U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-277/84-01
50-278/84-01

Docket No. 50-277
50-278

License No. DPR-44
DPR-56

Priority -- Category C
C

Licensee: Philadelphia Electric Company

2301 Market Street

Philadelphia, Pennsylvania 19101

Facility Name: Peach Bottom Atomic Power Station

Inspection At: Delta, Pennsylvania

Inspection Conducted: January 5-20, 1984

Inspectors: A. R. Blough, Sr. Resident Inspector — 1-27-84 date

for J. E. Tripp, W. H. Williams, Resident Inspector — 1/31/84 date

_____ — date

Approved by: Lowell E. Tripp, Chief, Reactor Projects Section 3A — 2/28/84 date

Inspection Summary:
January 5-20, 1984 (Combined Inspection Report 50-277/84-01 and 50-278/84-01)

Special, onsite, regular and backshift inspection by the resident inspectors (94 hours) and six members from the NRC's Office of Inspection and Enforcement and Region I (36 hours). The inspection, which included an onsite management meeting with senior PECo personnel on January 12, dealt with the practice of individually scramming control rods for normal shutdown and with a November 17, 1983 event where the reactor scrammed automatically from high scram discharge instrument volume level during individual rod scramming.

Results: Approval of individual rod scram procedures, as well as implementation of associated Rod Worth Minimizer changes, were found to be in apparent violation of 10 CFR 50.59. Also, three examples of inadequate procedures or procedural adherence were noted. Significant licensee corrective actions had been initiated.

Region I Form 12
(Rev. February 1982)

DETAILS

1. Persons Contacted

1.1 Licensee Personnel

M. J. Cooney, Superintendent, Generation Division - Nuclear
R. S. Fleischmann, Station Superintendent
F. W. Polaski, Outage Manager
S. R. Roberts, Operations Engineer
L. F. Rubino, Nuclear Services
*D. C. Smith, Assistant Station Superintendent
W. F. Ullrich, Superintendent, Nuclear Services
A. J. Wasong, Reactor Engineer
J. E. Winzenried, Technical Engineer

Other licensee personnel, including licensed operators, senior licensed operators, STAs, and staff engineers were also contacted.

*Present at exit interview.

1.2 NRC Inspection Participants

J. A. Axelrad, Director, Enforcement Staff, IE
L. H. Bettenhausen, Chief, Test Programs Section, Region I
A. R. Blough, Senior Resident Inspector
P. A. Farron, Events Analysis Branch, IE
R. R. Keimig, Chief, Projects Branch No. 3, Region I
R. W. Starostecki, Director, DPRP, Region I
L. E. Tripp, Chief, Reactor Projects Section 3A, Region I
J. H. Williams, Resident Inspector

All persons listed in 1.1 and 1.2 above were also present at the January 12, 1984 meeting.

2. Background

On November 17, 1983, the licensee was shutting down to replace a main steam safety-relief valve which was giving acoustic indications of pilot valve seat leakage. At 10:30 p.m., a turbine high vibration alarm was received. Reactor shutdown was accelerated through individually scramming rods, which was allowed per PORC approved procedure GP-3. By 10:34 p.m., about 10 rods had been scrammed and the turbine was taken off-line. Individual rod scramming continued. About 10:36 p.m., a scram discharge instrument volume (SDIV) high level rod block annunicated; although rod scrams were then suspended, a SDIV high level scram followed shortly. Licensee analysis indicated that about 25 additional rods had been scrammed in two minutes (from 10:34 p.m. to 10:36 p.m.) from the scram time test panel. Since many individual rod scram switches were left in the "scram" position, scram discharge volume inleakage from control rod drives was significant and continuous, exceeding

the small SDIV drain capacity. Thus, an actual SDIV high level condition resulted. The licensee promptly issued instructions to limit both the rate of individual rod scrams and the number of switches remaining in the scram position. The NRC questioned, however, the licensee's justification for individually scramming rods, in light of Rod Worth Minimizer (RWM) and Rod Sequence Control System (RSCS) operability requirements. In particular, NRC expressed concern that one of the intended functions of the RWM and RSCS (to restrict insertions of control rods to prespecified sequences to minimize the power excursion and possibility of fuel damage if a control rod drop accident was to occur) was lost by this mode of operation. Individual rod scramming circumvents RWM and RSCS controls which place constraints upon the Reactor Manual Control Systems (RMCS). Scramming does not involve the RMCS. The licensee stated that the practice had been permitted by licensee procedures for several years; therefore, time would be required to research its origin and justification. Consequently, on December 1, the licensee committed, in response to the senior resident inspector's request, to suspend the use of individual rod scrams for purposes other than either testing or ATWS response.

This special inspection, which included resident inspector efforts January 5-20 as well as a January 12 meeting onsite with senior PECo, NRC:IE, and Region I personnel was to review both the November 17, 1983 event and the issue of individually scramming rods for normal shutdowns.

3. Licensee Meeting

The licensee and NRC personnel listed in Detail 1 met on January 12, 1984. The NRC identified the meeting as part of the information-gathering process for the special inspection.

3.1 Licensee Presentations

After introductions, the licensee provided information which is summarized below.

3.1.1 Details of the 11/17/83 Event. The licensee's description of the event agreed with that in Detail 2 but included the following additional information:

-- During power reduction at about 30 percent power, the RWM surveillance could not be satisfactorily completed; the RWM was bypassed and a second licensed operator assigned, per Technical Specifications, to verify the rod sequence.

-- The RSCS gave rod blocks when it automatically activated (at about 21 percent power); this was still under investigation when the turbine vibration alarm occurred.

-- During individual rod scrams, after the turbine high vibration alarm, the sequence in which the remaining rods were scrammed was not witnessed by a second operator, although there was some verification that a rod, once scrammed, went full in. Shift personnel were preoccupied with response to the turbine vibration alarm. (These details were previously confirmed by the resident inspector during interviews with shift personnel.)

3.1.2 Licensee followup actions. The licensee described his followup actions, including post-scram reviews (per GP-18), Independent Safety Evaluation Group (ISEG) review, PORC reviews, Nuclear Review Board (Operations and Safety Review Committee) review, and various procedure revisions which resulted from these reviews. The plant procedure changes have eliminated individual rod scrams as an option for normal shutdown. (The ISEG review was an exercise of the ISEG function by available members of the ISEG group, which is not yet fully staffed.)

3.1.3 Rod Drop Analyses and Prevention. The licensee described the history of rod drop analyses, and prerequisite conditions for a severe rod drop accident. These involved an uncoupled rod whose blade sticks in when the control rod drive is fully withdrawn. The blade then free-falls out of the core at the assumed worst time (following rod sequence errors which were not prevented by the RWM, RSCS or operators). The analyses use maximum assumed values for control rod worth and rod drop velocity, and Technical Specification limit values for scram time (actual values, based on current core designs and on scram time tests, are more conservative, i.e., would lead to less severe rod drop consequences). If typical measured values of rod drop velocity and scram time are used, the analysis shows no potential rod drop accident producing fuel enthalpies above the design limit of 280 calories per gram (reference NEDO 10527).

The licensee also described the procedurally-required control rod coupling integrity checks:

-- Rod stoking (ST10.8) after fuel handling but prior to startup from each refueling outage includes checks of the rod position indication system (RPIS), neutron monitoring system (NMS) response, and rod overtravel.

-- Rod scram time testing (ST10.7), performed during hydrostatic testing before reactor startup following refueling, includes rod overtravel checks.

-- Weekly control rod exercises (ST9.2) includes a check of NMS response.

-- Startup procedure (GP-2A) includes checks of NMS response and, for fully withdrawn rods, rod overtravel checks.

Absence of an expected NMS response or occurrences or rod overtravel indications would be investigated as potentially uncoupled rods. The licensee also pointed out that all fully-out (normally over 75 percent of the rods) rods have the control rod blade seated and the weight of the drive is supported by the blade. Without proper coupling, the drive would be expected to overtravel.

The licensee also discussed operation of the RSCS and RWM during reactor startup and shutdown.

3.1.4 History of Shutdown by Individually Scramming Control Rods. The licensee discussed how the 1976 addition of Group Notch Control to RSCS had greatly added to the time required for rod insertion for shutdown. As a result, most BWR licensees chose to scram the reactor from about 30 percent power during shutdowns. The licensee and certain individuals in the vendor (General Electric) organization were concerned about the thermal cycling on CRD collets and feedwater nozzles during full scram shutdowns. The licensee determined that individual rod scramming would minimize thermal cycling, while still providing a reasonable pace of shutdown. On April 8, 1977, a PORC-approved shutdown procedure was implemented that allowed individual rod scrams to be used as an alternate method for normal reactor shutdowns. The licensee indicated that the procedure was not considered a violation of Technical Specification operability requirements for the RWM or RSCS. The PORC, at that time, considered the RSCS controls on "intermediate" rod positions (i.e., between full-in and the rod positions at full power) to be important only during startup.

3.1.5 Safety Significance/Conclusions. The licensee stated that it is still their desire to minimize thermal cycling of feedwater nozzles and CRD collets by such shutdown practices. They are investigating the possibility of obtaining analyses, and possibly Technical Specification changes, to allow reinstatement of the shutdown operation that uses individual rod scramming. The licensee believes they can show, considering current core designs and the remoteness of rod drop accident probabilities during shutdown, that individual rod scrams provide an improved method of shutting down the reactor as compared to the widely used industry practice of full scram shutdowns, without increasing the probability of a severe rod drop accident. In the interim, procedures, instructions, and RWM sequences have been changed to preclude the use of individual rod scrams during reactor shutdowns.

3.2 NRC Questions and Concerns

NRC questions during the meeting included the following:

3.2.1 What reviews and analyses went into the licensee's in-house development of a specialized RWM control rod insertion sequence for shutdown, which was compatible with individual rod scramming but different from the RWM sequences provided by the vendor and used in the vendor's analyses? The licensee stated that the sequence was developed and implemented within the site reactor engineering group, but was not subjected to review by PORC or the corporate reactor engineering group. Associated "Shutdown Instructions" to operators were also provided without PORC review. The licensee stated that he would formalize administrative controls over RWM sequences and associated startup and shutdown instructions to require PORC approval before use. Also, other reactor engineering funcitons will be reviewed to determine adequacy of procedural and management controls.

The NRC further questioned whether the use of the RWM sequence developed by the reactor engineers for shutdown, plus the bypassing of RSCS when individual rod scrams were used to shut the reactor down, resulted in core configurations outside the bounds of existing rod drop accident analyses. The licensee stated that the sequences were developed with consideration for minimizing rod worth and controlling flux shapes and, therefore, he does not believe any unanalyzed conditions resulted; however, he stated that he will either verify this statement or obtain analyses to include such core configurations. The NRC expressed concern that such verification was not performed prior to approval of individual rod scramming and associated RWM program changes.

3.2.2 Might inadequacies similar to those noted in 3.2.1 above exist in administrative controls over site activities outside the reactor engineering group? The licensee said this possibility would be evaluated.

4. Additional Inspection Activities and Findings

4.1 Adequacy of Licensee Pre-Implementation Reviews of Procedural Changes That Allowed Individual Rod Scrams

10 CFR 50.59 allows licensees to make changes in the facility as described in the safety analysis report (SAR) and make changes to procedures as described in the SAR, without prior Commission approval, unless the proposed change involves a change in Technical Specifications or an unreviewed safety question. Further, licensees are required to maintain records of changes in the facility as described in the SAR,

including for each change, a written safety evaluation which provides the bases for the determination that the change did not involve an unreviewed safety question.

The inspector evaluated the following licensee actions relative to 10 CFR 50.59.

4.1.1 Approval of Procedures that Allowed Individual Rod Scrams. Individual rod scramming was allowed through implementation of Revision 10 to GP-3, Normal Plant Shutdown, on April 8, 1977, with prior PORC procedure approval. Subsequent revisions of GP-3, as well as GP-9 (Fast Reactor Power Reduction), including those revisions in effect on November 17, also allowed individual rod scramming.

Technical Specifications require the RWM and RSCS to be operable, below 25 percent power and 21 percent power respectively, during shutdowns. Final Safety Analysis Report Sections J.4.13 and 7.16.3 describe the RWM and RSCS control rod sequences and operations during startup and shutdown. Section J.4.13 states that the purpose of the RSCS is to prevent the operator from moving an out-of-sequence rod during startup or shutdown. Section 7.16.3.3 states that the RWM supplements the operator through a control rod monitoring routine that enforces adherence to startup, shutdown and low power level control rod movement procedures. Individual rod scramming is independent of RWM and RSCS controls and therefore renders RWM and RSCS incapable of either enforcing a sequence or preventing movement of an out-of-sequence rod. Thus, a Technical Specification change, with prior Commission approval, was necessary for procedural changes that institute individual rod scramming. Failure to obtain prior Technical Specification changes and Commission approval for procedural changes affecting functioning of the RWM and RSCS is an apparent Violation (first of two examples).

4.1.2 RWM Program Changes. As noted in Detail 3.2.1, the licensee had changed one of two RWM rod sequences in order to be compatible with the individual rod scram practice. Licensee personnel said the change had occurred in about 1979. No PORC review or safety analysis was performed. Section 7.16.3.3 of the FSAR states that the operator can select either one of two permissible sequences. However, after the 1979 change, only one of the two sequences could be used for startup since the other was designed (onsite) for shutdown only. FSAR Section J 4.13 indicates that rod sequencing must be strictly adhered to during shutdown and is basically the reverse of startup. The shutdown sequence was not the reverse of an allowable startup sequence. Further, FSAR Section 7.16.3.3 states that the RWM sequences stored in the computer memory are based on

procedures designed to limit rod worths to acceptable levels as determined by the design basis rod drop accident (RDA). As noted in Detail 3.2.1, the licensee did not verify compatibility of his RWM program for shutdown with the vendor's RDA analysis referenced in the FSAR. Thus, the 1979 revision to the RWM program changed the system as described in the FSAR, yet no written safety evaluation of this change was made, nor were formal records of the change maintained. This is an additional example of the Violation noted in Detail 4.1.1 above (277/84-01-01, 278/84-01-01).

4.2 RWM and RSCS Status During the November 17 Shutdown

4.2.1 Equipment Operability. As stated in Detail 3.1.1, the licensee experienced problems with both the RWM and RSCS during the shutdown on November 17, 1983. During this inspection, the inspector interviewed various operators, senior operators and STAs to determine problems noted with the RWM and RSCS and corrective actions taken during and after the shutdown. The RWM apparently did not test or operate satisfactorily, was declared inoperable, and was bypassed. The inspector could not determine if a test document was filled out, but none was on file. The RSCS problems were under investigation at the time of the turbine vibration and thus testing was not completed. No maintenance request or other investigation of the RWM and RSCS problems was initiated after the scram. The RWM and RSCS tested satisfactorily before startup on November 21. However, the inspector noted that there were different initial test conditions for the November 17 shutdown than for the subsequent startup. The RWM also had different sequence programs for startup and shutdown.

Technical Specification 6.8, Procedures, and Regulatory Guide 1.33 (November 1972) require implementation of written procedures for troubleshooting and for control of maintenance. Administrative Procedure A-26, Revision 23, June 24, 1981, Procedure for Corrective Maintenance, requires plant problems to be investigated. If the problem cannot be corrected within eight hours through use of plant procedures, a Maintenance Request Form (MRF) shall be initiated. Failure to adequately investigate RWM and RSCS problems on November 17 and to initiate a MRF for problems that were not corrected within eight hours is an apparent Violation (first of three examples).

4.2.2 Compensation for Bypassed RWM. As stated in Detail 3.1.1, a second licensed operator was assigned when the RWM was bypassed on November 17, but did not actually verify the rod insertion sequence during individual rod scramming. Technical Specification 3.3.B.3b requires such verification. Specification 3.3.B.3c states that if 3.3.B.3b cannot be met, the

reactor shall be brought to a shutdown condition immediately. The reactor was in fact brought to a shutdown condition immediately. Thus, the oversight regarding sequence verification did not result in degradation beyond the least conservative Technical Specification action statement. Because this was an isolated case occurring at the time of the licensee's concern about, and haste to respond to, the turbine high vibration alarm, no Notice of Violation is issued in this instance. The licensee stated that procedural guidance to the "second licensed operator" would be strengthened as part of his procedural controls commitments described in Detail 3.2.1.

4.3 Surveillance Tests Reviews

4.3.1 Surveillance Completion Records. The inspector reviewed shut downs and scrams, over approximately one cycle for each unit, relative to the following surveillance requirements:

Technical Specification	Description	Licensee Surveillance
4.1.A and 4.1.2	IRM Comparison with APRMS during Controlled Shutdown	ST3.2.2
4.3.B.3.a	RSCS operability checks during shutdown	ST10.6
4.3.B.3.b.1	RWM operability checks during shutdown	ST10.5
4.3.C.2	Scram time requirements (required if scram occurs while scram time recorders are operable)	ST10.9

The inspector reviewed logs and records to determine which surveillance tests (STs) were required and completed. A list of discrepancies (i.e., cases where a surveillance appeared to have been required but there was no record in the licensee's list of completed tests) was provided to the licensee for resolution. Findings were as follows:

-- ST10.9, CRD Scram Insertion Timing. Four discrepancies were provided to the licensee. Two of the tests were recent and had been completed, but were not yet entered into the records management system. The inspector reviewed the completed tests. The licensee stated that he believed the scram time recorders were probably not operable during the other two scrams involving Unit 2 on October 23 and December 9, 1982. The inspector stated

that, in the absence of documentation (such as procedure sign-offs) that scram time information was not available (including the reasons and corrective action), the surveillance completion record is not auditable (see unresolved item below).

During this review, the inspector noted that neither the Technical Specifications nor licensee procedures requires completion of ST10.9 prior to the next startup. And, in most cases, it has not been completed until after startup. The licensee explained that the test requires detailed analysis of average insertion times to prescribed positions of various rod arrays. Average insertion times are usually well within specification and tend to vary slowly. Therefore, completion of detailed analyses before startup is not considered necessary. The licensee did, however, revise C.O.L. GP-18, Scram Review Procedure, to include a check of the data to ensure that no monitored rod exceeded the Technical Specification limit of 7 seconds for 90 percent insertion. The inspector reviewed this revision (dated January 18, 1984) to C.O.L. GP-18.

-- For ST 10.5, ST 10.6, and ST 3.2.2, the licensee was still investigating the apparent discrepancies at the completion of the inspection.

The issues of proper completion and record maintenance for the above-listed surveillance tests, and of auditability of ST 10.9 completion, are unresolved (277/84-01-03, 278/84-01-03).

4.3.2 Reviews of Completed RWM and RSCS Surveillances. The inspector reviewed randomly sampled records of ST10.5, RWM Operability Check, and ST10.6, Rod Sequence Control System (RSCS) Functional Test, for performance, completeness, and adherence to requirements. The samples included four ST10.5 and eight ST10.6 completed tests. Findings were as follows:

-- ST10.5, Revision 11, July 8, 1980, RWM Operability Check, at Unit 2 on May 28, 1983, was not completed properly in that the test calls for selecting one or more rods in Group 2 and verifying that a "SELECT ERROR" alarm occurs, then selecting 2 rods from Group 1 and verifying that the Group 1 rods do not cause a "SELECT ERROR." Rods selected (i.e., a total of at least three) are to be listed. However, only one rod (58-23) was documented as being selected. This is an asterisked step, which should have been completed satisfactorily for the acceptance of the test, as it is a Technical Specification surveillance requirement. The surveillance test was reviewed and approved by supervision indicating all asterisked steps completed satisfactorily. Failure to fol-

low surveillance procedures and to perform adequate management review is an apparent violation (second of three examples).

-- An important step in procedure ST10.6 which documented the Technical Specification surveillance requirement 4.3.B.3a of demonstrating group notch control of the RSCS after reaching 50% rod density on reactor startup was not properly identified in Revision 9 or Revision 10 of the procedure. If this step is performed without satisfactory results, the test should fail and corrective actions be initiated. Technical Specification 6.8.1 and Regulatory Guide 1.33 (November 1972) requires the written procedures for surveillance testing be established and implemented. Procedure A-47, Revision 2, April 14, 1980, Procedures for Generation of Surveillance Tests, requires that Technical Specification surveillance requirements be indicated with an asterisk and the test results section be signed only if all asterisked steps are completed satisfactorily. However, the step was not identified as critical to the test (i.e., asterisked). Also, ST10.6, Revision 9 and 10 did not require verification (i.e., a sign-off) that the Technical Specification surveillance requirement had been done. The failure to properly identify an important step in ST10.6 is an additional example of the apparent Violation described above in Details 4.2.1 and 4.3.2 (277/84-01-02; 278/84-01-02).

4.4 Process Computer Change Controls

In view of the inadequately controlled RWM Program change discussed in Detail 4.1.2, the inspector reviewed the controls on other modifications to the process computer. Administrative Procedure A14.1, Process Computer Modification Procedure, provides for processing modifications to the process computer programs and changes to the data book as minor modifications, and includes PORC approval of each change. The procedure has been frequently used (67 times since 1978) by the reactor engineers. However, modifications to the RWM rod sequence are specifically excluded from applicability of the procedure. Within the scope of this review, no violations were identified.

4.5 Procedure Revisions

The inspector reviewed the following procedures to verify they had been changed as discussed in the January 12, 1984 meeting.

-- GP-3, Revision 28, January 11, 1984, Normal Plant Shutdown.

-- GP-9-2, Revision 0, January 11, 1984, Fast Reactor Power Reduction.

-- GP-9-2 (Appendix I), Revision 0, January 19, 1984, Unit 2 Shutdown Instructions.

-- GP-9-3, Revision 0, January 11, 1984, Fast Reactor Power Reduction.

-- GP-9-3 (Appendix I), Revision 0, January 19, 1984, Unit 3 Shutdown Instructions.

No unacceptable conditions were noted.

5. Previous Inspection Item Update

(Closed) Unresolved Item (277/83-34-03, 278/83-32-03), acceptability of individual rod scrams. This report includes an inspection finding that individual rod scramming is not acceptable within the context of existing Technical Specification and cites this practice as an apparent Violation. The licensee was so informed at the exit meeting.

6. Unresolved Items

Unresolved items are items about which more information is required to ascertain whether they are acceptable, violations, or deviations. An unresolved item is discussed in Detail 4.3.1.

7. Management Meetings - Preliminary Inspection Findings

A verbal summary of preliminary findings was provided to the Assistant Station Superintendent at the conclusion of the inspection. During the inspection, licensee management was periodically notified verbally of the preliminary findings by the resident inspectors. No draft inspection report material was provided to the licensee during the inspection.