



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO THE INSERVICE TESTING PROGRAM AND REQUEST FOR RELIEF
VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2

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 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. Section 50.55a ¶ (f)(4)(iv) provides that inservice tests of pumps and valves may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in ¶ (b) of § 50.55a, subject to the limitations and modifications listed, and subject to Commission approval. 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 follow 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).

In rulemaking to 10 CFR 50.55a effective September 8, 1992, (see 57 Federal Register 34666), the 1989 edition of ASME Section XI was incorporated in ¶ (b) of § 50.55a. The 1989 edition provides that the rules for IST of pumps and valves shall meet the requirements set forth in ASME Operations and Maintenance Standards Part 6 (OM-6), *Inservice Testing of Pumps in Light-Water Reactor Power Plants*, and Part 10 (OM-10), *Inservice Testing of Valves in Light-Water Reactor Power Plants*. Pursuant to (f)(4)(iv), portions of editions or addenda may be used provided that all related requirements of the

respective editions or addenda are met, and subject to Commission approval. Because the alternatives meet later editions of the Code, relief is not required for those inservice tests that are conducted in accordance with OM-6 and OM-10, or portions thereof, provided all related requirements are met. Whether all related requirements are met is subject to NRC inspection.

This SE covers relief requests P-1 and P-11 as described in Virginia Electric and Power Company's letter dated June 29, 1993, and the additional information on the details of modifying a portion of the reference pump curve submitted on August 19, 1993. The licensee's IST program is based on the requirements of Section XI of the ASME Boiler and Pressure Vessel Code, 1980 Edition through the Winter of 1980 Addenda. The relief requests evaluated in this SE are included in the second 10-year IST interval for the Surry Power Station Units 1 and 2. The interval for both Units 1 and 2 has been extended to end on May 10, 1994.

2.0 RELIEF REQUEST P-1

The licensee has requested relief from the bearing temperature and vibration amplitude measurement requirements of Section XI, Paragraphs IWP-4300 and IWP-4500.

2.1 BASIS FOR RELIEF

The licensee states: "Pump vibration and bearing temperature measurements are used to detect changes in the mechanical characteristics of a pump. Regular testing should detect developing problems, thus repairs can be initiated prior to a pump becoming inoperable. The ASME Section XI minimum standards require measurements of the vibration amplitude displacement in mils every three months and bearing temperature once per year.

Our proposed program is based on vibration readings in velocity units, rather than vibration amplitude in mils displacement. This technique is an industry accepted method which is more sensitive to small changes that are indicative of developing mechanical problems and hence more meaningful. Velocity measurements detect not only high amplitude vibrations that indicate a major mechanical problem, but also the equally harmful low amplitude high frequency vibrations due to misalignment in balance, or bearing wear that usually go[es] undetected by simple displacement measurements.

In addition, these readings go far beyond the capabilities of a bearing temperature monitoring program. A bearing will be seriously degraded prior to the detection of increased heat at the bearing housing. Quarterly vibration velocity readings should achieve a much higher probability of detecting developing problems than the once per year reading of bearing temperatures.

Bearing temperature tests present problems which include the following:

1. Certain systems have no recirculation test loops and a limited source of water. An enforced thirty minute run time would deplete the source.
2. The lubrication fluid for some pumps is taken from the process water, which can change temperature depending on ambient conditions. Data trending for these cases is not meaningful.

Therefore, the detection of possible bearing failure by a yearly temperature measurement is extremely unlikely. The small probability of detection of a bearing failure by temperature measurement does not justify the additional pump operating time required to obtain the measurements. In addition, it is impractical to measure bearing temperatures on many pumps."

The licensee's letter dated June 29, 1993, which provided the background for Relief Request P-1, states: "Relief Request P-1 (attached) contains a note that establishes a minimum of 0.05 in/sec for vibration velocity reference values. In the SER [Safety Evaluation Report] dated August 27, 1990, the NRC evaluation states that this issue is being considered by the ASME O&M Working Group on Pumps. It is expected that, within two or three years, a permanent change will be made to OM-6 to address this issue. Therefore, the proposed alternative may be used for a period of three years. Before the end of this period, this relief request must be modified to reflect the code changes on this issue or be withdrawn. The issue of using minimum velocity reference value is still active with the O&M working group. However, a permanent change to OM-6 is not expected in the near future. Therefore, Surry Power Station requests an extension on the use of a minimum reference value for a period of three years beyond August 1993 or until OM-6 is changed, whichever occurs sooner."

2.2 ALTERNATIVE TEST

The licensee proposes, "Pump vibration measurements will be taken in vibration velocity (in/sec). The evaluation of the readings will be per the attached table. The ranges of test parameters given in the attached table were taken from ANSI/ASME OM (Part 6), An American National Standard In-Service Testing of Pumps."

2.3 Evaluation

The licensee's submittal requests relief from the bearing temperature and vibration amplitude measurement requirements of Section XI, Paragraphs IWP-4300 and IWP-4500 and proposes to use a vibration measuring program based on velocity measurements with a minimum reference value of 0.05 in/sec.

For pumps that do not have installed bearing temperature instrumentation, equipment modifications required to install temperature sensing instruments would be burdensome. Temperatures measured on the bearing housing are affected by the temperature and flow configuration of the coolant being

pumped, the environment surrounding the point of measurement and lubricant thermal characteristics. It may not be practical to duplicate all of these conditions during repeat testing. Further, pumps tested with limited system fluid inventory make it impractical to run the pump for a sufficient duration to stabilize bearing temperatures. Additionally, the later edition of the Code eliminates the requirement to measure bearing temperature.

The purpose of pump inservice testing is to monitor for degradation and initiate effective maintenance to terminate the conditions leading to pump inoperability. The proposed alternative test program to measure and monitor pump vibration velocity is an industry accepted practice of assessing pump condition and enables the licensee to identify indications of degradation. The advantages of measuring and monitoring vibration velocity are widely acknowledged in the industry and Codes and standards community. The requirements for inservice pump testing using vibration velocity are included in the ASME/ANSI OMa-1988 Part 6 Standard titled, "Inservice Testing of Pumps in Light-Water Reactor Power Plants." The licensee proposes to take pump vibration measurements and evaluate the deviations from the reference values with the limits provided in Table 3, "Ranges for Test Parameters provided in OM-6." The licensee proposes to use a 0.05 in/sec minimum vibration velocity reference value for smooth running pumps.

Based on the incorporation of the 1989 Edition of Section XI in 10 CFR 50.55a (b), the licensee may implement the requirements of OM-6 pursuant to 10 CFR 50.55a (f)(4)(iv) provided all the related requirements are met. The NRC has determined that licensees may implement the vibration monitoring requirements of OM-6 per paragraph (f)(4)(iv). Related requirements for vibration measurements in OM-6 include Paragraphs 4.6.1, 4.6.4, 5.1, 5.2 and 6.1. Whether all related requirements are met is subject to NRC inspection. The current approved revision of OM-6 does not address the use of a minimum vibration velocity reference value. The issue is still under consideration by the ASME O&M Committees.

The licensee's existing program includes the 0.05 in/sec minimum vibration velocity reference value. The licensee used this minimum reference value over the past 3 years under an interim relief request approval granted in a previous NRC SE. Because the interim period has expired, the licensee requests an extension of the approval of the relief request for another 3 years or until the ASME O&M Code Committees address the issue. The minimum vibration velocity reference value proposed by the licensee represents the lower limit of responses reported for new and smooth running equipment. Vibrational responses from the type of pumps encountered in nuclear plant applications are not expected, as reported in the industry published literature, to be measured in the range below the proposed minimum reference value. The licensee has not reported any pump problems attributable to the minimum reference velocity during its use over the past 3 years and requests continued use of the 0.05 in/sec value. The ASME O&M Code Committee Task

Group on Pump Vibration is considering establishing a minimum reference value of 0.1 in/sec. The licensee's proposal to continue the use of the 0.05 in/sec vibration velocity reference value for an interim period until the ASME O&M Committee changes OM-6 provides an acceptable level of quality and safety.

2.4 CONCLUSION

Based on the review of the licensee's request for relief from the requirements of Section XI for measuring bearing temperature and vibration amplitude and the proposed alternative to use a vibration monitoring program based on ASME O&M Standard Part 6, the staff concludes, by the incorporation of the 1989 Edition of Section XI in 10 CFR 50.55a (b), the licensee may implement the requirements of OM-6 or portions thereof pursuant to 10 CFR 50.55a (f)(4)(iv) provided all the related requirements are met. The NRC has determined that the licensee may implement the vibration monitoring requirements of OM-6 per paragraph (f)(4)(iv). Related requirements for vibration monitoring measurements in OM-6 include paragraphs 4.6.1, 4.6.4, 5.1, 5.2 and 6.1. Whether all related requirements are met is subject to NRC inspection. Based on the review of the licensee's request for an extension of the interim approval to use a minimum vibration velocity reference value of 0.05 in/sec, the staff concludes the proposed alternative to the Code requirements is authorized until the end of the second 10-year interval, pursuant to 10 CFR 50.55a(a)(3)(i), based on the alternative providing an acceptable level of quality and safety. The granting of relief is generally based on the current 10-year interval program for the Code requirements applicable to that interval; thus, extension beyond the end of the second 10-year interval (i.e., May 10, 1994), as requested by the licensee, is inappropriate. If the licensee intends to implement this relief request during the third 10-year interval, this relief request should be included in the third 10-year interval IST program update.

3.0 RELIEF REQUEST P-11

The licensee has requested relief from the inlet pressure and differential pressure measurement requirements of Section XI, Paragraph IWP-3110 for Surry Station Unit 1 emergency service water pumps 1-SW-P-1A, 1B and 1C. IWP-3110 requires that reference values be one or more fixed set of measured values and all subsequent test results shall be compared to these reference values.

3.1 BASIS FOR RELIEF

The licensee states, "No installed inlet pressure instrumentation exists. Inlet pressure will be calculated from the tide level and subtracted from the discharge pressure to yield differential pressure.

The emergency service water pumps take suction from the James River and discharge into the intake canal. The James River near the plant is subject to a tide level variation of approximately five feet. Therefore, the total static head for the system can vary from test to test. There are no valves in the lines to throttle flow and to compensate for the change in system static

head. The only way to duplicate flow and differential pressure from test to test is to perform the test at the same tide level each time. Trying to perform this test within a small enough tide level range to produce repeatable results has proven impractical. To compensate for the change in total system head, a pump reference curve will be prepared based on test results taken at different tide levels. Tests will be conducted within the tide level limits of the curve, and the results will be compared to acceptance criteria based on the reference curve and the ranges given in Table IWP-3100-2."

3.2 ALTERNATIVE TEST

The licensee proposes: "Inlet pressure will be calculated from the tide level and subtracted from the discharge pressure to yield differential pressure. Tests will be conducted within the tide level limits of the pump reference curve, and results will be compared to acceptance criteria based on the reference curve and the ranges given in Table IWP-3100-2."

3.3 EVALUATION

The licensee previously submitted this relief request for the emergency service water pumps 1-SW-P-1A, 1B and 1C. The staff reviewed and evaluated the request in the NRC SE issued by letter dated March 22, 1993. In this SE the relief was granted pursuant to 10 CFR 50.55a (f)(6)(i) provided the utilization of the pump curves meets the guidance outlined in the evaluation and the suction pressure calculation is proceduralized.

One of the seven guidance elements included in the SE regarding pump curves stated: "Curves are based on an adequate number of test data points, with a minimum of five." The licensee submitted additional information for NRC review and a requested concurrence on the adequacy of using only three data points for the definition of the small portion of the emergency service water pump curve affected by the tide changes.

The emergency service water pump test loop is a fixed resistance system affected by tidal level. The licensee reports the plant river inlet level varies about 5 feet due to tide level changes. The pump takes suction from the James River and discharges into the plant's intake canal. The reference value flow for the pump is approximately 17,000 gpm and the shutoff head of the pump is 120 feet. A maximum tide level change of +/-3 feet corresponds to less than 1000 gpm change of flow in the range of the reference flow value.

The five data point minimum recommended in the previous SE was provided in the absence of the additional information contained in this submittal which can be used to construct a complete pump reference curve. Three data points, representing high, low and mid-tide conditions, on the appropriate portion of the pump head curve affected by the tide, are adequate for inservice testing of these service water pumps and accounts for small performance variations induced by tide level changes during repeat pump testing.

3.4 CONCLUSION

Based on a review of relief request P-11, the previous NRC SE and the additional information provided by the licensee regarding the modification of a portion of the IST reference curve to account for tide level changes during the testing of the emergency service water pumps, the staff concludes 1) the use of three data points to modify the appropriate portion of the pump curve to account for tide level changes during testing is adequate, and 2) additional relief is not required. The authorization provided in the previous SE issued by NRC letter dated March 22, 1993, covers the proposed reference curve modification.

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