



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

December 23, 2010

10 CFR 50.73

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
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 50-259/2010-004, Revision 0**

The enclosed Licensee Event Report (LER) provides details of an event involving failure of a Residual Heat Removal (RHR) Low Pressure Coolant Injection (LPCI) System pump motor while in the shutdown cooling mode. The pump motor failed after a period of operation less than its postulated loss of coolant accident mission time. Because investigation results to date indicate that the pump motor would have most likely failed if called upon to perform its safety function, the mission time for the associated RHR subsystem during a postulated loss of coolant accident could not have been met, and the 1C RHR pump is considered to have been previously inoperable.

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.

TVA is currently completing the investigation and evaluation of this event. Once these actions are complete, TVA will supplement this report. There are no regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact J. E. Emens Jr., BFN Site Licensing Manager, at (256) 729-2636.

Respectfully,

K. J. Poisson  
Vice President

Enclosure: Licensee Event Report - Residual Heat Removal Low Pressure Coolant  
Injection System Pump Motor Failure

cc: See page 2

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NRR

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Enclosure  
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 - Residual Heat Removal Low Pressure Coolant Injection System  
Pump Motor Failure**

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**See Attached**

**LICENSEE EVENT REPORT (LER)**

(See reverse for required number of

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, NEOF-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:** Residual Heat Removal Low Pressure, Injection System Pump Motor Failure

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	27	2010	2010	004	00	12	23	2010	N/A	05000
									FACILITY NAME	DOCKET NUMBER
									N/A	05000

<b>9. OPERATING MODE</b>  5	<b>11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §:</b> (Check all that apply)											
	<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)								
<b>10. POWER LEVEL</b>  000	<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 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)	<small>Specify in Abstract below or in NRC Form 368A</small>									

**12. LICENSEE CONTACT FOR THIS LER**

<b>FACILITY NAME</b> Steve Austin, Licensing Engineer	<b>TELEPHONE NUMBER (Include Area Code)</b> 256-729-2070
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**13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT**

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO EPIX
B	BO	MO	G080	Y					

<b>14. SUPPLEMENTAL REPORT EXPECTED</b> <input checked="" type="checkbox"/> YES (If yes, complete 15. EXPECTED SUBMISSION DATE) <input type="checkbox"/> NO	<b>15. EXPECTED SUBMISSION DATE</b> MONTH: 03, DAY: 31, YEAR: 2011
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**ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)**

On October 27, 2010, at 1240 hours Central Standard Time (CST), the 1C Residual Heat Removal (RHR) pump motor tripped while in shutdown cooling mode. The Unit 1 Operations personnel also received reports of smoke coming from the RHR 1C pump room. Operations personnel responded to the reports in accordance with Emergency Plan Implementing Procedure (EPIP) - 17, "Fire Response Procedure," and Abnormal Operating Instruction (AOI) 0-AOI-26-1, "Fire Response." By approximately 1245 hours CST, Operations personnel declared the 1C RHR pump inoperable, and reestablished shutdown cooling by placing the 1A RHR pump in the shutdown cooling mode. Due to the absence of a fire, Operations personnel exited 0-AOI-26-1 and EPIP-17. The initial review has found that the 1C RHR pump motor failed after approximately 93.7 hours of operation in the shutdown cooling mode, apparently due to a defect that had been in place since the motor was refurbished in 2005. Because of the circumstances surrounding the failure of the motor, the mission time for the RHR pump during a postulated loss-of-coolant accident could not be met; therefore, the 1C RHR pump was not considered previously operable. The immediate cause of this event was that the motor experienced a mechanical failure from the rotor and shaft coming in contact with the stator and air/oil seals. The 1C RHR pump motor was replaced and post maintenance testing was successfully completed.

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**NARRATIVE**

**I. PLANT CONDITION(S)**

At the time of the event, Browns Ferry Nuclear Plant (BFN) Unit 1 was in Mode 5, the reactor vessel was flooded up and the moderator temperature was less than 100 degrees F. Loop 1 Residual Heat Removal (RHR) [BO] pump 1C was in service in the shutdown cooling mode.

**II. DESCRIPTION OF EVENT**

**A. Event:**

On October 23, 2010, at 0900 hours Central Standard Time (CST), Unit 1 entered refueling outage 8. At 1433 hours CST, Operations personnel placed Loop I of RHR in shutdown cooling mode in accordance with Operating Instruction (OI) 1-OI-74, "Residual Heat Removal System." RHR pumps 1A and 1C were in service. On October 24, 2010, at 2117 hours CST Unit 1 entered Mode 5.

On October 27, 2010, at 0131 hours CST Operations personnel secured the 1A RHR pump, RHR pump 1C remained in service, providing shutdown cooling. At approximately 1240 hours CST, the 1C RHR pump motor tripped on timed overcurrent. Additionally, the Unit 1 Operations personnel received reports of smoke coming from the RHR 1C pump room. Operations personnel responded to the reports in accordance with Emergency Plan Implementing Procedure (EPIP) - 17, "Fire Response Procedure," and Abnormal Operating Instruction (AOI) 0-AOI-26-1, "Fire Response." By approximately 1245 hours CST, Operations personnel declared the 1C RHR pump inoperable, and re-established shutdown cooling by placing the 1A RHR pump in the shutdown cooling mode. Due to the absence of a fire, Operations personnel exited 0-AOI-26-1 and EPIP-17.

Technical Specification (TS) 3.9 Refueling Operations, Limiting Condition for Operation (LCO) 3.9.7, Residual Heat Removal - High Water Level, requires that one RHR shutdown cooling subsystem be operable and in operation when the reactor is in Mode 5 with irradiated fuel in the reactor pressure vessel (RPV) and the water level greater than or equal to 22 ft above the top of the RPV flange. The action was met following the trip of the 1C RHR pump with the 1A RHR pump in service.

TS LCO 3.5.1, ECCS - Operating, requires each Emergency Core Cooling System (ECCS) injection/spray subsystem and the Automatic Depressurization System (ADS) function of six safety/relief valves shall be operable when the reactor is in Modes 1, 2 and 3, except high pressure coolant injection (HPCI) [BJ] and ADS [RV] valves are not required to be operable with reactor steam dome pressure less than or equal to 150 psig. TS 3.5.1 Condition A. Required Action A.1, requires with one low pressure ECCS injection/spray subsystem inoperable, restore the low pressure ECCS injection/spray subsystem to operable status within 7 days.

The initial review of the circumstances surrounding this event has found that the 1C RHR pump motor failed after approximately 93.7 hours of operation in the shutdown cooling mode during the 2010 refueling outage, and after approximately 1400 hours total operating time since being refurbished prior to the restart of Unit 1 in May of 2007.

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**NARRATIVE**

Upon disassembly and inspection of the motor, it was determined that the motor contained a defect that had been in place since the motor was refurbished.

The applicable safety related mode for the RHR system is to provide core cooling to the reactor pressure vessel for up to 30 days following initiation. Because of the findings to date regarding the failure of the motor, the 30-day mission time for the associated RHR subsystem during a postulated loss of coolant accident (LOCA) could not have been met at some point since May of 2007; therefore, the 1C RHR pump was considered previously inoperable for a period longer than that allowed by the TS. The Tennessee Valley Authority (TVA) is submitting this report in accordance 10 CFR 50.73(a)(2)(i)(B), as any operation or condition which was prohibited by the plant's Technical Specifications.

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

Other than the 1C RHR motor, there were no inoperable structures, components, or systems that contributed to the event.

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

June 23, 2004		The 1C RHR motor was shipped to the TVA Power Service Shop (PSS) for refurbishment.
September 18, 2005		The 1C RHR motor was reinstalled at BFN.
May 21, 2007		BFN Unit 1 entered Mode 2 for the first time following an extended outage.
October 23, 2010	0900 hours CST	BFN Unit 1 entered Refueling Outage 8.
	1433 hours CST	Operations personnel established shutdown cooling using Loop I RHR.
October 27, 2010	1240 hours CST	RHR pump motor 1C tripped.
	1245 hours CST	Operations personnel placed RHR pump 1A in service in the shutdown cooling mode.

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

Analysis of other systems or secondary functions affected is still in progress, and will be provided in a supplement to this LER.

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**NARRATIVE**

**E. Method of Discovery**

Operations personnel received main control room indications that the 1C RHR pump tripped. They also received high motor winding temperature alarms on the 1C RHR pump motor.

**F. Operator Actions**

Operations personnel responded in accordance applicable procedures. They reestablished shutdown cooling by placing the 1A RHR pump in the shutdown cooling mode.

**G. Safety System Responses**

None

**III. CAUSE OF THE EVENT**

**A. Immediate Cause**

The immediate cause of this event was the 1C RHR pump motor mechanical failure from the rotor and shaft coming in contact with the stator and air/oil seals while operating in shutdown cooling mode.

**B. Root Cause**

The root cause analysis is ongoing at this time. TVA will provide the root cause in a supplement to this LER.

**C. Contributing Factors**

None

**IV. ANALYSIS OF THE EVENT**

TVA is currently completing the analysis for this event; therefore, the following information is considered preliminary. The 1C RHR pump motor was shipped to the TVA Power Service Shop (PSS) for refurbishment in 2003. The 1C RHR pump motor was reinstalled at BFN in 2005. As part of the refurbishment process, the rotor was balanced separately from the stator. The balanced rotor was then installed in the vertically positioned stator for a no load test run. Although the rotor was balanced, the vibrations during no load test runs at the PSS were found unacceptable.

The PSS disassembled the 1C RHR motor repeating the rebuild process. All fits and clearances were rechecked, new bearings installed, testing repeated, including repeat of the rotor balance. The rotor balance was within an acceptable level. Again the balanced rotor was re-installed in the stator vertically for a no load test run. The vibrations were again found unacceptable. The rotor was then field balanced. Two weights totaling approximately 2.16 pounds were added to the upper bearing carrier. These weights were both located 180° from the rotor/stator rub.

The axial vibrations during no load operation were reduced. However, the coast down vibration was elevated. A decision was made at that time to accept the 1C RHR pump

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**NARRATIVE**

motor. Immediately upon return to service there was an increasing trend in both vibration and iron content in the motor lower bearing oil.

In October of 2006, following an initial uncoupled run of the 1C RHR motor, the lower bearing oil samples indicated high iron content and required flushing. Furthermore, between 2007 and 2008 the vibration on this motor fluctuated and elevated iron content was being identified in the oil samples. The lower bearing oil was flushed several times to remove the iron from the oil. In March of 2009 the vibration took a step change increase, and higher iron content in the lower bearing oil was identified. Oil analysis from 2009 to 2010 indicated higher iron content. Vibration analysis indicated a negative trend.

The post-event inspection of the motor found the rotor was bowed. The motor experienced a mechanical failure from the rotor and shaft coming in contact with the stator and air/oil seals.

**V. ASSESSMENT OF SAFETY CONSEQUENCES**

The assessment of the safety consequences is ongoing. TVA will provide complete results of the assessment in a supplement to this LER.

When the reactor is in Mode 5, the RHR system provides decay heat removal from the reactor coolant. With the unit in Mode 5 the RHR system is not required to mitigate any events or accidents evaluated in the safety analysis. At the time of the failure, the reactor coolant temperature was being maintained at less than 100 degrees F. Following the failure of the 1C RHR pump motor, the 1A RHR pump was placed in service in the shutdown cooling mode.

The applicable safety related mode for the RHR system is to provide core cooling to the reactor pressure vessel for up to 30 days following initiation. When the 1C RHR pump motor failed, it had been in service removing residual heat from the core during the Unit 1 refueling outage for approximately 93.7 hours. The motor had approximately 1400 hours of total run time since refurbishment.

**VI. CORRECTIVE ACTIONS**

**A. Immediate Corrective Actions**

The 1C RHR pump motor was replaced and post maintenance testing was successfully completed. TVA evaluated the remaining RHR pumps and found no similar predictive maintenance trends.

**B. Corrective Actions to Prevent Recurrence**

The root cause analysis is ongoing and incomplete at this time. The corrective actions to prevent recurrence will be provided in a supplement to this report.

**VII. ADDITIONAL INFORMATION**

**A. Failed Component**

A General Electric motor (model number 5K6348XC23A, serial number FEJ604001) refurbished by the TVA PSS failed.



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**B. Previous LERs On Similar Events**

No similar events were identified.

**C. Additional Information**

Corrective action document for this report is Problem Evaluation Report 274840.

**D. Safety System Functional Failure Consideration:**

Pending completion of the assessment of the safety consequences, the preliminary conclusion is that this event is not a safety system functional failure according to NEI 99-02.

**E. Scram With Complications Consideration:**

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

**VIII. COMMITMENTS**

None