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

October 5, 2011

10 CFR 50.73

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

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

Subject: **Licensee Event Report 50-259/2011-007-00**

On August 6, 2011, at 0522 hours Central Daylight Time, Browns Ferry Nuclear Plant Unit 1 Reactor Protection System (RPS) Motor-Generator (M-G) set 1B failed resulting in a partial loss of power to Primary Containment Isolation System (PCIS) groups and an invalid actuation of those PCIS groups. The combination of RPS M-G set 1B loss and PCIS group 6 isolation resulted in the isolation of the Drywell Floor Drain Sump and the Drywell Continuous Atmospheric Monitor for both particulate and gaseous activity. Thus, both means of automatic monitoring of Reactor Coolant System leakage became inoperable.

The Tennessee Valley Authority is submitting this report under 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)(2), general containment isolation signals affecting containment isolation valves in more than one system. This report also includes reporting under 10 CFR 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's Technical Specifications.

JE22  
MLR

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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 259/2011-007-00 - Multiple Containment System Isolations from Loss of RPS M-G Set 1B

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 259/2011-007-00 - Multiple Containment System Isolations  
from Loss of RPS M-G Set 1B**

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**See Attached**

**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 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.

<b>1. FACILITY NAME</b> Browns Ferry Nuclear Plant Unit 1	<b>2. DOCKET NUMBER</b> 05000259	<b>3. PAGE</b> 1 of 6
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**4. TITLE:** Multiple Containment System Isolations from Loss of RPS M-G Set 1B

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	06	2011	2011	- 007	- 00	10	05	2011	N/A	05000
									N/A	05000

<b>9. OPERATING MODE</b>  1	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §:</b> <i>(Check all that apply)</i>
<b>10. POWER LEVEL</b>  099	<input type="checkbox"/> 20.2201(b) <input type="checkbox"/> 20.2203(a)(3)(i) <input type="checkbox"/> 50.73(a)(2)(i)(C) <input type="checkbox"/> 50.73(a)(2)(vii) <input type="checkbox"/> 20.2201(d) <input type="checkbox"/> 20.2203(a)(3)(ii) <input type="checkbox"/> 50.73(a)(2)(ii)(A) <input type="checkbox"/> 50.73(a)(2)(viii)(A) <input type="checkbox"/> 20.2203(a)(1) <input type="checkbox"/> 20.2203(a)(4) <input type="checkbox"/> 50.73(a)(2)(ii)(B) <input type="checkbox"/> 50.73(a)(2)(viii)(B) <input type="checkbox"/> 20.2203(a)(2)(i) <input type="checkbox"/> 50.36(c)(1)(i)(A) <input type="checkbox"/> 50.73(a)(2)(iii) <input type="checkbox"/> 50.73(a)(2)(ix)(A) <input type="checkbox"/> 20.2203(a)(2)(ii) <input type="checkbox"/> 50.36(c)(1)(ii)(A) <input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A) <input type="checkbox"/> 50.73(a)(2)(x) <input type="checkbox"/> 20.2203(a)(2)(iii) <input type="checkbox"/> 50.36(c)(2) <input type="checkbox"/> 50.73(a)(2)(v)(A) <input type="checkbox"/> 73.71(a)(4) <input type="checkbox"/> 20.2203(a)(2)(iv) <input type="checkbox"/> 50.46(a)(3)(ii) <input type="checkbox"/> 50.73(a)(2)(v)(B) <input type="checkbox"/> 73.71(a)(5) <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)(C) <input type="checkbox"/> OTHER <input type="checkbox"/> 20.2203(a)(2)(vi) <input checked="" type="checkbox"/> 50.73(a)(2)(i)(B) <input type="checkbox"/> 50.73(a)(2)(v)(D)

Specify in Abstract below or in NRC Form 366A

**12. LICENSEE CONTACT FOR THIS LER**

FACILITY NAME Eric Bates, Licensing Engineer	TELEPHONE NUMBER (Include Area Code) 256-614-7180
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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
E	JC	RG	G080	Y					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b> <input type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input checked="" type="checkbox"/> NO	<b>15. EXPECTED SUBMISSION DATE</b>						
	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width:33%;">MONTH</th> <th style="width:33%;">DAY</th> <th style="width:33%;">YEAR</th> </tr> <tr> <td style="text-align: center;">N/A</td> <td style="text-align: center;">N/A</td> <td style="text-align: center;">N/A</td> </tr> </table>	MONTH	DAY	YEAR	N/A	N/A	N/A
MONTH	DAY	YEAR					
N/A	N/A	N/A					

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

On August 6, 2011, at 0522 hours Central Daylight Time, Browns Ferry Nuclear Plant Unit 1 Reactor Protection System (RPS) Motor-Generator (M-G) set 1B failed resulting in a partial loss of power to Primary Containment Isolation System (PCIS) groups and an invalid actuation of those PCIS groups. PCIS groups 1 and 2 received partial isolation signals with no subsequent system isolations, as designed. PCIS groups 3, 6, and 8 received partial isolation signals with resulting system isolations, as designed. The combination of RPS M-G set 1B loss and PCIS group 6 isolation resulted in the isolation of the Drywell Floor Drain Sump and the Drywell Continuous Atmospheric Monitor for both particulate and gaseous activity. Thus, both means of automatic monitoring of Reactor Coolant System leakage became inoperable. Unit 1 entered Technical Specification (TS) Limiting Condition for Operation (LCO) 3.4.5 Condition D, all required leakage detection systems inoperable, and immediately entered TS LCO 3.0.3 as required.

Trouble-shooting activities did not identify a specific condition that caused the voltage drop on the RPS M-G set 1B. However, there were two potential causes: (1) a loose connector or cable assembly at a terminal on the RPS M-G set control panel due to the machine design and operational characteristics (i.e., vibration induced), and (2) discontinuity within the voltage adjustment potentiometer.

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**NARRATIVE**

**I. PLANT CONDITION(S)**

Browns Ferry Nuclear Plant (BFN) Unit 1 was at approximately 99 percent power when the event occurred.

**II. DESCRIPTION OF EVENT**

**A. Event**

On August 6, 2011, at 0522 hours Central Daylight Time (CDT), BFN Unit 1 Reactor Protection System (RPS) [JC] Motor-Generator (M-G) [MG] set 1B failed resulting in a partial loss of power to Primary Containment Isolation System (PCIS) [BD] groups and an invalid actuation of those PCIS groups. PCIS groups 1 and 2 received partial isolation signals with no subsequent system isolations, as designed. PCIS groups 3, 6, and 8 received partial isolation signals with resulting system isolations, as designed. The combination of loss of RPS M-G set 1B and PCIS group 6 isolation resulted in the isolation of the Drywell Floor Drain Sump Monitoring System and the Drywell Continuous Atmospheric Monitoring System for both particulate and gaseous activity. Thus, both means of automatic monitoring of Reactor Coolant System (RCS) [IJ] leakage became inoperable. Unit 1 entered Technical Specification (TS) Limiting Condition for Operation (LCO) 3.4.5 Condition D, all required leakage detection systems inoperable, and immediately entered TS LCO 3.0.3 as required. TS LCO 3.0.3 requires Unit 1 to be in MODE 2 within 10 hours, MODE 3 within 13 hours, and MODE 4 within 37 hours.

Also, TS LCO 3.3.2.1 Condition A, one rod block monitor channel inoperable, was entered due to the loss of the Rod Block Monitor B.

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

RPS M-G set 1A was being supplied by its alternate power source, a regulating transformer, for scheduled maintenance. The alternate power source was not available to RPS M-G set 1B. The alternate power source is interlocked so that both the RPS M-G set 1A and the RPS M-G set 1B cannot be simultaneously fed from the alternate power source.

**C. Dates and Approximate Times of Major Occurrences**

- |                            |  |
|----------------------------|--|
| August 6, 2011 at 0522 CDT | Power lost from Unit 1 RPS M-G set 1B.   |
| August 6, 2011 at 0524 CDT | Unit 1 entered TS LCO 3.4.5 Condition D, TS LCO 3.0.3, and TS LCO 3.3.2.1.                     |
| August 6, 2011 at 0617 CDT | Unit 1 began reducing power from approximately 99 percent power due to the TS LCO 3.0.3 entry. |

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**NARRATIVE**

August 6, 2011 at 1204 CDT

Trouble-shooting was completed and power was restored to Unit 1 RPS M-G set 1B and to the RCS leakage monitors; exited TS LCO 3.3.2.1.

August 6, 2011 at 1208 CDT

Unit 1 exited TS LCO 3.0.3 and TS LCO 3.4.5 Condition D.

August 6, 2011 at 1548 CDT

Unit 1 began to increase power from approximately 91 percent power after the exit of TS LCO 3.0.3.

**D. Other Systems or Secondary Functions Affected**

RCS Leakage Detection Instrumentation was made inoperable.

**E. Method of Discovery**

The condition was discovered by an assistant unit operator.

**F. Operator Actions**

Operations personnel entered TS LCO 3.0.3.

**G. Safety System Responses**

PCIS groups 1 and 2 received partial isolation signals with no subsequent system isolations. PCIS groups 3, 6, and 8 received partial isolation signals with resulting system isolations.

**III. CAUSE OF THE EVENT**

**A. Immediate Cause**

BFN Unit 1 lost power from the RPS M-G set 1B. The RPS M-G set 1B voltage dropped from 120 volts-alternating current (VAC) to approximately 22 VAC.

**B. Root Cause**

Trouble-shooting activities did not identify a specific condition that caused the voltage drop on the RPS M-G set 1B. However, there were two potential causes: (1) a loose connector or cable assembly at a terminal on the RPS M-G set control panel due to the machine design and operational characteristics (i.e., vibration induced), and (2) discontinuity within the voltage adjustment potentiometer.

**C. Contributing Factors**

The Preventive Maintenance (PM) for the RPS M-G set 1B to check the terminal connections is on a three year frequency. This three year PM was last performed on January 11, 2008. In the PM tracking system, the PM is currently due on November 14, 2011, but the PM should have been due around January 11, 2011. Consequently, the PM was not scheduled within the 25 percent grace period. This condition, which was considered a possible contributing factor, was identified in Problem Evaluation Report (PER) 438509.

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**NARRATIVE**

**IV. ANALYSIS OF THE EVENT**

The Tennessee Valley Authority (TVA) is submitting this report under 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)(2), general containment isolation signals affecting containment isolation valves in more than one system.

Furthermore, TS LCO 3.4.5.D was entered because both means of automatic monitoring of RCS leakage became inoperable, requiring TS LCO 3.0.3 to be entered immediately. Therefore, this report also includes reporting under 10 CFR 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's Technical Specifications.

Trouble-shooting for this event involved the voltage adjustment potentiometer, the voltage regulator [RG], and the wiring between the voltage adjustment potentiometer and the voltage regulator.

The voltage adjustment potentiometer was wiped (operated over a full range to clean internals) while monitoring the resistive output. Even though the results indicated smooth changes and no discontinuities, discontinuities could not be ruled out as a potential cause.

The voltage regulator passed all failure analysis testing. The analysis was performed by PSI Repair Services, Inc. PSI Repair Services, Inc. disassembled the voltage regulator to clean and inspect it for damaged and missing components. The analysis identified the following: "a pinched wire with no physical damage and three electrolytic capacitors that should be changed due to their age; however, all components tested within specification." The Electric Power Research Institute (EPRI) guidance indicates that the expected shelf life for electrolytic capacitors is 14 years. This voltage regulator was received in 2004 and installed in 2005. The EPRI guidance also states the expected in-service life of this voltage regulator is 9.5 years at 48 degrees Celsius. This type of voltage regulator should be able to achieve its 10 year replacement frequency in the controlled environment where it was located.

Vibration measurements are taken on all RPS M-G sets on a quarterly basis. Since the control panel is mounted directly to the M-G set, any vibrations would be transferred directly to the control panel; however, vibration data is not taken on the control panel. Continuous vibrations could cause wiring terminals to loosen. The trouble-shooting section of the vendor manual lists "connectors or cable assemblies loose" as a cause for when the generator fails to build up rated voltage. A vibration-induced loose wire at a terminal was a potential cause of the output voltage drop. No specific loose connection was detected, but terminal connections were tightened during the trouble-shooting activities.

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**NARRATIVE**

Extent of Condition

The extent of condition is the RPS M-G Sets A and B for Units 1, 2, and 3. The RPS M-G sets are similar in size, continuously in service, and have the control panel bolted to the rotating equipment.

**V. ASSESSMENT OF SAFETY CONSEQUENCES**

The RPS provides timely protection against the onset and consequences of conditions that threaten the integrity of the fuel barrier and the nuclear system process barrier. The system is designed such that no single failure can prevent a reactor scram. The RPS is designed to automatically shutdown the reactor based on parameters that deviate from normal.

The failure of the RPS M-G set 1B occurred when Unit 1 was at approximately 99 percent power. The failure did not reduce defense-in-depth because the RPS fails to a safe condition. The failure caused a half scram to the reactor and rendered all required leakage detection systems inoperable. TS LCO 3.0.3 was initiated within the required one hour. TS LCO 3.0.3 requires Unit 1 to be in MODE 2 within 10 hours, MODE 3 within 13 hours, and MODE 4 within 37 hours. TS LCO 3.0.3 was exited within 10 hours which allowed Unit 1 to remain in MODE 1.

TS LCO 3.3.2.1 was exited within the required 24 hour completion time.

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

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

**A. Immediate Corrective Actions**

The voltage regulator was replaced, the voltage adjustment potentiometer was wiped (operated over a full range to clean internals), and all terminals were tightened.

**B. Corrective Actions**

1. Verify current three year RPS M-G set PMs are scheduled in next component outage window.
2. PM frequency for all RPS M-G sets will be increased from 3 years to 2 years.
3. Appropriate scheduling of the RPS M-G set PMs within grace will be addressed by PER 438509.

**VII. ADDITIONAL INFORMATION**

**A. Failed Components**

The failed component was the Unit 1 RPS M-G set 1B voltage regulator. The manufacturer of this component is General Electric and the model number is 3300A03B0044.



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**NARRATIVE**

**B. Previous LERs or Similar Events**

There was a previous similar event that occurred in 2004 on Unit 3. The voltage dropped on the RPS M-G set 3B. This occurrence was documented in PER 69358 and PER 70538. The cause for this event was determined to be premature degradation of the voltage regulator gain potentiometer due to a lack of periodic maintenance.

**C. Additional Information**

The corrective action documents for this report are PER 412934 and PER 438509.

**D. Safety System Functional Failure Consideration**

This event was not a safety system function failure according to NEI 99-02.

**E. Scram With Complications Consideration**

This event was not a complicated scram according to NEI 99-02.

**VIII. COMMITMENTS**

There were no commitments.