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

December 11, 2017

Site Vice President
Entergy Operations, Inc.
Waterford Steam Electric Station, Unit 3
17265 River Road
Killona, LA 70057-3093

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – RELIEF REQUEST PRR-WF3-2017-3, REQUEST FOR ALTERNATIVE TO ASME OM CODE REQUIREMENTS FOR COMPREHENSIVE TESTING OF HIGH PRESSURE SAFETY INJECTION PUMP AB (CAC NO. MF9875; EPID L-2017-LLR-0049)

Dear Sir or Madam:

By letter dated June 27, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17178A459), Entergy Operations, Inc., (Entergy, the licensee), submitted request for relief PRR-WF3-2017-3 to the U.S. Regulatory Commission (NRC), proposing an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code) associated with pump inservice testing (IST) for Waterford Steam Electric Station, Unit 3 (Waterford 3).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.55a(z)(2), the licensee requested to use the alternative proposed in PRR-WF3-2017-3, regarding IST of high-pressure safety injection pump AB, on the basis that the ASME OM Code requirements present an undue hardship without a compensating increase in the level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject request and has determined that for alternative request PRR-WF3-2017-3, the proposed alternative provides reasonable assurance that the affected components are operationally ready. The NRC staff concludes that complying with the specified ASME OM Code requirements would result in a hardship without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2).

Therefore, the NRC staff authorizes the use of the alternative request PRR-WF3-2017-3 for Waterford 3 until the end of Operating Cycle 22, which began on June 2, 2017 and is scheduled to be completed in the early part of 2019.

All other ASME OM Code requirements for which relief was not specifically requested and approved in the subject request remain applicable.

If you have any questions, please contact the Project Manager, April Pulvirenti at 301-415-1390 or via e-mail at April.Pulvirenti@nrc.gov.

Sincerely,

Robert J. Pascarelli, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure:
Safety Evaluation

cc: Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

ALTERNATIVE REQUEST PRR-WF3-2017-3

RELATED TO INSERVICE TESTING OF HIGH PRESSURE SAFETY INJECTION PUMP AB

WATERFORD STEAM ELECTRIC STATION, UNIT 3

ENTERGY OPERATIONS, INC.

DOCKET NO. 50-382

1.0 INTRODUCTION

By letter dated June 27, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17178A459), Entergy Operations, Inc. (the licensee) submitted an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code), associated with pump inservice testing (IST) at Waterford Steam Electric Station, Unit 3 (Waterford 3).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) paragraph 50.55a(z)(2), "Hardship without a compensating increase in quality and safety," the licensee requested to use the proposed alternative in request PRR-WF3-2017-3, regarding IST of high-pressure safety injection (HPSI) pump AB, on the basis that the ASME OM Code requirements present an undue hardship without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Section 50.55a(f), "Preservice and inservice testing requirements," of 10 CFR, states, in part, that IST of certain ASME Code Class 1, 2, and 3 pumps and valves be performed in accordance with the specified ASME OM Code and applicable addenda incorporated by reference in the regulations. The applicable ASME Code Edition and Addenda for Waterford 3 is the 2004 Edition through 2006 Addenda of ASME OM Code.

Paragraph 50.55a(z)(2) of 10 CFR states, that alternatives to the requirements of paragraph (f) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the Commission to authorize the alternatives requested by the licensee.

3.0 TECHNICAL EVALUATION

Applicable Code Requirements

The licensee requested to use an alternative to the applicable ASME OM Code requirements for HPSI pump AB (SI-MPMP-0002AB). This pump is classified as a Group B pump.

A similar alternative, dated July 6, 2016 (ADAMS Accession No. ML16182A270), was authorized during Waterford 3's third 10-year IST program interval, which ended on November 30, 2017. For the third 10-year IST interval, the applicable code was ASME OM Code 2001 Edition through 2003 addenda. Waterford 3 is currently in its fourth 10-year IST program interval, which began on December 1, 2017, and is scheduled to end on November 30, 2027. For the fourth IST interval, the Waterford 3 IST program was revised to comply with the ASME OM Code 2004 Edition through the 2006 Addenda. The applicable code requirements referenced below are those from the 2004 Edition through the 2006 Addenda.

- ISTB-3300, (e)(1), states, "Reference values shall be established within ±20% of pump design flow rate for the comprehensive test."

- ISTB-3300, (e)(2), states, "Reference values shall be established within ±20% of pump design flow for the Group A and Group B tests, if practicable. If not practicable, the reference point flow rate shall be established at the highest practicable flow rate."

- ISTB-3400, "Frequency of Inservice Tests," states, "An inservice test shall be run on each pump as specified in Table ISTB-3400-1."

- Table ISTB-3400-1, "Inservice Test Frequency," requires Group A and Group B tests to be performed quarterly, and Comprehensive tests to be performed biennially.

- Table ISTB-3510-1, "Required Instrument Accuracy," specifies the instrument accuracies for Group A, Group B, Comprehensive, and Preservice.

- Table ISTB-5121-1, "Centrifugal Pump Test Acceptance Criteria," defines the required acceptance criteria for Group A, Group B, and Comprehensive tests for centrifugal pumps.

- ISTB-6200, "Corrective Action," (a), "Alert Range," states, "If the measured test parameter values fall within the alert range of Table ISTB-5121-1, Table ISTB-5221-1, Table ISTB-5321-1, or Table ISTB-5321-2, as applicable, the frequency of testing specified in ISTB-3400 shall be doubled until the cause of the deviation is determined and the condition is corrected.

Reason for Request

During refueling outages, a comprehensive pump test (CPT) is performed on HPSI pump AB. The pump test flow rate is approximately 405 gallons per minute (gpm), and inboard and

outboard pump bearing vibration and pump differential pressure (DP) data are verified to be within the Acceptable Range criteria in Table ISTB-5121-1. The flow balance surveillance is then performed to verify that HPSI pump AB achieves the flow requirements of Waterford 3 Technical Specification (TS) Surveillance Requirement (SR) 4.5.2(h).

During refueling outage (RF) 20 in November 2015, a CPT was performed on HPSI pump AB. Two of the vibration readings (point 3H at the inboard bearing and point 4H at the outboard bearing) were in the Alert Range. The licensee also performed a vibration frequency spectrum analysis. Based on the recommendation of Flowserve, the current pump vendor, the licensee realigned the pump and motor and inspected the pump foundations for voids. The pump was inspected and found to be out of alignment. The pump and motor were realigned. The pump foundation was inspected and found to be satisfactory. On November 23, 2015, a post-maintenance CPT was performed and elevated vibration levels again were recorded at points 3H and 4H. The vibration readings were again in the Alert Range. Per ISTB-6200(a), when the vibration readings are in the Alert Range, the frequency of the CPT shall be doubled until the cause of the high vibration readings is determined and the condition is corrected.

The licensee performed a cause evaluation following the elevated vibration readings identified during RF20 and determined that the pump is in the beginning stages of end of life. The evaluation indicates that there are spikes in the vane pass frequencies (vibrations) for the pump. These vane pass frequencies normally increase over pump life, and the frequencies noted for HPSI pump AB do not currently exceed any ASME OM Code Acceptable Range limits. Vane pass frequencies are associated with the pump impeller (blades), and are due to imbalances when the flow from the impeller interacts with the diffuser or volute and creates flow disturbances. These vibrations increase over time as the clearances between the pump impeller and diffuser change. This is considered normal wear.

In order to avoid further pump wear, the licensee has been (and will continue to be) utilizing the following recommendations to the extent practical: (1) avoid using the pump for non-accident, non-surveillance scenarios/tasks that can be accomplished with other pumps, (2) use HPSI pump A (which has an upgraded rotating assembly) as the preferred pump, (3) minimize the pump stop/start cycles as much as possible, and (4) minimize the pump operation above 120 percent of the best efficiency point.

On July 6, 2016, the NRC staff authorized the use of the alternative in alternative request PRR-WF3-2016-1 for Waterford 3 until the end of Operating Cycle 21. The alternative allowed for use of the Group A test during Operating Cycle 21 in lieu of the requirement to perform the comprehensive test at the increased (doubled) frequency required by the corrective action of ISTB-6200. In this request, the licensee stated that the cause for the increased vibrations was the fact that the pump is in the beginning stages of end of life, and that pump refurbishment was scheduled to be performed during the 21st refueling outage (RF21).

Just prior to RF21, it was determined that the new shaft that had been procured to refurbish the HPSI pump AB in RF21 was damaged. The new shaft was therefore deemed unusable, and no alternatives were feasible. Because the pump could not be refurbished in RF21, the licensee has submitted this alternative request.

The licensee stated that the following information demonstrates that the pump is capable of performing its safety function:

- Bearing vibrations do not improve or worsen with higher flow rates and longer periods of operation (approximately 1 hour on November 23, 2015).

- Pump discharge flow has consistently achieved TS SR 4.5.2(h) flow requirements during each refueling outage.

- Pump has achieved TS SR 4.5.2(f)(1) DP requirements during each quarterly surveillance during Operating Cycles 20 and 21.

- The pump has been within IST CPT DP acceptance criteria with no degrading trend in pump hydraulic performance.

A CPT was performed on the HPSI pump AB in April 2017 during RF21. The vibration points 3H and 4H that were previously in the alert range were within the IST acceptance limits and therefore, were no longer in the Alert Range. An engineering evaluation determined that the uncoupling and recoupling of the pump and motor performed at the beginning of the refurbishment attempt affected the vibration readings, but that this is not the most likely cause of the increased vibrations identified in November 2015, and therefore, the licensee cannot say that the original condition has been resolved. Due to the circumstances presented by the fact that the HPSI pump AB could not be refurbished, the original condition that caused the elevated vibration readings has not been corrected.

The licensee provided data from CPTs that were performed on October 28, 2009, which was during RF16. Using the DP value from the RF16 CPT as the reference value, the data shows that, for the six CPTs performed since the test during RF16, the measured DP has consistently been in the Acceptable Range, and there has been no evidence of a degrading trend on pump hydraulic performance. The licensee stated that the data demonstrates that the pump is capable of performing its safety function.

Proposed Alternative

The licensee is requesting not to double the CPT test frequency as per ISTB-6200(a), because in order to perform an additional CPT, a mid-cycle shutdown is required and the reactor pressure vessel head must be removed. As an alternative to doubling the frequency of the CPT, the licensee proposes to perform Group A quarterly tests on the pump until corrective actions (i.e., pump refurbishment, can be performed).

The pre-October 2013 HPSI pump AB quarterly test flow rate was approximately 250 gpm, and the flow path was the hot leg injection line back to the refueling water storage pool (RWSP). The 250 gpm flow rate is greater than 60 percent of the HPSI pump AB CPT flow rate of 405 gpm, and it is the highest practicable flow rate for online testing. The 250 gpm flow rate is located on a sloped portion of the pump curve where pump degradation can be detected, and sufficient vibration data to assess the pump operation will be provided. The test data will be compared to the Group A vibration and DP acceptance criteria that were established when the pump was known to be operating acceptably prior to the third IST interval and analyzed to ensure there are no indications of unacceptable pump performance. ISTB-6200 shall remain applicable to the Group A quarterly tests. The vibration, flow, and pressure instrumentation used during the Group A tests shall meet the instrumentation accuracy requirements stated in Table ISTB-3510.

The licensee states that this proposed alternative is a one-time request until pump refurbishment is performed during RF22. The duration of the proposed alternative is for Operating Cycle 22, which began on June 2, 2017, and is scheduled to be completed in the early part of 2019.

NRC Staff Evaluation

The licensee requests an alternative to the ASME OM Code corrective action requirements of ISTB-6200(a) for the HPSI pump AB, which is classified as a Group B pump. ISTB-6200(a) requires that if a measured test parameter falls within the Alert Range, the frequency of testing shall be doubled until the cause of the deviation is determined and the condition is corrected. Vibration measurements at two locations on HPSI pump AB were in the Alert range when a CPT was performed on November 3, 2015. The pump and motor were realigned, and a CPT was performed again on November 23, 2015, and the vibration measurements at the same two locations were still in the Alert Range. Doubling the frequency of the CPT per ISTB-6200(a) would require a mid-cycle shutdown and removal of the reactor pressure vessel head, which is a hardship. In lieu of doubling the frequency of the CPT, the licensee proposes to perform Group A quarterly online tests on the pump instead of Group B online quarterly tests until RF 22, which is when the pump will be refurbished. The differences between Group A and Group B tests are that the Group A test is performed at a higher flow rate (approximately 250 gpm versus approximately 30 gpm for the Group B test), and vibration measurements are required for a Group A test and not for a Group B test. The flow path will be the hot leg injection line to the RWSP, which will allow for the higher flow rate of 250 gpm. The 250 gpm flow rate is located on a sloped portion of the pump curve, which will allow the monitoring of pump degradation.

The licensee determined that HPSI pump AB is in the beginning stages of end of life. In order to avoid further wear on the pump, the licensee limits operation of the pump to the extent practical through the following actions: avoids use of the pump for non-accident, non-surveillance scenarios/tasks that can be accomplished with other pumps; uses HPSI pump A as the preferred pump; minimizes the pump stop/start cycles as much as possible; and minimizes the operation of the pump above 120 percent of the best efficiency point.

The licensee provided CPT and TS surveillance data back to 2009 that indicate that HPSI pump AB has not shown any degradation in flow or differential pressure since that time. Also, bearing vibrations do not improve or worsen with higher flow rates and longer periods of pump operation (approximately 1 hour.)

By letter dated July 6, 2016, the NRC staff authorized the use of the same alternative in alternative request PRR-WF3-2016-1 for Waterford 3 until the end of Operating Cycle 21. In that request, the licensee stated that the cause for the increased vibrations was due to the fact that the pump was in the beginning stages of end of life, and that pump refurbishment was scheduled to be performed during the RF21.

Just prior to RF21 the licensee identified that the shaft that was procured to refurbish the HPSI pump AB in that refueling outage was damaged, deemed unusable, and alternatives were not feasible. Because the pump could not be refurbished in RF21, the licensee has submitted this alternative request.

Based on the above, the NRC staff finds that the proposed alternative provides reasonable assurance that HPSI pump AB will remain operationally ready until RF 22, at which time the pump will be refurbished.

4.0 CONCLUSION

As set forth above, the NRC staff has determined that, for alternative request PRR-WF3-2017-3, the proposed alternative provides reasonable assurance that HPSI pump AB (SI-MPMP-0002AB) is operationally ready. The NRC staff concludes that complying with the specified ASME OM Code requirements would result in a hardship without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2) for this proposed alternative. Therefore, the NRC staff authorizes the use of the alternative request PRR-WF3-2017-3 for Waterford 3 until the end of Operating Cycle 22, which began on June 2, 2017, and is scheduled to be completed in the early part of 2019.

All other ASME OM Code requirements for which relief was not specifically requested and approved in the subject request remain applicable.

Principal Contributor: Robert Wolfgang, NRR/DE/EPNB

Date: December 11, 2017

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – RELIEF REQUEST PRR-WF3-2017-3, REQUEST FOR ALTERNATIVE TO ASME OM CODE REQUIREMENTS FOR COMPREHENSIVE TESTING OF HIGH PRESSURE SAFETY INJECTION PUMP AB (CAC NO. MF9875; EPID L-2017-LLR-0049) DATED DECEMBER 11, 2017

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ADAMS Accession No. ML17341A120 *by email dated October 4, 2017

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