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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

INSERVICE TESTING PROGRAM (REV. 17 & 13) RELIEF REQUESTS

DUKE POWER COMPANY

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

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).

Duke Power Company's December 2, 1991 submittal of Revision 17 (Unit 1) and Revision 13 (Unit 2) to the McGuire Nuclear Station Inservice Test (IST) Programs contained modified or new relief requests that required NRC review and approval. This SE provides review of three relief requests in the December 2, 1991, submittal not previously evaluated, and also provides the further NRC determination on Relief Requests I.3(B) and I.4(C)/(B),(D)/(E),(E)/(D) relating to pump testing, as discussed in NRC's SE to Duke Power Company dated September 12, 1991.

2.0 EVALUATION OF RELIEF REQUESTS

Attachment 1 of the December 2, 1991, submittal provided a summary of the revisions to the McGuire Nuclear Station IST Programs. Relief Requests F(E), RR-SA1, IV, RR-NS-3, and RR-CA-1 are included in Attachment 1 as modified or new. An evaluation for RR-CA-1 and RR-NS-3 was performed on an exigent schedule as requested by the submittal (reference NRC SE dated January 13, 1992). Evaluation of the remaining relief requests, as well as Relief Requests I.3(B) and I.4(C - E)/(B - D), follows.

2.1 Relief Request F (Unit 1) and E (Unit 2)

This relief request relates to testing of the diesel generator room sump pumps and is applicable to both units. The licensee had identified modifications to the test loop for these pumps which will include direct flow indication and throttling capability to set either differential pressure or flow. In the previous revision of this relief request, the scheduled completion of the modifications was "by the 1992 refueling outages." The current revision modifies this completion schedule to state that "the modifications will be installed by the end of 1992."

The NRC SE issued to Duke Power Company on January 16, 1991, granted interim approval for Relief Request F(E) for a period of one year or until the next refueling outage, whichever is (was) greater. The interim testing during this period is performing full flow testing using a recirculation loop back to the sump. The licensee has not indicated the basis for the extended period noted in the relief request revision; therefore, interim relief cannot be extended. The licensee should submit a modification schedule with the basis for the extended period.

2.2 Relief Request RR-SA1

This relief request is applicable to check valves 1SA-5 (2SA-5) and 1SA-6 (2SA-6). These valves function in the steam supply to the auxiliary feedwater pump turbine, opening to supply steam and closing to prevent cross connecting steam generators 1B and 1C. The licensee requests relief from the frequency requirements of IWV-3521 for verifying that the valve prevents reversal of flow quarterly, and, alternatively, proposes to disassemble and inspect the valves during refueling outages.

2.2.1 Alternative Testing

The licensee proposes the following: "At least one of the two valves will be disassembled and inspected (verified to close) during each refueling. Both valves will have been disassembled and inspected after two consecutive refueling outages. Failure of one valve to function properly during a refueling outage will result in the remaining valve being disassembled and inspected during that outage."

2.2.2 Licensee's Basis for Relief

The licensee states: "System configuration and design do not provide a suitable means to prove the valve prevents reversal of flow. To check this valve on line would risk personnel safety since high energy steam would be involved."

2.2.3 Evaluation

The relief request is for verifying the closure function of the valves. However, the testing identified in the valve table included in the inservice

testing program document is unclear. The test requirements listed are "MTO, C-Q" with no reference to a relief request. A cold shutdown justification is referenced which may no longer be applicable.

This relief request was previously deleted in Revision 14 and has not been included in previous NRC Safety Evaluations. The licensee indicates in Attachment 1 of the December 2, 1991, submittal that the method of quarterly testing these valves did not verify proper closure, that the valves were never taken out of the sample disassembly program, and that the open verification tests were not changed. The 1SA-5 valve had been inspected during refueling outage EOC7, identifying a cracked seat, and was replaced. Because the method of testing identified in Revision 14 would not have indicated a cracked seat, modifications to the piping system have been written. While inservice testing for closure may identify a cracked seat, this degraded condition would more likely be identified by a leakage test. The licensee has not identified that these valves have a specified leakage limit. Disassembly and inspection can be used as an alternative test for verifying closure, but only if no other means exists. Nonintrusive methods have been developed which can be utilized to verify disc position. While it appears that the licensee attempted a test method, it was inadequate in assuring that the valves closed. With the current design and system configuration, reverse closure testing is impractical. The modifications discussed in the December 2, 1991, submittal should provide a test method to verify closure. When these modifications are complete, the licensee should discontinue the use of disassembly and inspection for the closure inservice testing of these valves and consider that this be a part of their preventative maintenance program with the frequency established based on the history of the valves and the inservice test results obtained.

No schedule was provided for the modifications. Until these are complete, the valves should be included in the disassembly and inspection program. The licensee should actively pursue the use of nonintrusive methods rather than utilizing disassembly and inspection for verifying disc closure. The program and maintenance procedures should comply with the guidelines in Generic Letter (GL) 89-04, Attachment 1, Position 2, including a full- or partial-stroke test following reassembly. The implementation of the disassembly and inspection is subject to NRC inspection.

To require the licensee to meet the test frequency requirements of IWV-3521 would be a considerable burden in that the system would have to be taken out-of-service, possibly resulting in a required plant shutdown, to isolate the valves for disassembly and inspection. The guidelines in GL 89-04, Attachment 1, Position 2, provide for a sampling program with valves grouped such that at least one valve in the group is inspected each refueling outage, with each valve being disassembled and inspected at least every 6 years. If degradation is evidenced, the remaining valves in the group are to be inspected during the same refueling outage. The licensee's proposed frequency is in accordance with this guidance. Therefore, the alternative provides an acceptable level of assurance of the operational readiness of the valves.

2.2.4 Conclusions

Relief from the test frequency requirements of IWV-3521 is granted for valves 1SA-5, 1SA-6, 2SA-5, and 2SA-6 pursuant to 10 CFR 50.55a(g)(6)(i) based on (1) the impracticality of meeting the Code required frequency, (2) the burden on the licensee if the requirements were imposed, and (3) the alternative testing providing an acceptable level of assurance of operational readiness of the valves, provided the disassembly and inspection program is in accordance with the guidelines in NRC GL 89-04, Attachment 1, Position 2. When system modifications provide a means to verify closure of these valves, this relief request will no longer be applicable and should be deleted.

2.3 General Relief Request IV

The licensee has requested relief from performing stroke time testing and trend analysis in both directions for Category A and B valves as required by IWV-3413 and IWV-3417.

2.3.1 Alternative Testing

The licensee proposes: "For EMO (electric-motor-operated) valves which do not receive an automatic signal or have a Design Bases stroke time in one or both directions of operation, proper valve movement will be tested at a frequency in accordance with IWV-3412(a) and IWV-3416."

2.3.2 Licensee's Basis for Relief

The licensee states: "For electric motor operated valves which do not receive an automatic signal to move to either the open or closed position or both, but rely on operator action to move, full stroke time testing and trending in the direction of non-automatic operation will not be performed. Since there is no design basis stroke times for valves of this type, applying a limiting time and trending of stroke times may result in unnecessary maintenance."

2.3.3 Evaluation

ASME Section XI, IWV-3412, requires valves to be exercised to the position required to fulfill their function. The intent of measuring stroke times and trending the results is to identify degradation. The licensee indicated that the subject valves have a safety function to change positions, though there may be no safety actuation in one direction of operation. Performing a stroke of the valves does not allow for monitoring degradation, only verifying that the valve operates in that direction. It is the NRC's position that valve stroke time be measured and trended for each direction the valve is required to operate to fulfill a safety function. The NRC has provided guidance on establishing the limiting stroke time for valves in GL 89-04, Attachment 1, Position 5, "Limiting Values of Full-Stroke Times for Power Operated Valves." Further information on stroke time measurements, which includes guidance when the limiting values are exceeded, is provided in response to Question 34 of the "Minutes of the Public Meetings on Generic Letter 89-04." Using this guidance should preclude performing unnecessary maintenance. The licensee has provided no basis for granting relief.

2.3.4 Conclusions

Relief is denied for not measuring and trending the stroke time of valves in a direction of operation for which the valves have a safety function. The licensee's proposed alternative testing provides no means of monitoring the valves for degrading conditions.

2.4 Relief Request I.3(B)

In the January 16, 1991, NRC SE, relief from measuring pump vibration amplitude was granted with the accepted alternate method of testing being to measure vibration velocity in accordance with ANSI/ASME OM-6. A revised relief request was submitted in the licensee's April 8, 1991, letter responding to the NRC SE anomalies. In the September 12, 1991, NRC SE, an interim relief was granted to allow time for NRC review of the licensee's proposed alternatives to OM-6 vibration monitoring.

2.4.1 Alternative Testing

The licensee proposes: "In lieu of the vibration requirements of IWP-3100 and IWP-3300, peak vibration velocity will be measured. In most cases, vibration velocity gives the best indication of machine mechanical condition.

"In lieu of IWP-4520(b), vibration instrumentation will be calibrated and vibration velocity will be measured over a range of 10 to 1000 Hz. This is the range that the state-of-the-art instrumentation used can be adequately calibrated over. In lieu of IWP-4250(b), vibration velocity will be measured over a range from 1/3 minimum pump shaft rotational speed to 1000 Hz. Measurements at other frequencies will be taken as necessary. This range will encompass most potential noise contributors. In lieu of the vibration instrument accuracy requirements of IWP-4100, the loop accuracy of vibration instruments will be +/- 6.56% of reading. This accuracy will be used because IWP does not specify an accuracy for vibration velocity. This accuracy is the best that can be reasonabl[y] obtained from the state-of-the-art instrumentation used. The requirements of IWP allow vibration inaccuracies of greater than +/- 15% of reading.

"In lieu of the range requirements imposed on vibration instrumentation by IWP-4120, there will be no vibration instrumentation range requirement (digital vibration instrumentation is auto-ranging). It is not necessary to have a range requirement because the accuracies stated above the readability of a digital gauge are not dependent upon instrument range.

"In lieu of the vibration ranges specified in IWP-3210, the following ranges shall be used. These ranges shall be used because IWP does not specify ranges for vibration velocity. These ranges are based on current vibration standards (vibration severity charts).

Range	Acceptable Range	Alert Range	Required Action
For All Pumps Vr <0.075 in/sec.	0 to 0.19 in/sec	>0.19 to 0.45 in/sec	>0.45in/sec
For Centrifugal Pumps When Vr >0.075 in/sec	<2.5Vr	>2.5Vr to 6Vr or >0.325 to 0.70 in/sec	>6Vr or >0.70 in/sec
For Reciprocating Pumps When Vr >0.075 in/sec	2.5Vr	<2.5Vr to 6Vr	>6Vr
For Internal Gear Positive Displacement Pumps When Vr >0.075 in/sec	<2.5Vr	>2.5Vr to 6Vr	>6Vr

In lieu of IWP-4510, peak vibration velocity measurements shall be taken during each test.

- On centrifugal and internal gear PD pumps, measurements shall be taken in a plane approximately perpendicular to the rotating shaft in two orthogonal directions. These measurements shall be taken on each accessible pump bearing housing. If no pump bearing housings are accessible, these measurements shall be taken at the accessible location that gives the best indication of lateral pump vibration. This location shall be one of the following:

Pump casing
Motor bearing housing

Measurements also shall be taken in the axial direction. This measurement shall be taken on each accessible pump thrust bearing housing. If no pump thrust bearing housings are accessible, this measurement shall be taken at the accessible location that gives the best indication of axial pump vibration. This location shall be one of the following:

Pump casing
Motor thrust bearing housing
Motor casing

- On reciprocating pumps, a measurement shall be taken on the bearing housing of the crankshaft, approximately perpendicular to both the crankshaft and the line of plunger travel."

2.4.2 Licensee's Basis for Relief

The licensee states: "Experience has shown that measuring vibration as required by IWP is not the most effective way to determine the mechanical condition of a pump. In order to better determine the mechanical condition of

[illegible] multiple vibration velocity measurements will be obtained/evaluated and supplemented, when necessary, with acceleration, displacement measurements and spectral analysis. In order to facilitate this testing, digital vibration instrumentation will be used. IWP does not provide adequate guidance/requirements for performing the better/alternate testing."

[illegible] also provided "Additional Information" on the vibration [illegible] program as Attachment 1 to their April 8, 1991, submittal.

[illegible]on

[illegible] has requested relief from the requirements of Section XI, [illegible]section IWP, pertaining to measurement of pump vibration amplitude and proposed alternative test to measure pump vibration peak velocity. The purpose of the pump vibration assessment is to assure operability, detect degradation and effect repairs prior to the onset of conditions leading to pump inoperability. The proposed alternative to measure and monitor vibration velocity is an industry-accepted method that provides a comprehensive and effective technique of assessing pump condition and early indications of degradation.

The advantages of measuring and monitoring vibration velocity, for assessing pump condition, are widely acknowledged in the industry codes and standards community. The ASME/ANSI OM-6 Standard, "Inservice Testing of Pumps in Light-Water Reactor Power Plants," includes this method of vibrational monitoring for inservice pump testing. This standard has been incorporated in ASME OM Code 1990, "Code for Operation and Maintenance of Nuclear Power Plants." Further, Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability ASME Section XI Division I," approved the use of Code Case N-465 which states ASME/ANSI OM Part 6 may be used for pump testing in lieu of Subsection IWP. The licensee's alternative testing reflects the pertinent requirements of ASME/ANSI OM Part 6 except for (1) the proposed inclusion of limits for the very smooth operating pumps, (2) calibration of instrumentation over a range of 10 to 1000 Hz, (3) vibration measurement points, and (4) the use of instrumentation that does not meet the +5% accuracy requirement.

(1) Although the licensee's proposed assigned absolute vibration velocity limits for very smooth operating pumps are not specifically defined in OM-6, the limits were established, in part, based on OM-6 acceptance criteria and are prescribed by one restrictive "Alert and Required Action Ranges."

(2) The vibration instrumentation calibration frequency response range is from 1/3 minimum pump speed to at least 1000 Hz. The Nuclear Service Water Pumps and the Diesel Generator Fuel Oil Transfer Pumps operate at 1185 rpm (6.58 Hz) and 1745 rpm (9.69 Hz). Therefore, only one group of pumps will be monitored significantly below the calibrated range of the instruments. However, the licensee indicates that the instruments are repeatable in this range and the instrument manufacturers specify that the accuracy statements are valid over this range under certain conditions. To require the licensee to purchase instrumentation, which can be calibrated in the range from 1 Hz to 10 Hz, would be a burden

without a compensating increase in the quality of the vibration monitoring program at this time. Future developments may make the expense of these instruments and the calibration such that the licensee can incorporate their use at a later time.

(3) The vibration measurements points allow flexibility from the required points in OM-6. In cases where bearing housings are not accessible, the relief request provides for vibration to be measured at accessible specified locations that give the best indication of pump vibration. The relief request also incorporates measurement points for internal gear positive displacement pumps which are not addressed by OM-6.

(4) The licensee notes that the +6.56% of "reading" accuracy of the instruments in the program is, in most cases, more accurate than the IWP requirement. The IWP accuracy requires +5% of "Full scale" and allows the full scale range to be three times the reference value. Therefore, IWP could allow an accuracy of +15% of "reading" at the reference value. A comparison cannot be made with the +5% OM-6 requirement since it is not specified as relative to "reading" or "full scale." The licensee's accuracy comparison with IWP requirements has merit. OM-6 and Section XI Code Case N-472, "Use of Digital Readout and Digital Measurement Devices for Performing Pump Vibration Testing," specify that the +5% accuracy applies over the calibrated range for digital instruments. Therefore, the proposed instrument accuracy is outside the required accuracy by +1.56% Further, considering the minor impact of +1.56% error on the specified "Alert" and "Required Action" ranges, it would be a burden without a compensating increase in the quality of the vibration measurements to require the licensee to replace the instruments at this time with other instruments that may meet +5% requirement. However, the licensee should consider instrument accuracy in the analyses and evaluations of the pump vibration monitoring test data.

2.4.4 Conclusions

Relief is granted for the licensee to implement the vibration monitoring as described in the relief request, pursuant to 10 CFR 50.55a(a)(3)(i) and 10 CFR 50.55a(a)(3)(ii) based on (1) the proposed alternative vibration monitoring program providing an acceptable level of quality and safety, and (2) imposition of the Code requirements would result in an undue burden on the licensee without a compensating increase in the level of quality and safety.

2.5 Relief Request I.4(C)/(B), I.4(D)/(E), I.4(F)/(D)

These relief requests apply to the safety injection, residual heat removal, and centrifugal charging pumps. Relief has been granted for performing quarterly testing utilizing minimum flow recirculation lines with full or substantial flow testing at cold shutdown (residual heat removal pumps) or refueling outages. In the NRC's SE issued September 12, 1991, the revisions that were made to these relief requests to address the previous SE/TER anomalies (measure and trend at least pump differential pressure and vibration during the quarterly testing) were indicated as acceptable. The NRC noted that furtner review of the relief request revisions, indicating that pump

that further review of the relief request revisions, indicating that pump curves may be used for pump testing during refueling outages, may result in questions. The use of pump curves is acceptable if the testing incorporates the following elements which will be subject to NRC inspection:

(1) Curves are developed, or manufacturer's pump curves are validated, when the pumps are known to be operating acceptably.

(2) Curves are based on an adequate number of points, with a minimum of three.

(3) Points are beyond the flat portion of the curves in a range which includes, or is as close as practicable, to design basis flows.

(4) Acceptance criteria, based on the curves, does not conflict with Technical Specifications or Facility Safety Analysis Report operability criteria, for flow rate and differential pressure, for the affected pumps.

(5) If vibration levels vary significantly over the range of pump conditions, a method for assigning vibration acceptance criteria should be developed for regions of the pump curve.

The licensee should factor these elements into their program and procedures for developing and utilizing the pump curves.

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