

U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Report No. 50-237/91036(DRP)

Docket No. 50-237

License No. DPR-19

Licensee: Commonwealth Edison Company

Facility Name: Dresden Nuclear Power Station, Unit 2

Inspection At: Dresden Site, Morris, IL

Inspection Conducted: October 20, 1991, through January 14, 1992

Inspectors: W. Rogers
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Approved By: B.L. Burgess for
B. L. Burgess, Chief,
Projects Section 1B

2/10/92
Date

Inspection Summary

Inspection from October 20, 1991 through January 14, 1992 (Report No. 50-237/91036(DRP)).

Areas Inspected: Special safety inspection conducted by resident and regional inspectors concerning the 2A recirculation pump discharge valve failure to close on August 7, 1991.

Results: The low pressure coolant injection system was inoperable for approximately seven months. Several weaknesses were identified in the site management control system:

- Limited root cause evaluation
- Inadequate documentation of qualification requirements for personnel performing a special process
- Use of a non-safety consultant for safety-related work
- Inadequate test acceptance criteria
- Lack of independence in analyzing VOTES traces
- Inaccurate Licensee Event Report information

Several additional weakness were identified in the corporate engineering management control system concerning:

- Failure to perform a safety-related engineering evaluation under rigorous management control
- Failure of engineering personnel to recognize and document a condition adverse to quality

DETAILS

1. Persons Contacted

Commonwealth Edison Company

- *C. Schroeder, Station Manager
- *J. Kotowski, Production Superintendent
- *D. Van Pelt, Assistant Superintendent - Maintenance
- *K. Kociuba, Nuclear Quality Programs Superintendent
- W. Kapinus, Motor Operated Valve Coordinator
- *D. Pool, Corporate Motor Operated Valve (MOV) Group
- *R. Radtke, Regulatory Assurance Supervisor
- *W. Morgan, BWR Nuclear Operations Supervisor
- *R. Kyrouac, Nuclear Quality Programs Supervisor
- *E. Zebus, Project Manager
- *L. Gerner, Technical Superintendent
- *R. Meadows, Maintenance Staff Supervisor
- *G. Smith, Assistant Superintendent, Operations
- *D. Booth, Master Electrician
- *H. Mulderink, BWR MOV Coordinator
- *R. Ungeran, Corporate MOV Administrator

*Denotes those attending the exit interview conducted on January 14, 1992.

The inspectors also talked with and interviewed several other licensee employees including members of the technical and engineering staffs.

2. Background

a. System Operability Requirements

At Dresden, the low pressure emergency core cooling system is comprised of the two core spray trains and the low pressure coolant injection (LPCI) system. Technical Specification (TS) 3.5.A requires LPCI to be operable during power operation to ensure adequate heat removal capability in the event of a loss of coolant accident (LOCA). The TS limiting condition for operation prohibits continued reactor operation beyond seven days if LPCI is inoperable.

For LPCI to be operable, the system must be able to determine in which reactor recirculation (RR) loop the LOCA occurred, isolate the faulted loop, and inject water into the reactor vessel via the non-faulted RR loop. Isolation of a faulted loop occurs when the associated RR discharge valve closes.

b. VOTES Testing Methods

The licensee tests motor operated valves using the Liberty Technologies Valve Operation Test Evaluation System (VOTES).

After recording the VOTES data, maintenance technicians select a zero reference point from the latter of two transition points in a closed-to-open-to-closed trace. The transition points occur when all stem compression and tension is relieved as the stem nut turns freely through the thread clearance. The VOTES computer software then uses data collected by a strain gage, located on the valve yoke, to calculate valve thrust by referencing the force coordinate events to the zero reference point. Based upon the calculated thrusts a torque switch setting is then established.

3. Reactor Recirculation Valve Failure

In December 1990, during the 12th refueling outage on Unit 2, the licensee performed VOTES testing on the 2A reactor recirculation loop discharge valve, 2-202-5A. The technician was unable to determine the zero reference point due to anomalies in the VOTES trace. One of the technicians sent the digital test data to a recognized VOTES industry expert, employed with Babcock and Wilcox Nuclear Technologies (BWNT), and requested guidance in identifying the zero reference point.

On December 14, 1990, the recognized industry expert telephoned the technician and assisted in identification of the zero reference point. This zero reference point was entered into the VOTES analysis program and the valve thrusts were calculated. From this calculation, the valve operator torque switch setting was reduced from 2.5 to 1.0.

On August 6, 1991, the 2A reactor recirculation pump tripped on over excitation due to a failed resistor in the motor generator voltage regulator circuit. After replacing the resistor, operations personnel attempted to restart the pump. In accordance with the procedure, the operator tried to close the loop discharge valve prior to restarting the pump. However, the valve would not close beyond the intermediate position. Investigation showed that the valve motor was prematurely tripping due to an improper torque switch setting. The incorrect torque switch setting corresponded to a valve operator thrust between 19,000 and 20,000 pounds. The required thrust window, based on a design differential pressure of 200 pounds per square inch, was between 48,280 and 56,517 pounds.

On August 10, 1991, the torque switch was reset to 3.25, based on a motor current trace, and the valve was declared operable.

On August 20, 1991, as part of the corrective action for the wrong torque switch setting, the corporate nuclear engineering department (NED) motor operated valve (MOV) group performed a reanalysis of the 39 remaining safety-related VOTES tests from the D2R12 outage. The reanalysis concluded that all the other valves were within their design thrust windows.

4. Event Contributors

a. Cause of the Event and Root Cause Evaluation

The licensee determined the cause of the event to be a misinterpretation of the zero reference point on the force versus time VOTES trace. The zero reference point identification was hampered by the unusual characteristics of the trace and the limitation of the VOTES computer software (Version 1.1) to expand the force axis portion of the trace. The licensee event report (LER) indicated the newer edition of the software (Version 2.1) provided enhanced resolution as well as other features to ensure proper zeroing interpretations.

The inspector concluded the root cause of the event was a limitation in the VOTES process. The determination of the zero reference point for the discharge valve was consistent with the VOTES methodology, as described in the formal VOTES training program and the VOTES manual. The reactor recirculation discharge valve yoke exhibited a bending moment when the valve was cycled. The bending effect resulted in abnormal running loads and a discontinuity between the first and second transition points of approximately 50,000 pounds force (lbf) compared to 200 lbf in a typical trace. The VOTES testing program, including the methodology, training, and software, was not equipped to properly evaluate the reactor recirculation discharge valve data, due to the bending yoke effect. Both versions of the VOTES software provided expansion capability of the time axis. The expansion feature allowed for clear identification of both transition points on the valve trace; however, expansion of the time axis may not have identified the torsional bending yoke effect to the uninformed individual. Therefore, the use of version 1.1 instead of version 2.1 did not contribute to the misidentification of the zero reference point.

b. Failure to Document Personnel Qualification

Nuclear Operations Directive NOD-MA.1, "Guidelines For Motor-Operated Valve (MOV) Testing, Maintenance and Evaluation, September 1990," delineated the special training requirements for the Station Motor Operated Valve (MOV) Coordinator, the Corporate MOV Coordinator, and engineering personnel performing work for the Corporate MOV Coordinator.

The inspector determined that the licensee had not maintained records documenting station and corporate personnel qualification to NOD-MA.1 requirements. The Nuclear Quality Programs group had previously identified this concern for corporate personnel as documented in Audit Report CE-91-04, November 18, 1991.

The inspector confirmed, through interview, that personnel performing VOTES analysis were qualified and that the lack of

as-left torque switch sittings, or the valve thrust windows.

- (2) The MOV coordinator's concerns about selecting the zero point on the valve and use of industry expert services were not documented. For example, no notations were made in the work package nor was a condition adverse to quality record initiated.
- (3) No independent analysis or evaluation was required by the test procedure. Additionally, no independent verification of conformance to the thrust windows was required.

The inspector determined through interview that the technicians performing the testing understood management's expectations that the valve torque switch settings would be set consistent with the design thrust windows. Therefore, the inadequacies in the test procedure were not a contributor in the event.

5. Corporate Engineering Involvement

a. Reanalysis of the VOTES Traces by NED

The corporate motor operated valve (MOV) group completed a reanalysis of the 39 safety related VOTES tests performed during the outage on August 20, 1991. The MOV Program Administrator issued a letter to the station concluding that all the valves, except the reactor recirculation discharge valve, were within the current design thrust window.

The inspector determined that five of the re-evaluated valves were actually outside the design thrust window. Two of the five valves had been identified during the outage and had been found acceptable, as documented in an engineering transmittal (CHRON No. 161468, January 15, 1991, to E. Eenigenburg). Based upon engineering judgement, NED MOV personnel determined that the operability of the other three valves was not affected by the degraded torque switch settings. The engineers involved failed to document either the reanalysis effort or the discrepancies between the plant configuration and design documentation. Further, the NED organization did not communicate to the station that discrepancies were found or how they were resolved.

b. MOV Design Thrust Window Data

The licensee contracted with Bechtel Corporation to provide MOV thrust windows for worst case differential pressure and minimum terminal voltage. The NED MOV group adjusted the Bechtel thrust window values as a function of torque switch tolerance, valve lubrication history and measured equipment uncertainty. The adjusted thrust values were sent to the site via letter. Station personnel used the letter to determine the acceptable valve thrust in the VOTES analysis.

documentation did not contribute to the incorrect torque switch setting.

c. Use of a Non-Safety-Related Consulting Service

Prior to the outage, the licensee contracted with Babcock and Wilcox Nuclear Technologies (BWNT) to provide consulting services for VOTES data analysis (Purchase Order Number 333188). In accordance with the contract, BWNT was to issue a formal analysis report within five days of receipt of valve data. The purchase order was issued as non-safety related.

Under this purchase order, a site technician sent the reactor recirculation discharge valve digital test data to BWNT for analysis, as described in section 3 above. Assisted by the BWNT recognized industry expert, the technician selected a zero point for the trace. When the BWNT industry expert participated in selecting the zero reference point for this safety related valve, he performed safety related work.

During the review of the valve trace, the BWNT industry expert determined a problem existed with the valve. This observation was not communicated to the site during the zero reference point dialogue. As stated in the contract, the industry expert wrote a VOTES summary report. The report concluded the valve might not shut off flow under actual operating conditions and recommended that the valve be disassembled and deficiencies corrected. However, BWNT failed to forward the summary report to the licensee. The site MOV coordinator failed to recognize that the summary report was not received.

The inspector concluded that the procurement of the consultant services under a non-safety purchase order was not a contributing factor to the event. All practical aspects of a safety related program were met. The expert was qualified and the analysis was documented in accordance with BWNT's QA program. The report was placed into the vendor's QA document control program. Procuring the consultant services under a non-safety related purchase order had no bearing on the consultant's failure to submit the report to the licensee.

d. Test Procedure Quality

The inspector reviewed the work package (WR D91331) and testing procedures for VOTES testing of the reactor recirculation discharge valve. The inspector identified the following weaknesses associated with the documentation of the work activities:

- (1) Neither the work package nor the testing procedure delineated any quantitative or qualitative acceptance criteria related to the VOTES diagnostic, the as-found or

The inspector requested to review the NED adjustment calculations. However, these calculations were not available since they were not retained under a QA program.

6. Licensee Event Report Followup

(Open) LER-237/91-023, 2A Recirculation Pump Discharge Motor-Operated Valve Failure to Close. The inspectors identified that the LER contained incorrect and misleading information. The licensee committed to revise the LER, correcting inaccuracies, and to review the LER information gathering process.

7. 10 CFR 21 Evaluation Followup

The station procedure for review and processing significant conditions adverse to quality, Dresden Administrative Procedure (DAP) 2-8, provides three Part 21 deviation screenings. The first review is performed by the Operation Engineer, the second by the deviation report coordinator and a final review by the on-site review group. When a deviation is identified through the screening, the information is forwarded to the corporate Part 21 coordinator. The coordinator then ensures that an evaluation for a defect, under 10 CFR Part 21, is completed.

For the reactor recirculation discharge valve incorrect torque switch setting, all three screenings concluded that a Part 21 evaluation was not required. However, the LER concluded that limitations of the VOTES computer software contributed to the improper zero reference point identification.

The inspector inquired why a Part 21 evaluation was not performed beyond the initial screenings. During the inspection, the licensee began a 10 CFR Part 21 evaluation of the VOTES process relating to the bending valve yoke phenomenon.

8. Analysis of Inspection Findings

Several weaknesses associated with the VOTES testing program were identified in the site management control system:

- The management control system did not ensure an adequate root cause evaluation was completed following the failure of the RR discharge valve to close.
- The management control system did not ensure the qualification requirements, as outlined in NOD-MA.1, were documented for personnel performing VOTES testing.
- The management control system did not ensure consultant services used for safety-related work were procured on a safety related purchase order.

- The management control system did not ensure the VOTES testing procedure/work package delineated quantitative or qualitative acceptance criteria.
- Given an emergent technology, the management control system did not establish a commensurate level of review of the VOTES analysis.
- The management control system did not ensure the abnormal VOTES trace was identified and documented as a condition adverse to quality.
- The management control system did not ensure that LER 91-023 contained factual information.

Several additional weaknesses were identified in the NED Management Control System:

- The management control system did not ensure the re-evaluation of the remaining Unit 2 MOVs was performed and documented under rigorous management controls.
- The management control system did not ensure engineering personnel recognized or documented the failure of three Unit 2 MOVs to meet the design specification as a condition adverse to quality.

The original unresolved item, 50-237/91022-08(DRP), issued on this matter will remain open. Closure of this item is dependent upon completion of the licensee's 10 CFR 21 evaluation of the VOTES process and further NRC review of the licensee's condition adverse to quality system and licensee calculation controls. An unresolved item is a matter requiring more information to ascertain whether it is an acceptable item, an open item, a deviation, or a violation.

9. Exit Interview

The inspectors met with licensee representatives (denoted in paragraph 1) during the inspection period and at the conclusion of the inspection period on January 14, 1992. 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.