

U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Reports No. 50-254/94007; 50-265/94007(DRS)

Docket Nos. 50-254; 50-265

Licenses Nos. DRP-29; DRP-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: January 31 through February 25, 1994

Inspector: *I. T. Yin*  
I. T. Yin

*3/24/94*  
Date

Approved By: *B. L. Burgess*  
B. L. Burgess, Chief  
Operational Programs Section

*3/25/94*  
Date

Inspection Summary

Inspection on January 31 through February 25, 1994 (Reports No. 50-254/94007; No. 50-265/94007 (DRS)).

Areas Inspected: Routine, announced inspection to assess licensee control and implementation of corrective action plans to resolve pump and valve cavitation and vibration problems identified during the NRC Diagnostic Evaluation Team (DET) inspection conducted in August and September 1993 (IP 37700).

Results: Of the areas inspected, no violations were identified. The licensee actions to correct the DET identified pump and valve vibration and cavitation findings were considered to be substantial. The specific provisions of the program addressing the DET findings were found to be generally acceptable, but in some cases were sketchy and lacked specificity. Examples included the poor evaluation of similar events during the initiation of a Deficiency Report; and the inadequate retrieval of available design basis information during implementation of a modification as part of the corrective action process.

## DETAILS

### 1.0 Persons Contacted

#### Commonwealth Edison Company (CECO)

L. K. Tucker, Technical Superintendent  
J. Burkhead, Quality Verification Program Supervisor  
A. Fuhs, Regulatory Assurance

#### U. S. Nuclear Regulatory Commission (NRC)

B. L. Burgess, Chief, Operational Programs Section  
C. G. Miller, Senior Residence Inspector

The above individuals and other licensee individuals attended the exit interview on February 25, 1994.

Other individuals were contacted during the course of this inspection.

### 2.0 Licensee Action on Previous Inspection Findings

(Closed) Violation 254/91005-02 (DRS): The violation contained a number of issues. The licensee corrective actions were as follows:

#### Modification M-4-1-88-019

A. Issue: Lack of documentation of test failure. Change of acceptance criteria to pass the test in lieu of a failure evaluation.

Action: The licensee's corrective action stated, "The engineer stated that he did not sign off the test until he had obtained new acceptance criteria.." This demonstrated that the licensee did not understand the 10 CFR 50, Appendix B, Criterion 11 requirement that signing off the test should have been based on the test acceptance criteria. However, this issue had little or no safety significance and no additional followup is required.

B. Issue: Failure to incorporate engineering instructions into the test procedure for monitoring the EDG turbo oil pump leak.

Action: The system engineer monitored the leak to ensure leakage did not exceed one drop per minute for the first eight hours of EDG operation.

#### Modification M-4-0-89-066

Issue: The air leakage test procedure for the air-operated containment valves was deficient in that the test did not specify a minimum leak rate but rather evaluated a leakage time irrespective of initial test pressure.

Action: The inspector reviewed the site test procedure QTS 105-9, "Pneumatic Accumulator System Pressure Decay and Fail Safe Test," Revision 6, and considered the corrective action adequate.

#### Modification M-4-1-91-009

Issue: No test acceptance criteria were specified for the MOV.

Action: The inspector reviewed the licensee Policy Letter RJW 91-9, dated July 2, 1991, and considered the matter resolved.

(Closed) Open Item 254/91005-03 (DRS): Concerns relative to potential low Instrument Air pressure that might not be sufficient to move the containment valves. The licensee tested all the affected air operated valves, except one. Valve 2-5742B in the reactor building vent isolation damper system was scheduled for testing during refueling outage Q2R13.

### 3.0 Introduction

The objective of the inspection was to assess the licensee's engineering and technical support activities in resolving pump and valve vibration and cavitation problems that occurred in the past. These problems were identified during the NRC DET inspection conducted in August and September 1993. Subsequently, the licensee initiated a corrective action program designated, "Resolution of Equipment Vibration Issues Site Working Group Charter," on January 8, 1994.

### 4.0 Problem Identification Forms (PIFs)

The Site Vibration Team had conducted vibration measurements for the 1B Reactor Water Cleanup pump, 1B Core Spray pump, 1B Control Rod Drive pump, 2F Condensate Demineralizer pump, 2B Core Spray pump discharge extension, and Unit 1 Emergency Diesel Generator Cooling Water pump. Deficiencies observed were documented in PIFs. The inspector assessed portions of the licensee correction action program by conducting technical evaluations of the following PIFs:

#### A. 254-200-89-09700

On October 23, 1989, erosion was found just downstream of a HPCI test return valve (MO-1-2301-10). An evaluation determined the cause was improper application of a globe valve given a system pressure differential of 1200 psi at the valve during system flow rates of 5600 gpm. The globe valve installation in the system at this location caused high fluid velocities downstream of the valve, cavitation, and erosion inside the valve.

The inspector questioned the likelihood of other valves in similar applications in plant systems. The licensee stated that there were no other reports of erosion of valve bodies caused by the installation of inappropriate valves. The inspector considered

the licensee's evaluation for similar problems to be narrowly focused on valve type, and missed the broader concern of excessive vibration and cavitation problems. This concern was discussed during the management exit.

B. 254-200-90-00500

On January 17, 1990, the 1C reactor feedpump seal cooling water line was found leaking due to vibration. The leak came from a cracked cooling water line pipe nipple at the pump casing to seal cooling water line interface. The cracking was evaluated and determined to be caused by line vibration. The licensee replaced this and all other similar nipples for each of the six reactor feed pumps. However, no documentation or evaluation of the magnitude of the vibration which cracked the fitting was completed; and no evaluation was performed of the vibration effects on adjacent components. An engineering evaluation was conducted in January 1989, and a subsequent modification was completed in 1990. However, the evaluation was considered to be inadequate because available original design basis information was not used to determine acceptable corrective actions (the modification). A review of event reports revealed that similar seal line cracking problems had been reported dating back to 1984.

The Condensate-Feedwater system is classified as a reliability related system, and is discussed in Section 11.3 of the FSAR. The piping for the feedpump seal cooling water system consisted of a flexible hose and 1/2" carbon steel piping. The repair of the vibration problem in 1990 involved replacing the carbon steel pipe with stainless steel tubing and retaining the flexible hose in the system. The inspector reviewed and discussed the original piping design requirements with the technical staff, and identified that the flexible hose was not considered in the original Sargent and Lundy design for the 1/2" pump seal cooling piping. In an evaluation of the length of the flexible hose and its proximity to the cracked nipple, the inspector surmised that the nipple cracking could be caused by high cycle fatigue resulting from excessive free end line vibration. The absence of cracking observed in the other feedpump seal water cooling lines could be attributed to higher material strength and ductility of the 1/2" piping, and a larger bend radius in the flexible tubing that could increase the line natural frequency and reduce the vibration magnitude and stresses at the pipe nipples.

C. 254-200-90-13700

On November 25, 1990, during testing, two sheared motor tie bolts were found on Core Spray valve 1-14-02-4A. The failure of the valve bolts was ascribed to system piping vibration and cavitation caused by a downstream flow restricting orifice. Current plans are to remove the orifice and install anti-cavitation trim into

the four affected valves during the next refueling outage. In the "Previous Events" section of the PIF, DVR 4-1-89-059 was listed as a similar failure. The inspector reviewed this DVR, and determined that the similar events listed were not similar. The DVR stated that 1B recirculation pump suction valve failure was caused by intergranular stress corrosion cracking separating the rotor ring from the motor rotor core, and not caused by system piping vibration and cavitation.

D. 254-200-92-06600

On June 17, 1992, the licensee found four of the eight motor tie bolts for valve MO-1-1001-36B on the RHR test return and torus cooling line were broken off. The 14" globe valve was designed to throttle flow during testing to achieve a 9000 gpm flow rate in accordance with the Technical Specification. The root cause of the failure was determined to be vibration induced fatigue. The valve will be replaced in March or September 1994. The inspector concurred with the evaluation and corrective actions. Under the "Previous Events" section of the PIF, DVR 4-1-89-059 was again listed as a similar failure similar to PIF 254-200-90-13700. This issue is discussed in inspection report item (50-254/265;94004-18b(2)(DRP)) and will be evaluated as part of the corrective action follow-up.

E. 254-201-93-055800 and -088900

On September 1, 1993, cavitation induced vibration was found on valves 1(2)-1001-5A/B, 1(2)-1001-28A/B, 1(2)-1001-29A/B, 1(2)-1001-34A/B, and 1(2)-1001-36A/B. The licensee's corrective actions, including the investigation of vibration problems, were prompted by NRC DET findings. The licensee performed operability analyses for Valves 34 and 36. These analyses were bounding for Valves 28 and 29, since these valves were physically connected. The licensee's operability analysis was largely based on valve internal parts and surface cavitation inspection, and evaluation of inspection results. Current monitoring efforts included periodic walkdowns to check for loosened bolts and nuts and the addition of a lock-tight device on tie nuts. For Valves 5A and 5B, the observed problem was cavitation with little or no component vibration. A corrective action violation was issued for the licensee's failure to take appropriate corrective actions for this concern. Licensee corrective actions for RHR valve vibrations will be reviewed during NRC follow-up inspections.

F. 254-201-93-057900 and 059200

On September 1, 1993, during vibration testing of the 1D Residual Heat Removal Service Water (RHRSW) pump, high vibration was encountered at support M-994D-585. Licensee followup identified one bowed support plate, and three base plates with gaps from 1/8"



to 1/4" at each of the remaining three RHRSW pumps. These defects were caused by misalignment of the pump and the motor after the pump overhaul. After the pumps were realigned and proper shimming of the support plate completed, vibration levels were within acceptable limits. This issue will be evaluated as part of inspection report item (50-254/265;94004-25b(DRP)).

G. 265-201-93-064500

On December 8, 1993, while using the condensate system recirculation valve 2-3499-2 to maintain condensate system flow, severe system vibration occurred. The valve appeared to be improperly sized. During interviews with cognizant personnel, the licensee stated that this particular valve line up was used only during plant startup and shutdown for approximately three to four hours duration. Vibration measurements and corrective actions to minimize system vibration were planned prior to plant shutdown and refueling outage in March 1994.

H. 254-201-93-089000

The licensee identified cavitation induced vibration across minimum flow valves 1(2)-1402-4A/B, and 38A/B in the Core Spray system. This PIF was initiated on October 23, 1993, to determine operability. The inspector reviewed a substantial amount of engineering data, and the operability analyses performed by licensee contractors, and had no adverse comments.

In general, the pump and valve vibration and cavitation corrective action program was considered acceptable. However, the program lacked certain elements, including the retrieval and evaluation of original design criteria when evaluating corrective actions and poor evaluation of past events to determine similarity to current events. As mentioned in the above paragraphs, failure to consider relaxant design information when determining corrective action to a design problem can result in the elimination or reduction of design margin. Also, the poor evaluation of past events may result in trending data that is not a true indicator of a system's performance, causing unnecessary or inappropriate corrective action. The inspector discussed these concerns during the management exit.

5.0 Exit Interview

The inspector met with the licensee representatives (denoted in Paragraph 1) at the conclusion of the inspection. The inspector summarized the purpose and findings of the inspection. The licensee representatives acknowledged this information. The inspector also discussed the likely informational content of the inspection report with regard to documents or processes reviewed during the inspection. The licensee representatives did not identify any such documents and processes as proprietary.