear in the housing relieved the pressure and also provided an escape pathway for the potting compound used to seal and insulate the windings. This failure resulted in a rise in neutral voltage causing the turbine to trip on a generator neutral over voltage signal from the 1A generator neutral overvoltage relay.

H. Operator actions:

Following the automatic reactor scram and PCIS isolation, Operations personnel responded to the scram in accordance with the Abnormal Operating Instructions. Operations personnel entered an Emergency Operating Instruction on Low Reactor Water Level.

III. Cause of the Event / Problem Statement

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

Direct Cause

The direct cause of the automatic reactor scram was the actuation of the Neutral Overvoltage Relay.

Root Cause

The root cause of the event was the failure of an internal fuse [FU] to Generator Circuit Breaker Potential Transformer to clear a fault due to improper fuse size. This was the result of insufficient technical rigor during vendor design and in the Tennessee Valley Authority's (TVA) review of the vendor design.

Contributing Cause

The contributing cause for this event was vendor manufacturing defects caused the Generator Circuit Breaker A-Phase Potential Transformer to experience a catastrophic failure.

NARRATIVE

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

There was not a human performance related root cause.

IV. Analysis of the event:

The 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 (a)(2)(iv)(B), reactor protection and containment isolation systems.

On August 26, 2014, at 1730 CDT, BFN, Unit 1, experienced a turbine trip resulting in an automatic reactor scram. The cause of the turbine trip was a control valve fast closure signal that was generated by a generator neutral over voltage signal. The generator neutral over voltage relay actuated due to catastrophic failure of the A-Phase Potential Transformer contained in the generator circuit breaker.

The failed Potential Transformer was installed as part of the generator circuit breaker replacement in December of 2012. In June 2014, preventive maintenance was performed on all three BFN generators and isophase bus systems. No deficiencies related to this failure were identified.

During this event, the 2A protective fuse in the A-Phase Potential Transformer failed to clear. The cause evaluation for this event concluded the fuse's failure to clear the fault was due to improper fuse size resulting from insufficient technical rigor during vendor design and TVA's review of the design. The protective fuse should have been sized to clear all failure modes of the Protective Relay. The corrective action to prevent recurrence will develop and implement a design change to change the Potential Transformer protective fuse from a 2 Amp fuse to a 0.5 Amp fuse. The change in fuse size will cause the fuse to clear prior to the actuation point of the Generator Neutral Overvoltage Relay preventing Potential Transformer failures from impacting plant generation.

V. Assessment of Safety Consequences

Nuclear Safety was challenged by the need for a reactor scram. However, Nuclear Safety was maintained by the automatic protective functions that resulted in the scram followed by appropriate operator actions based on procedural requirements.

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

The failed component was related to power generation. No safety systems were adversely impacted by 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:

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

NARRATIVE

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:

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

VI. Corrective Actions

Corrective Actions are being managed by TVA's corrective action program under Problem Evaluation Report (PER) 926429.

Immediate and Interim Corrective Actions

- TVA implemented a temporary modification to disconnect Unit 1 Main Generator Circuit Breaker Potential Transformers on both the Main Bank Transformer side and Main Generator Neutral Overvoltage Relay
- Work orders were issued for BFN Unit 1 to perform inspections of the Potential Transformers, Surge Arresters, and Capacitors within the Generator Circuit Breaker for indication of potential failure.
- Replaced Potential Transformers.
- Initiated work orders to perform visual inspections and electrical testing of the BFN Unit 1 isophase bus.

Corrective Actions to Prevent Recurrence

The corrective action to prevent recurrence is to develop and implement a design change for all three BFN Units to replace the fuses contained within the Main Generator Circuit Breaker Potential Transformers with a fuse that will coordinate with the Generator Neutral Overvoltage Relay and clear prior to the actuation point of the Generator Neutral Overvoltage Relay during any postulated failure of the Potential Transformers.

VII. Additional Information:

A. Previous similar events at the same plant:

A search of the Corrective Action Program and BFN Licensee Event Reports for Units 1, 2, and 3, for approximately the past three years did not identify any similar events.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

In accordance with the Nuclear Energy Institute (NEI) 99-02, "Regulatory Assessment Performance Indicator Guideline," this event is not considered a system functional failure.

NARRATIVE

D. Scram with Complications Consideration:

This event did not result in an unplanned scram with complications because:

1. The Reactor Protection system established a shutdown rod pattern for a cold clean core;
2. Reactor Pressure control was able to be established following the initial transient;
3. Power was not lost to any class 1E Emergency / Engineered Safety Feature bus;
4. A Level 1 Injection signal was not received;
5. The Main Feedwater system was available or recoverable using approved plant procedures during the scram response: and
6. Following the initial transient, stabilization of the reactor pressure/level and did not require remaining in the BFN emergency operating instructions.

VIII. Commitments

There are no commitments.