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

October 7, 2011

10 CFR 50.73
10 CF21

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

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

Subject: **Licensee Event Report 50-260/2011-001-00**

The enclosed Licensee Event Report provides details of a failure of a GE Type HGA relay installed in the Unit 2, Loop II, Core Spray System Logic. 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, 10 CFR 50.73 (a)(2)(v)(D), as any event that could have prevented the fulfillment of the safety function of structures or systems that are needed to mitigate the consequences of an accident, and also in accordance with 10 CFR 21.2(c)., reporting of defects and noncompliance.

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,

FOR, PER TELECON

K. J. Polson
Vice President

Enclosure: Licensee Event Report - Unit 2, 50-260/2011-001-00

cc (w/ Enclosure):

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

IE22
NRR

JEE:PAH:LAJ
Enclosure
bcc (Enclosure):
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ENCLOSURE

Browns Ferry Nuclear Plant
Unit 2

Licensee Event Report 2011 - Core Spray Relay Found in Incorrect Position

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See Attached

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 10

4. TITLE: Core Spray Relay Found in Incorrect Position

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	08	2011	2011	001	00	10	07	2011	NA	NA
									FACILITY NAME: NA	DOCKET NUMBER: NA

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)	10 CFR 21.2 (c)

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER *(Include Area Code)*
Paul A. Herrmann III, Licensing Programs Manager	256-729-7479

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
B	BG	RLY	G080	706					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR
XX	XX	XX

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

On August 8, 2011, Surveillance Procedure 2-SR-3.3.5.1.6 (CS II) "Core Spray System Logic Functional Test Loop II," was being performed. Contacts 3-7 and 4-8 for normally energized relay 14A-K30B were determined to be not fully open. On August 9, 2011, the cover on the relay was adjusted per WO 112545536 and the contacts went fully open. 2-SR-3.3.5.1.6 (CS II) testing recommenced and the relay is subsequently reenergized. The surveillance and LCO were exited. During a walkdown on august 12, 2011, contacts 3-7 and 4-8 for normally energized relay 14A-K30B were again determined to be not fully open. The troubleshooting revealed there was a relay armature problem. An LCO was entered. On August 13, 2011, the relay was replaced and the surveillance was successfully completed.

A failure analysis indicated the HGA's relay hinged armature can intermittently become bound in an undesired position, limiting the ability of the relay to operate as expected. The binding occurs within the hinged armature mechanism, particularly on the right side.

This report also constitutes a Part 21 notification.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant Unit 2	05000260	2011	-- 001	-- 00	2 of 10

NARRATIVE

I. PLANT CONDITION(S)

Browns Ferry Nuclear Plant (BFN) - Unit 2 was at 100 percent power.

II. DESCRIPTION OF EVENT

A. Event:

On August 8, 2011, LCO 3.5.1.A, one low pressure ECCS injection/spray system inoperable or one low pressure coolant injection (LPCI) pump in both LPCI subsystems inoperable, was entered to perform Surveillance Procedure 2-SR-3.3.5.1.6 (CS II) "Core Spray [BG] System Logic Functional Test Loop II." The normal interval for performance of this surveillance is 24 months. Relay [RLY] 2-RLY-075-14A-K30B, DG PWR AVAIL 4KV SD BD C (Division II), at step 7.5 [3], contacts 3-7 and 4-8 for normally energized relay 14A-K30B were visually observed to be closed (de-energized state) instead of open as required by the procedure. On August 9, 2011, the cover on the relay was adjusted per WO 112545536 and the contacts went fully open. Surveillance Procedure 2-SR-3.3.5.1.6 (CS II) testing recommenced. Steps 7.5 [75] and 7.11 [5.1] both de-energize the 14A-K30B relay and the relay is subsequently reenergized. The surveillance was exited on August 11, 2011, at 05:45 CDT.

During a walkdown on August 12, 2011, System Engineering personnel determined contacts 3-7 and 4-8 for normally energized relay 14A-K30B were again determined to be not fully open. The troubleshooting revealed there was a relay problem, which has since been attributed to intermittent relay binding due to a possible manufacturing defect. LCO 3.5.1.A, was again entered. On August 13, 2011, the relay was replaced by Work Order 112565983, the relay passed surveillance testing, and the surveillance was successfully completed.

TVA is submitting this report in accordance with 10 CFR 21.2(c), reporting of defects and non-compliance; 10 CFR 50.73 (a)(2)(i)(B), any operation or condition prohibited by the plant's Technical Specifications; 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 mitigate the consequences of an accident. Past inoperability is based on the equipment history and cause of failure; and a conclusion was reached that the relay should be considered non-functional from April 27, 2011, until the relay was replaced and successfully passed PMT's on August 13, 2011, at 1355 CDT.

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

None

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant Unit 2	05000260	2011	-- 001	-- 00	3 of 10

NARRATIVE

C. Dates and Approximate Times of Major Occurrences:

April 8, 2009	Relay received receipt inspection. No discrepancies noted. Material inspection form signed on April 12, 2009.
May 5, 2009	Relay was bench tested prior to installation in the plant. Bench test verifies the relay will energize and de-energize. The test verifies relay contacts change state by checking continuity and visually inspects relay contacts for signs of pitting and corrosion. The PMT after installation verified continuity across normally closed relay contacts 3-7 and 4-8. The relay was also visually verified to be energized and that normally closed relay contacts 3-7 and 4-8 were open. The testing verified proper operation of the relay and contacts and their material condition. Relay BFN-2-RLY-075-14A-K30B is located in panel 2-PNLA-009-0033.
August 8, 2009	Relay verified to be energized in performing step 7.5 [3] of Procedure 2-SR-3.3.5.1.6 (CSII), CS System Logic Functional Test, Loop II.
November 13, 2010	Relay verified to be energized during performance of step 7.11 [8] A, SR 0-SR-3.8.1.9(C), Diesel Generator C Emergency Unit 1 Load Acceptance Test.
February 10, 2010	Thermography determined relay to be energized.
April 27, 2011@1635 CDT	Loss of offsite power (LOSP) to Units 1, 2, and 3 occurred due to severe weather causing tornadoes and high winds in the immediate vicinity.
April 27, 2011@1636 CDT	Units 1, 2, and 3 experienced a reactor scram due to loss of offsite power. The loss of offsite power condition resulted in the diesel generator supplying power to the 4KV shutdown boards C and D, [EB] This would have caused Relay 2 RLY-075-14A-K30B to de-energize and subsequently re-energize (cycle the contacts).
November 13, 2010 to August 8, 2011	No procedures or PMs that removed the relay cover.
August 8, 2011@ 08:50 CDT	OPS performed 2-SR-3.3.5.1.6 (CSII), "Core Spray System Logic FT-Loop II".
August 8, 2011@ 10:40 CDT	CS Loop II declared inoperable for performance of 2-SR-3.3.5.1.6 (CS II). Entered TS LCO 3.5.1 Condition A. Required Action is to restore LP ECCS to Operable Status within 7 days.

NARRATIVE

August 8, 2011@18:20 CDT Outside Unit Supervisor (US) reports that step 7.5 [3] of Procedure 2-SR-3.3.5.1.6 (CS II) failed when contacts 3-7 and 4-8 did not indicate open with the test switch in the A-B position.

August 9, 2011@ 1:47 CDT Ops authorized WO 112545536 to troubleshoot relay 2-RLY-075-14A-K30B for 2B CS Pump Logic.

August 9, 2011@ 3:26 CDT As part of troubleshooting, when technicians removed the relay cover, the relay picked-up. Relay cover was reinstalled and relay in required position for testing.

August 9, 2011@ 4:00 CDT Ops recommenced surveillance 2-SR-3.3.5.1.6 (CS II). Step 7.5 [75] and step 7.11 [5.1] both de-energize relay 2-RLY-075-14A-K30B.

August 11, 2011@ 5:45 CDT Ops completed 2-SR-3.3.5.1.6 and exits action statement entered on August 8, 2011, at 10:40 CDT.

August 12, 2011@ 9:45 CDT Determined Relay 2-RLY-075-14AK30B contacts in wrong position. Entered TS LCO 3.8.7.A.1 and A.2 for the C 4kV SDBD and TS 3.8.1.B.1, B.2, and B.3 for the C D/G. (Second entry)

August 12, 2011@ 11:05 CDT Entered TS 3.5.1.A, one low pressure ECCS injection/spray subsystem inoperable.

August 13, 2011@ 10:00 CDT WO112565983 initiated to replace relay for 2B Core Spray Pump.

August 13, 2011@ 13:55 CDT Relay energized correctly during post-maintenance testing.

August 13, 2011@ 15:45 CDT Operated 2B Core Spray pump IAW-2-OI-75 to verify pump operation and exited LCO that was entered on August 12, 2011, at 11:05 CDT.

D. Other Systems or Secondary Functions Affected

None

E. Method of Discovery

The contacts were discovered to be in the incorrect position during performance of surveillance testing, Procedure 2-SR-3.3.5.1.6(CS II), Core Spray System Logic Functional Test Loop II. This occurred two (2) times.

F. Operator Actions

Operations personnel declared one low pressure ECCS injection/spray subsystem inoperable (Unit 2 TS 3.5.1.A) from 10:40 on August 8, 2011, until 05:45 on August 11, 2011. Additionally, another period of inoperability was declared between 11:05 on August 12, 2011, until 15:45 on August 13, 2011.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant Unit 2	05000260	2011	-- 001	-- 00	5 of 10

NARRATIVE

G. Safety System Responses

There were no safety system responses.

III. CAUSE OF THE EVENT

A. Immediate Cause

The contacts for HGA relay 14A-K30B failed to open.

B. Root Cause

A Kepner-Trego (K-T) analysis was performed by BFN Site Engineering to analyze the equipment failure. The K-T analysis determined the most probable cause of the relay failure was a manufacturing defect causing intermittent binding of the relay contacts. A cursory inspection of the replaced relay revealed intermittent sticking/binding of the movable contacts. The hinged armature can intermittently become bound in an undesired position, limiting the ability of the relay to operate as expected.

The HGA relay was also shipped to the Tennessee Valley Authority's Central Labs to determine the failure mechanism. The failure report stated that the General Electric HGA relay's hinged armature can intermittently become bound in an undesired position, limiting the ability of the relay to operate as expected. External forces do not appear to be a factor, as in the misplacement of the cover. The binding takes place within the hinged armature mechanism, particularly on the right side; however, binding occurred intermittently in both directions. The failure mechanism for this relay is a bound hinged armature. A specific cause for the binding was not identified.

The relay was also sent to GE-Hitachi for their review and analysis.

IV. ANALYSIS OF THE EVENT

The condition being reported is the operation of BFN Unit 2 in a manner prohibited by Technical Specifications, the loss of a safety function, and a defect in a basic component. LCO 3.3.5.1.A requires that with one or more channels inoperable, to immediately enter the condition referenced in Table 3.3.5.1-1 for the channel. For the Core Spray system, Function 1e in Table 3.3.5.1-1 is the core spray pump start with time delay relay and pumps A, B, C, and D (with diesel power) should start between 6 to 8 seconds. For the LPCI system, with time delay relay and pumps A, B, C, and D on diesel power, the pumps should start between 0 and 1 seconds. The condition associated with the HGA relay may not have allowed the RHR pumps and Core Spray pumps to sequence properly. Core Spray logic is such that the B and D pumps either both start or both do not start. RHR pumps in the LPCI mode may have one pump not start, but their logic is not tied together as that previously discussed for the Core Spray pumps. The relay failure caused the Core Spray pump motor sequencing logic to be inoperable. In addition, the opposite division was removed from service between April 27, 2011, until August 13, 2011, when the relay was replaced.

NARRATIVE

Therefore, over this time interval, the safety function provided by core spray was not always available.

V. ASSESSMENT OF SAFETY CONSEQUENCES

When normal power is lost at bus C, relay 14A-K29B de-energizes which drops out relay 14A-K124B. With relay 14A-K30B de-energized due to the malfunction, relay 14A-K123B remains energized, which maintains the start signal on the 2B Core Spray pump. (Note: Bus C supplies power for the 2B Core Spray pump). The 2B Core Spray pump will be tripped by 27SCX and/or 27SCY relays. When power comes back on the C bus, the 27SCX and/or 27SCY relays will reset and the standing start signal will reclose the 2B Core Spray breaker without a time delay. Without this time delay, the Residual Heat Removal (RHR) [BO] pumps and the Core Spray would have attempted to start at the same time, which cannot be supported by the diesel. One or both of the pump motors would be expected to stall and trip on over current.

With normal power available, no problems occur as a result of a relay failure. If both the C and D bus lose power and regain a power supply from the diesel generators, the Core Spray and RHR pumps would have sequenced back on.

However, for the single failure of the C bus coincident with an accident signal, the RHR pumps and Core Spray pumps would have attempted to start at the same time and one or both of the pump motors would stall and trip on over current.

VI. CORRECTIVE ACTIONS

TVA will track completion of these actions in the Corrective Action Program.

A. Immediate Corrective Actions

The relay that was found in the incorrect position (BFN-2-RLY-075-14A-K30B) was replaced. The contacts for other HGA relays identified in the extent of condition have been visually verified to be in the correct position.

Work orders have been prepared to have HGA relays, which were received in the same lot, manually cycled a minimum of 20 times to verify no binding of the hinged relay armature occurs.

B. Corrective Actions to Prevent Recurrence

A PM that checks coils using thermography will be expanded to also include checking the contacts position

Other corrective actions:

1. Address relay binding. Submit a revision to Preventive Maintenance (PM) to visually verify the relay contacts are in the correct position. (Projected completion date is October 28, 2011)

2. Address relay binding. Submit a revision to PM to visually verify relay contacts are in the correct position. (Projected completion date is November 14, 2011)
3. Address relay binding. Revise ECI-0-000-RLY003 (Electrical Corrective Instruction Replacement of relays) to test the HGA relays being installed by cycling the relay a minimum of 20 times to verify no binding of the hinged relay armature occurs. (Projected completion date is December 15, 2011)

VII. ADDITIONAL INFORMATION

A. Failed Components

GE HGA relay, PN 1376C6183P014, Model Number 12HGA111A1F.

B. Previous Similar Events

Browns Ferry Unit 3 Failure Number 484 (PERs 141604 and 141624:

On April 4, 2008, at 1200 hours, following implementation of DCN 51017 Stage 2, U3 CASA logic modifications, continuity checks were performed on all relay contacts, relay coils and wire terminations in Panel 3-9-32. During performance of this PMT, 3-RLY-74-10AK104C contacts 3-7 and 3-RLY-75-14A-K30A contacts 3-7 and 4-8 were identified to be "open" when they should have been closed. PERs 141604 and 141624, respectively, were initiated to document these findings. WOs 08-714071-000 and 08-714101-000 were initiated to replace the relays. The relays were removed and inspected by Systems and Design Engineering. The initial inspection identified that the armature assembly was easily disturbed from its normally pulled forward de-energized state. The ease of movement was attributed to a weak spring that did not demonstrate the normal amount of tension on the armature to ensure the normally closed contacts were firmly made up. Multiple continuity checks were performed on these relays with similar findings as documented in the WOs. During the visual inspections performed, the armature was verified to be free from binding, all connections appeared to be secure, the contacts were not pitted or severely corroded and the normally closed contacts were verified to be made up. These relays were then sent to Central Labs (CL) for failure analysis. This evaluation of the relays at CL concluded that the control springs did not keep the normally closed contacts firmly pulled together due to the control spring tension. The corrective action was to replace the relays. Additionally, another action was to replace the relays listed in the extent of condition.

On November 5, 2008, at 03:45 CST, during performance of 1/2-ETU-SMI 1-C.4 (Relay Functional Checks on 4 kV Shutdown Board C) [EB], General Electric Company model 12HGA11A51F (12HGA11A51F), model 12HGA11A51F (12HGA11A51F relays, BFR-1-RLY -074- 10AK132B and BFN-2-RLY -074-10AK132B failed to de-energize. When the relay covers were removed and reinstalled on these

NARRATIVE

relays, the Trip Signal Cancel Relay (TSCRN) (0-RLY-211-TSCRNC) relay located on Panel 25-45C energized as expected. The apparent cause was a weakened spring or bonding of the contacts. Corrective actions consisted of replacing the relays, initiated thermography scan PMs to proactively detect adverse trends associated with normally energized risk significant HGA relays.

C. Additional Information

The corrective action document for this report is PER 415242.

D. Safety System Functional Failure Consideration:

This event is considered a safety system functional failure. The fulfillment of a safety function (core spray) during a loss of offsite power could have been prevented; therefore in accordance with NEI 99-02 guidance, this event is considered a safety system functional failure.

E. Scram With Complications Consideration:

This event did not include a reactor scram.

F. 10 CFR 21 Reporting Requirements

The following information is provided at this time to meet the requirements of 10 CFR Part 21.21(d)(4) (i)-(viii).

(i) Name and address of individual informing the Commission:

Mr. K. J. Polson
Vice-President-Browns Ferry Nuclear Plant
Tennessee Valley Authority
P. O. Box 2000
Decatur, Alabama 35609-2000

(ii) Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which fails to comply or contains a defect.

Facility: Browns Ferry Nuclear Plant

Basic component which contains a defect: GE relay, Q Level QA 1, type: electromagnetic, coil volts: 250 DC, construction: semi-flush mount, rear connections, Type HGA. Relay in located in the Core Spray System logic.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant Unit 2	05000260	2011	-- 001	-- 00	9 of 10

NARRATIVE

(iii) Identification of the firm constructing the facility or supplying the basic component which fails to comply or contains a defect.

Basic component supplier: GE-Hitachi Nuclear Energy
3901 Castle Hayne Rd
Wilmington, NC 28402

GE Part No. is 1376C6183P014

(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

Nature of the defect:

The General Electric HGA relay's hinged armature can intermittently become bound in an undesired position, limiting the ability of the relay to operate as expected. External forces do not appear to be a factor, as in the misplacement of the cover. The binding takes place within the hinged armature mechanism, particularly on the right side; however binding occurred intermittently in both directions. The failure mechanism for this relay is a bound hinged armature.

Safety hazard which could be created by such defect:

When normal power is lost at bus C, relay 14A-K29B de-energizes which drops out relay 14A-K122224B. With relay 14A-K30B de-energized due to the malfunction, relay 14A-K123B remains energized, which maintains the start signal on the 2B core spray pump. (Note that bus C provides power to the 2B Core Spray pump). The 2B pump will be tripped by 27SCX and/or 27SCY relays. When power comes back on the C bus, the 27SCX and/or 27SCY relays will reset and the standing start signal will reclose the 2B Core Spray breaker without a time delay. Without this time delay, the RHR pumps and the Core Spray would have attempted to start at the same time which cannot be supported by the diesel. One or both of the pump motors would be expected to stall and trip on overcurrent.

(v) The date on which the information of such defect or failure was obtained.

October 6, 2011.

NARRATIVE

(vi) In the case of a basic component which contains a defect or fails to comply, the number and location of all such components in use at, supplied for, or being supplied for one or more facilities or activities subject to the regulation of this part.

Number and Location of all such components in use at BFN was restricted to those relays received on or after the receipt of the defective relay since no failure have been observed with those received earlier.

BFN Item Number

2-RLY-075-14A-K30A
2-RLY-075-14A-K32A
2-RLY-074-10AK104C
2-RLY-074-10AK104A
2-RLY-075-14A-K30B
2-RLY-075-14A-K32B
2-RLY-074-10AK104D
2-RLY-074-10AK104B
3-RLY-075-14A-K32A
3-RLY-074-10AK104A
3-RLY-074-10AK104B
3-RLY-074-10AK104D
3-RLY-075-14A-K32B
3-RLY-075-14A-K30B

(vii) The corrective action which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and the length of time that will be taken to complete the action.

The corrective actions in response to this event are discussed in the LER, Section VI., Corrective Actions.

(viii) Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.

In addition to the immediate corrective actions taken and proposed corrective actions, TVA has forwarded the relay and internal evaluation report to GE-Hitachi, who is performing a separate analysis.

VIII. COMMITMENTS

None