April 24, 2003

U.S. Nuclear Regulatory Commission 10 CFR 50.73
ATTN: Document Control Desk
Mail Stop OWFN, P1-35
Washington, D. C. 20555-0001

Dear Sirs:

TENNESSEE VALLEY AUTHORITY - BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 2 - DOCKET 50-260 - FACILITY OPERATING LICENSE DPR-52 - LICENSEE EVENT REPORT (LER) 50-260/2003-001-00

The enclosed report provides details of an unplanned, automatic scram which occurred on Unit 2 during cooldown of the reactor following the planned shutdown which began the Unit 2 Cycle 12 refueling outage. During the cooldown evolution, reactor water level briefly dropped below the low water level scram setpoint.

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

Sincerely,

ORIGINAL SIGNED BY:

Ashok S. Bhatnagar

cc: See page 2

Enclosure
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NRC FORM 366 (7-2001)	U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

LICENSEE EVENT REPORT (LER)

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

Estimated burden per response to comply with this mandatory information 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 Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bjs1@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 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.

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE
Automatic Scram resulting from low reactor water level during reactor cooldown

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									None	N/A
02	24	2003	2003 - 001 - 00			04	24	2003	FACILITY NAME None	DOCKET NUMBER N/A

9. OPERATING MODE	3
10. POWER LEVEL	000

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

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

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Paul S. Heck, Nuclear Engineer, Licensing and Industry Affairs	256-729-3624

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				15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (if yes, complete EXPECTED SUBMISSION DATE)	X	**NO**				

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

On February 24, 2003, during the Unit 2 reactor cooldown evolution following its shutdown to begin the cycle 12 refueling outage, at 1117 hours CST an automatic actuation of the reactor protection system (RPS) occurred as a result of a low reactor water level condition. Reactor water level control was being transferred from operation of a single turbine driven reactor feed pump (RFP) to the motor-driven condensate/condensate booster pumps via the reactor feedwater startup level control valve. Difficulties in closing the RFP discharge valve and subsequent slow operation of the startup level control valve allowed reactor water level to drop slightly below the scram setpoint of 2 inches. The lowest reactor water level observed was 1.6 inches. Reactor water level was immediately recovered to the normal operating range by increased make-up flow through the feedwater startup level control valve. No control rod motion occurred as a result of the RPS actuation, since all control rods had previously been fully inserted via the manual scram which had commenced the earlier, planned reactor shutdown. All expected system responses were received, including the actuation of primary containment isolation system groups 2, 3, 6, and 8 due to the same low reactor water level condition.

The cause of the event was off-normal RFP discharge valve operation combined with a slow response of the feedwater startup level control valve. Corrective actions include maintenance on the discharge valve, evaluation of the design of the control scheme, and additional operator training on the system response.

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

I. PLANT CONDITION(S)

At the time of the reactor scram event, Unit 2 was in Mode 3 (hot shutdown) at approximately 290 psig. Unit 3 was in Mode 1 at 98.7 percent reactor power (approximately 3412 megawatts thermal). Unit 1 was shutdown and defueled. Units 1 and 3 were unaffected by the event.

II. DESCRIPTION OF EVENT

A. Event:

On February 24, 2003, during the Unit 2 reactor cooldown evolution following its shutdown to begin the cycle 12 refueling outage, at 1117 hours CST an automatic actuation of the reactor protection system (RPS) [JC] occurred as a result of a low reactor water level condition. Reactor water level control was being transferred from operation of a single turbine driven reactor feed pump (RFP) [SJ] to the motor-driven condensate/condensate booster pumps [SD] via the reactor feedwater startup level control valve. Difficulties in closing the RFP discharge valve and subsequent slow operation of the startup level control valve allowed reactor water level to drop slightly below the scram setpoint of 2 inches. The lowest reactor water level observed was 1.6 inches. Reactor water level was immediately recovered to the normal operating range by increased make-up flow through the feedwater startup level control valve.

No control rod motion occurred as a result of the RPS actuation, since all control rods had previously been fully inserted via the manual scram which had commenced the earlier, planned reactor shutdown. All expected system responses were received, including the actuation of primary containment isolation system (PCIS) [JM] groups 2, 3, 6, and 8 due to the same low reactor water level condition. This PCIS logic isolates shutdown cooling [BO] (if in service), isolates the reactor water cleanup (RWCU) [CE] system, isolates the normal reactor building ventilation [VA], initiates the standby gas treatment (SGT) [BH] system, initiates the control room emergency ventilation (CREV) [VI] system, and retracts Traversing Incore Probes (TIP) [IG] (if inserted). The normal heat rejection path (from the reactor to the main condenser via the main steam lines with reactor water make-up provided by the condensate/feedwater system) remained in service. Neither the high pressure coolant injection (HPCI) [BJ] nor reactor core isolation cooling (RCIC) [BN] systems were used during this event. Reactor water level did not approach the auto-initiation point for these systems, and they were not manually placed in service by the control room staff.

Because this event involved the valid, automatic actuation of the RPS and the operation of containment isolation valves in more than one system, and because the scram was not part of a pre-planned sequence, this event is reportable in accordance with 10 CFR 50.73 (a) (2) (iv) (A).

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

None

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

C. Dates and Approximate Times of Major Occurrences:

February 24, 2003	0900 hours CST	The Unit 2 reactor was manually scrammed from approximately 22% power to begin its cycle 12 refueling outage. Reactor depressurization and cooldown commenced in accordance with plant operating instructions.
	1117 hours CST	Automatic actuation of the RPS occurred on lowering reactor water level. PCIS groups 2, 3, 6, and 8 isolated in accordance with the plant design. Water level was immediately raised above the scram setpoint.
	1130 hours CST	The SGT and CREV systems were secured and normal reactor building ventilation re-established.
	1143 hours CST	RWCU system returned to service.
	1436 hours CST	Required eight-hour reports were made via telephone to the NRC Operations Center.

D. Other Systems or Secondary Functions Affected

None

E. Method of Discovery

This event was identified through numerous indications and alarms in the control room.

F. Operator Actions

This event directly resulted from a combination of off-normal balance-of-plant equipment operation and the responsiveness of the startup bypass level control design scheme which is optimized for reactor start-up performance. The reactor operator (RO) responsible for water level control was correctly using the appropriate operating procedures. Upon the failure of the RFP discharge valve to close when initially demanded, and judging that the feedwater startup level control valve was not adequately responding, the RO placed the associated controller into manual mode and attempted to increase flow to the reactor vessel.

All operator actions taken in response to the scram and in the recovery from the event were appropriate. These actions included immediately restoring water level above the scram setpoint, verifying that the expected system isolations and initiations had occurred, and accomplishing the subsequent restoration of these systems to normal alignments.

G. Safety System Responses

All safety-system equipment operated in accordance with the plant design during this event.

The RPS logic responded to the lowering water level per design to initiate the reactor scram. No rod motion occurred as all control rods were already fully inserted prior to the event.

The PCIS logic responded per design to the lowered reactor water level by actuating the following isolation groups:

- Group 2 - Residual Heat Removal shutdown cooling function isolation (not in service at the time of the event)
- Group 3 - RWCU system isolation
- Group 6 - primary and secondary containment isolation, including the isolation of the normal reactor building ventilation, and the initiation of the SGT and CREV systems
- Group 8 - withdrawal and isolation of the Traversing Incore Probes (the probes were not inserted at the time of this event)

No automatic or manual operation of other water make-up systems (such as HPCI, RCIC, RHR, or Core Spray) were required during this event.

III. CAUSE OF THE EVENT

A. Immediate Cause

The immediate cause of this event was a slow flow increase through the feedwater startup level control valve in response to the operator demand for the increase.

B. Root Cause

The root causes of this event were determined to be:

1. Equipment performance - During the normal cool down evolution, the reactor feed pump discharge valves are closed, however, one reactor feed pump discharge valve failed to close when initially demanded. The delayed closure of this valve initiated the subsequent vessel level control problems.

2. System Design - During a reactor cool down, at the point of reactor make-up transition from the reactor feed pumps to the condensate system, reactor pressure is greater than the shutoff head of the condensate booster pumps. Reactor depressurization must continue until condensate pressure is approximately 100 psid above reactor pressure. At this point, the feedwater startup level control valve must be manually opened to greater than 50% to provide injection flow equal to the steaming rate of approximately 0.3 million pounds per hour. Manual operation of the feedwater startup level control valve is required because the valve size and the control system settings are not sufficient to allow adequate automatic response to level changes resulting from normal shutdown steaming with an initial valve position of fully closed. In this case the valve was in automatic mode in accordance with the procedure, and process conditions had initially driven it to the fully closed position. The valve size and the control system settings are optimized for startup conditions.

C. Contributing Factors

None

IV. ANALYSIS OF THE EVENT

During power operation and during the higher pressure portions of reactor start-up or shutdown, the reactor water inventory is maintained by operation of steam-turbine driven reactor feed pumps. At lower pressures, typically less than 300 psig, the reactor inventory is maintained by the motor-driven condensate and condensate booster pumps. The fundamental design of the BFN boiling water reactors requires the transition between these two primary sources of reactor water make-up as reactor pressure is decreased or increased through the range of 250-350 psig. In this pressure range during startup the reactor power is very low, and only decay heat exists during cooldown evolutions. Low steaming rates exist (i.e., reactor inventory boil-off is low), therefore a very large safety margin exists with regard to core cooling.

In this event the RFP discharge isolation valve did not immediately close when demanded by the control room operator. Additional actions by personnel both inside the control room and in the plant were therefore required to fully close the valve. Condensate and feedwater system parameters were affected by the behavior of the discharge valve, and these parameters also had an effect on the operation of the feedwater startup level control valve. The water level in the reactor is also directly affected by operation of the main turbine bypass valves which are used to control the reactor pressure and temperature. Manipulation of turbine bypass valve position was necessary at this time as well to maintain the reactor cooldown rates within the prescribed limits. The combination of the varying parameters within the condensate and feedwater systems, together with the vessel level perturbations introduced via turbine bypass valve operation, was sufficient to allow the reactor water level to momentarily drop beneath the scram setpoint.

The operation of other systems (e.g., RPS, containment isolation, start up of SGT and CREV, isolation of normal reactor building ventilation, RWCU isolation, TIP isolation, etc.) occurred in accordance with the plant design. The main condenser continued to function as the heat sink throughout the event. All post-event operator actions were appropriate in restoring normal water level, verifying proper equipment initiations and isolations, and in restoring normal equipment alignments.

V. ASSESSMENT OF SAFETY CONSEQUENCES

The event described in this event report was far less severe than any described in the FSAR. The low reactor water level scram setpoint is chosen so as to provide wide margins to core uncovery while assuming the reactor is operating at full power when this water level is reached. In this case, with the reactor already shutdown and substantially depressurized, a decrease in the water level to this same scram setpoint had very minimal consequences. Multiple safety systems were available for automatic operation to rapidly restore vessel inventory if the level decrease had continued. At the decay heat power levels in existence at the time, very long response times were available for manual operator actions as well. The health and safety of the public were not affected.

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

VI. CORRECTIVE ACTIONS

A. Immediate Corrective Actions

- Physical operation of the reactor feed water pump discharge valve and the feedwater startup level control valve was adjusted.
- Just-in-Time training was provided to the Operations staff on operation of the feedwater startup level control valve to support Unit 2 startup following the cycle 12 outage.
- The system operating instruction for Unit 2 was revised prior to Unit 2 restart to improve the methods in which level control transition is accomplished.

B. Corrective Actions to Prevent Recurrence[1]

- The system operating instruction for Unit 3 has been revised to improve the methods in which level control transition is accomplished.
- Long-term options to enhance system response during cooldown will be investigated and recommendations for modifications will be made as appropriate.
- Simulator modeling will be revised to enhance the modeling of the feedwater startup level control valve.

VII. ADDITIONAL INFORMATION

A. Failed Components

None

B. Previous LERs on Similar Events

None

C. Additional Information

None

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

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

D. Safety System Functional Failure Consideration:

This event does not involve a safety system functional failure which would be reported in accordance with NEI 99-02. The scram resulted from difficulties in closing a RFP discharge valve and the slow operation of a non-safety related level control valve. All safety-related equipment performed in accordance with the plant design in response to the event.

E. Loss of Normal Heat Removal Consideration:

This unplanned RPS actuation event did not occur while the reactor was critical, therefore consideration of a loss of normal heat removal condition is not relevant. This event does not constitute a scram with a loss of normal heat removal which would be reported in accordance with NEI 99-02.

VIII. COMMITMENTS

None