NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
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LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Sequoyah, Unit 2	0 5 0 0 0 3 2 8	1 OF 0 7

TITLE (4) Rod Control System Deficiencies Caused Inaccuracies In The Rod Group Demand Position Indication Resulting In Three Manual Reactor Trips

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 NAMES	DOCKET NUMBER(S)
0 3	1 6	8 8	8 8	0 1 3	0 3	0 4	2 8	8 9		0 5 0 0 0
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THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

OPERATING MODE (9)							
3		20.402(b)		20.405(c)	XX	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)		20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)	73.71(c)
0 0 0		20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)		50.73(a)(2)(i)		50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)		50.73(a)(2)(ii)		50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)		50.73(a)(2)(iii)		50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (AREA CODE)
G. E. Tiner, Plant Reporting Section	6 1 5 8 4 3 - 6 2 3 2

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)	XX NO				

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

This LER is being revised to provide additional information regarding the corrective actions TVA has planned to prevent recurrence of these events.

On March 16 and 17, 1988, with unit 2 in mode 3 (hot standby), rod control system testing was being performed in preparation for entry into mode 2. At two different times during the performance of this testing, it was determined that the rod group demand position indication was not within ± 2 steps of the actual demand position as required by TS LCO 3.1.3.3. As a result, plant operators complied with the action statement of the subject LCO and opened the reactor trip breakers. On March 19, 1988, unit 2 was maintaining mode 3 conditions while additional testing of the rod control system was performed. During this testing, rod group movement for Shutdown Bank B was out of sequence by three steps. Although the demand step counters accurately indicated rod position, the operator conservatively assumed that LCO 3.1.3.3 was applicable and opened the reactor trip breakers.

The first event was caused by a failure of the demand step counter circuitry while the second event was caused by internal binding of the step counter itself. In both of these events, however, the rod groups moved as designed. The third event was caused by an open switch to the rod lift coils that precluded movement of one group of rods. As a result, a shutdown bank was withdrawn out of sequence, and the operator conservatively tripped the reactor even though the rod demand position indication was accurate. To prevent recurrence of these events, TVA has implemented procedures to clean and test the rod control circuitry on a periodic basis.

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This LER is being revised to provide additional information regarding the corrective actions TVA has planned to prevent recurrence of these events.

BACKGROUND

This report describes three events in which a manual reactor trip (EIIS Code JC) was initiated in accordance with the action statement of Technical Specification (TS) Limiting Condition for Operation (LCO) 3.1.3.3. For the first two events, plant operators correctly tripped the reactor when it was determined that the rod group demand position indication (EIIS Code AA) was not within ± 2 steps of the actual demand position. For the third event, the operator did not have to trip the reactor because the demand position indication accurately indicated rod position. However, since rod group movement was out of sequence, the operator conservatively assumed that LCO 3.1.3.3 was applicable and opened the reactor trip breakers.

Sequoyah Nuclear Plant (SQN) units 1 and 2 utilize two independent rod position monitoring systems, a demand position indication, and an analog rod position indicator (RPI) system. The demand position indication is generated within the rod control system and provides an indication of the position that a group of rods should assume in response to rod motion command signals. The signal display is an electro-mechanical add or subtract step counter (each step indicates rod movement of 5/8 of an inch in either direction) which receives a "count" pulse each time the particular group of rods is demanded by the rod control system to move up or down. This information is then displayed by counters located on the main control board. A pulse-to-analog (P/A) converter receives a similar "count" pulse and converts these pulses to a DC analog signal which is proportional to control bank demand position. This information is then used by the rod insertion limit comparator to ensure control rods are maintained within the rod insertion limits of TS LCO 3.1.3.6. In addition, the P/A converter has its own local digital display to indicate control rod bank demand position.

The actual position (as opposed to demand position) of each rod is generated within the analog RPI system which provides individual indication of the actual position each rod has assumed in response to the rod control system command signals. The RPI system consists of field mounted detectors, mounted electronic (signal conditioning) equipment, and control board position indication.

Each rod position detector has alternately stacked primary and secondary coil windings mounted outside and concentric with the rod drive pressure housing. The position of the rod drive shaft within the pressure housing determines the amount of coupling between the primary and secondary windings. As a rod is withdrawn, the coupling between the primary and secondary coils increases and the signal induced to the secondary coils increases. Thus, the signal induced to the secondary coils is proportional to the actual rod position.

The AC signal from each rod position detector (i.e., from the secondary coil windings) is rectified and processed by a signal conditioning module located in the RPI cabinets. The range of the DC output voltage from this module corresponds to the full range of potential rod motion (i.e., from 0 to 230 steps withdrawn). The signal from this component is then sent to the individual rod position indicators located on main control room panels.

DESCRIPTION OF EVENT 1

On March 16, 1988, SQN unit 2 was in mode 3 (0 percent power, 2235 psig, 536 degrees F) and Surveillance Instruction (SI)-11, "Reactivity Control Systems Movable Control Assemblies," was in progress. During plant operation in mode 3, this SI satisfies TS Surveillance Requirement (SR) 4.1.3.3 by moving each rod control bank at least 10 steps and verifying that the group demand rod position indicators are capable of determining the demand position of each control rod bank to within ± 2 steps.

At approximately 0030 EST on March 16, 1988, the control rods in Control Bank D were withdrawn 10 steps in accordance with SI-11. When the rods were inserted, only the group 2 demand step counter indicated rod motion (there are two counters for control bank D, one per group). The rods were then withdrawn 2 steps and both demand step counters worked correctly. However, when the rods were inserted 1 step, only the group 2 demand step counter indicated rod motion. Operations personnel then checked the demand position for Control Bank D on the pulse-to-analog (P/A) converter in the RPI cabinets. The local read-out on the P/A converter indicated that the group 1 demand position was 6 steps, which agreed with the group 2 demand step counter. Following a check of the RPIs for Control Bank D position, it was determined that all RPIs had indicated proper rod motion. The unit operator then discussed the apparent failure of the group 1 demand position indicator with the shift supervisor (SS), a senior reactor operator (SRO), and the shift technical advisor (STA). Following this discussion, at approximately 0036 EST, SQN unit 2 entered TS LCO 3.1.3.3 and complied with the action requirements by opening the reactor trip breakers. Because of a low reactor coolant system (EIIS Code AB) (RCS) average temperature (i.e., Tavg less than 554 degrees F), a main feedwater isolation signal (EIIS Code JE) was generated concurrent with the reactor trip, as designed. Following the reactor trip, LCO 3.1.3.3 was exited since the subject LCO is not applicable when the reactor trip breakers are open.

DESCRIPTION OF EVENT 2

On March 17, 1988, unit 2 was being maintained in mode 3 conditions (hot standby) while SI-43, "Rod Drop Time Measurements," was being performed to satisfy TS SR 4.1.3.4. During the performance of this SI, Control Bank B was withdrawn to 228 steps and each rod was dropped and timed individually. Following the completion of this testing, the subject control bank was in the fully inserted (0 steps)

position. However, a subsequent evaluation of the data revealed that the drop time for the rod K-2 could not be ascertained because of an improperly connected recorder; thus, the test director requested that Control Bank B be withdrawn again. At approximately 0630 EST on March 17, 1988, a unit 2 lead operator was withdrawing Control Bank B when he observed a 10-step deviation between the group 1 and group 2 demand step counters. The group 1 counter indicated 59 steps, the group 2 counter indicated 69 steps, and the P/A converter in the RPI cabinets indicated 69 steps.

Control Bank B was then withdrawn an additional 3 steps and the demand step counters checked again; the group 1 counter indicated 60 steps while the group 2 counter indicated 72 steps. At approximately 0639 EST on March 17, 1988, LCO 3.1.3.3 was entered, the reactor trip breakers were opened, then LCO 3.1.3.3 was exited. As described in event 1, the low RCS Tavg concurrent with the reactor trip signal also resulted in a main feedwater (EIIS Code SJ) isolation.

DESCRIPTION OF EVENT 3

On March 19, 1988, with unit 2 still maintaining mode 3 conditions, Operations personnel initiated the performance of SI-67, "Periodic Calibration of RPI System," to ensure that the subject SI was within its required frequency before entry into mode 2. During the withdrawal of Shutdown Bank B at approximately 2314 EST, the group 2 demand step counter failed to move, while the group 1 counter moved out to 3 steps. As a result, LCO 3.1.3.3 was entered, and the reactor trip breakers were opened. As expected, a main feedwater isolation signal was also generated. A subsequent evaluation of this event determined that the operator did not have to trip the reactor because the demand step counters accurately indicated the rod position. However, since group movement was out of sequence (i.e., group 1 moved while group 2 did not move), the operator conservatively assumed that LCO 3.1.3.3 was applicable and opened the reactor trip breakers.

CAUSE OF EVENT 1

The immediate cause of the first reactor trip was an inaccuracy in the group 2 demand step counter for Control Bank D that resulted from a failure of supervisory and data logging printed circuit (P/C) board A114.

Following additional testing of this board, it was determined that the root cause of this event was a defective computer chip on the subject P/C board. Contributing to this event was the lack of a procedure to verify the proper operation of the rod control system before testing in accordance with SI-11 was required.

CAUSE OF EVENT 2

The immediate cause of the intermittent operation of the group 1 demand step counter for Control Bank B was internal binding of the counter resulting from foreign material inside the counter. The root cause of this condition was the lack of an adequate preventative maintenance plan to periodically clean the subject counters.

CAUSE OF EVENT 3

The immediate cause of the out of sequence movement for Shutdown Bank B was a fusible disconnect switch to the group 2 rod lift coils that was not fully closed. As described previously, the demand step counters for this event accurately indicated rod group position (i.e., 3 steps for group 1 and 0 steps for group 2); thus, there was no requirement to enter LCO 3.1.3.3 and trip the reactor. However, because of the previous problems encountered with the demand step counter position indication, it was not clear if the Shutdown Bank B groups were actually misaligned or if both shutdown groups were still fully inserted and the step counters were not indicating the demand position of the rods to within ± 2 steps. The root cause of the third reactor trip, therefore, was the conservative decision by the plant operator that TS LCO 3.1.3.3 was applicable. That is, the plant operator tripped the reactor solely on the basis of the demand step counters for rod groups 1 and 2 (of Shutdown Bank B) being out of sequence. Since the plant operator was not certain that the step counters were properly indicating rod position, he conservatively assumed that LCO 3.1.3.3 was applicable and tripped the reactor.

ANALYSIS OF EVENTS

These events are being reported in accordance with 10 CFR 50.73, paragraph a.2.iv, as manual actuations of the reactor protection system.

The intent of LCO 3.1.3.3 is to ensure that accurate rod position indication is available to (1) verify that acceptable power distribution limits are maintained and (2) limit the potential effects of rod misalignment on the accident analysis contained in Chapter 15 of the SQN Final Safety Analysis Report. For the three events described herein, no nuclear power was being generated in the core; hence, there was no possibility of obtaining an unacceptable power distribution. In addition, because the RCS boron concentration was greater than 2000 ppm during these events, a rod misalignment would not have had any effect on the FSAR Chapter 15 accident analysis.

In all three events, plant operators opened the reactor trip breakers to comply with the action statement of LCO 3.1.3.3. The reactor trip immediately realigned all rods (at 0 steps) and resulted in the plant exiting the subject LCO. Thus, there were no safety consequences associated with this event.

CORRECTIVE ACTION

As immediate corrective action for event 1, IM personnel replaced supervisory and data logging P/C board A114 in the circuitry for the group 1 demand step counter for Control Bank D. Following this event, troubleshooting of the A114 P/C board revealed that the subject board contained a defective computer chip. The defective computer chip was subsequently replaced, and the board was tested at TVA's Power Operations Training Center. This testing verified that the subject P/C board was capable of performing its intended function. To prevent recurrence of this event, Maintenance Instruction (MI)-21.3.085.02, "Functional Check Of Rod Control Logic Cabinet," was approved on September 21, 1988 to verify the operability of the rod control logic cabinet.

As immediate corrective action for event 2, IM personnel replaced the group 1 demand step counter for Control Bank B. To prevent recurrence of this event, MI-23.1.085.01, "Inspection and Cleaning Of Rod Control Step Counters," was approved on December 13, 1988 and provides direction for cleaning and inspecting the step counters.

As immediate corrective action for event 3, IM personnel removed, cleaned, and tested all of the demand step counters except for the counter for group 1 of Control Bank B (which was replaced following event 2). In addition, IM personnel tested and cycled the entire rod control system logic cabinet (including the step counter, P/A converter and bank overlap) and verified that the equipment was operating properly. Following the discovery that the fusible disconnect switch to the Shutdown Bank B group 2 lift coils was not fully closed, IM personnel simply closed the switch.

TVA has recently reviewed a history of the work requests written on the rod control system to determine if similar failures have occurred and if additional recurrence controls are appropriate. There have been six recorded cases of failed step counters and at least one failure associated with the step counter circuitry. The majority of the rod control problems were the result of connection problems at the reactor vessel head; however, these connections are now hard-wired, and TVA does not anticipate further problems in this area. In addition, TVA has determined that no previous problems with the fusible disconnect switches have been reported. If further problems are encountered in this area, TVA will implement provisions to better secure these switches. At this time; however, TVA does not believe that corrective actions (other than those already described) will be necessary to prevent the recurrence of this event.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

ADDITIONAL INFORMATION

The supervisory and data logging P/C board described in event 1 was manufactured by Westinghouse; Model Number 3361C08G01.

There have been no previous occurrences where inaccuracies in the demand step counters have resulted in reactor trip.

TVA has determined that a TS change is not necessary at this time. To date, TVA has not experienced any additional problems with the rod control system that have resulted in a reactor trip. TVA is continuing to evaluate TS LCO 3.1.3.3 to determine if future enhancement changes can be made to provide greater clarification and flexibility.

COMMITMENTS

None.

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April 28, 1989

U.S. Nuclear Regulatory Commission
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Gentlemen:

TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT UNIT 1 - DOCKET NO. 50-327 - FACILITY OPERATING LICENSE DPR-77 - REPORTABLE OCCURRENCE REPORT SQRO-50-328/88013 REVISION 3

The enclosed licensee event report is being revised to provide additional information regarding the corrective action TVA has taken to prevent recurrence of these events. These events were originally reported in accordance with 10 CFR 50.73, paragraph a.2.iv, on March 16, 1988 and subsequently revised on July 29, 1988 and April 28, 1989.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

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