

February 4, 2004

Mr. Mark E. Warner, Site Vice President
c/o James M. Peschel
Seabrook Station
FPL Energy Seabrook, LLC
PO Box 300
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SUBJECT: SEABROOK STATION, UNIT NO. 1 - INSERVICE TESTING PROGRAM
RELIEF REQUEST PR-3 (TAC NO. MB8941)

Dear Mr. Warner:

By letter dated May 9, 2003, as supplemented by letter dated September 23, 2003, Florida Power and Light Energy Seabrook, LLC (the licensee) requested relief from certain requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code for Operations and Maintenance of Nuclear Power Plants (ASME OM Code).

The U.S. Nuclear Regulatory Commission (NRC) staff concludes that certain inservice testing (IST) requirements can be modified to the extent proposed by the licensee in relief request PR-3 because the alternative provides an acceptable level of quality and safety. The NRC staff finds the request for relief acceptable. Therefore, relief is granted pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(a)(3)(i), for the second 10-year IST interval. The NRC staff has determined that the relief is authorized by law and will not endanger life or property, or the common defense and security and is otherwise in the public interest. The staff's safety evaluation is enclosed. This completes the staff's efforts on TAC No. MB8941.

Sincerely,

/RA/

Darrell Roberts, Acting Chief, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-443

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO INSERVICE TESTING PROGRAM RELIEF REQUEST PR-3

FPL ENERGY SEABROOK, LLC

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

1.0 INTRODUCTION

By letter dated May 9, 2003, FPL Energy Seabrook, LLC (FPL, the licensee) submitted relief request PR-3 for Seabrook Station. FPL requested relief for containment building spray (CBS) pumps from the inservice testing requirements of Table ISTB 5.2.1-1 of the 1995 Edition of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code for Operation and Maintenance (ASME OM Code), of nuclear power plants, including the 1996 Addenda. The licensee proposes to increase the Alert Range limit from 0.325 inches per second (ips) to 0.35 ips for the outboard bearing of the CBS pumps in the horizontal and vertical directions. In a subsequent letter dated September 23, 2003, FPL submitted a revision to relief request PR-3 which requested the proposed Alert Range limit of 0.35 ips be applied to all bearings of the CBS pumps.

2.0 REGULATORY EVALUATION

Title 10 of the Code of Federal Regulations (10 CFR), Section 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 OM Code and applicable addenda, except when alternatives have been authorized or relief has been requested by the licensee and granted by the Commission pursuant to 10 CFR 50.55a(a)(3)(i), 10 CFR 50.55a(a)(3)(ii), or 10 CFR 50.55a(f)(6)(i). In proposing alternatives or requesting relief, the licensee must demonstrate that (1) the alternatives will 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 would be impractical for its facility. The regulations in 10 CFR 50.55a authorize the Commission to approve alternatives and to grant relief from ASME Code requirements upon making the necessary findings. Nuclear Regulatory Commission (NRC) guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provides alternatives to ASME Code requirements which are acceptable. Further guidance is given in GL 89-04, Supplement 1, and NUREG-1482, "Guidance for Inservice Testing at Nuclear Power Plants."

Enclosure

The licensee is required to meet the requirements of the 1995 Edition including the 1996 Addenda of the ASME OM Code for pump and valve inservice testing for its second 10-year IST interval. The NRC staff's findings with respect to FPL's alternative to the Alert Range limit as required in the ASME OM Code are contained in this safety evaluation.

3.0 TECHNICAL EVALUATION

3.1 Pump Relief Request PR-3

FPL has requested relief for pumps CBS-P9-A and -P9-B from the requirements of ISTB Table 5.2.1-1 of the 1995 Edition and 1996 Addenda of the ASME OM Code. The licensee proposes to increase the Alert Range limit from 0.325 ips to 0.35 ips for all bearings of the affected CBS pumps.

3.1.1 Licensee's Basis For The Relief Request

The licensee states:

1. Pump casing resonance amplification causes the CBS-P-9-B pump bearing vibration to exceed the ISTB Table 5.2.1.1 Alert Range absolute limit.
2. Pump casing resonance amplification causes the CBS-P-9-A pump bearing vibration to approach the ISTB Table 5.2.1.1 Alert Range absolute limit leaving very little room for test repeatability.

The cause of the vibration is well understood, and is a result of our original pump design and the sizing of our recirculation line. It is not a result of any material degradation from the original installation. An impeller design change would be required to obtain vibration test margin; however, this design change would not fix any material degradation, or restore lost margin.

The pump casing resonance amplification issue impacts both pumps, although only the CBS-P-9-B pump has gone into the ALERT condition. The corresponding vibration levels on Containment Spray Pump CBS-P-9-A has not reached the Alert Range, but are very close to the limit (the most recent reference value, V_r is 0.319 in/sec at the outboard pump bearing, vertical).

Increasing the ISTB Table 5.2.1-1 Alert Range Absolute limit from 0.325 ips to 0.35 ips for all of the PUMP BEARING limits on both 1-CBS-P-9-A and 1-CBS-P-9-B, will provide adequate margin for test repeatability.

Seabrook Station has always monitored the CBS Pump vibration as part of the Predictive Maintenance Monitored Equipment Program.

Containment Spray Pump CBS-P-9-B outboard bearing overall vibration amplitude exceeds the ASME OM Code IST ALERT limit of >0.325 in/sec. The initial outboard pump bearing, horizontal reference value, V_r , is 0.347 in/sec. Since July 2001, the readings at this point have been between 0.311 and 0.347 in/sec. The pump inboard vertical bearing has just recently (e.g., post OR08 pump disassembly) increased from

0.274 ips to 0.343 ips. A review of the historical data shows that this inboard bearing for CBS-P-9-B has repeatedly been over 0.325 ips limit. CBS-P-9-A is of the same pump design as the CBS-P-9-B pump. Vibrations on all bearings are higher than expected although we have had only one occurrence of a bearing exceeding the 0.325 [ips] limit. This occurrence was on 11/04/99, which pre-dated our adoption of the ASME OM Code. Some of the other bearings vibrations have approached the 0.325 [ips] limit.

Additional vibration data collection and analysis identified high pump vane pass spectral responses. Pump casing resonance testing identified that the pump has a resonance frequency similar to that of pump vane pass. This condition results in vibration amplitude amplification that is responsible for most of the vibration magnitude. A review of past pump history, including plant pre-operational test data identified similar pump vane pass vibration amplification.

CBS pump design uses a wide, four-vane impeller that is susceptible to elevated vane pass vibration. This induced vibration amplitude, along with casing resonance near vane pass frequency, results in elevated overall vibration levels. There are no corrective actions to minimize this condition without replacing the pump impeller, or to modify the stiffness of the pump bearing housings. Either of these design changes would require undue burden to comply with the regulation.

Recent pump bearing resonance test results are consistent with tests performed during initial plant startup (1986). These results identify that the casing resonance contributes to the overall vibration amplitude. Continued pump operation at these levels is acceptable. Additionally, high resolution vibration data analysis has not found any indications of bearing wear or degradation.

During Refueling Outage 08 (OR08), Seabrook Station performed a disassembly and inspection of CBS-P-9-B. This inspection indicated that the pump did not have to be refurbished to restore any lost margin. Inspections of the wearing ring clearances were found to be satisfactory. The clearance acceptance criteria is 0.017 inches to 0.025 inches. The inboard clearances were 0.021 to 0.023 inches and outboard clearances were 0.022 to 0.023 inches. This disassembly validated our performance monitoring programs.

Based on this test history, the OR08 CBS-P-9-B disassembly, and the current vibration values, an ISTB 5.2.1-1 ALERT RANGE increase of the lower vibration limit from 0.325 inches per second to 0.35 inches per second for the pump outboard bearing vibration readings is warranted. The bases for the 0.35 inches per second is to simply provide some margin for test repeatability and to define a limit for additional actions.

3.1.2 Alternative Testing

The licensee states:

The CBS Pumps will be subject to additional testing, trending, and diagnostic analysis as required by the Seabrook Station Predictive Maintenance Program. This program employs predictive monitoring techniques that go beyond the vibration monitoring and analysis required by ISTB. These techniques also now include oil sampling and analysis.

If the measured parameters were found to be outside the normal operating range or were determined to be trending toward an unacceptable degraded state, then appropriate actions would be taken. These actions include monitoring additional parameters, review of specific information to identify cause, and potential removal of the pump from service to perform necessary maintenance.

The licensee proposes to increase the ISTB Table 5.2.1-1 Alert Range Absolute limit from 0.325 ips to 0.35 ips for all pump bearing absolute limits on both 1-CBS-P-9-A and 1-CBS-P-9-B.

3.1.3 Evaluation

The licensee requests relief for CBS pumps 1-CBS-P-9-A and -9-B from meeting the acceptance criteria of the Alert Range of 0.325 ips to 0.7 ips. In lieu of meeting 0.325 ips, the licensee proposes to increase the lower end of the Alert Range to 0.35 ips for all bearings of the affected CBS pumps.

CBS pumps supply water to the containment spray headers during a design-basis accident. During normal operation, the pumps are tested using an alternate mini-flow path which is capable of carrying flow at the rate of 1915 to 1955 gallons per minute. This less-than-full-flow rate increases pump internal recirculation flow that would increase pump impeller vane pass vibration response. The CBS pumps are a Bingham-Willamette Company Type CD. The pump style is a double-suction, single-discharge, single-stage pump having a flooded suction. The pump impeller is configured with a wide, flat discharge vane exiting to the discharge diffuser. According to the vendor, the pump impeller design is prone to vane pass induced vibration. The vendor stated that the present impeller design is no longer manufactured and its current replacement impeller has a modified vane exit passage to reduce vane pass excitation.

Since initial operation as well as the pre-operational test, elevated vibration at all monitored locations has been experienced for these CBS pumps. Due to the elevated vibration levels, the measured vibrations for CBS-P-9-B fluctuate above and below the Alert limit of 0.325 ips. The measured vibrations for CBS-P-9-A have not reached the Alert limit but are very close to 0.325 ips. In accordance with ASME OM Code requirements, the licensee has increased the test frequency for CBS-P-9-B when the vibration exceeds the Alert limit. In addition, the licensee has taken the following actions to determine the cause of the elevated vibration level and its impact on pump performance.

- 1) Pump vibration has been programmatically recorded since 1991. During routine pump surveillance testing both vibration amplitude and spectral data are collected. Pump and motor spectral data are reviewed and trended over a frequency range of 5 to 1000 Hz. This data indicates that there are no pump rolling element-bearing or motor-bearing degrading trends. In addition, data analysis has not identified any bearing distress frequencies or indications of improper rotor balance or shaft rubs.
- 2) The licensee's data analysis identified high pump vane pass spectral responses, and pump casing resonance testing identified that the pump has a resonance frequency similar to that of pump vane pass. This condition results in vibration amplitude amplification that is responsible for most of the vibration magnitude. A review of past pump history, including plant pre-operational test data, identified similar pump vane pass

vibration amplification. The licensee stated that there are no corrective actions to minimize this condition without replacing the pump impeller, and that continued operation at this level is acceptable.

- 3) The original pump vendor is Bingham-Willamette Company and now is a part of Sulzer Pump (US) Inc. The vendor has been involved in evaluating the pump vibration data and agrees with increasing pump-bearing vibration limits due to vane pass frequency phenomena. The licensee has forwarded additional pump modal response vibration data to Sulzer for their evaluation. As a result, the vendor now recommends a new pump-bearing low "Alert Limit" of 0.35 ips.
- 4) Seabrook Station has always monitored the CBS pump vibration as part of its Predictive Maintenance Monitored Equipment Program. During RFO RO08, the licensee also performed a disassembly and inspection of CBS-P-9-B. This inspection indicated that the pump did not have to be refurbished to restore any lost margin. This disassembly validated the licensee's performance monitoring programs.

Based on its review of the historical and recent vibration data, and actions taken so far, the licensee concluded that doubling the test frequency does not provide any additional information nor additional assurance on information as to the condition of the pump and its ability to perform its safety function.

To eliminate unnecessary pump testing, the licensee proposes to slightly increase the value for the lower end of the Alert Range from 0.325-0.7 ips to 0.35-0.7 ips, but keep the "Required Action" level unchanged. Because the increased pump testing has not produced any useful information, and the pump has been running acceptably and without any detectable degradation since 1985, the staff finds that the slight increase of the vibration Alert Range will have little effect on the timely detection of pump degradation prior to component failure, especially since the "Required Action" level (0.7 ips) is unchanged. Furthermore, the licensee proposes that these CBS pumps will be subject to additional testing, trending, and diagnostic analysis as required by the Seabrook Station Predictive Maintenance Program. This program employs predictive monitoring techniques that go beyond the vibration monitoring and analysis required by the ASME OM Code. These techniques also include oil sampling and analysis. If the measured parameters were found to be outside the normal operating range or were determined to be trending toward an unacceptable degraded state, then appropriate actions would be taken by the licensee. These actions include monitoring additional parameters, review of specific information to identify cause, and potential removal of the pump from service to perform necessary maintenance.

The staff finds that the licensee's proposal to use the slightly increased Alert Range is acceptable on the basis that the affected pumps have been operating acceptably at vibration velocities at or slightly above the ASME OM Code Alert Range with little change in performance and without any detectable degradation since 1985; and that testing the pumps on an increased frequency has not produced any additional information for improving pump vibration performance. Therefore, the slight increase of the vibration Alert Range will have insignificant effect on the timely detection of pump degradation prior to component failure, especially since the "Required Action" level (0.7 ips) is not being changed.

4.0 CONCLUSION

Pursuant to 10 CFR 50.55a(a)(3)(i), relief request PR-3 is authorized on the basis that the proposed alternative provides an acceptable level of quality and safety.

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: J. Huang

Date: February 4, 2004