NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20603.

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Browns Ferry Unit 2	050000260	1 OF 5

Reactor Scram Resulting from Pressure Perturbation in the Electro-Hydraulic Control System Caused by Testing #1 Turbine Control Valve

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
						11	25	97	N/A	
10	28	97	97	007	00				FACILITY NAME: N/A	DOCKET NUMBER

OPERATING MODE (9)	N	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)			
POWER LEVEL (10)	070	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)	X 50.73(a)(2)(iv)	OTHER
		20.2203(a)(2)(iii)	50.36(c)(1)	50.73(a)(2)(v)	Specify in Abstract below
		20.2203(a)(2)(iv)	50.36(c)(2)	50.73(a)(2)(vii)	or in NRC Form 366A

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
Mark DeRoche, Industry Affairs Specialist	(205) 729-7559

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 October 28, 1997, at 1509 Central Standard Time (CST), Unit 2 automatically scrammed from approximately 70 percent power while cycling #1 Turbine Control Valve after repair. The scram resulted from an actuation of scram channel B1 caused by a pressure perturbation in the electro-hydraulic control (EHC) system at the turbine control valves. The pressure perturbation was induced by opening #1 turbine control valve. A half scram was previously present in RPS A due to cycling #1 control valve. Subsequent testing showed that the seal-in contact for one of the contactors in scram channel B1 (5A-K14B) exhibited chattering when subjected to reduced voltage. The scram contactor was replaced. Other corrective actions include procedure revisions to mitigate the consequences of pressure perturbation experienced while testing control valves, the installation of orifices in the EHC lines on the turbine control valves, and conducting a failure analysis of the RPS contactor that was replaced.

TVA is reporting this event in accordance with 10 CFR 50.73(a)(2)(iv), as an event that resulted in automatic actuation of an engineered safety feature including the reactor protection system.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION	
Browns Ferry Unit 2	05000260	97	007	00	2 OF 5

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

I. PLANT CONDITIONS

At the time of the scram, Unit 2 was at 70 percent power. #1 turbine control valve had been closed for post-maintenance testing, resulting in an expected half scram. Unit 3 was operating at rated power and Unit 1 was shutdown and defueled. Units 1 and 3 were not affected by this event.

II. DESCRIPTION OF EVENT

A. Event:

On October 28, 1997, at 1509, Unit 2 automatically scrammed while cycling #1 turbine control valve after repair. When #1 turbine control valve was cycled for post-maintenance testing, one of the reactor protection system (RPS) [JC] channel B1 scram contactors dropped out. Opening the control valve resulted in a short duration pressure transient in the electro-hydraulic control (EHC) system [TG] at the control valves. The pressure switch for the #2 turbine control valve, which provides an input to RPS logic when pressure decreases below setpoint, indicating control valve fast closure, was subjected to the pressure transient. Although the transient was of such a short duration that the pressure switch did not completely operate, it is believed that the transient resulted in a decreasing voltage to the scram contactors in RPS channel B1. One of the pair of contactors dropped out, although its companion did not.

Since a half scram was already present in RPS A due to #1 control valve maintenance, when the B1 channel scram contactor dropped out, 93 control rods (in groups 1 and 4) scrammed and one of the two backup scram valves operated, venting the scram pilot air header. The consequent drop in pressure in the scram pilot air header resulted in a full scram signal.

The scram resulted in the actuation or isolation of the following Primary Containment Isolation [JE] (PCIS) systems/components.

- PCIS group 2, shutdown cooling mode of Residual Heat Removal [BO] system; Drywell floor drain isolation valve; Drywell equipment drain sump isolation valve [WP].
- PCIS group 3, Reactor Water Cleanup [CE].
- PCIS group 6, Primary Containment Purge and Ventilation [JM]; Unit 2 Reactor Zone Ventilation [VB]; Refuel Zone Ventilation [VA]; Standby Gas Treatment (SGT) [BH] system; Control Room Emergency Ventilation (CREV) [VI].
- PCIS group 8, Tranverse Incore Probe [IG].

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

None.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION	
Browns Ferry Unit 2	05000260	97	007	00	3 OF 5

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

C. Dates and Approximate Times of Major Occurrences:

October 28, 1997 at 1140 (CST)	During plant rounds, a non-licensed operator identified a leak on the EHC system.
October 28, 1997 at 1223 (CST)	A senior reactor operator located the EHC leak on the servo valve for #1 turbine control valve.
October 28, 1997 at 1305 (CST)	The operating crew began power reduction in preparation for closing #1 turbine control valve.
October 28, 1997 at 1322 (CST)	Reactor power approximately 70 percent. The operating crew closed #1 turbine control valve, isolating the EHC leak. The expected half scram in RPS A was received.
October 28, 1997 at 1450 (CST)	Repairs to #1 turbine control valve completed satisfactorily. The valve was re-opened and the associated half scram was reset.
October 28, 1997 at 1507 (CST)	The operating crew closed #1 turbine control valve for post-maintenance testing. The expected half scram in RPS A was received.
October 28, 1997 at 1509 (CST)	Shortly after opening #1 turbine control valve, the Unit 2 reactor automatically scrammed.
October 28, 1997 at 1838 (CDT)	A four-hour non-emergency report is made to the NRC pursuant to 10 CFR 50.72(b)(2)(ii).

D. Other Systems or Secondary Functions Affected:

None.

E. Method of Discovery:

The operating crew received alarms associated with the full reactor scram.

F. Operator Actions:

Operators responded to the scram in accordance with the emergency operating instructions and stabilized the unit in hot shutdown.

G. Safety System Response:

The safety systems listed in section IIA of this report responded to the reactor scram as designed. However, immediately prior to the scram, RPS contactor 5A-K14B dropped out prematurely in response to a momentary voltage drop which did not affect the companion contactor, 5A-K14F, or initiate any upstream RPS relays.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION	
Browns Ferry Unit 2	05000260	97	007	00	4 OF 5

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

III. CAUSE OF THE EVENT

A. Immediate Cause:

The immediate cause of the scram was the dropping out of RPS contactor 5A-K14B with an RPS A half scram previously present.

B. Root Cause:

The root cause of the scram was the momentary pressure drop in the EHC system at #2 turbine control valve as a result of opening #1 turbine control valve.

C. Contributing Factors:

None.

IV. ANALYSIS OF THE EVENT

The transient was initiated from an unexpected partial scram (i.e., one of the contactors in automatic scram channel B1 dropped out) as a result of EHC pressure perturbations during turbine control valve testing. The dropping out of this contactor, with RPS A previously tripped, resulted in the actuation of one of two backup scram valves. The actuation of the backup scram valve caused the scram pilot air header to be vented. The resulting low scram pilot air header pressure signal completed the scram.

On-line corrective maintenance to repair an EHC oil leak was in progress when the scram occurred. While performing post-maintenance testing for repair of an oil leak on the #1 turbine control valve, momentary pressure decreases were experienced on the other control valves causing the scram. Such pressure decreases were confirmed by testing to occur any time a control valve is stroked in the test mode. Pressure drops on other control valves during single control valve testing increases the probability of a scram and is undesirable system performance. A recently issued vendor document recommends that restricting orifices be installed in the EHC oil lines at the control valves to minimize these pressure drops.

RPS contactor 5A-K14B dropped out prematurely in response to a momentary voltage drop which did not affect the companion contactor, 5A-K14F, or initiate any upstream RPS relays. Subsequent testing showed that the seal-in contact on relay 5A-K14B exhibited chattering when subjected to reduced voltage. This problem was not found on the other scram contactors. Relay 5A-K14B was replaced.

V. ASSESSMENT OF THE SAFETY CONSEQUENCES

All safety systems operated as expected in response to this event. Operator actions were appropriate and consistent with plant procedures. There were no equipment failures during or following the scram that complicated recovery. As a result, there were no threats to public health and safety.

Reactor water level decreased to approximately -35 inches and was recovered by the Feedwater Level Control System [JB], as designed. This is well above the top of the active fuel.

This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv) as any event or condition that resulted in manual or automatic actuation of any engineered safety feature including the reactor protection system.

FACILITY NAME (1)	DOCKET	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION	
Browns Ferry Unit 2	05000260	97	007	00	5 OF 5

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

VI. CORRECTIVE ACTIONS

A. Immediate Corrective Actions:

Operators responded to the scram in accordance with the emergency operating instructions and stabilized the plant in hot shutdown.

B. Corrective Actions to Prevent Recurrence:

The scram contactor (5A-K14B) was replaced prior to unit restart. The remaining Unit 2 scram contactors were tested satisfactorily. TVA will conduct a failure analysis of this scram contactor. TVA will revise procedures to mitigate the consequences of the EHC pressure drops experienced while testing control valves.[1]

TVA will install orifices in the EHC lines to the turbine control valves. These orifices will control the rate at which the operating mechanism of a previously closed valve is refilled and re-pressurized when the valve is opened, resulting in smaller pressure decreases at the other control valve pressure switches.

VII. ADDITIONAL INFORMATION

A. Failed Components:

None.

B. Previous Similar Events:

On September 16, 1983, during testing of the #2 turbine control valve following replacement of the EHC servo, Unit 2 scrammed from approximately 90 percent power. The cause of the reactor scram could not be definitely determined, but the best estimate was 'indicated' turbine control valve fast closure. The investigation concluded that as #2 turbine control valve was re-opened and the fast-acting solenoid reset, air in the EHC lines caused a pressure disturbance which actuated the pressure switches which sense turbine control valve fast closure. Discussion with a vendor revealed a recommendation for the installation of orifices in the EHC lines. However, at that time, the recommendation was limited to intercept valves, so orifices were only installed on the intercept valves. Therefore, implementing that recommendation would not have prevented the October 28, 1997 scram.

VIII. COMMITMENTS

TVA will install orifices in the EHC lines at the turbine control valves, as recommended by the vendor. This action will be completed for Unit 2 by April 30, 1999 and completed for Unit 3 by November 30, 1998.

1. These actions are being tracked by TVA's Corrective Action Program and are not considered regulatory commitments.

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