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

November 25, 2013

10 CFR 50.73

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

Browns Ferry Nuclear Plant, Unit 2
Renewed Facility Operating License No. DPR-52
NRC Docket No. 50-260

Subject: **Licensee Event Report 50-260/2013-002-00**

The enclosed Licensee Event Report provides details of the High Pressure Coolant Injection System being declared inoperable due to an unqualified electrical splice. The Tennessee Valley Authority is submitting this report in accordance with Title 10 of the Code of Federal Regulations (10 CFR) 50.73(a)(2)(v)(B) and 10 CFR 50.73(a)(2)(v)(D).

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,

K. J. Polson
Vice President

Enclosure: Licensee Event Report 50-260/2013-002-00 – High Pressure Coolant Injection System Declared Inoperable Due an Unqualified Electrical Splice

cc (w/ Enclosure):

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

IE22
NRR

ENCLOSURE

Browns Ferry Nuclear Plant
Unit 2

Licensee Event Report 50-260/2013-002-00

High Pressure Coolant Injection System Declared Inoperable Due an Unqualified Electrical Splice

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See Enclosed

NRC FORM 366 (10-2010) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 10/31/2013

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.

LICENSEE EVENT REPORT (LER)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Browns Ferry Nuclear Plant, Unit 2	05000260	1 of 9

4. TITLE: High Pressure Coolant Injection System Declared Inoperable Due to an Unqualified Electrical Splice

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	05000
09	24	2013	2013	- 002 -	00	11	25	2013	FACILITY NAME	DOCKET NUMBER
									N/A	05000

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

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Christopher Bennett, Licensing Engineer	256-729-2475

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 September 24, 2013, during an Environmental Qualification (EQ) review of a work order, it was discovered that the motor leads for the valve actuator on the High Pressure Coolant Injection (HPCI) main pump minimum flow valve had an unqualified electrical splice; and as a result, Operations personnel declared the valve inoperable and entered Technical Specification (TS) 3.6.1.3 Condition C. At 1530 hours Central Daylight Time, as a result of the inoperability of the HPCI main pump minimum flow valve, Operations personnel declared the HPCI System inoperable, and Browns Ferry Nuclear Plant, Unit 2, made an unplanned entry into TS 3.5.1 Condition C.

The root cause of this event was determined to be a lack of clear and specific procedural guidance related to: (1) overt direction on locating and determining the component classification relative to 10 CFR 50.49 requirements, and (2) guidance on changes to EQ components and associated work orders.

Corrective actions to prevent recurrence are to revise the work control planning procedure to include: (1) the requirement that changes to EQ work orders are considered major changes, (2) the requirement that revisions to EQ work orders are reviewed and concurred with by the EQ program manager or designee, and (3) the location of the EQ classification information.

I. Plant Operating Conditions Before the Event

At the time of the event, Browns Ferry Nuclear Plant (BFN), Unit 2, was in Mode 1 at approximately 100 percent rated thermal power.

II. Description of Events

A. Event:

On September 24, 2013, at 1530 Central Daylight Time (CDT), BFN, Unit 2, High Pressure Coolant Injection (HPCI) System [BJ] was declared inoperable due to inoperability of the HPCI main pump minimum flow valve [FCV], 2-FCV-073-0030. Engineering personnel identified during an Environment Qualification (EQ) review of a work order that the motor [MO] leads on the valve actuator for the HPCI main pump minimum flow valve were taped instead of terminated with a Raychem heat shrink splice. The valve actuator is an EQ component and requires termination of the motor leads to the incoming power cable by Raychem splice or a Marathon 300 terminal block. Upon discovery of the unqualified electrical splice, a prompt Engineering evaluation was requested and initial operability of HPCI main pump minimum flow valve could not be supported due to the tape being unanalyzed for harsh environmental conditions. The HPCI main pump minimum flow valve has a required open safety function to prevent overheating the HPCI pump [P] and a closed safety function to provide containment isolation. Technical Specification (TS) 3.5.1, Emergency Core Cooling System - Operating, Condition C was entered for HPCI System inoperability. In addition, TS 3.6.1.3, Primary Containment Isolation Valves, Condition C was entered due to the inoperability of the primary containment isolation function of the HPCI main pump minimum flow valve.

Limiting Condition for Operation (LCO) 3.6.1.3 requires each Primary Containment Isolation Valve (PCIV) to be Operable in Modes 1, 2, and 3 and when the associated instrumentation is required to be Operable per LCO 3.3.6.1. Condition C of TS 3.6.1.3 was entered due to the HPCI main pump minimum flow valve inoperability. Required Action C.1 of TS 3.6.1.3 requires that the affected penetration [PEN] flow path be isolated by use of at least one closed and de-activated automatic valve, closed manual valve, or blind flange within 4 hours and Required Action C.2 requires verification that the affected penetration flow path is isolated every 31 days.

LCO 3.5.1 requires each Emergency Core Cooling System (ECCS) [BJ] [BM] [BO] injection/spray subsystem and the Automatic Depressurization System (ADS) [SB] function of six safety/relief valves [V] to be Operable in Mode 1 and Modes 2 and 3, except HPCI and ADS valves are not required to be Operable with reactor steam dome pressure less than or equal to 150 psig. Condition C of TS 3.5.1 was entered due to inoperability of the HPCI main pump minimum flow valve. Required Action C.1 of TS 3.5.1 requires that Reactor Core Isolation Cooling (RCIC) System

[BN] be verified Operable immediately and Required Action C.2 of TS 3.5.1 requires that the HPCI System be restored to Operable status within 14 days.

The RCIC System was verified to be Operable immediately on September 24, 2013 at 1530 hours CDT by Operations personnel.

Engineering personnel reviewed other applicable EQ packages for similar and previously unidentified issues and did not identify any issues with the work performed. Based on Engineering's extent of condition review and successful completion of post maintenance testing after replacing the tape splice with a Raychem heat shrink splice, on September 26, 2013, at 0230 hours CDT, Operations personnel declared the HPCI main pump minimum flow valve Operable and exited TS 3.6.1.3 Condition C, as well as declared the HPCI System Operable and exited TS 3.5.1 Condition C.

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

The unqualified splice was discovered on September 24th, 2013, at which time Operations personnel contacted Engineering for an evaluation. Based on the discussion with Engineering, initial operability of the HPCI main pump minimum flow valve could not be supported due to the tape being unanalyzed for harsh environmental conditions. This led Operations personnel to declare the HPCI main pump minimum flow valve inoperable. Due to the inoperability of the HPCI main pump minimum flow valve, the HPCI System was declared inoperable.

Subsequently, a past operability evaluation completed on October 7, 2013 determined that there is reasonable assurance that the worst-case harsh environmental conditions seen by the tape splice would not have caused failure of the tape splice, and concluded that a properly installed tape splice would not have failed in any harsh environment postulated and the HPCI main pump minimum flow valve would have been operable for all of its specified safety functions up to the time it was isolated by Operations personnel on September 24th, 2013.

C. Dates and approximate times of occurrences:

March 22, 2013	Field work began on the HPCI main pump minimum flow valve.
April 2, 2013	Planner is contacted by craft personnel requesting to apply a tape splice in lieu of a Raychem heat shrink termination.
April 2, 2013	Planner changes Raychem heat shrink termination to tape splice with a clarification / minor change to the work order.

April 3, 2013	Craft personnel applied the tape splice to the motor leads of the valve actuator for the HPCI main pump minimum flow valve.
September 24, 2013	During review of the work order, Engineering personnel discovered the discrepancy of the tape splice application.
September 24, 2013, at 1530 hours CDT	Operations personnel declared the HPCI main pump minimum flow valve inoperable and entered TS 3.6.1.3 Condition C.
September 24, 2013, at 1530 hours CDT	Operations personnel declared the HPCI System inoperable and entered TS 3.5.1 Condition C.
September 24, 2013, at 2221 hours CDT	BFN reported the event to the NRC in accordance with 50.72(b)(3)(v)(D).
September 25, 2013	The tape splice was removed and replaced with a Raychem heat shrink termination.
September 26, 2013, at 0235 hours CDT	Operations personnel declared the HPCI main pump minimum flow valve Operable and exited TS 3.6.1.3 Condition C
September 26, 2013, at 0235 hours CDT	Operations personnel declared the HPCI System Operable and exited TS 3.5.1 Condition C.
October 7, 2013	A past operability evaluation determined that the HPCI System was operable from the time of the tape splice application.

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

There was no failure of a component for this 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:*

Engineering personnel identified during an EQ review of a work order that the motor leads on the valve actuator for the HPCI main pump minimum flow valve were taped instead of terminated with a Raychem heat shrink splice.

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

There was no failure of a component. The problem was an unqualified splice that caused Operations personnel to declare the HPCI main pump minimum flow valve inoperable resulting in the unplanned HPCI System inoperability.

H. Operator actions:

Operations personnel declared the HPCI main pump minimum flow valve inoperable and entered TS 3.6.1.3 Condition C, and declared the HPCI System inoperable and entered TS 3.5.1 Condition C.

I. Automatically and manually initiated safety system responses:

There were no automatically or manually initiated safety system responses.

III. Cause of the event

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

Immediate Cause

The immediate cause of this event was the decision by the planner to revise the work order as a minor revision without a peer check or consultation with another person or supervisor resulting in a single point failure that allowed an unqualified splice to be installed on a piece of EQ equipment.

Root Cause

The root cause was identified as a lack of clear and specific guidance in NPG-SPP-07.6, NPG Work Control Planning Procedure, related to the following:

1. Overt direction on locating and determining the component classification relative to 10 CFR 50.49 requirements.
2. Guidance on changes to EQ components and associated work orders.

Contributing Cause

There is no formalized training for the planning population related to EQ components and program knowledge.

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

The decision by the planner to revise the work order as a minor revision was made without peer check or consultation with another person or supervisor. As a result of determining that the revision was minor, the affected organizations were not required to approve the revision and a single-point failure occurred.

IV. Analysis of the event:

The Tennessee Valley Authority (TVA) is submitting this report in accordance with 10 CFR 50.73(a)(2)(v)(B) and 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 remove residual heat and mitigate the consequences of an accident.

Operations personnel declared the HPCI main pump minimum flow valve inoperable based on a prompt Engineering evaluation determining that initial operability of valve could not be supported due to the tape being unanalyzed for harsh environmental conditions. The HPCI main pump minimum flow valve has a required open safety function to prevent overheating the HPCI pump and a closed safety function to provide containment isolation. Due to the failure of its primary containment isolation function, the flowpath for the HPCI main pump minimum flow valve was isolated. The flowpath isolation resulted in the HPCI System being declared inoperable and an unplanned LCO 3.5.1 entry. Inoperability of the HPCI system is a failure of a single train system preventing accident mitigation and residual heat removal. Inoperability of a single train is reportable even though the plant TS may allow such a condition to exist for a limited time.

On March 22, 2013 during the BFN, Unit 2, refueling outage, field work began on the HPCI main pump minimum flow valve which included disconnecting and removing the actuator components. On April 2, 2013 during reinstallation of the valve actuator, the craft personnel performing the work order contacted the planning department requesting the use of a tape splice in lieu of the Raychem heat shrink termination listed on the work order.

The planner had been informally trained that any component that required special EQ consideration would be identified with a unique identifier on the drawings available. The planner checked the drawing and did not see the splice identified with a unique identifier and assumed it was not an EQ component. The assumption, validated by the inconsistent drawing information, and compounded by a knowledge gap, directly resulted in the changes to the work order and the subsequent impact to the components EQ classification and inoperability of the HPCI System.

The misinterpretation of the Nuclear Power Group (NPG) Work Control Process Procedure that led to the planner's assumption and belief the all EQ components were assigned unique identifiers was incorrect. This belief was fostered in part through pass-down knowledge transfer and self discovery.

The planning population does have the requisite knowledge and skills to initially plan and develop work orders for EQ equipment. A review of the corrective action program database did not identify a substantial number of work orders with initial planning issues related to EQ. The prior success in performance coupled with interviews of planning individuals, indicates the level of knowledge in planning is sound but is based on informal pass-down of knowledge, self teaching, and self research. This extends to the EQ component classification ability of the planners.

The inconsistent identification of EQ components in plant drawings was a factor in the decision to revise the work order since the planner's initial knowledge base included the aforementioned belief that all EQ components had unique identifiers and since the

component (splice) did not have one, and was therefore not EQ. Since current station procedures for EQ reference Maximo as the official repository of EQ information, any information contained on plant drawings and prints is not considered official documentation of EQ status.

The work control process and the lack of overt reference to the method of or location of the EQ database and its status as the governing product for EQ and the lack of guidance concerning revisions to EQ related work orders forces individuals in the planning organization to work in a "knowledge based" mode. Had sufficient guidance existed in the NPG Work Control Planning Procedure, the decision leading up to the revision of the work order would have been a "rule based" decision and therefore not impacted by planner knowledge, drawing and print accuracy, or other influences. Had the NPG Work Control Planning Procedure contained direction on EQ component identification and instructions on EQ work order revisions, the decision would have either not been made to revise the work order, or if it was revised, the decision would have required EQ Program Manager or designee approval.

Analysis points to the lack of clear and specific guidance in NPG-SPP-07.6, NPG Work Control Planning Procedure. Specifically, there is neither overt direction on locating and determining component classifications relative to 10 CFR 50.49 requirements nor guidance on changes to EQ components and associated work orders.

V. Assessment of Safety Consequences

The HPCI System consists of a steam turbine-driven system driving a constant-flow pump assembly to inject either Condensate Storage Tank [KA] water or Suppression Pool [BT] water into the reactor under emergency conditions. The HPCI System provides adequate core cooling for all break sizes which do not result in rapid depressurization of the reactor vessel and functions independent of off-site power sources and Emergency Diesel Generators [EK].

The HPCI main pump minimum flow valve is a safety related valve and has safety functions in both the open and close directions. The valve must open to prevent pump damage during HPCI operation. The valve must close, and stay closed, to provide Primary Containment Isolation.

The Safety Consequences Evaluation, coupled with the Past Operability Evaluation concluded that there was no reduction in the defense in depth to Nuclear Safety, Industrial Safety, or Radiological Safety. The causal analysis concluded the procedural deficiencies, inappropriate decisions, and the resultant taping vs. splicing of the cable termination did not have a direct impact to safety. Nuclear safety was maintained by the application of tape and additional insulating tape in accordance with existing procedures which resulted in a connection that would have maintained its integrity during a postulated event and allowed the system to function for the allotted service time.

A. Availability of systems or components that could have performed the same function as the components and systems that failed during the event:

This event resulted in the HPCI System being inoperable. The RCIC System and all other ECCS Systems remained Operable to maintain adequate core cooling during the period of HPCI System inoperability.

B. For events that occurred when the reactor was shut down, availability of systems or components needed to shutdown the reactor and maintain safe shutdown conditions, remove residual heat, control the release of radioactive material, or mitigate the consequences of an accident:

BFN, Unit 2, was not shut down during this event.

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:

The HPCI System was declared inoperable on September 24, 2013, at 1530 hours CDT, and returned to Operable status 1 day, 11 hours and 5 minutes later on September 26, 2013, at 0235 hours CDT.

VI. Corrective Actions

Corrective Actions are being managed by TVA's corrective action program under Problem Evaluation Report (PER) 784586.

Immediate Corrective Actions

Engineering Equipment Reliability reviewed the applicable BFN, Unit 2, refueling outage EQ packages for similar or previously unidentified issues, the work order to install the Raychem heat shrink terminations was completed, and a stand-down was held for planning department personnel to raise awareness and to distribute initial lessons learned from the event.

Corrective Actions to Prevent Recurrence or to Reduce Probability of Similar Events Occurring in the Future

Revise NPG-SPP-07.6, NPG Work Control Planning Procedure, to include guidance on the following:

1. Revise section 3.7.10 or successor section to include the requirement that changes to EQ work orders are considered major changes.
2. Revise section 3.7.12 or successor section to include the requirement that revisions to EQ work orders are reviewed and concurred with by the EQ program manager or designee.
3. Revise section 3.8.2 to describe the location of the EQ classification information in Maximo.

Corrective Actions

Review the root causes and contributing causes from the root cause analysis and determine if training for EQ program requirements and processes should be included in the Maintenance Training program for Electrical, Mechanical, and I&C disciplines; and the Maintenance Supervisor Training.

Determine the scope, frequency, content, and appropriate population to be trained on changes made to NPG-SPP-07.6, NPG Work Control Planning Procedure.

VII. Additional Information:

A. Previous similar events at the same plant:

A search of BFN Licensee Event Reports for Units 1, 2, and 3 for the last five years did not identify any similar events.

A search was performed on the BFN corrective action program. A similar PER related to the condition which caused the event reported in this LER is PER 759438.

PER 759438 identified that Raychem splices for EQ motor operated valves are inconsistently addressed in the EQ Program. The corrective actions for this PER are still being implemented, therefore they would not have prevented this event from occurring.

B. Additional Information:

There is no additional information.

C. Safety System Functional Failure Consideration:

In accordance with Nuclear Energy Institute 99-02, this event is considered a safety system functional failure.

D. Scram with Complications Consideration:

This event did not result in an unplanned scram with complications.

VIII. COMMITMENTS

There are no commitments.