September 30, 2005

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop OWFN, P1-35
Washington, D. C. 20555-0001

10 CFR 50.73

Dear Sir:

TENNESSEE VALLEY AUTHORITY - BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 2 - DOCKET 50-260 - FACILITY OPERATING LICENSE DPR - 52 - LICENSEE EVENT REPORT (LER) 50-260/2005-007-00

The enclosed report provides details of a Unit 2 automatic scram due to a low reactor water level caused by a loss of feedwater pumps.

In accordance with 10 CFR 50.73 (a) (2) (iv) (A), TVA is reporting this event as an a valid actuation of the reactor protection system and containment isolation valves in more than one system. There are no commitments contained in this letter.

Sincerely,

Original signed by:

Brian O'Grady

cc: See page 2

Enclosure
cc (Enclosure):
(Via NRC Electronic Distribution)

Ms. Eva Brown, Project Manager
U.S. Nuclear Regulatory Commission
(MS 08G9)
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852-2739

Mr. Stephen J. Cahill, Branch Chief
U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW, Suite 23T85
Atlanta, Georgia 30303-8931

NRC Resident Inspector
Browns Ferry Nuclear Plant
10833 Shaw Road
Athens, Alabama 35611-6970

WDC:DTL:SWA:BAB
Enclosure
cc (Enclosure):
B. M. Aukland, POB 2C-BFN
A. S. Bhatnagar, LP 6A-C
J. C. Fornicola, LP 6A-C
N. M. Moon, BR 4T-C
R. F. Marks, PAB 1C-BFN
G. W. Morris, BR 4X-C
R. G. Jones, NAB 1A-BFN
J. R. Rupert, NAB 1A-BFN
K. W. Singer, LP 6A-C
E. J. Vigluicci, ET 11A-K
NSRB Support, LP 5M-C
INPO:LEREvents@inpo.org
EDMS WT CA - K

S:lic/submit/lers/260-2005-007.doc

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 06/30/2007

Estimated burden per response to comply with this mandatory collection request:: 50 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)

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

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Browns Ferry Unit 2	05000260	1 OF 6

4. TITLE
Reactor Scram Due To Low Reactor Water Level Caused By Loss Of Feedwater Pumps.

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
									none	N/A
08	05	2005	2005-007-00			09	30	2005	FACILITY NAME none	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)	X	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, Licensing and Industry Affairs	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

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

At 1708 hours Central Daylight Time (CDT) on August 5, 2005, the Unit 2 Reactor automatically scrammed on low reactor water level from 100 percent power following a sequential loss of Reactor Feed Pumps (RFP) 2C and 2B. RFP 2C was lost when the RFP turbine main steam flow control valve (FCV) control linkage failed. RFP 2A and RFP 2B increased flow in an attempt to maintain reactor feedwater level, however; RFP 2B tripped when the thrust bearing wear detector trip actuated. Loss of RFP 2C and RFP 2B resulted in low reactor water level, an automatic runback and trip of the Reactor Recirculation System pumps, and a reactor water level automatic scram. When the reactor water level reached the low low water level, the High Pressure Coolant Injection and Reactor Core Isolation Cooling systems auto initiated recovering reactor water level. The cause of the event was a low reactor water level resulting from the sequential loss of RFP 2C and RFP 2B. First, the control valve linkage for RFP 2C came disconnected from the low pressure steam admission FCV actuator. The FCV failed closed and RFP 2C stopped. Second, RFP 2B turbine thrust bearing wear detector actuated and tripped the pump turbine. The investigation into the root cause of the main steam control valve linkage failure of for RFP 2C was inadequate installation of a locking device. The investigation into the root cause for RFP 2B turbine trip is ongoing. Oil samples do not indicate any thrust bearing wear and a calibration check of the turbine thrust bearing wear detector indicated satisfactory operation.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Browns Ferry Nuclear Plant Unit 2	**05000260**	**2005**	**-- 007**	**-- 00**	2 OF 6

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

I. PLANT CONDITION(S)

Prior to the scram event, Units 2 and 3 were in operating in Mode 1 at 100 percent thermal power (approximately 3458 megawatts thermal). Unit 1 was shutdown and defueled. Units 1 and 3 were unaffected by the event.

II. DESCRIPTION OF EVENT

A. Event:

At 1708 hours Central Daylight Time (CDT) on August 5, 2005, the Unit 2 Reactor automatically scrammed on low reactor water level from 100 percent power following a sequential loss of the Reactor Feed Pumps [SJ] (RFP) 2C and 2B. RFP 2C was lost when the RFP turbine main steam flow control valve (FCV) control linkage failed. RFP 2A and RFP 2B increased flow in an attempt to maintain reactor feedwater level, but RFP 2B tripped when the thrust bearing wear detector actuated. RFP 2A could not maintain reactor water level and the reactor scrammed when water level reached Level 3 (low water level). Following the reactor scram, RFP 2A ran back to minimum flow.

Loss of RFP 2C and RFP 2B resulted in low reactor water level, an automatic runback of the Reactor Recirculation System [AD] pumps, and a reactor water level automatic scram. When the reactor water level reached level 2 (low low water level) the High Pressure Coolant Injection (HPCI) [BJ] and Reactor Core Isolation Cooling (RCIC) [BN] systems auto initiated to recover water level and the Reactor Recirculation System pumps tripped. Operations entered Emergency Operating Instruction (EOI) -1 on low reactor water level.

During the event all control rods Inserted. As a result of the low water level, the Primary Containment Isolation System (PCIS) isolations [JM] Group 2 (Residual Heat Removal (RHR) System [BO] Shutdown Cooling), Group 3 Reactor Water Cleanup (RWCU) [CE] System, Group 6 (Ventilation), and Group 8 Traversing Incore Probe (TIP) [IG] were received along with the auto start of the Control Room Emergency Ventilation (CREV) [VI] System and the three Standby Gas Treatment (SGT) System trains.

At approximately 1728 hours CDT, the reactor scram was reset. SGT and CREV systems were secured by approximately 1730 hours CDT. By about 1830 hours CDT the HPCI and RCIC systems were secured and placed in standby readiness. EOI-1 and EOI-2 were exited at 1838 hours CDT. Reactor water level and normal heat rejection were being maintained by the feedwater and condensate system.

This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv)(A), as an event that resulted in an automatic actuation of the systems listed in paragraph 10 CFR 50.73(a)(2)(iv)(B) (i.e., Reactor Protection System including reactor scram or trip, and general containment isolation signals affecting containment isolation valves in more than one system).

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

None.

C. Dates and Approximate Times of Major Occurrences:

August 5, 2005	1708 hours	Unit 2 received an automatic reactor scram in response to a low reactor water level.
August 5, 2005	1728 hours	Operations reset the reactor scram.
August 5, 2005	2050 hours	TVA made a four hour non-emergency report per 10 CFR 50.72(b)(iv)(A), 10 CFR 50.72(b)(iv)(B), and an eight hour non-emergency report per 10 CFR 50.72(b)(3)(iv)(A).

D. Other Systems or Secondary Functions Affected

None.

E. Method of Discovery

The event was immediately apparent to the operating crew through numerous indications and alarms in the Unit 2 Control Room.

F. Operator Actions

Operations personnel responded to the event in accordance with applicable plant procedures.

G. Safety System Responses

All control rods Inserted. The PCIS isolations Group 2 (RHR System Shutdown Cooling), Group 3 Reactor RWCU System, Group 6 (Ventilation), and Group 8 TIP isolation were received along with the auto start of the CREV System and the three SGT System trains. Reactor water level was recovered by HPCI and RCIC system operation.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of the event was a low reactor water level resulting from the sequential loss of RFP 2C and RFP 2B.

B. Root Cause

There were two unrelated root causes to this event. First, the main steam FCV linkage for RFP 2C failed. Second, RFP 2B turbine thrust bearing wear detector actuated and tripped the pump turbine.

RFP 2C

The root cause of the main steam control valve linkage failure of RFP 2C was the inadequate installation of a locking device on the upper joint of the control valve operating cylinder for the main steam inlet FCV linkage. The FCV operating cylinder linkage is held in place with a threaded pivot pin and a castellated nut with a locking device (roll pin). The locking device was found in the immediate vicinity of the nut and pivot pin that had become unfastened from the linkage, the linkage was found disconnected from the valve.

A visual inspection of the nut, pivot pin, and the locking device determined the locking device was inadequately staked during reinstallation following maintenance. The locking device came out of the control valve linkage, the castellated nut vibrated off the pivot pin, and the linkage disconnected from the valve controller.

RFP 2B

The root cause investigation for RFP 2B turbine trip from the turbine thrust bearing wear detector is still ongoing. Oil samples taken following the RFP turbine trip do not indicate any thrust bearing wear. A calibration check of the turbine thrust bearing wear detector indicated satisfactory operation.

The 2B RFP turbine is currently operating with the thrust bearing wear trip in the alarm only mode. Testing performed thus far has not identified any abnormal conditions. Further testing is planned to determine the root cause when the turbine can removed from service.

C. Contributing Factors

None.

IV. ANALYSIS OF THE EVENT

The reactor scram was uncomplicated. The temporary lowering of the reactor water level is an expected response to loss of feedwater flow at 100 percent thermal power.

The RFP control logic is designed so that when RFP 2C tripped, the subsequent lowering of reactor water level results in RFP 2A and RFP 2B automatically increasing flow to recover reactor water level. Following the trip of RFP 2C, RFP 2 A and RFP 2B increased flow to attempt to recover reactor water level, however; RFP 2B tripped, which lead to the reactor scram.

Additionally, on a reactor scram, the RFP control logic normally maintains RFP 2C in automatic control and runs RFP 2A and run back to minimum flow. If RFP 2C is not in automatic control at the time of the scram, RFP 2B is maintained in automatic control and RFP 2A is run back to minimum flow. If neither RFP 2C or RFP 2B is in automatic control at the time of the scram, RFP 2A is maintained in automatic control. This logic is designed to maintain reactor water level following a reactor scram from a normal water level.

During this event, the circumstances surrounding the loss of RFP 2C did not generate a trip signal, and, therefore the pump appeared to still be in automatic control. After RFP 2B tripped, only RFP 2A remained in service and a single RFP has insufficient capacity to maintain reactor water level at 100 percent power. Water level lowered to the low reactor water level scram setpoint. RFP 2A ran back to minimum flow because the post scram level control logic still considered RFP 2C available in automatic control. With the level shrink that took place after the reactor scram, reactor water level lowered below the HPCI and RCIC initiation setpoints.

Equipment response following the reactor scram was in accordance with plant design for a loss of RF water. The short term lowering of the reactor water level was recovered by HPCI and RCIC operation. Following the initial transient, reactor pressure was controlled by main steam bypass valve [SB] operation. The operation of other systems post scram (e.g., containment isolation, start-up of SGT and CREV systems, isolation of normal reactor building ventilation, RWCU isolation, TIP isolation, etc) also occurred in accordance with the plant design. The main

condenser continued to function as the heat sink following the reactor scram. The operator actions in response to the event were appropriate.

V. ASSESSMENT OF SAFETY CONSEQUENCES

UFSAR Section 14.5.5.3 addresses the complete loss of feedwater transient. Loss of feedwater flow is the most severe from high power conditions. Transient analysis is performed at 102 percent thermal power and 100 percent rated core flow. Conservative heat values are used to maximize the heat addition to the vessel, Main Steam Relief Valve challenges, and inventory loss. Water Level is considered to be normal. The three feed pumps are assumed to coast down in one second. RCIC is assumed to initiate at level 2 (low low water level). HPCI is not assumed to start and no MSIV closure takes place. The analysis shows that no safety limits are exceeded for the loss of feedwater transient.

The transient described in this LER, is bounded by the analysis presented in UFSAR Section 14.5.5.3. First, the RFP 2C coasted down due to the FCV closure. RFP 2B and RFP 2A increased flow in an attempt to maintain reactor water level, however RFP 2B tripped when the turbine thrust wear detector actuated. With Unit 2 at 100 percent power, reactor water level could not be maintained with the remaining RFP. When the reactor water level reached Level 3 (low water level) the reactor scram occurred as designed. Upon reactor scram Pump RFP 2A went to minimum speed in accordance with the post scram level control design. The water level continued to fall, and, at the Level 2 setpoint RCIC and HPCI initiated, returning water level to normal.

VI. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

Operations placed the reactor in a stable condition in accordance with plant procedures. The spring pin used as a locking device for the secondary operating cylinder of the control valve linkage for RFP 2C was replaced with a cotter pin. A cotter pin is considered to be better suited for this application.

B. Corrective Actions to Prevent Recurrence(1)

RFP 2C

- The valve linkage on RFPs 2A, and 2B as well as 3A, 3B, and 3C RFPs were inspected to verify the existence of a locking device. All of these valve linkages were verified to already have cotter pins as a locking mechanism.
- Procedures for the RFP and RFP turbines will be reviewed and, if necessary, revised to include a locking device in this type application.

RFP 2B

The reason for the turbine bearing wear detector trip has not been identified. Additional testing, which can only be performed with the RFP out of service, is required to determine a

(1) TVA does not consider these corrective actions regulatory commitments. The completion of these actions will be tracked in TVA's Corrective Action Program.

root cause of the trip. TVA plans to perform this testing during the next available feedpump turbine outage.

VII. ADDITIONAL INFORMATION

A. Failed Components

None.

B. Previous LERs on Similar Events

None.

C. Additional Information

None.

D. Safety System Functional Failure Consideration:

No safety functions were compromised as a result of this event. Therefore, this event is not considered a safety system functional failure in accordance with NEI 99-02 in that functional capability of the overall system was maintained.

E. Loss of Normal Heat Removal Consideration:

The condenser and RFP 2A remained available, providing a normal heat removal path following the reactor scram. Accordingly, this event did not result in a scram with a loss of normal heat removal as defined in NEI 99-02.

VIII. COMMITMENTS

None.