U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report Nos. 50-254/94003(DRP); 50-265/94003(DRP)

Docket Nos. 50-254; 50-265 License Nos. DPR-29; DPR-30

Licensee: Commonwealth Edison Company
Executive Towers West III
1400 Opus Place, Suite 300
Downers Grove, IL 60515

Facility Name: Quad Cities Nuclear Power Station, Units 1 and 2

Inspection At: Quad Cities Site, Cordova, Illinois

Inspection Conducted: February 3 and 4, 1994.

Inspectors: F. Brush
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Approved By: Patrick L. Hiland
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Reactor Projects Section 1B

3/3/94
Date

Inspection Summary

Inspection on February 3 and 4, 1994 (Report Nos. 50-254/94003(DRP); 50265/94003(DRP):

Areas Inspected: A special safety inspection was performed to examine the licensee's evaluation of a control rod mispositioning event which occurred on January 27, 1994. The inspectors evaluated the event's safety significance and time line, the controls in place for an unexpected power increase, the use of procedures in the control room, the qualified nuclear engineer's (QNE) performance, and the control room environs with regard to the test performance.

Results: The inspectors determined that the licensee was conducting an in-depth evaluation of the event. The inspectors also concluded that the event was of minimal safety significance. An unresolved item was identified in paragraph 5 concerning the root causes of the rod mispositioning event. The results of the licensee's investigation will be reviewed by the resident staff.

EXECUTIVE SUMMARY

Overview

The licensee was performing an in-depth investigation into the control rod mispositioning event of January 27, 1994.

The event was of minimal safety significance.

Plant Operations

There were no formal controls in place for response to an unexpected power increase.

Operators were aware of management's expectations for procedure compliance.

The inspector's time line closely followed the licensee's.

Engineering

The qualified nuclear engineers (QNE) did not properly perform the function of "second verifier" during control rod movements.

This was the first time the QNEs had functioned as the test director for this evolution. The QNEs were uncertain of the duties and where the test director should be stationed in the control room.

DETAILS

1. Persons Contacted

Commonwealth Edison Company (CECo)

*R. Pleniewicz, Site Vice President
*G. Campbell, Quad Cities Station Manager
*N. Chrissotimos, Supervisor, Regulatory Assurance
*B. McGaffigan, Assistant Superintendent - Work Planning
*J. Manemann, Regulatory Assurance (Operations) Team Member
*B. Moravec, Engineering and Nuclear Construction Site Manager
*J. Morris, CECO Performance Enhancement Supervisor
*J. Neal, Regulatory Assurance, Investigative Team Leader
*B. Palagi, CECO Chief Nuclear Engineer
L. Tucker, Technical Superintendent

*Denotes those attending the exit interview conducted on February 4, 1994.

The inspectors also contacted other licensee personnel, including members of the engineering, operations, and training staff.

2. Event Sequence

On January 27, 1994, Unit 2 was maintaining power between 20 to 25 percent. Quad Cities Test Surveillance, QTS 130-4, "Control Rod Scram Timing in the Hot Condition," was in progress with about 160 rods tested over the previous 20 hours. Power was being held at less than 25 percent due to reactor core isolation cooling (RCIC) system testing. The restriction was removed prior to the rod mispositioning event.

Three nuclear engineers were assigned to perform the scram time testing. Two engineers were qualified nuclear engineers (QNEs) and one engineer was a nuclear engineer in training (NEIT). The NEIT had previously performed control rod scram time testing when the evolution was directed by system engineers and was acting as test director (TD) under instruction. The QNE assigned as the TD had never performed the scram time test but had walked through the procedure and observed about 10 control rods being tested the previous day. Prior to the test, the two QNEs questioned the QNE supervisor about the second verifier and expressed concern about the workload. The QNEs were told to keep going and not hold up the work. There was pressure, either perceived or actual, on the QNEs not to delay the plant startup.

The test organization at the beginning of the shift had the QNE at the rod control panel with the test nuclear shift operator (NSO), hereafter called the NSO. The second QNE, who was the TD, was behind the nuclear engineer in training (NEIT) acting as the scram time verifier. The NEIT was about eight feet behind the NSO and QNE at a desk communicating on sound powered phones with an NSO at the individual rod trip switches and

an equipment operator at the control rod hydraulic control units (HCU). This organization tested over 50 control rods when the NEIT left to prepare for jumpering rods to complete the test. The TD took over the sound powered phones and the QNE took over the job of scram time verifier in addition to the QNE responsibilities. This test organization was in effect when the event occurred.

At 13:28 on January 27, 1994, Control Rod L-11 was test inserted and "bounced" to position 02. The QNE and TD decided to retest the rod. The QNE wrote a special maneuver sheet to pull the control rod to position 48 and re-perform the scram time test. Control Rod L-11 was pulled and tested successfully.

At 13:44, Control Rod M-8 was pulled to position 48 and then scrammed. The control rod went to position "--" (called double hash by the NSO) and did not subsequently settle to 00 as expected. The NSO asked the TD and QNE if the control rod should be retested. Neither the TD nor the QNE responded to the question; however, the QNE went to check the scram time and decided that the time was acceptable. The NSO then asked the TD, "pull rod Mike 8 to 48?" The TD repeated back, "pull rod Mike 8 to 48." The NSO assumed that permission was given to pull Control Rod M-8. The QNE removed the control rod pull sheet since Control Rod M-8 was the last rod on the sheet. The NSO and the TD assumed that the QNE had written a special maneuver sheet to move Control Rod M-8.

At 13:47, the NSO pulled Control Rod M-8 to position 48. The NSO did not check to ensure that a special rod maneuver sheet was present (it was not present). Neither the TD nor the QNE second-verified the rod to be pulled. Both QNE's assumed that the other was responsible for the verification. Prior to the NEIT leaving to prepare for jumpering, both QNE's were verifying the rod pulls.

The test NSO acknowledged an alarm for the unit NSO immediately after the control rod pull and did not attempt to initial the special maneuver sheet as required.

The TD instructed the NSO to pull Control Rod M-6 which was the next control rod to be tested. At 13:48, the NSO started to pull Control Rod M-6 to position 12 and asked about the expected power increase but did not remember that Control Rod M-8 was fully withdrawn. After receiving QNE input that no unexpected power increases would occur, the NSO withdrew Control Rod M-6 to position 48.

The Unit NSO recognized that the power increase was greater than expected by about 15 megawatts electrical. The unit NSO looked at the rod display and recognized that rods were not in proper alignment. At about the same time the TD and the test NSO recognized that rod M-8 was mispositioned.

The unit senior reactor operator (SRO) and the shift engineer were notified. Control Rod M-8 was repositioned in accordance with the abnormal procedure and Control Rod M-6 was inserted to position 00. The test was stopped.

3. Inspector Evaluation

The inspectors interviewed facility personnel involved and investigating the event, reviewed licensee procedures, and reviewed the licensee's event time line in order to determine if appropriate management attention was being given to the event.

a. Safety Significance

The event was of minimal safety significance. The plant was at about 22 percent power when the event occurred and no thermal limits were approached. Calculations showed the maximum heat flux was 5 KW/FT with the thermal limit of 14 KW/FT. The control rods were separated by Control Rod M-7 which was full out (position 48) at the time of the event; therefore, the neutron flux was not sharply peaked by the rod mispositioning.

b. Procedural Usage

The licensee's procedures required second verification of rod pulls by the QNE. This was not accomplished. The rod scram timing procedure did not specify the person that was required to be the second verifier; however, the procedure covering rod movement required the QNE to verify special rod movement. This was the first time the QNEs supervised the test. This led to confusion as to the responsibilities of the QNEs involved. In addition, the QNEs switched responsibilities during the test which confused the QNEs regarding rod motion verification. The QNEs were aware of the requirement to verify the rod motion. During the event, the QNE that was serving as the test director was also the control rod movement second verifier. This QNE was not in position to see the control rod special maneuver sheets in order to verify the moves. The QNE relied upon the operator telling him what the move was and then looked to see if that control rod was selected.

During the previous shift, the QNE that was checking the rod scram times on the computer printer acted as the second verifier. That individual did look at the special maneuver sheets and the control rod that the operator had selected.

The QNEs on shift during the event questioned the engineering supervisor about the second verifier requirement. The QNEs were told to keep going and not to hold up the work. There was pressure, either perceived or actual, on the QNEs not to delay the plant startup. Licensee senior management subsequently stated that expectations were that there was no schedule pressure and that safety was paramount.

The control rod special maneuver sheets were not numbered or serialized. This could be confusing if a number of sheets were generated.

The test NSO did not verify that a special rod maneuver sheet was written for Control Rod M-8. The test NSO did not attempt to initial the rod maneuver sheet after withdrawing Control Rod M-8. The NSO was aware of the procedural requirement to verify and initial rod pulls but was distracted by the alarm acknowledged on the adjacent board. The time between pulling Control Rod M-8 and then starting to pull Control Rod M-6 was less than 1 minute.

c. Controls for Response to Unexpected Power Increase

There were no "formal controls," i.e. procedures. The experience and training of the NSOs and QNEs were used to respond to such an event. Management stated that the QNE was responsible for the power distribution of the rod movement. The QNE reviewed the power increase using the average power range monitors (APRMs) and did not use additional available computer printouts; therefore, the QNE missed an opportunity to discover the mispositioned rod.

d. Human Factor Performance

There was a basic misunderstanding among the control room personnel performing the test. The NSO believed that Control Rod M-8 had to be retested (after scram testing the rod did not immediately settle out and remained in a double hashed position "- -") when in fact a definitive decision had not been made and a special maneuver sheet for retesting had not been prepared. The NSO's belief on re-testing of Control Rod M-8 was based on the fact that about one hour earlier a special maneuver sheet had been written and the rod (L-11) had been retested for a similar reason. Personnel involved made false assumptions about what the other individuals were doing. No single person in the control room had a clear understanding of what was going on during the time that the control rod was mispositioned. In particular, there was not a clear understanding on performing the function of independent rod maneuver verification.

Both verbal and written communications were less than adequate in the control room during the time period when the test was being conducted. Repeat backs were used between the test NSO and the TD but were not effective in ensuring that communication took place. The written special maneuver sheets were also not effective in preventing the event.

The TD was not physically located in a position to conduct the rod maneuver verification. The TD could not clearly see the special maneuver sheets. The TD could possibly have plugged in a headset at another location which would have allowed better rod position verification.

The work load of the TD was not adequately reviewed prior to the event. Questions related to work load had been raised prior to the test by the TD and it was not clear that these questions were adequately resolved. The TD was wearing headphones and was responsible for communicating with both the NSO on the back panel and an operator at the local control rod drive HCU banks. The TD was also communicating (without headphones) with the test NSO withdrawing the control rods and the QNE verifying the scram times and preparing the special maneuver sheets.

The format and order of communications for the scram test was not clear to all participants and was further complicated when a reduction in the number of people involved with the test occurred. Following the reduction of test personnel, no review of personnel assignments and responsibilities was performed.

The operating crew on Unit 2 were on 8-hour shifts and the shift was nearing completion at the time of the event. During that shift, the test NSO had been involved with the test the entire shift with the exception of about 6 control rods. Those 6 rods were completed by another NSO assigned to Unit 2. Fatigue was not considered by the operating crew to be a major contributor to the event. The QNEs, however, were on 12-hour shifts during the startup of Unit 2. The QNEs had not had a break since the initiation of the test at 08:55 and had not eaten lunch since there was a policy that only the unit operators could eat in the control room. Fatigue appeared to be a contributing factor for the QNEs involved in this event. In addition to fatigue, the QNEs felt a level of stress was present to complete the test prior to the end of the shift.

4. Licensee's Immediate Corrective Actions

The decision to assign a level II investigation team to this event was an appropriate management response for root cause investigations. The immediate licensee corrective actions included stopping the test and prohibiting non-emergency control rod movements; requiring the operators and the QNEs to participate in training on rod mispositioning and other reactivity events using classroom and plant simulator; and reviewing the event with all other operators and QNEs. The immediate corrective actions appeared to reinforce the licensee's management expectations that procedures be followed.

The testing was completed on January 29, 1994, after the licensee implemented the following changes:

- The TD was required to communicate the appropriate control rod to be tested to the NSO.

- The NSO was required to repeat back the instructions from the TD.

- All future rod moves (except for CRD weeklies) required a second verification.

- Special communication controls, which included confirmation by all individuals prior to procedure execution, were put in place for completion of the testing.

5. Inspector Conclusions

The inspectors concluded that the root causes of this event were being adequately investigated by the licensee. The licensee's investigative team had the appropriate level of management support to investigate the event and had appropriate multi-disciplinary coverage including operations, nuclear engineering, and a human factor specialist. The licensee's team appeared thorough in developing causal factors to lead to the root causes. At the conclusion of the inspection, all root causes had not been identified and additional review will be required to evaluate the effectiveness of the licensee's developed recommendations and implementation plan. Root cause(s) to the rod mispositioning event is considered an Unresolved Item (50-254/265-94003-01(DRP)) pending further review of the licensee's investigation results.

One area which the inspectors believed should be more fully developed was the SRO oversight of the test evolution. The Unit SRO was preparing for turnover at the time of the event and had minimal input into the conduct of the evolution. In addition, the "Unit SRO" position was only recently implemented at the Quad Cities Station. Previously, the SRO oversight for both units was provided by the station control room engineer (SRO and STA qualified). When the control room staffing arrangement was revised, management oversight of the newly appointed Unit SROs appeared to be minimal. This was a noted weakness in Inspection Report 50-254/265-93032, dated March 7, 1994. The inspectors review of the licensee's investigative report will include further evaluation of management oversight provided to control room personnel.

One conclusion reached by the licensee was that a heightened level of awareness (HLA) associated to the test by the operations department may have prevented the rod mispositioning. When asked how HLA would have effected the way the test was run, the SROs were not sure how this could have changed the response. The main difference in a HLA event is that a brief would have been held by the SRO; however, a brief was held prior to the evolution which covered the appropriate sections of the HLA briefing.

6. Unresolved Items

Unresolved items are matters which require more information in order to ascertain whether it is an acceptable item, an open item, a deviation or a violation. One unresolved items disclosed during this inspection is discussed in paragraph 5.

7. Exit Interview

The inspectors met with licensee representatives denoted in paragraph 1 during the inspection period and at the conclusion of the inspection on February 4, 1994. The inspectors summarized the scope and results of the inspection and discussed the likely content of this inspection report. The licensee acknowledged the information and did not indicate that any of the information disclosed during the inspection could be considered proprietary in nature.