UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE INSERVICE TESTING PROGRAM RELIEF REQUESTS

COMMONWEALTH EDISON COMPANY

QUAD CITIES STATION, UNITS 1 AND 2

DOCKET NOS. 50-254 AND 50-265

1.0 INTRODUCTION

The Code of Federal Regulations, 10 CFR 50.55a(g), requires that inservice testing (IST) of certain ASME Code Class 1, 2, and 3 pumps and valves be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable addenda, except where specific written relief has been requested by the licensee and granted by the Commission pursuant to Subsections (a)(3)(i), (a)(3)(ii), or (g)(6)(i) of 10 CFR 50.55a. In requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance with certain requirements of the applicable Code edition and addenda is impractical for its facility.

These regulations authorize the Commission to grant relief from ASME Code requirements upon making the necessary findings. The NRC staff's findings with respect to granting or not granting the relief requested as part of the licensee's IST Program are contained in this Safety Evaluation (SE).

In Commonwealth Edison's July 2, 1990, submittal, Revision 3 of the Quad Cities Station Inservice Test (IST) Program was provided. Revision 3 incorporated NRC guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs." This submittal supplemented your response to GL 89-04 in letters dated October 2, 1989, and March 14, 1990. New relief requests were identified which were submitted for NRC review. In addition, several relief requests submitted prior to issuance of GL 89-04 (April 3, 1989) which did not conflict with positions covered by GL 89-04, Attachment 1, were included in the program submittal. Relief was granted by GL 89-04 for these relief requests as noted in Table 1. Relief requests that meet the guidance of GL 89-04, Attachment 1, are also listed in Table 1. Evaluations of the new relief requests are provided in this SE.

The NRC may conduct inspections to determine licensee conformance with the provisions of the approval granted by the GL and may inspect aspects of the IST program not addressed by GL 89-04.

2.0 DESCRIPTION AND DISCUSSION - PUMP RELIEF REQUESTS (RR)

2.1 Relief Request RP-00A

The licensee submitted this RR as one of three identified during their program review for GL 89-04. It is applicable to all Code Class 1, 2, and 3 pumps in the IST program. Relief from the requirements of IWP-4510, and Tables IWP-3100-1 and -2 relative to measuring vibration amplitude is requested. Alternatively, the licensee proposes to measure vibration velocity.

2.1.1 Alternative Testing

The licensee proposes that pump vibration measurements will be taken in vibration velocity (inches per second) if the pump speed is greater than or equal to 600 RPM. There are no safety-related centrifugal pumps that operate at speeds < 600 RPM at Quad Cities. Also, there are no safety-related vertical line shaft pumps at Quad Cities. The proposed allowable ranges of vibration velocity are as follows:

Pump Type	Acceptable Range	Alert Range	Required Action Range
Centrifugal with speed ≥ 600 RPM (except HPCI and RHRSW)	≤ 2.5 Vr	> 2.5 Vr and ≤ 6.0 Vr or > 0.325 ips	> 6.0 Vr or > 0.700 ips
Centrifugal with speed ≥ 600 RPM (HPCI and RHRSW)	≤ 1.5 Vr	> 1.5 Vr and ≤ 2.5 Vr	> 2.5 Vr
Reciprocating	≤ 2.5 Vr	> 2.5 Vr and ≤ 6.0 Vr	> 6.0 Vr
Gear	≤ 2.5 Vr	> 2.5 Vr and ≤ 6.0 Vr	> 6.0 Vr

Vr = vibration reference value
ips = inches per second

2.1.2 Licensee's Basis for Relief

The licensee states: "Low amplitude, high frequency vibration due to misalignment, imbalance, or bearing wear is difficult to detect via vibration amplitude measurements when pump speed is greater than or equal to 600 RPM. Vibration velocity measurements are much more sensitive to small changes that are indicative of developing mechanical problems. Vibration velocity is a far more informative reading because it accounts for both displacement and frequency range. A vibration monitoring program based on velocity is more comprehensive than that required by the Code.

The specific limits assigned to the HPCI and RHRSW pumps are based on extensive experience with these pumps and the inherent high vibration levels associated with pumps of this design. The HPCI pump impellers have been modified to reduce vibration levels (50%) yet absolute levels remain high. The elimination of absolute Alert Range (0.325 ips) and Required Action Range (0.700 ips) will be compensated for by reducing the multiplier for the Required Action Range from 6 to 2.5."

2.1.3 Evaluation

Vibration velocity has been recognized as an acceptable parameter for monitoring the condition of pumps and is generally considered equivalent (or better) to vibration amplitude as an indicator of pump performance. ASME Operations and Maintenance Standard, Part 6 (OM-6), 1988, "Inservice Testing of Pumps in Light-Water Reactor Power Plants," includes both vibration amplitude (displacement) and vibration velocity as alternate test parameters and provides limits for both. The NRC has endorsed the use of OM-6 as an acceptable alternative to IWP of Section XI for pump testing through approval of ASME Code Case N-465 in Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI Division," Revision 8, November 1990.

The licensee's proposed allowable ranges are consistent with OM-6 for centrifugal pumps with speeds ≥ 600 RPM (except HPCI and RHRSW) and reciprocating pumps. Gear pumps are not specifically categorized in OM-6; however, these positive displacement rotary-type pumps would most closely resemble reciprocating pumps. The proposed ranges for gear pumps, then, are consistent with OM-6. The licensee should comply with the other requirements of OM-6 for measuring vibration, including location and direction of the measurements (Section 4.6.4) and instrumentation (Section 4.6.1).

The licensee has assigned specific limits for HPCI and RHRSW pumps indicating these pumps experience inherent high vibration levels due to their design. Specific quantitative details on the vibration levels were provided by the licensee August 16, 1991. The data indicate all HPCI and RHRSW pumps would be operable within absolute limits of OM-6. (Alert: 0.325 ips and Required Action: 0.70 ips). Though several values indicate that an "Alert" absolute limit of 0.325 ips has been exceeded, only the U2HPCI pump appears to have an inherent problem that would consistently result in measurements above 0.325 ips.

In reviewing the basis for "Alert" and "Required Action" absolute limits established by the OM Committee in developing OM-6, the values of 0.325 ips for "Alert" and 0.700 ips for "Required Action" are consistent with industry standards such as Vibrametrics, ISO/VDI, IRD Mechanalysis (reference NUREG/CP-0111, "Proceedings of the Symposium on Inservice Testing of Pumps and Valves," planned session paper "Basis of the New Vibration Measurement Criteria and Requirements of Part 6"). The licensee has not provided adequate justification for elimination of the absolute

limits for HPCI and RHRSW pump vibration levels. However, the licensee may be able to justify assigning a higher "Alert" absolute limit for the U2HPCI pump if the higher levels being experienced can be shown to be acceptable for normal operation of the pump.

2.1.4 Conclusion

The licensee's proposed alternative testing meets OM-6 for vibration measurement limits, except for the proposed limits of the HPCI and RHRSW pumps. NRC has approved the use of OM-6 as an acceptable alternative to IWP of Section XI through ASME Code Case N-465. Therefore, the proposed testing provides an acceptable level of quality and safety and relief is granted pursuant to 10 CFR 50.55a(a)(3)(i) except for the proposed testing of the HPCI and RHRSW pumps. The licensee must also meet the requirements of OM-6, Section 4.6, related to vibration measurement and instrumentation.

Relief cannot be granted for the elimination of absolute limits for HPCI and RHRSW pumps. The absolute Alert and Required Action Range limits must be applied to the HPCI and RHRSW test results.

3.0 VALVE RELIEF REQUESTS (RR)

3.1 RELIEF REQUEST RV-00D

The licensee submitted this new RR identified during their program review for GL 89-04. RR RV-00D applies to all Category A and B power operated valves. Relief is requested from the requirements of IWV-3417(a) to compare valve stroke times to previous test results for determining corrective actions.

3.1.1 Alternative Testing

The licensee has proposed that Quad Cities Station will establish a reference value stroke time when the valve is known to be operating acceptably. When a reference value may have been affected by repair or routine servicing of the valve, a new reference value will be determined or the previous reference value will be reconfirmed. The test frequency will be increased to monthly if the measured full stroke time is in the Alert Range, and the valve will be declared inoperable if the measured full stroke time is in the Required Action Range. Specific acceptable, alert, and required action ranges, identified as multipliers of the established reference stroke time, for power operated valve stroke times for each type of valve actuator are identified in the RR. For main steam isolation valves (MSIVs), the acceptable range is per technical specifications, no alert range is defined, and the required action limiting value is the upper limit for operability stated in the technical specification.

3.1.2 Licensee's Basis for Relief

The licensee states: "The Code requirement for more frequent testing is based on a comparison between the current stroke time and the previous stroke time. This approach allows the threshold for more frequent testing to slowly creep up over time, if there are small changes between the current stroke time and the previous stroke time. A variable limit based on the previous stroke time is difficult to administer because the limit is not a permanent entry in the test procedure. Conversely, a fixed limit based on a reference value stroke time will yield a tighter band of acceptable stroke times and is easy to administer."

3.1.3 Evaluation

The NRC has indicated in GL 89-04, Position 6, that measuring changes in stroke times from a reference value as opposed to measuring changes from the previous test is an acceptable alternative. What is not specifically stated in the relief request is the method for establishing the maximum stroke time (limiting value for full-stroke) for valves other than MSIVs. However, the licensee has clarified the method in technical approach and position TV-00A which states the following:

"Maximum stroke times are established using multipliers and the reference stroke time value. For SOVs with Tr < 2s, Tmax = 2s. For MOVs with Tr < 10s, Tmax = 2.0Tr. For MOVs with Tr > 10s, Tmax = 1.75Tmax. For AOVs/HOVs, Tmax = 2.0Tr. In all cases, if the technical specification maximum stroke time is less than that calculated using the multipliers, the technical specification stroke time will apply."

The approach is consistent with guidelines in GL 89-04, Position 5, "Limiting Values of Full-Stroke Times for Power Operated Valves." For the main steam isolation valves (MSIVs), elimination of an alert range is acceptable in that a 2-second range of operability ($3 \leq t \leq 5$ seconds) as defined by technical specifications (TS) provides a narrow operational range with limiting values. With stroke times measured to the nearest second, an alert range for the MSIVs would extend beyond the operability limits. However, the licensee should add to Table 1 of the RR "Tfs < 3.0" for the lower limiting value of the required action range for the MSIVs with "Tfs > 5" for the upper limiting value. Additional information on MSIVs stroke times is provided in the licensee's technical approach and position TV-30C.

3.1.4 Conclusions

Because the relief request and proposed alternative testing are consistent with a position the NRC staff has previously indicated provides equivalent assurance of the operational readiness of power operated valves, and therefore, an acceptable level of quality and safety, relief is granted pursuant to 10 CFR 50.55a(a)(3)(i). The licensee is to assign limiting values of stroke times, as applicable, per their technical approach and position TV-00A, and assign a lower limiting value of 3 seconds and an upper limiting value of 5 seconds for MSIVs per TS requirements.

3.2 RELIEF REQUEST RV-00F

The licensee submitted this new RR identified during their program review for GL 89-04. A number of check valves are listed for which relief from the requirements of IWV-3521, "Test Frequency," and IWV-3522, "Exercising Procedure," is requested. The subject check valves are required to close to fulfill their safety function. The valves are identified in the IST Plan Valve Listing as follows:

Valve Number	Valve Function
Unit 1 Valves:	
1001-131	RHR - condensate makeup transfer line isolation
1001-136A	RHR - condensate makeup transfer line isolation
1001-136B	RHR - condensate makeup transfer line isolation
1402-071	Core spray - condensate makeup transfer line isolation
2301-020	HPCI to condensate storage tank backflow prevention
2301-052	HPCI gland seal/lube oil cooling pump backflow prevention
2301-076	HPCI gland seal condenser return pump backflow prevention
2301-108	HPCI ECCS fill system to HPCI backflow protection
2399-005	HPCI turbine exhaust vacuum breaker
2399-006	HPCI turbine exhaust vacuum breaker
2901-010	HPCI safe shutdown makeup to HPCI backflow protection
3999-085	LPSW - DG cooling water pump discharge check valve
3999-088	LPSW - DG cooling water pump discharge cross-tie check valve
5199-158	Diesel oil - excess fuel return backflow protection
Unit 1/2 Valves:	
5199-158-1/2	Diesel oil - excess fuel return backflow protection
Unit 2 Valves:	
1001-131	RHR - condensate makeup transfer line isolation
1001-136A	RHR - condensate makeup transfer line isolation
1001-136B	RHR - condensate makeup transfer line isolation
1402-070	Core spray - condensate makeup transfer line isolation
2301-020	HPCI to condensate storage tank backflow prevention
2301-051	HPCI gland seal/lube oil cooling pump backflow prevention
2301-076	HPCI gland seal condenser return pump backflow prevention
2301-108	HPCI ECCS fill system to HPCI backflow prevention
2399-005	HPCI turbine exhaust vacuum breaker
2399-006	HPCI turbine exhaust vacuum breaker
2901-010	HPCI safe shutdown makeup to HPCI backflow protection
3999-088	LPSW - DG cooling water pump discharge cross-tie check valve
5199-158	Diesel oil - excess fuel return backflow protection

3.2.1 Alternative Testing

The licensee proposes: "The operability of the subject check valves will be verified by disassembly. Due to the scope of this testing (specifically, the personnel hazards involved and system operating restrictions), disassembly and inspection will be performed during reactor refueling outages. Since it would be burdensome to disassemble and inspect all of the subject check valves during each refueling outage, a sample disassembly and inspection plan for groups of identical valves in similar applications will be employed.

Check valves will be disassembled to the extent necessary to assess the condition of the valve and to allow manual exercising of the disk. During the visual examination, full stroke capability will be verified. Any loose or corroded parts will be evaluated and appropriate corrective action will be taken, if required.

The population of check valves listed in this relief request has been broken down into sample groups that contain no more than four valves. All of the valves in a given sample group are of identical design (manufacturer, size, model number, and materials of construction) and have the same service conditions including valve orientation."

3.2.2 Licensee's Basis for Relief

The licensee states: "Quad Cities has conducted a detailed evaluation of the testability of each of the subject valves. We have concluded that there is no quantitative means of verifying that the subject check valves have been exercised to the closed position by either a reverse flow or "seat leakage" type test. A variety of pressure tests, vacuum tests, special system alignments, etc., were evaluated, and no conclusive test is possible."

3.2.3 Evaluation

The licensee is employing disassembly and inspection to verify check valve closure capability. The basis indicates that no quantitative means was identified to verify closure. Though there are cases which require quantitative means for verifying closure capability, these involve measurement of the leakage rates of valves. The relief request does not relate to leakage rate measurement.

The NRC encourages the use of non-intrusive methods for evaluating the position of check valve disks. The listing of valves covered by this relief request includes several where valve closure could possibly be verified by some means that is acceptable, such as non-intrusive methods, but not "quantitative" (reference GL 89-04, Position 3, "Backflow Testing of Check Valves," questions and answers in the 10/25/89 "Minutes of the Public Meetings on Generic Letter 89-04"). Disassembly and inspection for verifying the closed position of check valves is considered an acceptable option only when no other means is available.

Based on the possibility that other means, including non-intrusive techniques or monitoring of system parameters that are non-quantitative, exist to verify the valves are closed, relief cannot be granted on a long-term basis. However, because the licensee will be required to investigate other options, an interim period of time should be allowed for this effort. With current design and testing methods, it is impractical to verify the valves are closed. The alternative testing provides reasonable assurance of the operational readiness for the valves in the interim. Immediate imposition of the Code requirements is an undue burden on the licensee as it would result in declaring the valves inoperable and possibly require a plant shutdown until an alternative test method for each valve could be developed and implemented.

3.2.4 Conclusion

Based on (1) the impracticality of verifying valve closure with the current design configuration and testing methods, but the possibility of verification utilizing other test methods, (2) the burden on the licensee if Code requirements were immediately imposed, (3) the alternative testing providing reasonable assurance of the operational readiness of the valves for an interim period, and (4) consideration of the time involved in evaluating and implementing alternative test methods, interim relief for a period of one year or until the next refueling outage, whichever is later, is granted pursuant to 10 CFR 50.55a(g)(6)(i). In the interim, the licensee should determine a means of verifying valve closure other than employing a disassembly and inspection program. If no other means, including non-intrusive, can be utilized, specific relief for each individual valve, or group of similar valves, will be required describing the reasons why no other means are available.

4.0 ANOMALIES

1. RR RP-00A, Section 2.1: The licensee has not justified elimination of the vibration absolute limits for the HPCI and RHRSW pumps. The proposed limits for centrifugal pumps should be applied to these pumps as well. Additionally, the licensee should ensure that all of the elements of vibration monitoring in OM-6, 1988, are included in the Quad Cities program. A specific relief request addressing the U2HPCI pump could be submitted, if the licensee can justify that the vibration levels being experienced on this pump do not adversely affect operational readiness of the pump.

2. The licensee's basis for Relief Request (RR) RP-00C appears to utilize Article IWP-3210, "Allowable Ranges of Inservice Test Quantities," as an argument against establishing new reference values. It appears that RR RP-00C would allow the licensee to continue to rely on a pump which has demonstrated obvious degradation by performing an operability analysis and expanding the allowable ranges. This course of action is inconsistent with the intent of ASME Section XI which is to identify degradation of components in an effort to ensure

operational readiness of pumps and valves. Deviations detected are symptoms of changes and, depending upon the degree of deviation, indicate need for further tests or corrective action.

Expansion of the allowable ranges per IWP-3210 is to provide owners a means of addressing pumps with low ranges and narrow margins such that normal operation is demonstrated within acceptable, extended limits, not to allow expansion of the ranges to encompass deviations of mechanical or hydraulic performance identified during inservice testing. The need to establish new reference values following an operability analysis is to allow other requirements of IWP to be met within the new range of operating conditions which have been determined acceptable by the analysis. Reference values are fixed values for repeatability in performing inservice testing.

The licensee is cautioned in using RR RP-00C under the approval provisions of GL 89-04. If a degraded pump has demonstrated deviations within the required action range of Table IWP-3100-2, it is to be declared inoperative and not returned to service until the cause of the deviation has been determined and the condition corrected. If correction is by analysis, new reference values should be established in order to set new required action range values rather than expanding the required action range. To use less conservative ranges per IWP-3210, the Owner shall show that the overall pump performance has not degraded from its intended function (reference ASME Code interpretation XI-1-79-19). This would be difficult to demonstrate if a pump is already performing beyond required action limits. Reliance on RR RP-00C does not preclude the licensee from meeting the remaining requirements of IWP for inservice testing.

3. RR RV-00A: The licensee should ensure that the requirements of IWV-3426 and IWV-3427(a) for analysis of leakage rates and corrective action will continue to be met, as required by GL 89-04, Position 10.

4. RR RV-00D or Section 3.1: The licensee is to assign limiting values of stroke times, as applicable, per their technical approach and position TV-00A, and assign a lower limiting value of 3 seconds and an upper limiting value of 5 seconds for MSIVs per TS requirements.

5. RR RV-00E: The licensee should explicitly state that all valves within each grouping will be disassembled and inspected at least once every six years. Without this clarification, extension of the interval beyond six years must be justified. Additionally, the valves should be partial-stroke exercised quarterly, at cold shutdown, or following reassembly, if possible. The licensee is encouraged to pursue other positive means for verification of full stroking of these check valves, such as non-intrusive techniques.

6. RR RV-00F, Section 3.2: The licensee should determine a means of verifying valve closure other than employing a disassembly and inspection program. If no other means, including non-intrusive, can be utilized, specific relief for each individual valve, or group of similar valves, will be required describing the reasons why no other means are available.

7. RR RV-30B: The licensee indicates that the "as-found" setpoint testing done at the test facility is not necessarily representative of a valve's condition when it was installed in the plant. The 1980 Edition of Section XI with addenda through the 1980 Winter Addendum, the Code applicable to the current interval Quad Cities IST Program, requires safety and relief valve setpoints be tested in accordance with ASME PTC 25.3 - 1976. Section 3.09 of the PTC requires that no adjustment to the valve shall be made during the test.

   The TS requirements for testing these valves are written to ensure that at least one-half of the nine safety valves are properly set prior to startup from a refueling outage. The purpose of ASME Code, Section XI, inservice testing is to monitor the condition of pumps and valves to provide assurance of operational readiness of the components. One aspect of the inservice testing per IWV-3513 not covered by TS requirements is that when a degraded condition on one valve is identified, additional valves are tested to assess if other components could also be affected. Applying this relief could result in a situation where all of the tested valves fail with no further testing of the remaining valves. Reference NRC's Safety Evaluation on Dresden Nuclear Power Station, Units 2 and 3, Section 4.3.3, dated July 25, 1990.

8. Technical Approach and Position Summary TV-00C and TV-16A: These approaches relate to testing containment isolation valves or drywell/wetwell vacuum breakers in groups rather than individually. Generally, relief is required for test configurations which do not monitor valves individually. The licensee should consider submitting these positions as relief requests. If any valves in the groupings can be tested individually, the measured individual leakage rates should be subtracted from the leakage rate measured for the group.

9. Technical Approach and Position Summary TV-00F: For safety and relief valves, PTC-25.3-1976 (not PTC-25.2-1976) is to be utilized for testing per the 1980 Edition of Section XI. The requirements of Section 3.0, Guiding Principals, as well as the operational readiness testing requirements of Section 4.09 are to be met.

10. Test Frequency Abbreviations: The frequency for reactor refueling indicates that no duration in days is applicable because it does not have a repetitive duration. The licensee should determine a maximum duration for a "refueling" frequency such that if an extended shutdown occurs, inservice testing for a number of valves scheduled to be tested during refueling outages would be tested during the

extended shutdown, if possible. Generally, the maximum duration for a refueling frequency is based on the fuel cycle for a plant, up to 24 months. The frequency will impact the schedule for check valves included in the licensee's disassembly and inspection, which should be structured on a maximum schedule of 6 years unless an extreme hardship is justified, as described in GL 89-04, Position 2.