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,

LICENSEE EVENT REPORT (LER)

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

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Sequoyah Nuclear Plant (SQN) Unit 2	05000328	1 OF 9

TITLE (4)

Reactor Trip Breakers were Manually Opened with an Automatic Generation of a Feedwater Isolation Signal and a Manual Reactor Trip

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
06	05	96	96	-- 003 --	00	07	05	96	NA	05000
									FACILITY NAME: NA	DOCKET NUMBER: 05000

OPERATING MODE (9)	3
POWER LEVEL (10)	0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)

	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 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)
J. Bajraszewski, Compliance Licensing Engineer	(423) 843-7749

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 June 5, 1996, at 0137 Eastern daylight time (EDT), with Unit 2 in Mode 3 (hot standby) recovering from a refueling outage, the reactor trip breakers were manually opened because Shutdown Bank "D" dropped into the reactor core during rod position indicator hot calibration testing. Upon the opening of the reactor trip breakers, a feedwater isolation (FWI) signal was automatically generated because the reactor coolant system temperature was below the FWI setpoint. On June 7, 1996, at 0243 EDT, with Unit 2 in Mode 2 (plant startup), a manual reactor trip was initiated because of a dropped rod. During low power physics testing, Rod H-14 in Control Bank "C" dropped into the reactor core. In accordance with procedures, the reactor was tripped. Troubleshooting was performed to determine the cause of each of these events. The Shutdown Bank "D" dropped into the reactor core because the bank selector switch was manipulated while rod movement was in progress. Rod control system testing was completed without incident and the system was returned to service. A caution was added to an Operations procedure to address the condition. The rod drop was caused by a loose connection on the sensing resistor for the power supply to Rod H-2 stationary coil in Control Bank C, Group 1. The sensing resistor connections in the Unit 2 rod control system were inspected, and voltages were measured. The identified deficiencies were corrected.

I. PLANT CONDITIONS

Event No. 1

Unit 2 was in Mode 3 (hot standby, reactor coolant system [RCS] temperature at 547 degrees Fahrenheit [F] and RCS pressure at 2235 pounds per square inch gauge [psig]), recovering from a refueling outage. Rod position indicator (RPI) hot calibration was in progress, Shutdown Bank "D" was fully withdrawn, other rods were withdrawn to various positions.

Event No. 2

Unit 2 was in Mode 2 (startup; the reactor was critical) at approximately 0 percent power just below the point of adding heat. Control Bank C was fully withdrawn, and Control Bank D was being withdrawn.

II. DESCRIPTION OF EVENT

A. Event No. 1:

On June 5, 1996, at 0137 Eastern daylight time (EDT), the reactor trip breakers [EIIS Code AA] were manually opened because Shutdown Bank "D" [EIIS Code AA] dropped into the reactor core during rod position indicator (RPI) hot calibration testing. Upon the opening of the reactor trip breakers, a feedwater isolation (FWI) signal was automatically generated because the RCS temperature was below the FWI setpoint (reactor trip breakers are open, and RCS temperature is less than 550 degrees F).

Event No. 2:

On June 7, 1996, at 0243 EDT, a manual reactor trip was initiated because of a dropped rod [EIIS Code AA]. During low power physics testing with Control Bank D in motion, Rod H-14 in Control Bank C, Group 1 dropped into the core. In accordance with procedures, the reactor was tripped.

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

None.

C. Dates and Approximate Times of Major Occurrences:

Event No. 1:

June 4, 1996 at 1524 EDT	RPI hot calibration was started.
June 5, 1996 at 0040 EDT	A main control room operator was manipulating the bank selector switch through the manual-automatic positions. Shutdown bank "D" dropped into the reactor core from 231 steps. A rod urgent alarm annunciated.
June 5, 1996 at 0137 EDT	The reactor trip breakers were manually opened. As a result of plant conditions, a feedwater isolation signal was automatically generated.

Event No. 2:

June 6, 1996 at 1334 EDT	Low power physics testing was started.
June 6, 1996 at 2142 EDT	Unit 2 was taken critical.
June 7, 1996 at 0239 EDT	Control Bank D was being withdrawn from 208 steps to 231 steps.
June 7, 1996 at 0240 EDT	Rod H-14, located in Control Bank C, dropped into the reactor core. A rod bottom annunciation was received in the main control room.

June 7, 1996 at 0243 EDT — The Unit 2 assistant shift manager directed the unit operator to manually trip the reactor in accordance with procedures.

D. Other Systems or Secondary Functions Affected:

None.

E. Method of Discovery:

The rod urgent alarm, FWI, and rod at bottom conditions were annunciated in the main control room.

F. Operator Actions:

Control room personnel responded as prescribed by emergency procedures. They promptly diagnosed the plant condition and took the actions necessary to maintain the unit in a safe condition.

G. Safety System Responses:

The equipment associated with the events responded as designed.

III. CAUSE OF THE EVENT

A. Immediate Cause:

Event No. 1:

The immediate cause of the event was that the "D" shutdown bank dropped into the reactor core during RPI hot calibration testing. This resulted in the manual opening of the reactor trip breakers and the automatic generation of an FWI signal.

Event No. 2:

The immediate cause of the event was that the rod at the H-14 location dropped into the reactor core. This resulted in the reactor being manually tripped.

B. **Root Cause:**

Event No. 1:

The root cause of the event is attributed to manipulation of the bank selector switch while rod movement was in progress. Rod movement occurred as a result of the bank select switch being rotated through the automatic position in conjunction with an RCS temperature deviation between $T_{average}$ and $T_{reference}$ being present. As the handswitch was rotated through the Shutdown Bank "D" position, the rod bank dropped into the reactor core. These conditions resulted in a logic error and multiplex failure of the rod control system. One or both of these rod control system conditions in conjunction with Shutdown Bank "D" dropping into the reactor core generated the rod urgent alarm. The multiplex failure is an indication that more than one bank of rods was selected for movement at the same time. The logic error indicates that movement may have been requested in one bank while the bank selector switch was moved to another bank causing loss of both stationary and moveable currents to the rod drive mechanism.

Event No. 2:

The root cause of this event was a loose connection and a missing lock washer on the sensing resistor for the rod at location H-2 in Control Bank C, Group 1. The added impedance because of the loose connection caused voltages that drove the supply current down until the coil with the lowest magnetic retention (H-14) allowed the rod to drop. Based on a review of maintenance and modification records, the missing lock washer condition appears to have been a preexisting condition from the time the equipment was supplied to TVA.

C. **Contributing Factors**

Event No. 1:

None.

Event No. 2:

A contributing factor to this event was the lack of a questioning attitude during the evaluation of an elevated voltage drop across the sensing resistor to determine the cause of the deviation. During the performance of the current order testing surveillance, used to measure timing of the rods, it was noted that the voltage across the H-2 rod appeared to be elevated. The test equipment shows voltage wave shape form across the dropping resistor. The performers noted a difference in the amplitude. An evaluation of signal amplitude was performed, and it was determined that the resistors in Control Bank C, Group 1 were 250 mili-volts (mV) except for Rod H-2 which was 300 mV. The 300mV was the maximum allowable voltage within the tolerance band. An evaluation by Westinghouse of the condition determined that the elevated voltage drop should not result in the dropping of a rod. However, the cause of the deviation in voltage was not determined during performance of the evaluation.

IV. ANALYSIS OF THE EVENT

Event No. 1:

The safety-related design of the rod control system is to unlatch the control rods and allow full insertion of the rods into the reactor core upon receipt of a reactor trip signal. The rod urgent condition did not affect this design function. Upon opening the reactor trip breakers, the rods that were withdrawn from the core were fully inserted. Therefore, the event did not adversely affect the health or safety of plant personnel or the general public.

Event No. 2:

Plant responses during and after the unit trip were consistent with responses described in the Final Safety Analysis Report. The reactor coolant system (RCS) pressure dropped to approximately 2180 psig following the trip, increased to 2254 psig, and stabilized at 2235 psig. The RCS average temperature dropped to 538 degrees F following the trip and was stabilized at 547 degrees F. The initial pressure and temperature decrease were experienced because of the reactor trip at zero power (just below the point of adding heat) in conjunction with the increased supply of cold water from the auxiliary feedwater system. There was no indication that any primary side

relief valve lifted, and no RCS pressure limits were exceeded. The RCS temperature profile was consistent with the RCS pressure profile. Because of the RCS temperature falling below 540 degrees F, emergency boration was performed. Therefore, the event did not adversely affect the health and safety of plant personnel or the general public.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions:

Control room personnel responded as prescribed by emergency procedures. They promptly diagnosed the plant condition and took the action necessary to stabilize the unit in Mode 3. Troubleshooting was performed to determine the cause of each event.

In the first event, no faults were identified in the rod control system. Current orders were monitored during the completion of RPI hot calibration and rod drop timing tests, and no deficiencies were noted. Based on satisfactory completion of testing, the rod control system was considered operable.

In the second event, a loose connection on the sensing resistor for Rod H-2 in Control Bank C, Group 1 was identified. The loose connection was corrected. The sensing resistor connections in the Unit 2 rod control system were inspected, and voltages were measured. One connection was found to have a missing jam nut and lock washer. Three additional connections were found to have missing lock washers, but were determined to be tight. The identified conditions were corrected. The voltage across the stationary gripper coil sensing resistors was verified before restart of the unit.

B. Corrective Actions to Prevent Recurrence:

Event No. 1:

A caution statement was added to the appropriate Operations procedure to ensure that a reactor coolant system temperature deviation does not exist between $T_{average}$ and $T_{reference}$ during manipulation of the bank select handswitch.

Event No. 2:

None.

VI. ADDITIONAL INFORMATION

A. Failed Components:

None.

B. Previous LERs on Similar Events:

Event No. 1:

A review of previous reportable events identified one LER (50-327/93002) associated with a rod urgent condition. That event was attributed to a problem with the rod control system timing circuitry. Actions taken for that event would not have prevented the event described in this LER.

Event No. 2:

A review of previous reportable events identified one LER (50-328/89008) associated with a reactor trip resulting from a dropped rod. That event described a high negative flux rate trip resulting from a dropped rod. The specific cause could not be determined. It was concluded that the trip was the result of a spurious control signal fault. Actions taken for that event would not have prevented the event described in this LER.

C. Additional Information:

Event No. 1:

The lessons learned from the event will be reviewed by the Training organization for potential inclusion into operator training.

Event No. 2:

Unit 1 current order test values from the previously performed rod drop test have been reviewed for identification of excessive voltage drop conditions. The review did not identify any anomalies. Sensing resistor connections in the Unit 1 rod control system will be inspected during the next outage of sufficient duration for missing connection components (jam nuts and lock washers). The rod control system maintenance procedure will be reviewed by October 12, 1996, for changes based on lessons learned from the dropped rod event.

VII. COMMITMENTS

1. The lessons learned from the first event will be reviewed by August 9, 1996, by the Training organization for potential inclusion into operator training.

2. Sensing resistor connections in the Unit 1 rod control system will be inspected during the next outage of sufficient duration for missing connection components (jam nuts and lock washers).

3. The rod control system maintenance procedure will be reviewed by October 12, 1996, for changes based on lessons learned from the dropped rod event.