



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

October 3, 2016

10 CFR 50.73

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


Browns Ferry Nuclear Plant, Units 1, 2, and 3
Renewed Facility Operating License Nos. DPR-33, DPR-52, and DPR-68
NRC Docket Nos. 50-259, 50-260, and 50-296

Subject: **Licensee Event Report 50-259/2016-003-00**

The enclosed Licensee Event Report provides details of a 10 CFR 50.48(c) nonconforming condition associated with the Browns Ferry Nuclear Plant NFPA 805 analysis and Fire Safe Shutdown procedures, which do not consider the potential for fire-induced failure of the 4kV Shutdown Board under-voltage trip functions for Emergency Diesel Generator power supply alignments. The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(ii)(B), as any event or condition that results in the nuclear power plant being in an unanalyzed condition that significantly degraded plant safety.

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 50-259/2016-003-00 – Fire Safe Shutdown Procedures
Do Not Consider Potential for Fire-Induced Failure of 4kV Shutdown Board
Under-Voltage Trip Functions

cc (w/ Enclosure):

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

ENCLOSURE

**Browns Ferry Nuclear Plant
Units 1, 2, and 3**

Licensee Event Report 50-259/2016-003-00

**Fire Safe Shutdown Procedures Do Not Consider Potential for Fire-Induced Failure of 4kV Shutdown
Board Under-Voltage Trip Functions**

See Enclosed

1. FACILITY NAME Browns Ferry Nuclear Plant (BFN), Units 1, 2, and 3	2. DOCKET NUMBER 05000259	3. PAGE 1 OF 6
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4. TITLE
Fire Safe Shutdown Procedures Do Not Consider Potential for Fire-Induced Failure of 4kV Shutdown Board Under-Voltage Trip Functions

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
08	03	2016	2016	003	00	10	03	2016	BFN Unit 2	05000260
									BFN Unit 3	05000296

9. OPERATING MODE	11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)			
1	<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 checked="" 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 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)
	<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
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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
<input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO	MONTH: N/A DAY: N/A YEAR: N/A

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

On August 3, 2016, at 1300 Central Daylight Time (CDT), during reviews to respond to a NRC information request for the 2016 NRC Triennial Fire Protection Inspection regarding Emergency Diesel Generator A (EDG) alignment in Fire Safe Shutdown (FSS) procedure 0-FSS-9 (Electrical Battery Board Room 2A and 250V Battery Rooms EL 621'), it was discovered that the National Fire Protection Association (NFPA) 805 analysis and FSS procedures do not consider the potential for fire-induced failure of the 4kV Shutdown Board under-voltage trip function for EDG power supply alignments. Fire-induced failure of the board under-voltage trip function may result in the need for Operations personnel to perform additional actions. These actions, to trip board loads, are currently not included in the FSS procedures.

The cause of this condition was a human error which occurred during the transition of the fire protection program from Appendix R to NFPA 805. Corrective actions are to revise fire protection calculations, update fire protection models, provide coaching to the individuals involved, and add interim compensatory measures to FSS procedures in order to account for this condition. The risk significance of this condition was determined to be very low.

NRC FORM 366A

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104

EXPIRES: 10/31/2018

(11-2015)



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 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.

1. FACILITY NAME	2. DOCKET NUMBER	3. LER NUMBER		
		YEAR	SEQUENTIAL NUMBER	REV NO.
Browns Ferry Nuclear Plant, Units 1, 2, and 3	05000259	2016	- 003	- 00

NARRATIVE

I. Plant Operating Conditions Before the Event

At the time of discovery, Browns Ferry Nuclear Plant (BFN), Unit 1, was operating in Mode 1 at approximately 84 percent rated thermal power. BFN Units 2 and 3 were operating in Mode 1 at approximately 100 percent rated thermal power.

II. Description of Events

A. Event:

On August 3, 2016, at 1300 Central Daylight Time (CDT), during reviews to respond to a NRC information request for the 2016 NRC Triennial Fire Protection Inspection regarding Emergency Diesel Generator (EDG)[DG] A alignment in Fire Safe Shutdown (FSS) procedure 0-FSS-9 (Electrical Battery Board Room 2A and 250V Battery Rooms EL 621'), it was discovered that the National Fire Protection Association (NFPA) 805 analysis and FSS procedures do not consider the potential for fire-induced failure of the 4kV Shutdown Board (SDBD)[ECBD] under-voltage trip function for EDG power supply alignments. Fire-induced failure of the board under-voltage trip function may result in the need for Operations personnel to perform additional actions, to trip board loads, that are currently not included in the FSS procedures.

On August 3, 2016, at 2038 CDT, Event Notification 52150 was made to the NRC.

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

No inoperable systems, structures, or components contributed to the event.

C. Dates and approximate times of occurrences:

June 24, 2016	BFN Transitioned to NFPA 805
August 3, 2016, 1300 CDT	Unanalyzed condition discovered during reviews to respond to a NRC information request.
August 3, 2016, 2038 CDT	Event Notification 52150 made to the NRC

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.

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NARRATIVE

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

This condition was discovered during reviews to respond to a NRC information request.

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 cause of this condition was a human error which occurred during the transition of the fire protection program from Appendix R to NFPA 805.

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

Engineers who developed the Nuclear Safety Capability Analysis (NSCA) logic for the 4kV SDBDs did not identify the functional requirement for load management when crediting manual alignment of EDGs. This was a human error during the large one-time effort to transition the fire protection program from Appendix R to NFPA 805. The personnel involved had the necessary skill and knowledge but overlooked an important function.

IV. Analysis of the event:

The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(ii)(B), as any event or condition that results in the nuclear power plant being in an unanalyzed condition that significantly degraded plant safety.

The NFPA 805 analyses were derived from the Appendix R Safe Shutdown Analysis (SSA), and apply new failure modes such as Multiple Spurious Operation and new FSS strategies. This work was performed by a project team dedicated to NFPA 805 transition, and resulted in a deterministic compliance model (NSCA) and a Fire PRA risk model. As part of an effort to more specifically determine the functional impact of fire damage, the 4kV SDBDs were broken up into multiple components and/or functions. During this process, the need for load management was not identified as a required function. As a result, the NFPA 805 analyses failed to identify the need to clear loads from the 4kV Shutdown Boards, either automatically or manually, prior to connecting the EDG. The NSCA model therefore did not identify the appropriate failures and thus did not result in disposition of the failures in the form of risk evaluation, operator actions or modifications.

(11-2015)



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

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V. Assessment of Safety Consequences

The engineering analyses and FSS procedures that support the BFN NSCA to demonstrate compliance with NPFA 805 do not address the potential to overload EDGs when the EDGs are aligned manually. The NSCA does not take credit for automatic transfer of the 4kV SDBDs to the EDGs and, instead consistently takes credit for operators manually starting and aligning the EDGs when power from the EDG is credited. The Fire Probabilistic Risk Assessment (PRA) credits automatic transfer of the 4kV SDBDs to the EDGs. Part of the automatic logic, performed by the under-voltage auxiliary relays, includes load management so that the EDG does not become overloaded. However, neither the NSCA nor the PRA modeled the function of the under-voltage relays to trip 4kV SDBD loads. As a result, the NFA 805 'Credited Operator Actions' calculation and the FSS procedures contain steps for the operators to manually align the EDGs to the 4kV SDBDs but do not contain load management steps to trip loads.

As a result, EDGs relied upon for safe shutdown could have become overloaded during a Fire event, resulting in failure of a fire safe shutdown success path.

A risk sensitivity analysis performed for TVA concluded that the risk significance of this condition is very low, with a maximum change in Core Damage Frequency of less than 1E-06 for each unit.

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 did not occur when the reactor was shut down.

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:

No safety systems were rendered inoperable as a result of this event.

VI. Corrective Actions:

Corrective Actions (CA) are being managed by TVA's Corrective Action Program (CAP) under Condition Report (CR) 1199002.

The CAs described below address this condition:

1. Revise the NSCA model (EDQ099920110010) to include the under-voltage load breaker trip functions for 4kV SDBDs and to perform Fire Area evaluations.
2. Update the fire PRA cable selection calculation (EDN0009992012000056) to include the under-voltage load breaker trip functions for 4kV SDBDs.

NRC FORM 366A

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3. Update the Fire PRA model to include the under-voltage load breaker trip functions for 4kV SDBDs.
4. Update Fire Risk Evaluation (FRE) calculation to disposition any new Variations from Deterministic Requirements for the under-voltage load breaker trip functions for 4kV SDBDs and to update the Fire Area risk evaluations.
5. Revise MDQ0009992014000237 NFPA 805 Credited Operator Actions Calculation as needed for any operator action impacts from updated Fire Risk Evaluation.
6. Issue a design change to update design output, as necessary, for any resulting changes required from the updated Fire Risk Evaluation.
7. Provide and document coaching for the individual(s) involved, including discussion of the significance of the errors and the tools in place to prevent future occurrences.

The Interim Actions described below were initiated in response to this condition:

1. For Fire Safe Shutdown procedure changes needed to incorporate interim corrective actions for CR 1199002, develop Training Needs Analysis (TNA) and present TNA to Operations personnel.
2. Complete a Fire Protection Program Change Evaluation for FSS procedure changes to incorporate interim corrective actions for Fire Areas 01-03, 02-03, 02-04, 04, 05, 08, and 09 as outlined in the Functional Evaluation for CR 1199002.
3. Issue FSS procedure changes for 0-FSS-1-3, 0-FSS-2-3, 0-FSS-2-4, 0-FSS-4, 0-FSS-5, 0-FSS-8, 0-FSS-9 to incorporate interim corrective actions for Fire Areas 01-03, 02-03, 02-04, 04, 05, 08, and 09 as outlined in the Functional Evaluation for CR 1199002.

VII. Additional Information:

A. Previous Similar Events:

A review of the BFN CAP and Licensee Event Reports (LERs) for Units 1, 2, and 3 found ten instances within the past five years of degraded or unanalyzed conditions related to the fire protection program:

- BFN LER 259/2013-008-00 – Fire Damage to Cables in Fire Areas Could Cause Residual Heat Removal Pumps to Spuriously Start
- BFN LER 259/2012-009-00 – 480 Volt Shutdown Board Breaker Actions in Safe Shutdown Instruction Procedures May Not Work as Written Due to Cable Fire Damage
- BFN LER 260/2012-005-00 – Unanalyzed Conditions Discovered during National Fire Protection Association 805 Transition Affecting Division II of the Residual Heat Removal System
- BFN LER 259/2012-007-02 – Routing Errors Found in the Appendix R Separation Analysis

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- BFN LER 259/2012-005-01 – Combustible Materials not in Compliance with the 20-Foot Exclusion Zone Requirements
- BFN LER 260/2012-004-01 – Fire Damage to Cables in Fire Areas Could Cause a Residual Heat Removal Service Water Pump to Spuriously Start
- BFN LER 259/2012-003-01 – Reactor Protection System Circuit Potentially remain Energized During an Appendix R Fire
- BFN LER 259/2012-002-01 – Fault Propagation During A Postulated Appendix R Event Could Result In An Inability To Close Motor Operated Valves
- BFN LER 259/2012-001-01 – Unanalyzed Conditions Discovered During NFPA 805 Transition Review
- BFN LER 259/2011-010-00 – DC Ammeter Cables Not Adequately Isolated.

The cause of each of these events was legacy human performance errors. The corrective actions could have prevented the error described in this report.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

No safety systems were rendered inoperable as a result of this event. Therefore, this event is not considered to be a Safety System Functional Failure in accordance with NUREG-1022.

D. Scram with Complications Consideration:

This event did not result in a reactor scram.

VIII. COMMITMENTS

There are no new commitments.