NRC FORM 366 (6-1998) U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

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TITLE (4)
Unit 3 High Pressure Coolant Injection (HPCI) System Inoperable Due To A Loose Wire

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									NA	NA
04	08	1999	1999 --	003 --	00	05	06	1999	NA	NA

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
POWER LEVEL (10)	100		20.2201(b)		20.2203(a)(2)(v)		50.73(a)(2)(i)		50.73(a)(2)(viii)
			20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)	X	50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Gerald F. Moody, Licensing Project Manger	256-729-7534

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On April 8 , 1999, at approximately 2045 hours Central Daylight Time (CDT) during the performance of a regularly scheduled Instrumentation surveillance on the Unit 3 HPCI Steam Line Space High Temperature switches, a loose wire was found in the power supply pathway for the HPCI logic circuit. This loose wire had the potential to prevent adequate voltage from being supplied to the initiation and isolation logic for the Unit 3 HPCI system. The loose wire was tightened. The potential for inadequate voltage being available for the HPCI logic circuit resulted in the decision to declare the HPCI system inoperable. The most likely cause of this event was determined to be a failure to properly tighten the screw at some time in the past.

This report is submitted pursuant to 10 CFR 50.73 (a) (2) (v) as a condition that alone could have prevented the fulfillment of the safety function of a structure or system needed to mitigate the consequences of an accident.

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

I. PLANT CONDITION(S)

At the time of the event, Unit 1 was shutdown and defueled. Unit 2 was in Mode 1 at 81 percent reactor power, approximately 2678 megawatts thermal, coasting down for a scheduled refueling outage. Unit 3 was in mode 1 at 100 percent reactor power at approximately 3457 megawatts thermal.

II. DESCRIPTION OF EVENT

A. Event:

On April 7, 1999, at approximately 0757 hours Central Daylight Time (CDT) a surveillance (3-SR-3.3.6.1(3D)) was started to calibrate the High Pressure Coolant Injection (HPCI) [BJ] System Steam Line Temperature switches). On April 8, 1999, at approximately 2045 hours CDT during the performance of this regularly scheduled Instrumentation surveillance, a loose wire was found in the power supply pathway for the HPCI logic circuit. This loose wire had the potential to prevent adequate voltage from being supplied to the initiation and isolation logic for the Unit 3 HPCI system. The potential for inadequate voltage being available for the HPCI logic circuit resulted in the decision to declare the HPCI system inoperable. As required by Technical Specifications, Browns Ferry Unit 3 entered a fourteen-day Limiting Condition for Operation (LCO) for an inoperable HPCI system. A 4 hour Non-Emergency notification was made to the NRC in accordance with 10 CFR 50.72 (b) (2) (iii). Repairs were completed and following post maintenance testing, HPCI was returned to an operable status on April 9, 1999 at 0122 hours CDT.

This report is submitted pursuant to 10 CFR 50.73 (a) (2) (v) as a condition that alone could have prevented the fulfillment of the safety function of a structure or system 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:

April 7, 1999, 0757 hours CDT	Surveillance SR 3.3.6.1(3D) - HPCI Steam Line Temperature Switch calibration started.
April 8, 1999, 2045 hours CDT	A loose terminal was found on a fuse feeding the HPCI logic bus. HPCI was declared inoperable and repairs were started.
April 8, 1999, 2351 hours CDT	A 4 Hour Non-Emergency notification was made to the NRC in accordance with 10 CFR 50.72 (b) (2) (iii).
April 9, 1999, 0122 hours CDT	HPCI system was returned to operable status.

D. Other Systems or Secondary Functions Affected

None.

E. Method of Discovery

During performance of a regularly scheduled instrumentation surveillance on Unit 3 HPCI Steam Line Space High Temperature switches, a loose wire was found in the power supply pathway for the HPCI logic circuit.

F. Operator Actions

No operator actions contributed to this event.

G. Safety System Responses

None.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of this event was a loose electrical connection. The terminal connection was loose to the touch and manipulation of the attached wire caused the associated relays to cycle. Arcing could be observed at the connection as the wire was manipulated. Therefore, it was concluded that the single bad connection found in the (+) side power bus was the cause.

B. Root Cause

The terminal screw required approximately ½ turn to tighten properly. The terminal strip is located in a fixed panel in the auxiliary instrument room where the absence of vibration and infrequent human handling minimizes the potential of any failure mechanism that could loosen the terminal screw over time. Therefore, the cause of the loose screw was most likely failure to properly tighten the screw at some time in the past. There was no recent work activity in the panel (prior to development of the symptoms) that would have disturbed the wire.

C. Contributing Factors

None

IV. ANALYSIS OF THE EVENT

The following malfunctions in the HPCI system logic were observed between 0757 on April 7, 1999 and 0122 on April 9, 1999.

During 3-SR-3.3.6.1(3D), two temperature switches failed to actuate their associated relays as expected. It was also noted that the Integrated Computer System (ICS) [JA] did not indicate a tripped condition for the associated data points. These switches were jumpered at the field location and the associated relays again failed to actuate. It was also observed that another relay was cycling or not energized when conditions called for it to be energized. This relay (23-A-K16) was associated with the HPCI minimum flow valve.

These relays and ICS points are all powered from HPCI logic bus B and are the only devices that would have been called upon to energize given the existing plant conditions and ongoing activities. Therefore, they are the only devices that would be expected to exhibit observable symptoms during a power supply interruption. HPCI logic bus B is powered from 250V DC power [EJ]. The (+) logic power is supplied to the individual devices through a wiring chain made from lugged wires connecting a series of terminals on a terminal strip. Similarly, the (-) logic power is supplied to the individual devices through a wiring chain made from lugged wires connecting a series of terminals on the individual devices themselves (so called daisy-chain). All of the listed devices and computer points are on the same (+) side wiring chain but they do not have the same (-) side chain. The (+) side connections are all located on the same terminal strip.

During troubleshooting each wire terminal in the (+) circuit was manipulated while observing relay 23-A-K16. Terminal 1 of fuse F1-3-058CA (located at the bottom of terminal strip CC) was the only connection that caused relay operation when manipulated. The terminal connection was loose to the touch and manipulation of the attached wire caused relays to cycle. Arcing could be observed at the connection as the wire was moved. Therefore, it was positively concluded that the single bad connection found in the (+) side power bus was the cause.

The cause of the loose screw was most likely failure to properly tighten the screw some time in the past. A search of work orders and design documentation did not indicate any work that would have involved terminal 1 of fuse FU1-3-58CA. Therefore, the cause could not be linked to a specific work activity. There was no recent work activity in the panel (prior to development of symptoms) that would have disturbed wires.

The wire lugs and loose terminal were in physical contact and would not have been able to completely separate. That configuration would be expected to cause intermittent problems with the electrical characteristics of the connection degrading over time due to oxide and arc residue buildup. Several quarterly surveillances are performed which would have identified an existing circuit interruption. Also, alarm window 3-XA-55-3F-28 (HPCI GLAND SEAL CONDENSER LEVEL LOW) would have activated in the control room alerting the operators to the problem. The recent surveillance tests were completed satisfactorily. Therefore, the condition was not serious enough to effect operability until these events occurred.

V. ASSESSMENT OF THE SAFETY CONSEQUENCES

The HPCI system is provided to assure that the reactor is adequately cooled to limit fuel cladding temperature in the event of a small pipe break in the nuclear system and loss of coolant which does not result in rapid depressurization of the reactor vessel. The HPCI system permits the nuclear plant to be shut down, while maintaining sufficient reactor vessel water inventory until the reactor vessel is depressurized. The HPCI system continues to operate until the reactor vessel pressure is below the pressure at which Low Pressure Coolant Injection (LPCI) [BO] operation or Core Spray (CS) [SM] operation maintains core cooling. In the event HPCI is not available or not sufficient to maintain reactor water level, the Automatic Depressurization System (ADS) [SB] functions to reduce reactor pressure so that flow from the LPCI and CS systems enter the reactor vessel in time to cool the core and limit fuel cladding temperature.

BFN Technical Specifications allow continued reactor operation for up to fourteen days if HPCI is inoperable, provided ADS, CS, LPCI, and Reactor Core Isolation Cooling (RCIC) [BN] systems are operable. RCIC provides an alternate supply of high pressure makeup while ADS would depressurize the reactor to allow CS and LPCI to provide adequate low pressure ECCS makeup to the reactor. The availability of these redundant and diversified systems provides adequate assurance of core cooling while the HPCI system is inoperable. For this event, HPCI was inoperable approximately 4 ½ hours of the 14 days allowed by the LCO. During the period that the HPCI system was inoperable, these required systems were operable and would have performed their design function if called upon.

Accordingly, there was no reduction in the degree of protection provided to public health and safety. Furthermore, the safety of the plant, its personnel, and the public was not compromised.

VI. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Troubleshooting was performed to identify the bad connection and confirm that it was the cause of the problem. The loose terminal was immediately tightened under appropriate plant work instructions and testing was completed on the circuit. This corrected the physical condition.

B. Corrective Actions to Prevent Recurrence

None.

VII. ADDITIONAL INFORMATION

A. Failed Components

None.

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B. Previous LERs on Similar Events

There have been no previous LERs involving the inoperability of equipment due to a loose wire.

VIII. COMMITMENTS

None.

Energy Industry Identification System (EIIS) system and component codes are identified in the text with brackets (e.g., [XX]).