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

April 28, 2017

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 50-259/2016-004-01**

Reference: Letter from TVA to NRC, "Licensee Event Report 50-259/2016-004-00," dated December 7, 2016

On December 7, 2016, the Tennessee Valley Authority (TVA) submitted Revision 0 to Licensee Event Report (LER) 50-259/2016-004-00 (Reference). This LER was based on a preliminary investigation, which has since been finalized.

The enclosed Licensee Event Report provides details of the incorrect tap settings for the Unit 1 480V Shutdown Board Transformers and associated 480V shutdown boards that resulted in inoperability of several transformers. This resulted in a condition prohibited by Technical Specifications (TS) and a Safety System Functional Failure. TVA is submitting this report in accordance with 10 CFR 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's TS; 10 CFR 50.73(a)(2)(ii)(B), as any event or condition that resulted in the nuclear power plant being in an unanalyzed condition that significantly degraded plant safety; and 10 CFR 50.73(a)(2)(v)(A)/(B)/(C)/(D), as any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to shut down the reactor and maintain it in a safe shutdown condition, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident.

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

Respectfully,

S. M. Bono
Site Vice President

Enclosure: Licensee Event Report 50-259/2016-004-01 – Incorrect Tap Settings for the Unit 1 480V Shutdown Board Transformers Results in Inoperability of Associated 480V Shutdown Boards

cc (w/ Enclosure):
NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

ENCLOSURE

Browns Ferry Nuclear Plant
Unit 1

Licensee Event Report 50-259/2016-004-01

Incorrect Tap Settings for the Unit 1 480V Shutdown Board Transformers Results in Inoperability of Associated 480V Shutdown Boards

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See Enclosed

NRC FORM 366 (06-2016) **U.S. NUCLEAR REGULATORY COMMISSION**

APPROVED BY OMB: NO. 3150-0104 **EXPIRES: 10/31/2018**

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 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)

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4. TITLE

Incorrect Tap Settings for the Unit 1 480V Shutdown Board Transformers Results in Inoperability of Associated 480V Shutdown Boards

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
10	08	2016	2016	- 004	- 01	04	28	2017	FACILITY NAME N/A	DOCKET NUMBER N/A

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*			
5	☐ 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)
	☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☒ 50.73(a)(2)(v)(C)	☐ 73.77(a)(1)
000	☐ 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)*
Justin K. Garner, Licensing Engineer	(256)729-7955

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
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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 October 8, 2016, during the performance of preventive maintenance of the transformer winding turns ratio test on the 480V Shutdown Board transformer TS1B, it was discovered that the transformer was set on the incorrect tap. This would result in lower than minimum required voltages at the electrically downstream buses and equipment during a postulated loss of coolant accident coincident with degraded voltage conditions. Transformers TS1A and TS1B and their associated 480V shutdown boards were determined to be inoperable since installation prior to Unit 1 restart from an extended outage in 2007. This event is being reported as a condition which was prohibited by the plant's Technical Specifications, a condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to shut down the reactor and maintain it in a safe shutdown condition, remove residual heat, or mitigate the consequences of an accident, and a condition that resulted in the nuclear plant being in an unanalyzed condition that significantly degrades plant safety.

The cause of this event was the technicians did not use the correct drawings to install the transformers because they were incorrectly classified and listed as "documentation only" drawings. There were no steps in the work order to correctly set the taps. Corrective actions were to re-set the taps for the transformers in accordance with the applicable drawing, validate other similar transformer settings, and revise the classification for the applicable drawing.

NARRATIVE

I. Plant Operating Conditions Before the Event

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 1, was in a planned refueling outage in Mode 5 at 0 percent rated thermal power.

II. Description of Event

A. Event Summary:

On October 8, 2016, during the performance of preventive maintenance of the transformer winding turns ratio test on the 480V Shutdown Board transformer 1-XFA-231-TS1B (TS1B)[XFMR], it was discovered that the transformer was set on the incorrect tap [TTC] (4160/480V instead of 3952/480V). After TS1B was found to be on the incorrect tap, additional inspections were performed on the 480V Shutdown Board transformer 1-XFA-231-TS1A (TS1A). TS1A was also discovered to be set on the incorrect tap (4160/480V instead of 3952/480V). The taps on 480V Shutdown Board transformers TS2A, TS2B, and THB were inspected and found to be correct. After discovery, TS1A was set on the correct tap setting on October 12, 2016, and TS1B was set on the correct tap setting on October 9, 2016.

The tap settings for the 480V Shutdown Board Transformers TS1A and TS1B were not set as specified on the applicable drawings and as established in the applicable calculation when installed. The consequences of the referenced transformer taps being improperly set would be lower than the minimum required voltages at the electrically downstream buses [BU] and equipment under degraded voltage conditions.

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.

LICENSEE EVENT REPORT (LER) CONTINUATION SHEET

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C. Dates and approximate times of occurrences:

November 18, 2004	TS1A winding tap incorrectly set
December 15, 2004	TS1B winding tap incorrectly set
May 21, 2007	Unit 1 entered Mode 2
October 8, 2016 0049 CST	Incorrect tap setting for transformer TS1B discovered
October 9, 2016	TS1B set to the correct tap
October 10, 2016 2038 CST	Incorrect tap setting for transformer TS1A discovered
October 12, 2016	TS1A set to the correct tap
December 7, 2016	LER 50-259/2016-004-00 was submitted.
December 21, 2016 1555 CST	8-hour Event Notification System (ENS) notification for an unanalyzed condition. (EN 52452)

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

No component failures were identified that occurred during the event.

E. Other systems or secondary functions affected:

There were no other systems or secondary functions affected.

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

This condition was discovered during preventive maintenance. It was determined that the TS1A and TS1B tap settings did not agree with the applicable drawing and calculation.

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

There were no components that failed during the event.

H. Operator actions:

There were no operator actions performed in response to this event.

I. Automatically and manually initiated safety system responses:

There were no safety system responses initiated in response to this event.

III. Cause of the event

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

The installation Work Orders (WOs) were planned incorrectly in that the drawing which specified the transformer tap settings on TS1A and TS1B were listed in the implementation WOs as a Category 3 drawing. This represents both divisions and opposite trains. As a result during the installation of these transformers, there was not a step in the WOs to set the taps on the correct tap. Since there was no specific step in the WOs to change the settings for TS1A and TS1B to match the applicable drawing, the transformers were left on the same tap setting (4160/480V) as they were shipped from the factory.

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

There were no human performance related root causes.

IV. Analysis of the event:

The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's Technical Specifications; 10 CFR 50.73(a)(2)(v)(A)/(B)/(C)/(D), as any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to shut down the reactor and maintain it in a safe shutdown condition, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident; and 10 CFR 50.73(a)(2)(ii)(B), as any event or condition that resulted in the nuclear plant being in an unanalyzed condition that significantly degrades plant safety.

Technical Specification (TS) 3.8.7 requires that the Unit 1 480V Shutdown Boards and the Unit 1 Reactor Motor Operated Valve (RMOV) Boards 1A and 1B be Operable. The required action for Condition B for the 480V shutdown board is to restore the board to Operable status within 8 hours and 12 days from discovery of the failure to meet the Limiting Condition for Operation (LCO). If the required action and associated completion time of Condition B is not met, the Unit must be in Mode 3 within 12 hours and Mode 4 within 36 hours. TS Bases Section B 3.8.7 states the Operability of the AC and DC electrical power distribution subsystems is consistent with the initial assumptions of the accident analyses and is based upon meeting the design basis of the unit. This includes maintaining distribution systems Operable during accident conditions in the event of:

a) An assumed loss of all offsite power or all onsite AC electrical power sources; and
b) A postulated worst case single failure.

The Specified Safety Function affected by the condition is the ability of the Unit 1 480V Shutdown Boards 1A and 1B to receive proper voltage from the 4kV Shutdown Board supply via transformers TS1A and TS1B, respectively. The transformer tap changer settings for TS1A and

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TS1B ensure proper voltage is available to 480V Shutdown Board 1A and 1B respectively during all required operating conditions and accident scenarios. Proper voltage availability on the AC and DC buses ensures that the required power is readily available for motive as well as control functions for critical system loads connected to these buses. 480V RMOV Boards 1A and 1D are powered by 480V SD BD 1A, with backup power to these boards coming from 480V SD BD 1B. 480V RMOV Boards 1A, 1C, and 1E are powered by 480V SD BD 1B, with backup power to these boards coming from 480V SD BD 1A.

An electrical calculation software evaluation (ETAP) performed with the TS1A and TS1B taps set on the incorrect setting of 4160/480V concluded that, with a degraded voltage condition of greater than 3900 but less than 3983V at the 4kV Shutdown Board, the voltage at 480V Shutdown Board 1A would be 431V and the voltage of the 480V Shutdown Board 1B would be 433V. This is less than the required 440V specified in the associated calculation, which results in a lower voltage on the downstream RMOV boards. The 480V RMOV board bus voltages would be as follows: 480V RMOV Board 1A would be at 430V, 480V RMOV Board 1B would be at 431V, 480V RMOV Board 1C would be at 432V, and 480V Control Bay Vent Board A would be at 428V with 432V being the minimum required bus voltage at the boards specified in the applicable calculation.

The required 90% of rated voltage would not have been available for the valves on the 480V RMOV Boards according to the ETAP calculation. The consequences of the referenced transformer taps being improperly set would be lower than the minimum required voltages at the electrically downstream buses and equipment under degraded voltage conditions. Specifically, the Reactor Building Closed Cooling Water Primary Containment Discharge Outlet valve, 1-FCV-70-47, would not meet the requirements to assure that its valve motor would start under these conditions. The failure of this valve would require a manual shutdown of the reactor.

TVA determined an unanalyzed condition existed due to the tap settings for the 480V Shutdown Boards Transformers TS1A and TS1B. Because both 480V SD BDs 1A and 1B were affected by this issue, no alternative source of power was available to these boards, resulting in the failure of this system to perform its required safety function. These BDs were inoperable from 2007 when Unit 1 entered the mode of applicability, and the condition was not corrected until transformers TS1A and TS1B were set on the correct tap in October 2016, resulting in the inoperability of these BDs for longer than allowed by plant TS.

With a qualified offsite power source, operation at the degraded voltage dropout setting is considered an abnormal operating condition that is expected to be a short term duration until the load tap changer attempts to take action to increase the voltage to above the reset setting. The licensing and/or design basis requirement as per the "4.16kV and 480V Bus Load and Voltage Drop Calculation" is that connected loads not become damaged or become unavailable due to protective device actuation as a result of operating at a degraded voltage. Any voltage below the reset value of 3983V is degraded, and operation is expected to be a short duration. If the voltage at the degraded voltage level did not recover within 5.6 seconds, the Emergency Diesel Generator (EDG)[DG] associated with the 4kV Shutdown Board would start and carry the loads. The offsite power system is designed to be independent of the diesel generators to supply power to safety related equipment during a LOCA, therefore the 480V Shutdown Boards were not considered to

have been able to perform their specified safety function of ensuring the availability of AC and DC electrical power for the systems required to shut down the reactor and maintain it in a safe condition after an abnormal operational transient or a postulated Design Basis Accident (OBA). Therefore, the offsite power source would not be considered Operable as per the requirements of 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 17, and this event resulted in an unanalyzed condition that significantly degraded plant safety.

V. Assessment of Safety Consequences

A Probabilistic Risk Assessment was performed during the period of the 480V RMOV Boards inoperability and found that there was a negligible increase in risk. TVA has concluded that, during the time period that the boards were inoperable, there was no significant risk to the health and safety of the public or plant personnel for 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:

No components or systems failed due to this event.

B. For events that occurred when the reactor was shut down, availability of safety-related systems or components:

This event occurred while the reactor was shut down. Due to the condition existing when operability was required when Unit 1 entered the mode of applicability since 2007, past operability was assessed.

480V RMOV Boards 1A and 1D are powered by 480V SD BD 1A, with backup power to these boards coming from 480V SD BD 1B. 480V RMOV Boards 1A, 1C, and 1E are powered by 480V SD BD 1B, with backup power to these boards coming from 480V SD BD 1A. Because both 480V SD BDs 1A and 1B were affected by this issue, no alternative source of power was available to these boards.

480V Control Bay Vent BD A is powered by 480V SD BD 1A, with backup power to the board coming from 480V Common BD 1 Bus 2. Therefore an alternative source of power was available to this board.

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

The time frame for the condition is from November 18, 2004, for TS1A and December 15, 2004, for TS1B for Modes 1, 2, and 3 until the condition was corrected. However, the inoperability was recordable beginning in 2007 when Unit 1 entered the mode of applicability. The condition was corrected when transformer TS1A was set on the correct tap on October 12, 2016, and transformer TS1B was set on the correct tap on October 9, 2016.

VI. Corrective Actions:

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Corrective Actions (CA) are being managed by TVA's Corrective Action Program under Condition Report (CR) 1221273.

The CAs described below address this condition:

1. The transformer taps for transformers TS1A and TS1B have been set in accordance with the applicable drawing, which specify the correct tap settings.
2. Verify that the 4160/480V transformer tap settings are correct in accordance with the applicable drawings.
3. Revise the classification for the applicable drawing from Category 3 to Category 2.

VII. Previous Similar Events:

A review for CRs was performed for similar events. The following instance was discovered in regards to transformer tap settings.

- CR 03-001022-000 - Two Unit 3 transformer tap settings, TUSS 3A and THB, were found to disagree with the value used in the ETAP database, the applicable calculation, and drawing. The immediate corrective action was to perform calculations to verify that system voltages were acceptable. The corrective action for the CR was to revise the applicable calculation to support the correct tap settings for TUSS 3A and THB.

The actions for CR 03-001022-000 would not have prevented this condition.

VIII. Additional Information:

The offsite power system is designed to be independent of the EDGs to supply power to safety related equipment during a LOCA; therefore, the 480V Shutdown Boards were not considered to have been able to perform their specified safety function. In conclusion, this event is considered to be a Safety System Functional Failure in accordance with NUREG-1022.

IX. COMMITMENTS

There are no new commitments.