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

July 28, 2010

10 CFR 50.73

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

Browns Ferry Nuclear Plant, Unit 3
Facility Operating License No. DPR-68
NRC Docket No. 50-296

Subject: **Licensee Event Report 50-296/2009-002, Revision 1**

The enclosed Licensee Event Report (LER) provides details of an event involving an inoperable High Pressure Coolant Injection (HPCI) system due to excessive water in the steam line drain. The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(v)(D), as any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident. TVA is submitting this revision to discuss the inoperability of the Unit 3 Reactor Core Isolation Cooling system during the period the HPCI system was inoperable.

There are no new regulatory commitments contained in this letter. Should you have any questions concerning this submittal, please contact Dan Williamson, Acting Site Licensing and Industry Affairs Manager, at (256) 729-2636.

Respectfully,

K. J. Polson
Vice President

cc: See page 2

IE22
NRR

Enclosure
cc (w/ Enclosure):

NRC Regional Administrator - Region II

NRC Senior Resident Inspector - Browns Ferry Nuclear Plant

NRC FORM 366 (9-2007) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 08/31/2010

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 Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@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 3	05000296	1 of 6

4. TITLE: Inoperable High Pressure Coolant Injection System Due To Excessive Water In The Steam Line Drain

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
11	12	2009	2009	- 002 -	01	07	28	2010	FACILITY NAME N/A	DOCKET NUMBER N/A

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☐ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☐ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☐ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☐ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☐ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☐ 50.73(a)(2)(i)(B)	☒ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER *(Include Area Code)*
Steve Austin, Licensing Engineer	256-729-2070

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

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 November 12, 2009, at approximately 1235 hours Central Standard Time (CST), while securing the High Pressure Coolant Injection (HPCI) turbine following the performance of Surveillance Procedure, Unit 3 HPCI Main and Booster Pump Set Developed Head and Flow Rate Test at Rated Reactor Pressure, Browns Ferry Nuclear Plant (BFN) Operations personnel received an alarm indicating high water level in the HPCI turbine exhaust steam drain pot. In accordance with the applicable Alarm Response Procedure, Operations personnel opened the HPCI condensate level control valve and subsequently dispatched personnel to the HPCI pump to drain the condensate from the drain pot through the drain pot level switch instrument test drain. Operations personnel removed in excess of 80 gallons of condensate from the HPCI turbine exhaust drain pot to clear the alarm. At 1711 hours CST, because Operations personnel could not verify the HPCI system exhaust line was fully drained the system was declared inoperable. The immediate cause of HPCI inoperability was high water level in the HPCI turbine exhaust drain pot. BFN has determined that the cause for the HPCI system inoperability was siphoning of water from the suppression pool. Immediate corrective actions included isolating the HPCI turbine exhaust drain line from the suppression pool. BFN is planning to permanently remove the HPCI turbine exhaust drain line from service. On November 14, 2009, prior to returning HPCI to operable status, the Reactor Core Isolation Cooling system was declared inoperable. This condition existed for approximately 2 hours due to loss of power to the flow controller.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A) (17)*

I. PLANT CONDITION(S)

At the time of discovery, Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 were at 100 percent power.

II. DESCRIPTION OF EVENT

A. Event:

On November 12, 2009, 1235 hours Central Standard Time (CST), Unit 3 Operations personnel completed the performance of 3-SR-3.5.1.7, High Pressure Coolant Injection (HPCI) [BG] Main and Booster Pump Set Developed Head and Flow Rate Test at Rated Reactor Pressure, and commenced returning of the HPCI turbine to standby readiness. While securing the HPCI turbine, BFN Operations personnel received an alarm indicating high water level in the HPCI turbine exhaust steam drain pot. In accordance with the applicable Alarm Response Procedure, Operations personnel opened the HPCI system condensate level control valve and subsequently dispatched personnel to the HPCI pump to drain the condensate from the drain pot through the drain pot level switch instrument test drain. Operations personnel removed in excess of 80 gallons of condensate from the HPCI turbine exhaust drain pot to clear the alarm. BFN Chemistry personnel analyzed the condensate and determined it was from the suppression pool.

On November 12, 2009, at 1711 hours CST BFN Unit 3 Operations Personnel declared the Unit 3 HPCI system inoperable due to excessive water in the turbine exhaust line drain pot. BFN Operations personnel entered Technical Specification (TS) 3.5.1, Action C, which requires the Reactor Core Isolation Cooling (RCIC) [BN] system to be immediately verified by administrative means to be operable and the HPCI system restored to operable status in 14 days.

On November 14, 2009, at 0630 hours CST, during troubleshooting and return to service activities for the HPCI system, BFN Operations personnel received indication that the RCIC Electronic Flow Controller failed. BFN Operations personnel immediately declared RCIC inoperable. With RCIC inoperable, TS 3.5.1 Required Action C.1, which requires verification by administrative means that the RCIC system is operable, was no longer met. As a result, BFN Operations personnel were required to enter TS 3.5.1 Action G, which requires the unit to be placed in Mode 3 within 12 hours and reactor steam dome pressure to be reduced to less than or equal to 150 psig within 36 hours. With the RCIC system inoperable, BFN Operations personnel immediately entered TS 3.5.3 Action A, which requires the HPCI system to be immediately verified by administrative means to be operable and the RCIC system to be restored to operable status in 14 days. Since HPCI was inoperable, TS 3.5.3 Required Action A.1 was not met. Operations personnel were then required to enter TS 3.5.3 Action B, which requires the unit to be placed in Mode 3 within 12 hours and reactor steam dome pressure to be reduced to less than 150 psig within 36 hours.

BFN Maintenance personnel determined the RCIC flow controller failure was the result of a loose ribbon cable connector to the power supply. As soon as the connector was reconnected the RCIC controller began to indicate normally. At 0830 hours CST, on November 14, 2009, BFN Operations personnel declared RCIC operable and exited TS 3.5.3 Action B. Following the restoration of RCIC to an operable status, TS 3.5.1 Action C remained in effect until HPCI could be returned to operable status.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A) (17)*

On November 16, 2009, at 0150 hours CST, as part of the troubleshooting activities, the HPCI system was placed in service. While the HPCI system was in operation the "HPCI drain pot level high" alarm came in; however, once the HPCI System was secured, the alarm cleared.

Unit 3 Operations and Engineering personnel have determined that following the November 12, 2009, performance of 3-SR-3.5.1.7, the suppression pool water siphoned back into the turbine exhaust drain pot via the HPCI Turbine Drain Line causing the High water level alarm. BFN Operations personnel, in order to prevent recurrence, isolated HPCI turbine drain pot drain line from the suppression pool on November 18, 2009, at approximately 0100 hours CST. At 0300 hours CST, on November 18, 2009, as a post maintenance test for isolating the suppression pool from the HPCI drain line, BFN Operations Personnel commenced performance of 3-SR-3.5.1.7. At 0830 hours CST, following successful completion of 3-SR-3.5.1.7, and final review of the HPCI Functional Evaluation, Operations exited TS 3.5.1 Condition C and declared the HPCI System Operable.

The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(v)(D), as any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident.

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

None

C. Dates and Approximate Times of Major Occurrences:

November 12, 2009 at 1130 hours CST	Unit 3 Operations personnel completed performance of 3-SR-3.5.1.7 and commenced returning of the HPCI turbine to standby readiness.
November 12, 2009 at 1235 hours CST	Unit 3 Operations personnel receive alarm indicating the turbine exhaust drain tank level is high.
November 12, 2009, at 1711 hours CST	Unit 3 Operations personnel declared Unit 3 HPCI inoperable.
November 12, 2009, at 2136 hours CST	Operations personnel made a Non-Emergency Notification System report in accordance with 10 CFR 50.72(b)(3)(v).
November 14, 2009, at 0630 hours CST	Unit 3 Operations personnel receive alarm indicating the RCIC flow controller had failed and immediately declared RCIC inoperable.
November 14, 2009, at 0830 hours CST	Upon return of the RCIC flow controller to service, Unit 3 Operations personnel declared RCIC operable.
November 18, 2009, at 0830 hours CST	Following successful completion of 3-SR-3.5.1.7, and final review of the HPCI Functional Evaluation, Operations declared the HPCI System Operable.

D. Other Systems or Secondary Functions Affected

None

E. Method of Discovery

Operations personnel received a main control room alarm indicating the HPCI turbine steam exhaust drain tank level was high. Operations personnel received a main control room indication that the RCIC Flow Controller had failed.

F. Operator Actions

The operator opened the HPCI turbine exhaust condensate pot level control valve from the main control room. An Auxiliary Unit Operator was dispatched to the HPCI pump to manually drain the condensate from the HPCI turbine exhaust drain pot.

G. Safety System Responses

None

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of the HPCI system inoperability was high water level in the HPCI turbine exhaust drain pot. The cause of the RCIC system inoperability was a loose ribbon cable connector in the RCIC flow controller.

B. Root Cause

The root cause for HPCI inoperability was siphoning of water from the suppression pool. The siphoning resulted in water flowing back from the suppression pool to the HPCI drain pot via the HPCI drain pot drain line. No root cause for the RCIC loose ribbon cable connector has been determined.

C. Contributing Factors

The original design of the HPCI exhaust drain piping contributed to the event. The design relied on gravity for the flow of condensate from the HPCI turbine exhaust drain pot to the suppression pool. However, the BFN piping configuration rises in elevation from the turbine exhaust drain pot to the suppression pool. The drain line penetrates the top of the torus and terminates below the suppression pool water line; thus, requiring a check valve to prevent the siphoning of water out of the suppression pool. The drain path afforded by the drain line is functional only during turbine operation. Some of the later vintage plants do not utilize the drain line.

IV. ANALYSIS OF THE EVENT

The HPCI exhaust steam line contains a steam pot and steam trap drain line arrangement that is connected to the low point of the HPCI turbine exhaust line. The drain pot collects condensate present in the steam and discharges it through the steam trap to the suppression pool through a two inch line (HPCI system turbine exhaust drain line) or bypasses flow to the gland steam condenser through a one-inch line. A check valve and isolation valve installed in the HPCI turbine exhaust drain line should prevent suppression pool water from flowing back into the HPCI turbine.

A drain pot level control valve regulates the condensate level in the drain pot sending the majority of the condensate to the gland seal condenser. The HPCI turbine exhaust drain pot level control valve automatically opens on receipt of a high drain pot level signal via two HPCI turbine exhaust drain line pot level switches. In this event, suppression pool water flowed back to the HPCI turbine exhaust drain pot following HPCI system operation.

The RCIC system failed when the flow controller failed because of a loose connector to the power supply in a panel mounted enclosure. The design is such that the internally mounted rack mount modules are typically not accessible when installed (slid into panel mounted enclosure). The complete power supply rack mount modules which are connected with the ribbon connectors are not typically disconnected (at the ribbon connector) from the panel mounted enclosures. The ribbon cable found partially connected/seated is typical of the ribbon cable assemblies used extensively throughout the plant to supply power rack components. The connector involved is designed to be installed by simply pushing the connector assembly down onto a imbedded receptacle at the rear of a "rack" assembly. As soon as the connector was reseated, the RCIC controller began to indicate normally.

V. ASSESSMENT OF SAFETY CONSEQUENCES

The safety consequences of this event were not significant. BFN TS 3.5.1, Required Action C.2, allows continued power operation for up to 14 days with the HPCI system inoperable as long as the RCIC system is operable. In this condition, the other required Emergency Core Cooling Systems were operable and remained capable of mitigating design basis accidents and transients assumed in the UFSAR. In addition, with the exception of approximately 2 hours that RCIC was inoperable, the RCIC system would have automatically provided makeup water to the reactor if required, at most reactor operating pressures. Therefore, TVA concludes that there was no significant reduction in the protection of the public by this event.

VI. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Immediate corrective actions included isolating the turbine exhaust drain line between the turbine exhaust drain pot and the suppression pool. BFN Operations and Maintenance personnel commenced troubleshooting and return to service activities. The connector to the RCIC Flow Controller was reseated on to the power supply and proper controller output voltage was verified.

B. Corrective Actions to Prevent Recurrence - The corrective actions to prevent recurrence are being managed by TVA's corrective action program.

TVA is planning to remove the HPCI turbine exhaust drain line from service for all three units.

There is no evidence that the failure of the ribbon cable connector to remain seated RCIC controller is a generic or recurring problem. Only one similar previous occurrence was identified in 2004 on a non-critical piece of equipment. As an enhancement to current rack component work related practices, the rear ribbon cable connector will be visually inspected for proper seating prior to and after maintenance which involves removing rack mounted devices from/into panel installation slots.

NARRATIVE *(If more space is required, use additional copies of NRC Form 366A) (17)*

VII. ADDITIONAL INFORMATION

A. Failed Components

None

B. Previous LERs On Similar Events

No previous similar LERS were identified. In 1995 an event that occurred on Unit 2 resulted in between 15-20 gallons of water in the Unit 2 HPCI turbine exhaust line. The evaluation did not identify the capability of the drain line to siphon water from the suppression pool. TVA determined HPCI system maintained functionality with this amount of water in the exhaust line.

Another similar event occurred on Unit 1 on September 20 and again on September 21, 2007. Operations Personnel had main control room indication of high level in the exhaust drain pot. A review of the main control room annunciators had found that the annunciator had been receive each time HPCI was run since Unit 1 restart in May of 2007. The annunciator clears after the turbine is shut down. Additionally, on Units 2 and 3, the annunciator was received and clears several times during the performance of the surveillance. TVA's evaluation of these events concluded that the HPCI system remained fully functional. The high velocity of the exhaust steam exiting the HPCI turbine entrains the condensate from the exhaust line and delivers it to the suppression pool.

C. Additional Information

Corrective action documents for this report are Problem Evaluation Reports 207915, 208077 and 234082.

D. Safety System Functional Failure Consideration:

This event is classified as 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