UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF RELIEF REQUESTS AND ACTION ITEM RESPONSES

FOR THE INSERVICE TESTING PROGRAM

FOR

IES UTILITIES INC.

CENTRAL IOWA POWER COOPERATIVE

CORN BELT POWER COOPERATIVE

DUANE ARNOLD ENERGY CENTER

DOCKET NO. 50-331

1.0 INTRODUCTION

The *Code of Federal Regulations*, 10 CFR 50.55a, 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 relief has been requested and granted or proposed alternatives have been authorized by the Commission pursuant to 10 CFR 50.55a(f)(6)(i), (a)(3)(i), or (a)(3)(ii). In order to obtain authorization or relief, the licensee must demonstrate that: (1) conformance is impractical for its facility; (2) the proposed alternative provides an acceptable level of quality and safety; or (3) compliance would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. NRC guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provided alternatives to the code requirements determined to be acceptable to the staff and authorized the use of the alternatives in Positions 1, 2, 6, 7, 9, and 10, provided the licensee follows the guidance delineated in the applicable position. When an alternative is proposed, which is in accordance with GL 89-04 guidance and is documented in the IST program, no further evaluation is required. However, implementation of the alternative is subject to NRC inspection.

Section 50.55a authorizes the Commission to grant relief from ASME Code requirements or to approve proposed alternatives upon making the necessary findings. The NRC staff's findings with respect to granting or not granting the relief requested or authorizing the proposed alternative as part of the licensee's IST program are contained in this safety evaluation (SE).

IES Utilities, in a letter dated November 21, 1996, submitted relief requests and responses to action items identified in an NRC SE dated November 21, 1995,

ENCLOSURE

9706040353 970529
PDR ADOCK 05000331
P PDR

for the Duane Arnold Energy Center IST program for pumps and valves. An evaluation of this submittal is provided below. The licensee's IST program covers the third 10-year IST interval from February 1, 1995, to January 31, 2005. The program was developed in accordance with the requirements of the 1989 Edition, Section XI, of the ASME Boiler and Pressure Vessel Code.

2.0 EVALUATION OF ACTION ITEM RESPONSES

This table lists a brief summary of each of the licensee's responses to the action items contained in the NRC's November 21, 1995, SE. The table also contains the most recent status of any relief request(s) associated with each action item.

Action Item	Relief Request	Description of Issue	Licensee Response	Current Status
5.1	PR-02 and PR-04	The licensee was requested to document the impracticality of setting the reference value to within ± 2 percent of the reference flow and was requested to proceduralize the ΔP calculation. This action item pertains to river water, core spray, HPCI, and RHR pumps.	The licensee has indicated that the ΔP calculation is in the procedure and stated that variation of ± 2 percent will introduce data scatter to the test results and require additional test personnel.	This item is resolved.
5.2	PR-04	The licensee was informed that justification must be provided for not running the HPCI pump for 2 minutes during testing.	This portion of the relief request regarding the 2-minute operation of the pump during testing has been deleted.	This item is resolved.
5.3	VR-02	The licensee was informed that a relief request is not required to perform remote position verification and leak-rate testing on a refueling outage frequency.	VR-02 has been deleted. Refueling justification RRJ-03 has been prepared that addresses the impracticality of exercise testing the valves quarterly and during cold shutdowns.	This item is resolved.

Action Item	Relief Request	Description of Issue	Licensee Response	Current Status
5.4	VR-04	The licensee was requested to evaluate whether the rupture disks in question are within the scope of the IST program.	The disks are outside the scope of the IST program and VR-04 has been withdrawn.	This item is resolved.
5.5	VR-23	The licensee was informed that additional basis is necessary before relief can be granted. This relief request pertains to stroke time measurement of emergency service water control valves.	The licensee proposed an alternative limiting value of 5 seconds, stating that the code required limiting value, corresponding to ± 50 percent change in stroke time, is not practical for stroke times of 2 to 2.5 seconds.	The licensee's response does not address in sufficient detail the burden or impracticality of complying with the code or address the adequacy of the alternative. This remains an open item.
5.6	VR-03	The licensee proposed to exercise the HPCI and RCIC to feedwater valves (V-14-001/3) when practical (i.e., when operating above 90 percent power and pressure instruments are available). The alternative was approved in accordance with GL 89-04, Position 1, with the condition that impracticality of quarterly testing is documented.	The licensee indicated that quarterly full-stroke testing is not practical below 90 percent reactor power because instrument inaccuracy results in an inconclusive flow determination.	The licensee has responded to NRC concerns. Deferred test justifications are subject to review during NRC inspections.
5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, and 5.15	These action items relate to cold shutdown justifications and refueling outage justifications for deferral of testing from quarterly during power operations to cold shutdowns or refueling outages. The ASME Code (OM-10 by reference) allows such deferrals when the testing is otherwise impractical. The licensee may, therefore, make such deferrals without NRC prior approval and remain in compliance with the code. Thus, the justifications are subject to NRC inspection, but are not further evaluated herein.			

Action Item	Relief Request	Description of Issue	Licensee Response	Current Status
5.14		The licensee should revise the program to indicate that the 25 percent extension is not applicable to valve testing performed under OM-1.	The IST program has been revised accordingly.	This item is resolved.
5.16	VR-07 and VR-08	The components in question are not ASME Code classified and staff approval is not required.	VR-07 and VR-08 have been deleted.	This item is resolved.
5.17		The IST program scope was reviewed for residual heat removal and service-water pumphouse systems. The licensee was requested to review scope-related areas of concern identified for the two systems and make changes to the IST program where appropriate.	The licensee has addressed the concern related to the IST program scope for the systems in question and has committed to develop deferral justification, as applicable, for check valves that are disassembled.	The licensee has responded to NRC concerns. The scope of the IST program is subject to NRC inspection.
5.18		The licensee was requested to ensure that the code classification is consistent with FSAR commitments.	The licensee stated that a thorough review of ISI boundaries was performed. As a result of this boundary review, PR-01 and VR-12 have been resubmitted for NRC review.	The licensee has responded to NRC concerns. The scope of the IST program is subject to NRC inspection.

3.0 RELIEF REQUEST PR-01

PR-01 requests relief from OM-6, paragraph 4.6.1.6, which requires that the frequency response range of the vibration measuring instruments shall be from one-third minimum pump shaft rotational speed to at least 1000 Hz. This request pertains to standby liquid control (SLC) pumps 1P-230 A&B. The licensee has proposed to use the existing vibration instrumentation which does not meet the minimum frequency response range requirements specified by the code.

3.1 Licensee's Basis For The Relief Request

The licensee stated the following:

The nominal shaft rotational speed of these pumps is 242 RPM, which is equivalent to approximately 4 Hz. Based on this frequency and Part 6, paragraph 4.6.1.6, the required frequency response range of instruments used for measuring pump vibration is 1.33 to 1000 Hz. Procurement and calibration of instrument to cover this range to the lower extreme (1.33 Hz) is impractical due to the limited number of vendors supplying such equipment and the level of sophistication and cost of the equipment.

These are of a simplified reciprocating (piston) positive displacement design with rolling element bearings, Model Number TD-60, manufactured by Union Pump Corporation. Union Pump Corporation has performed an evaluation of the pump design and has determined that there are no probable sub-synchronous failure modes associated with these pumps under normal operating conditions. Furthermore, there are no known failure mechanisms that would be revealed by vibration at frequencies below that related to shaft speed (4 Hz.); thus, no useful information is obtained below this frequency nor will indication of pump degradation be masked by instrumentation unable to collect data below this frequency.

The requirement to measure vibration with instruments, with response to one-third shaft rotational speed, stems from the need to detect oil whip or oil whirl associated with journal bearings. In the case of these pumps, there are no journal bearings to create these phenomena, thus satisfying the frequency response range criteria would serve no significant purpose. The significant modes of vibration with respect to equipment monitoring are as follows:

- 1-Times Crankshaft Speed - An increase in vibration at this frequency may be an indication of rubbing between a single crankshaft cheek and rod end, cavitation at a single valve, or coupling misalignment.

- 2-Times Crankshaft Speed - An increase in vibration at this frequency may be an indication of looseness at a single rod-bearing or crosshead pin, a loose valve seat in the fluid cylinder, a loose plunger/crosshead stub connection, or coupling misalignment.

- Other Multiples of Shaft Speed - An increase in vibration at other frequencies may be indications of cavitation at several valves, looseness at multiple locations, or bearing degradation.

Based on the foregoing discussion, it is clear that monitoring pump vibration within the frequency range 4 to 1000 Hz will provide adequate information for evaluating pump condition and ensuring continued reliability with respect to the pump's function. Compliance with the code requirement would result in a significant hardship and cost without any compensating increase in pump performance or plant safety.

3.2 Proposed Alternate Testing

The licensee proposed the following:

> Vibration levels of the standby liquid control pumps will be measured in accordance with the applicable portions of Part 6, paragraph 4.6 with the exception of the lower frequency response limit for the instrumentation (paragraph 4.6.1.6). In this case, the lower response limit of the vibration measuring equipment will be 4.03 Hz or less.

3.3 Evaluation

The standby liquid control pumps 1P-230 A&B have a safety function to provide liquid poison to the reactor vessel to shut down the reactor from a full-power condition, independent of any control rod motion, and maintain the reactor subcritical during cooldown. The code requires that the vibration instrumentation frequency response range used in quarterly testing be from one-third pump rotational speed (1.34 Hz for the SLC pumps at Duane Arnold) to 1000 Hz. Nominal running speed for these pumps is 242 rpm (4.03 Hz).

These pumps are positive displacement pumps with rolling element bearings. Pump-bearing degradation mechanisms with rolling elements are predominant at running speeds of 1 times pump rotational speed and greater. Degradation mechanisms at sub-synchronous speeds for the SLC pumps are limited to looseness, oil whip, and oil whirl that occur only in journal-bearing designs. Further, the pump vendor, Union Pump Corporation, has determined that there are no probable sub-synchronous failure modes associated with these pumps under normal operating conditions.

The licensee has proposed to use instruments with a range of 4.03 to 1000 Hz instead of the code required range of 1.34 to 1000 Hz. The proposed testing provides reasonable assurance of operational readiness because the faults associated with frequencies less than rotational speed involve journal bearings that are not part of the SLC pumps in question. Requiring the licensee to procure new instrumentation to meet the code requirements would be undue hardship since the instrumentation currently available would provide an accura e assessment of the SLC pump condition.

3.4 Conclusion

The proposed alternative to the code vibration instrument frequency response range requirements for the SLC pump vibration instrumentation is authorized pursuant to 10 CFR 50.55a(a)(3)(ii) based on the determination that compliance with the specified requirements results in a hardship without a compensating increase in the level of quality and safety.

4.0 RELIEF REQUEST PR-008

PR-008 requests relief from OM-6, paragraph 4.6.1.2(a), which states that the full-scale range of each analog instrument shall not be greater than 3 times the reference value. This request pertains to discharge pressure for the river water pumps 1P-117A to D. The licensee has proposed to follow an

alternative specified in NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," Section 5.5.1, which states that the staff will grant relief when the combination of the range and accuracy yields a reading at least equivalent to the reading achieved from instruments that meet the code requirements (i.e., up to ± 6 percent).

4.1 Licensee's Basis For The Relief Request

The licensee stated the following:

> The installed pump discharge pressure gauge (PI-2909A, B, C, D) for each river water supply pump has a 0-30 psig full-scale range. Surveillance tests performed per ASME Code are conducted at approximately 6250 gpm, with a corresponding pump discharge pressure of 5 to 9 psig. Attempts to permanently install gauges meeting the full-scale requirements have resulted in gauge damage due to over-ranging. This over-ranging is caused by higher discharge pressure observed during pump startup and system mode changes. Pump shutoff head is approximately 50 psid, which equates to a pump discharge pressure at the gauge location of 32 psig. The installed gauges are calibrated to 1 percent or better of full-scale. Currently, temporary test gauges meeting the OM Part 6 requirements are installed each time the pumps are tested. These 0-15 psig range gauges are then removed upon test completion. The use of a temporary test gauge is undesirable due to: 1) wear associated with the breaking and reassembly of mechanical connections; 2) the additional calibration requirements associated with unnecessary instrumentation; and 3) the additional manhours required to install and remove the test gauges.

4.2 Proposed Alternate Testing

The licensee proposed the following:

> Pump discharge pressure will be measured using installed instrumentation calibrated to 1 percent or better of full-scale, providing readings equivalent to code-specified instrumentation. NUREG-1482, Section 5.5.1, discusses the range and accuracy requirements of analog instruments. NUREG-1482 notes that instruments that meet the intent of the code requirement for actual readings yield an acceptable level of quality and safety for testing.

4.3 Evaluation

The licensee has proposed to use permanently installed analog pump discharge pressure instruments (PI-2909A, B, C, D) for river water pumps (1P-117A, B, C, D) that do not meet the range requirements of the code. The instrument accuracy and range requirements of OM-06, paragraph 4.6, are to ensure that test measurements are sufficiently sensitive to changes in pump condition to allow detection of degradation. OM-6, paragraph 4.6, states that: (1) accuracy for instruments used in the measurement of pressure shall be ± 2 percent; and (2) full-scale range of analog instruments shall be 3 times the reference value or less. A range of greater than 3 times the reference value

can be acceptable if the instrument is proportionately more accurate than required. As indicated in Section 5.5.1 of NUREG-1482, an alternative can be approved if the combination of range and accuracy yields a reading that meets ± 6 percent of reference value.

Pump discharge pressure will be measured using installed instrumentation calibrated to 1 percent or better of full-scale (± 0.3 psig on a full-scale of 0-30 psig) and with reference values between 5 to 9 psig. The licensee has proposed to follow NUREG-1482, Section 5.5.1, which states that the staff will grant relief when the combination of the range and accuracy yields a reading at least equivalent to the reading achieved from instruments that meet the code requirements. In this case, the combination of range and accuracy yields a reading that meets ± 6 percent of reference value. The licensee's proposed alterative, therefore, provides an acceptable level of quality and safety for testing.

4.4 Conclusion

The proposed alternative is authorized pursuant to 10 CFR 50.55a(a)(3)(i) based on a determination that the proposal provides an acceptable level of quality and safety.

5.0 RELIEF REQUEST VR-12

VR-12 requests relief from the exercise test frequency and the stroke time acceptance criteria requirements of OM-10, paragraphs 4.2.1.2 and 4.2.1.4(b), for solenoid-operated valves that provide containment isolation for the containment atmosphere monitoring system. The valves in question are SV-8101A/B, 8102A/B, 8103A/B, 8104A/B, 8105A/B, 8106A/B, 8107A/B, 8108A/B, 8109A/B, and 8110A/B. The licensee has proposed to exercise these valves quarterly by direct observation of flow initiation/cessation without measuring stroke time and perform stroke time measurement using non-intrusive techniques each operating cycle.

5.1 Licensee's Basis For The Relief Request

The licensee stated the following:

> These valves are not provided with individual remote position indicators. The valve stems of these solenoid-operated valves are enclosed, making local observation and stroke timing stem movement impractical. The advent of new technologies allows the application of non-intrusive test instrumentation to measure valve stroke time.
>
> This instrumentation is expensive and delicate. Though non-intrusive, collecting the requisite data is time consuming and, accordingly, impractical to perform during plant operation quarterly or during cold shutdowns. The reduced frequency of testing is offset by the quality of information gathered. Valve times can be measured in milliseconds and data are not influenced by human reaction time as typical for rapid-acting valves.

Relief is requested to perform the requisite testing on a cyclic basis, once per operating cycle. This allows for more effective outage planning, as anomalies in performance can be identified during an on-line test due to the enhanced quality of test data and appropriate corrective action or further testing planned.

5.2 Proposed Alternate Testing

The licensee proposed the following:

These valves will be exercised and their position locally verified every 3 months by direct observation of flow initiation/cessation through the valves. Stroke times will not be measured. Once per operating cycle, the stroke times of these valves will be measured utilizing non-intrusive test instrumentation. For IST purposes, the valves will be designated rapid-acting.

5.3 Evaluation

The code requires that Category A and B power-operated valves be stroke tested every 3 months. The code also requires that power-operated valves shall be stroke timed to at least the nearest second every 3 months. These valves are rapid acting and solenoid operated. Paragraph 4.2.1.8(e) states that valves which stroke in less than 2 seconds are exempt from the corrective action requirements of paragraphs 4.2.1.8(c) and 4.2.1.8(d). Also, GL 89-04, Position 6, allows licensees to establish limiting stroke times for rapid acting valves at 2 seconds.

The licensee has proposed to exercise this valve quarterly by direct observation of flow initiation/cessation through the valve, without recording stroke time, and to stroke time these valves once per operating cycle with non-intrusive test instrumentation. The licensee stated that the reason for not stroke timing the valves quarterly is that collecting data using non-intrusive instrumentation is time consuming.

NUREG/CR-6396, Section 2.1.3, and NUREG-1482, Section 4.2.8, provide guidance to assess degradation in solenoid-operated valves. Assigning reasonable, objective acceptance criteria to an observable parameter, such as flow rate or ΔP, is included as a potential method to assess degradation. However, the proposed alternative for the quarterly testing (i.e., "direct observation of flow initiation/cessation through the valve") would not be considered acceptable without establishing reference values and acceptance criteria. Verifying, for example, that flow rates change from full-flow to zero and from zero to full-flow within 2 seconds would be an acceptable means of stroke timing and testing, provided a reference value is assigned for full-flow consistent with the design bases of the system and the valve. In this example, failure or significant degradation of the valve would be indicated by exceeding the limiting stroke time of 2 seconds for flow cessation (full-flow to zero) or initiation (zero to full-low). The licensee should provide justification if the guidance of NUREG/CR-6396 and NUREG-1482 is impractical or would result in hardship without a compensating increase in the level of quality and safety.

It is not evident, based on the information presented, that the licensee has considered the guidance of NUREG/CR-6396 with regard to assigning reasonable, objective acceptance criteria to an observable parameter, such as flow rate or ΔP, to assess degradation. Therefore, long-term relief cannot be granted. An interim relief would provide the time necessary for the licensee to address this issue. Immediate compliance would be an undue burden since the proposed alternative testing should provide a reasonable assurance of operational readiness during the interim.

5.4 Conclusion

Interim relief is granted by authorizing the proposed alternative to the code power-operated valve stroke timing and testing requirements for the containment atmosphere monitoring system containment isolation valves pursuant to 10 CFR 50.55a(a)(3)(ii) based on the determination that immediate compliance with the specified requirements results in a hardship without a compensating increase in the level of quality and safety. The alternative is authorized for an interim period of 120 days from the date of this SE to allow the licensee time to incorporate applicable guidance provided in NUREG/CR-6396 and NUREG-1482 or to justify alternatives.

6.0 CONCLUSION

Relief request PR-01 is authorized pursuant to 10 CFR 50.55a(a)(3)(ii).
Relief request PR-008 is authorized pursuant to 10 CFR 50.55a(a)(3)(i).
Relief request VR-12 is authorized pursuant to 10 CFR 50.55a(3)(3)(ii) for an interim period of 120 days from the date of this SE to allow the licensee time to incorporate applicable guidance provided in NUREG/CR-6396 and NUREG-1482 or to justify alternatives.

Action Item 5.5, which concerns relief request VR-23, remains an open item. For this action item, the licensee must address in sufficient detail: (1) the burden of complying with the applicable code requirements and the adequacy of the alternative; or (2) the impracticality of complying with the requirements. The licensee must take action within 60 days from the date of this SE to comply with Action Item 5.5 or meet applicable code requirements.

Principal Contributor: K. Dempsey

Date: May 29, 1997