

**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: 50.0 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 20503.

FACILITY NAME (1) Duane Arnold Energy Center		DOCKET NUMBER (2) 05000-331	PAGE (3) 1 OF 7
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TITLE (4)  
Inadequate Test of the Reactor Mode Switch to Shutdown Position Rod Block Function and Rod Block Monitor

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
6	24	97	97	07	00	7	24	97		05000-331
										05000-331

OPERATING MODE (9) 1

POWER LEVEL (10) 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5: (Check one or more) (11)

20.2201(b)	20.2203(a)(2)(v)	X	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)		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)

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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)

YES (If yes, complete EXPECTED SUBMISSION DATE).	X	NO	EXPECTED SUBMISSION	MONTH	DAY	YEAR
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ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On June 24 and 25, 1997, while operating at 100% power, it was discovered that two surveillance procedures did not fully satisfy the requirements in the current Technical Specifications (TS). The events were discovered during the review of the procedures for their adequacy to meet Improved Technical Specifications (ITS) requirements. The procedures were STP 41A012-CY, Reactor Mode Switch In Shutdown - Instrument Functional Test, and STP 42C002-Q, Rod Block Monitor Functional Test. The applicable Limiting Condition for Operation (LCO) actions were performed; a tagout directing Operations personnel to verify a rod block if the Reactor Mode Switch (RMS) were placed in the "SHUTDOWN" position was hung on the RMS, and a fuse was pulled in Panel 1C28 to insert a rod block in order to prevent control rod withdrawal.

The cause of the events was procedural inadequacy. The root cause is inadequate implementation of TS Amendment 193. A contributing factor to both events was lack of details in the current TS. STP 41A012-CY has been revised and is available for the next plant shutdown. STP 42C002-Q has been revised and was re-performed satisfactorily on both RBM channels at 2300 hours, on July 8, 1997. The ITS will include a more detailed description of what is required for Reactor Manual Control System multiplexer testing. Other ITS-required surveillance procedures will receive an equivalent level of review to ensure they meet all requirements. This will be completed prior to the implementation of the ITS.

These events did not impact the safe operation of the plant.

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**I. EVENT DESCRIPTION:**

On June 24, 1997, the plant was operating at 100% rated thermal power (RTP). At approximately 1500 hours, during a review of a cyclic functional test procedure (STP 41A012-CY, Reactor Mode Switch In Shutdown - Instrument Functional Test) for its adequacy to meet Improved Technical Specifications (ITS) requirements, it was determined that the procedure did not fully satisfy the surveillance requirement in the current Technical Specifications (TS), Tables 3.2-C/4.2-C. Table 3.2-C requires that both channels of the "Reactor Mode Switch - Shutdown Position" rod block function be operable when the plant is in Mode 3 or 4 (hot/cold shutdown) and if one channel is inoperable, a rod block must be initiated. Because the existing procedure only required that a rod block actuate during the test and did not verify that each channel is capable of initiating a rod block by itself, it was determined that the procedure would not fully satisfy the TS requirement as proper performance of one channel could mask inoperability of the second channel. The "Reactor Mode Switch - Shutdown Position" rod block function has two channels actuated from the single Reactor Mode Switch (RMS). Either one is capable of initiating a rod block (see Figure 1).

At 1750 hours, the rod block function was declared inoperable, although it was not required because the function is only required when the plant is in the shutdown condition. A warning tag (97-0735) was placed on the RMS to direct Operations personnel to verify a rod block if the RMS were taken to the "SHUTDOWN" position.

On June 25, 1997, the plant was operating at 100% RTP. At approximately 1545 hours, during a review of a quarterly functional test procedure (STP 12C002-Q, Rod Block Monitor Functional Test) for its adequacy to meet future ITS requirements, it was determined that the procedure did not fully satisfy the surveillance requirement of Note (c) in Table 4.2-C of the current TS. Note (c) of Table 4.2-C states "Includes reactor manual control multiplexing system input". A review of the existing procedure determined that only the input from a center rod with four Local Power Range Monitor (LPRM) strings around it was tested. In reviewing the Rod Block Monitor (RBM) circuitry, it was determined that the inputs of "no rod selected", "peripheral rod selected", and "center rod selected with two, three, or four LPRM strings around it" would be a more appropriate test to fully satisfy Note (c) of Table 4.2-C. At 1720 hours, both RBM channels were declared inoperable and the reactor was verified to not be in a Limiting Control Rod Pattern (LCRP).

A LCRP for Rod Withdrawal Error (RWE) exists whenever the core thermal power is greater than or equal to 30% RTP and less than 90% RTP and the Minimum Critical Power Ratio (MCPR) is less than 1.70, or when the core thermal power is greater than or equal to 90% of rated and the MCPR is less than 1.40. Per Section 3.3.C.3 of the TS, during operation with LCRP, either: a) both RBM channels shall be operable, or b) with one RBM channel inoperable, control rod withdrawal shall be blocked within 24 hours, unless operability is restored within this time period, or c) with both RBM channels inoperable, control rod withdrawal shall be blocked until operability of at least one channel is restored.

At 2052 hours, a rod block was inserted by pulling a fuse in Panel 1C28 and a warning tag (97-0744) was hung in order to prevent inadvertent control rod withdrawal if the reactor were in a LCRP due to both RBM channels being inoperable per Section 3.3.C.3.

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Per the current TS, Table 4.2-C requires that the RBM channel functional test be performed quarterly and prior to reaching 30% RTP on startup. During the revision of the RBM functional test procedure for operability testing, on July 3, 1997, it was discovered that the additional Reactor Manual Control System (RMCS) multiplexer testing would be difficult to perform prior to reaching 30% RTP during plant startup as required by Note (d) of TS Table 4.2-C. In order to perform the additional testing, the RBM has to be "unbypassed". The RBM "unbypasses" when its reference Average Power Range Monitor (APRM) senses power above the Reference Downscale (D/S) trip setpoint. The Reference D/S trip is set conservatively at approximately 27% RTP. Because of this, the reactor power level has to be maintained above 27% RTP (actual RBM downscale auto-bypass setpoint setting) and below 30% RTP (TS required RBM operability setting). This condition results in a tight band for Operations personnel to operate the plant while testing is being performed during startup.

The RBM functional test procedure was revised to include the additional testing and re-performed satisfactorily on both RBM channels. When tested properly on July 8, 1997, the 'B' RBM channel was found fully operable. The 'A' RBM channel performed properly with the exception of the INOP trip function for a center rod selected with five LPRMs bypassed. This function did not trip as required. A calibration was performed and the channel was restored to a fully operable condition. Both RBM channels were declared operable at 2300 hours, on July 8, 1997. The tagout had been cleared and the removed fuse re-inserted at 1914 hours to support this testing.

**II. CAUSE OF EVENT:**

The cause of these events was procedural inadequacy. The requirements for testing the Reactor Mode Switch - Shutdown Position rod block function and the input functions from the RMCS multiplexer were added to the TS during the implementation of TS Amendment 193 in 1993 in an effort to improve the clarity and consistency with Standard TS (NUREG-C123).

For the event on June 24, the procedure (STP 41A012-CY) had been revised to verify that a rod block was generated when the RMS was placed in the "SHUTDOWN" position; however, it had not been revised adequately to verify that each channel was capable of initiating a rod block by itself. The fact that a single switch (the RMS) initiated both channels could have contributed to the interpretation that the two channels in TS Table 3.2-C were referring to the two Rod Block channels and not separate RMS input channels. The Bases of the ITS provide more detail on what testing is required and led the procedure writer to question the adequacy of the original testing. Detailed review of the RMS drawings was then necessary to determine that the RMS actuates two separate sets of contacts, one set for each of the Rod Block channels.

For the event on June 25, the procedure (STP 42C002-Q) was not revised during the implementation of Amendment 193 because the procedure was already testing the input of a center rod from the RMCS. The fact that Note (c) of Table 4.2-C did not specify the exact inputs that required testing could have contributed to confusion about what testing was required. Interviews with personnel who were involved with the amendment implementation did not provide any details of the past implementation or documentation identifying what functions were required to be tested. The assumption was that the procedure could have been determined to be adequate to meet the TS requirement at the time of the implementation and therefore was not revised. The cause of the inoperable 'A' RBM channel INOP trip function was instrument drift due to the lack of a routine calibration.

The root cause of these events is inadequate implementation of TS Amendment 193. A contributing factor to both events was lack of detail in the current TS.

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III. ANALYSIS OF EVENT:

The RBM system provides protection for control rod withdrawal error events during high power operation. During low power operations, control rod blocks from the Rod Worth Minimizer (RWM) enforce specific control rod sequences designed to mitigate the consequences of the Control Rod Drop Accident (CRDA). Although it is not required by TS, the RWM has remained in operation during high power operation as a good practice at the DAEC. During plant shutdown conditions, rod blocks from the RMS rod block function ensure that all control rods remain inserted to prevent inadvertent criticality events.

The RMS rod block function is to ensure that all control rods remain inserted to prevent inadvertent control rod withdrawal during shutdown conditions (in Modes 3, 4, or 5 when the RMS is required to be in the "SHUTDOWN" position). This rod block function has two channels, both of which are actuated by the Reactor Mode Switch. Although both are required to be operable by TS, each channel is capable of initiating a rod block. The channels are mechanically actuated based solely on the RMS position.

For the June 24 event, although the procedure did not verify that each channel is operable, the "Reactor Mode Switch - Shutdown Position" rod block function was operable in that a rod block was confirmed to be actuated during tests. The last scheduled test had been performed satisfactorily on October 18, 1996. This event did not impact the safe operation of the plant.

The RBM system is designed to prevent violation of the Minimum Critical Power Ratio (MCPR) safety limit from an inadvertent withdrawal of a single control rod when in a LCRP. This is accomplished by inserting a rod block if the RBM signal exceeds a predetermined limit during withdrawal of any non-peripheral control rod. The reactivity worth of a peripheral control rod has been determined to be low enough that use of the RBM rod block function is not needed. The RBM system consists of two essentially identical channels, and only one of them is required to trip to prevent rod withdrawal. The RBM functions are required when the core thermal power is greater than 30% of rated and a LCRP exists per TS Section 3.3.C.3.

Per General Electric Topical Report (NEDC-30813-P, "Average Power Range Monitor, Rod Block Monitor, and Technical Specification Improvement (ARTS) Program for the Duane Arnold Energy Center," dated December 1984), no RWE event will result in exceeding the MCPR safety limit if the reactor is operated at a power level of greater than or equal to 90% and with the MCPR greater than or equal to 1.40.

Throughout the event (from June 25 through July 8, 1997) when both RBM channels were declared inoperable, the only time that the reactor was operated in a LCRP was from approximately 0300 hours to 0500 hours on July 5, 1997. The reactor power was lowered due to a request from the Load Dispatcher. During this period, the reactor was operated in a LCRP with a reactor power level of less than 90% RTP (the actual lowest was 89%) and a MCPR value of less than 1.70 (the actual lowest was 1.478). No control rod movement was performed (or possible) due to the removed fuse in Panel 1C28; the reactor power was lowered using the recirculation flow. When tested properly on July 8, 1997, the 'B' RBM channel was found fully operable. A minor adjustment was performed on the 'A' RBM channel when its INOP trip function did not trip as required. Both channels were tested satisfactorily and declared operable at 2300 hours, July 8, 1997.

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A search of the plant computer database for the period between 1993 and prior to this event did not identify any events related to control rod withdrawal error. Per the DAEC's Integrated Plant Operating Instruction procedures (IPOI 2 and 3, Startup and Power Operation, respectively), whenever control rod movement is to be performed, the RWM shall be operable and in service, or verification by a second reactor operator shall be performed. As discussed previously, the RWM is normally maintained in service during high power operation as a good practice at the DAEC. This system blocks movement of rods not within the rod group for which withdrawal is planned. Therefore, had a control rod not within the applicable rod group been inadvertently selected, rod movement would have been prevented by the RWM. In addition, the RWM blocks movement of rods within the rod group that would violate the group notch criteria. This event did not impact the safe operation of the plant.

**IV. CORRECTIVE ACTIONS:**

For the June 24 event, the "Reactor Mode Switch - Shutdown Position" rod block function was declared inoperable upon the discovery, although it was not required because the reactor was not in the shutdown condition. A warning tag was placed on the RMS to direct Operations personnel to verify a rod block if the RMS were taken to the "SHUTDOWN" position. The RMS rod block procedure (STP 41A012-CY) has been revised and was implemented on July 16, 1997 to functionally test both channels individually and is available for use during the next plant shutdown. This test can not be performed with the plant in operation.

1. An administrative control has been put in place to direct Operations personnel to verify a rod block until the revised STP 41A012-CY is performed and completed. Once the revised STP is completed, the administrative control will be removed. This action item will be completed during startup from refuel outage 15 currently scheduled for 1998, or before, if allowed by plant conditions and is being tracked by AR 97-1744.01.

For the June 25 event, a rod block was inserted by pulling a fuse in Panel 1C28 to prevent a rod withdrawal prior to the completion of the procedure revision and re-performance. STP 42C002-Q was revised to include testing the inputs from the RMCS multiplexer. The procedure was re-performed satisfactorily and the RBM system was declared operable at 2300 hours on July 8, 1997. The tagout had been cleared and the fuse re-inserted at 1914 hours on July 8, 1997 to support this testing.

1. A review of other surveillance procedures identified one additional procedure (STP 42C002-SA, Rod Block Monitor Semi-Annual Calibration) that requires revision to add the same RMCS multiplexer input testing. This action item will be completed by September 19, 1997 and is being tracked by AR 97-1308.02.
2. The ITS will include more detail concerning required RMCS multiplexer testing and ensure the test can be performed on startup. This action item will be completed prior to the implementation of the ITS and is being tracked by AR 97-1308.03.

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As a long term corrective action for these events and part of an ongoing effort at the DAEC for converting to the ITS, all the ITS-required surveillance procedures will receive an equivalent level of review to ensure they meet all requirements. This corrective action will be completed in accordance with the schedule of implementation of the ITS. It should be noted that the events in this LER and the event in LER 97-06 were discovered during the review process for ITS-required test procedures.

#### V. ADDITIONAL INFORMATION:

##### A) Previous Similar Events

A review of the DAEC LERs since 1984 identified LERs 97-06, 97-05, 95-03, 94-11, 94-08, 94-05, 94-03, 94-01, 93-02, 91-11, and 85-32 as reporting inadequate surveillance tests, LERs 97-05 and 94-03 were identified as related to "incomplete implementation of TS Amendment 193" as a causal factor. LER 97-06 was discovered during the review process for the future ITS; the cause of the event was inadequate previous technical reviews.

LER 97-06, Inadequate Functional Test of the High Pressure Coolant Injection System Steam Leak Detection Time Delay.

LER 97-05, Setpoint for Recirculation Flow Upscale Rod Block Greater Than Technical Specification Allowable.

LER 94-03, Failure to Establish Secondary Containment During Routine Maintenance. One of the corrective actions from LER 94-03 was a review of plant procedures impacted by TS Amendment 193. Quality Assurance (QA) Surveillance S-93-097 was conducted to assess the completeness and accuracy of the procedures and the changes associated with TS Amendment 193. The surveillance checked a sample of the surveillance test procedures that were associated with TS Amendment 193. The surveillance did not identify discrepancies between STP requirements and the appropriate TS sections.

##### B) EISS System and Component Codes

Reactor Power Control System -- JD

##### C) Equipment Information

The 'A' RBM INOP trip function circuit was made by General Electric Company (G082).

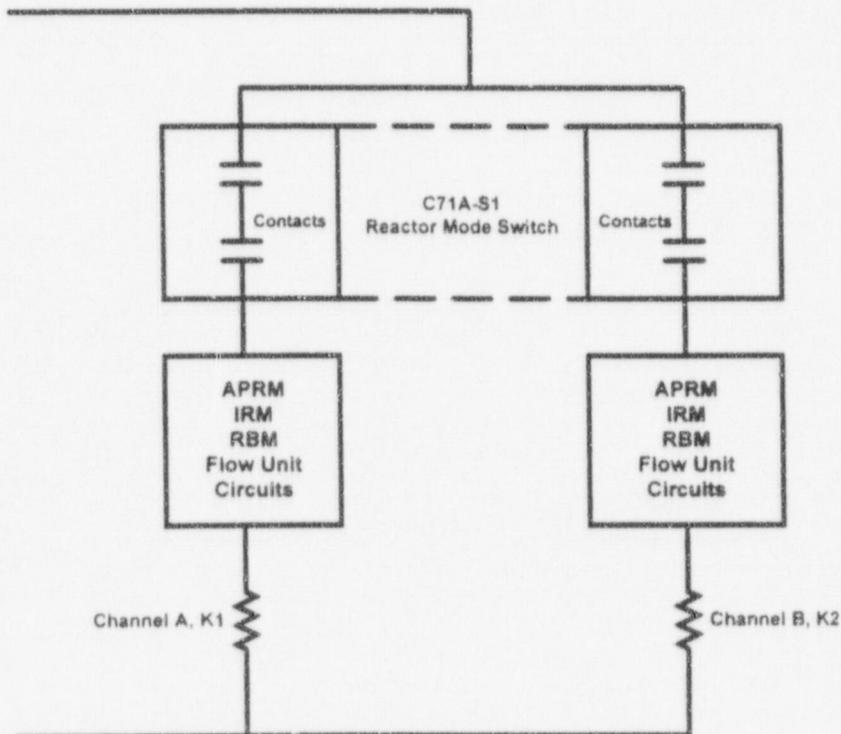
This report is being submitted pursuant to 10CFR50.73(a)(2)(i)(B)

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Figure 1. Simplified "Reactor Mode Switch - Shutdown Position" Rod Block Function Circuit, Channel A/B



Note: Normally, relays K1 and K2 are energized. De-energizing either relay generates a rod block. Current test procedure cannot determine which relay is de-energized (or which channel is activated). Current Tech Spec requires both channels to be operable.

Reference: APED-C11-24(6), Revision 8, dated August 31, 1983