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Waterford 3

10 CFR 50.55a

W3F1-2017-0048

June 27, 2017

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Subject: Relief Request from ASME Code Requirements for High Pressure Safety Injection (HPSI) Pump AB [SI-MPMP-0002AB] Testing Requirements, Relief Request PRR-WF3-2017-3
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

Dear Sir or Madam:

Pursuant to 10 CFR 50.55a, "Codes and Standards," paragraph (z)(2), Entergy Operations, Inc. (Entergy) hereby requests NRC approval of the attached relief request associated with the Third and Fourth Inservice Testing (IST) Intervals of the IST Program for Waterford 3.

Entergy is requesting relief from ASME OM Code Section ISTB-6200 to double the frequency of testing if a parameter value falls within the Alert range. During the performance of an IST Comprehensive Test of High Pressure Safety Injection (HPSI) Pump AB, bearing vibration values were recorded in the Alert range. Compliance with ISTB-6200 would require a mid-cycle shutdown and removal of the reactor pressure vessel head. Entergy is proposing to perform IST Group A quarterly tests on HPSI Pump AB until corrective actions can be performed. The details of the relief request are provided within the Attachment.

Entergy requests approval by February 3, 2018 to ensure that relief is obtained prior to the time that testing would need to be performed, which is 39 weeks following the previous test due to the increased testing frequency requirement.

This letter contains no new commitments.

If you have any questions or require additional information, please contact the Regulatory Assurance Manager, John P. Jarrell, at (504) 739-6685.

Sincerely,

JPJ/MMZ

Attachments: 1. Proposed Alternative in Accordance with 10 CFR 50.55a(z)(2) PRR-WF3-2017-3.

2. Characteristic Curve (HPSI AB Pump Curve), Ingersoll-Rand Company, Pump No. 0672176, Curve No. N-603, September 17, 1974.

cc: Mr. Kriss Kennedy, Regional Administrator
U.S. NRC, Region IV
RidsRgn4MailCenter@nrc.gov

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Attachment 1

to

W3F1-2017-0048

Waterford 3 Steam Electric Station
10 CFR 50.55a Request No. PRR-WF3-2017-3

Proposed Alternative in Accordance with 10 CFR 50.55a(z)(2)
Hardship Without a Compensating Increase in Quality and Safety

(9 pages)

Waterford 3 Steam Electric Station
10 CFR 50.55a Request No. PRR-WF3-2017-3

Proposed Alternative in Accordance with 10 CFR 50.55a(z)(2)
Hardship Without a Compensating Increase in Quality and Safety

Entergy is requesting relief from the requirement of ASME OM Code Section ISTB-6200 to double the frequency of testing if a measured test parameter value falls within the Alert range until the condition is corrected.

During the performance of an IST Comprehensive Test of HPSI Pump AB during RF20 (November 2015), bearing vibration values were recorded in the Alert range. On July 6, 2016, the NRC authorized the use of the alternative in Relief Request PRR-WF3-2016-1 for Waterford 3 until the end of Operating Cycle 21 (ML16182A270). 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 frequency required by the corrective action of ISTB-6200. In this request, Entergy stated that the cause for the increased vibrations was due to 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).

Group A test results show that the HPSI AB pump continues to exhibit satisfactory hydraulic performance with no degrading trend. Elevated, yet acceptable, vibration measurements were observed during Operating Cycle 21.

It was identified just prior to RF21 that the shaft that was procured to refurbish the HPSI AB pump in RF21 was damaged, deemed unusable, and alternatives were not feasible.

The HPSI AB comprehensive test was performed during RF21 (April 2017). The vibration points that previously were in the alert range are within IST acceptance limits and no longer within the Alert Range. Engineering evaluation determined that the uncoupling and recoupling performed at the beginning of the refurbishment attempt affected the vibration readings; however, this is not the most likely cause of the increased vibrations identified in November 2015 and therefore Entergy cannot say that the original condition has been resolved. Due to the circumstances presented by the fact that the HPSI AB pump could not be refurbished, the original condition that caused the elevated vibration has not been corrected.

ISTB-6200 requires that the comprehensive pump test, which can only be performed during an outage (Mode 6), be performed mid cycle. This would require a mid-cycle shutdown and removal of the reactor vessel pressure head. Entergy is requesting, similar to the request which was authorized for Operating Cycle 21, that the alternative to allow the Group A test be used in lieu of performance of the comprehensive test until corrective actions can be performed.

Background

HPSI Pump AB is subject to pump flow rate and differential pressure (DP) requirements in accordance with Technical Specifications (TS) Section 4.5.2 and IST vibration and DP requirements in accordance with ASME OM Code 2001 Edition with 2003 Addenda, Subsection ISTB.

TS 4.5.2(f)(1) requires that each HPSI pump required to be operable be verified to perform with a DP greater than or equal to 1429 psid on recirculation flow (≥ 25 gpm). TS 4.5.2(h) requires that during flow balance surveillance in Cold Leg injection mode, the sum of injection line flow rates of each pump, excluding the highest flow rate, shall be greater than or equal to 675 gpm. Also, during the same flow balance surveillance and while operating in Hot/Cold Leg injection mode, each pump must perform with a flow rate greater than or equal to 436 gpm and within ±10% of cold leg flow.

ASME OM Code 2001 Edition with 2003 Addenda Section ISTB-3400 requires an IST Comprehensive Test be performed on a biennial frequency and a Group B test on a quarterly frequency. Waterford 3 complies with this requirement by performing the Comprehensive Test on an eighteen (18) month frequency along with the TS flow balance surveillance during refueling outages. The Group B test is performed quarterly and in conjunction with the TS 4.5.2(f)(1) surveillance.

During a refueling outage, the IST Comprehensive Test is performed with flow established at approximately 405 gpm and inboard and outboard pump bearing vibration and pump DP data recorded and verified to be within IST Comprehensive Test acceptance criteria as stated in Table ISTB-5100-1. The flow balance surveillance is then performed to verify the HPSI pump achieves the flow requirements of TS 4.5.2(h).

During RF20, the HPSI AB vibration monitoring values obtained as part of Comprehensive pump testing were determined to be low in the alert range (0.325 < V ≤ 0.700) (inches/second) at vibration points 3H (inboard bearing) and 4H (outboard bearing). Historical Comprehensive Test data is provided in Table 1.

Table 1. HPSI Pump AB Comprehensive Test Data (Historical)

Date	Outage	Flow Rate (gpm)	DP (psid)	Pump Bearing Vibrations				
				3H	3V	4H	4V	4A
10/28/2009	RF16	404	1202	0.267	0.191	0.252	0.266	0.050
04/16/2011	RF17	422.8	1184.2	0.235	0.161	0.241	0.250	0.058
12/18/2012	RF18	411	1215	0.249	0.166	0.226	0.234	0.049
04/19/2014	RF19	411.2	1190.7	0.090	0.083	0.070	0.072	0.058
11/03/2015	RF20	406	1194.5	***0.332***	0.191	***0.336***	0.230	0.088
11/23/2015	RF20	408.5	1202.2	***0.397***	0.225	***0.399***	0.179	0.078
4/21/2017	RF21	411.6	1194.7	0.213	0.124	0.219	0.141	0.042

Note: The pump bearing vibration data taken in RF19 is suspect because the recorded vibration data is considerably lower than previously recorded vibration data, and no maintenance had been performed on HPSI Pump AB which could have lowered vibration readings. This unrelated condition was entered into the corrective action program.

Following the initial RF20 testing, the current pump vendor, Flowserve, was contacted to discuss the higher vibrations. Flowserve suggested that the pump was most likely out of alignment. It

was also suggested that the vibration could be occurring due to voids in the grout. The pump foundation consists of a steel box that is filled with grout through several pouring iterations. If this is done improperly, it is possible that the upper foundation plate can loosen from the grout and cause pump instability. An as-found alignment inspection found the pump/motor out of alignment. Pump alignment was completed on November 17, 2015. Inspection of the pump foundation for voids found it to be satisfactory. During the post-maintenance Comprehensive retest on November 23, 2015, elevated vibration at points 3H and 4H was recorded as shown in Table 1. In addition to the comprehensive pump test, a vibration frequency spectrum analysis was performed on HPSI Pump AB during RF20.

A cause evaluation performed following the elevated vibration condition identified during RF20 determined that the HPSI AB pump is in the beginning stages of end of life. The analysis indicates that there are spikes in the vane pass frequencies for the pump. These frequencies normally increase over pump life, and the frequencies noted for HPSI AB do not currently exceed any alarm limits. Vane pass frequencies (vibrations) are associated with the pump impeller (blades), and are due to imbalances when the flow from the impeller (blade) 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 (normal wear).

Recommendations regarding operation of this pump to avoid further wear have been (and will continue to be) utilized to the extent practical. These consist of avoidance of using the pump for non-accident, non-surveillance scenarios/tasks that can be accomplished with other pumps, use of HPSI Pump A (which has an upgraded rotating assembly) as the preferred pump, minimizing the pump stop/start cycles as much as possible, and minimizing operation above 120% of the best efficiency point. Although HPSI AB is classified as a Group B pump, these recommendations are appropriate because the HPSI pumps are used periodically to refill the Safety Injection Tanks during operation or to refill the reactor cavity during outages. Following identification of the elevated vibration during RF20, actions to complete refurbishment of the HPSI AB pump were initiated. To correct vane pass frequencies in the HPSI AB pump, new laser hardened wear rings will be installed when the pump is refurbished.

The classification of HPSI AB as a Group B pump was reviewed during activities related to the update to the IST Program for the Fourth IST Interval. It was determined that the classification as a Group B pump is appropriate because of the following: 1) The intent of the Group B classification is intended for pumps which do not have a full-flow hydraulic circuit during normal operations (HPSI pumps can only achieve full flow conditions during refueling conditions); and 2) The definition of Group A pumps are "Pumps that are operated continuously or routinely during normal operations, cold shutdown, or refueling operations." The intent of the phrase "continuously or routinely" applies to the use of the pump in order to perform its safety-related design function. As stated previously, the design function of the pumps is to inject borated water into the RCS following a LOCA. When the HPSI pumps are used to refill the Safety Injection Tanks during normal operations or for filling the reactor cavity during refueling outages, these evolutions are not being performed in response to a LOCA.

On July 6, 2016, the NRC authorized the use of the alternative in Relief Request PRR-WF3-2016-1 for Waterford 3 until the end of Operating Cycle 21 (ML16182A270). The alternative allowed for use of the Group A test which requires vibration data be taken on a quarterly basis in addition to the flow and DP in lieu of the requirement to perform the comprehensive test at the increased frequency required by the corrective action of ISTB-6200.

This allowed Entergy to monitor the vibration while online in order to identify if the condition was worsening.

TS and Group A DP data (Tables 2 and 3) shows that the HPSI AB pump exhibits satisfactory hydraulic performance with no degrading trend. Elevated, yet acceptable, vibration measurements were observed when performing Group A testing (Table 3).

Table 2. HPSI Pump AB TS 4.5.2(f)(1) Differential Pressure Data (Operating Cycles 20, 21, and 22)

Operating Cycle 20		Operating Cycle 21		Operating Cycle 22	
Date	Differential Pressure (psid)	Date	Differential Pressure (psid)	Date	Differential Pressure (psid)
06/10/2014	1491	03/09/2016	1492.3	6/16/2017	1467.6
09/09/2014	1462	06/07/2016	1466.2		
12/12/2014	1491.5	09/09/2016	1467.4		
03/05/2015	1466.5	12/01/2016	1470.1		
06/02/2015	1471.6	03/10/2017	1474.1		
09/04/2015	1497	04/07/2017	1468.5		

Table 3. HPSI Pump AB Group A Test Data (Operating Cycles 21 and 22)

Date	Differential Pressure (psid)	Pump Bearing Vibrations				
		3H	3V	4H	4V	4A
03/09/2016	1376.2	0.278	0.220	0.310	0.292	0.062
06/07/2016	1347.5	0.282	0.210	0.231	0.286	0.072
09/09/2016	1335.2	0.27	0.20	0.29	0.29	0.07
12/01/2016	1340.5	0.26	0.20	0.24	0.30	0.06
03/10/2017	1336.6	0.28	0.25	0.23	0.31	0.05
04/07/2017*	1345	0.143	0.142	0.151	0.223	0.050
6/16/2017	1337.9	0.253	0.163	0.245	0.274	0.061

*data taken for post maintenance test following recoupling

It was identified just prior to RF21 that the shaft that was procured to refurbish the HPSI AB pump was damaged by the fabricator and was deemed unusable by engineering evaluation. The pump is unique to Waterford 3 and Arkansas Nuclear One and spare materials were not available. Lead time for a new shaft was beyond the start date of Operating Cycle 22.

Prior to identification that the shaft was unusable, the pump was uncoupled from the motor. It was recoupled when it was identified that refurbishment could not be completed. No additional maintenance was performed. This activity was performed from March 30 through April 7, 2017.

The HPSI AB comprehensive test was performed on April 21, 2017. The vibration points that previously were in the alert range are within IST acceptance limits and are no longer within the Alert Range (Table 1). Engineering evaluation of the vibration data is that the uncoupling and recoupling affected the observed vibration; however, this is not the most likely cause of the increased vibrations identified in November 2015 and therefore Waterford 3 cannot say that the original condition has been corrected, as required by ISTB-6200.

Analysis

The information provided below demonstrates the HPSI AB pump is capable of performing its safety function because of the following:

- Bearing vibrations do not improve or worsen with higher flow rates and longer periods of operation (i.e., approximately one hour);
- Pump discharge flow has consistently achieved TS 4.5.2(h) flow requirements during each refueling outage;
- Pump has achieved TS 4.5.2(f)(1) DP requirements during each quarterly surveillance during Operating Cycle 20 and Operating Cycle 21;
- The pump has been within IST Comprehensive test DP acceptance criteria with no degrading trend in pump hydraulic performance.

The data substantiating the evidence consists of a multiple-flow test performed after the post-maintenance test performed on November 23, 2015, historical IST Comprehensive test DP, and historical TS 4.5.2(h) and TS 4.5.2(f)(1) surveillance data.

After the 2015 IST Comprehensive retest data was recorded, the pump was run at several different flow rates for a total duration of approximately one hour to obtain additional vibration data. The data suggests that the pump runs more efficiently in the 600-750 gpm range and that running the pump for longer periods of time (i.e., approximately one hour or more) does not necessarily improve or worsen the elevated vibration condition. This data and comparison data from the November 3, 2015 Comprehensive test is provided in Table 4.

Table 4. HPSI Pump AB RF20 Comprehensive Test Data and Additional Data at Multiple Flow Rates

Date	Time	Flow Rate (gpm)	Location									
			Motor					Pump				
			1H	1V	2H	2V	2A	3H	3V	4H	4V	4A
11/03/2015	0855	406	0.1184	0.0653	0.1379	0.0586	0.0485	***0.3315***	0.1910	***0.3359***	0.2295	0.0877
11/23/2015	0810	408.5	0.2524	0.0865	0.1891	0.1853	0.2076	***0.3971***	0.2250	***0.3996***	0.1787	0.0776
Multiple Flow Rate Data 11/23/2015	0849	900	0.2145	0.0964	0.1674	0.1902	0.1517	0.3131	0.1559	0.2518	0.1571	0.0667
	0901	680	0.2284	0.0513	0.1843	0.1885	0.1392	0.2951	0.1707	0.2806	0.1289	0.0634
	0910	580	0.2203	0.0655	0.1601	0.1746	0.1400	0.2830	0.1734	0.2871	0.1440	0.0902
	0918	390	0.2214	0.0548	0.1629	0.2152	0.1324	0.3138	0.1813	***0.3414***	0.2376	0.0871
	0924	250	0.2153	0.0588	0.1598	0.2116	0.1288	0.2320	0.2005	0.2807	0.2367	0.2043

Initial Comprehensive Test data was taken in RF16. It was identified and documented in a condition report in October 2015 that the DP acceptance criteria in the IST Comprehensive Testing procedure is not in compliance with ASME OM Code Table ISTB-5100-1; rather, the acceptance criteria reflects the pump curve provided by the original pump manufacturer. Corrective action for this condition includes performing a reference run following pump repair (scheduled for RF22) and incorporation of the new reference values into the procedure. (Note that this corrective action was originally planned to be completed during RF21; however, it was not possible due to the fact that refurbishment was not performed.)

Table 5 provides historical recorded DP data taken during IST Comprehensive Tests since RF16. Also provided in the table are Acceptable, Alert, and Required Action Ranges that have been calculated based on the multipliers listed in Table ISTB-5100-1 using the RF16 DP as the reference value. The DP data for pump performance shows the pump was within the IST acceptable range with steady performance and no evidence of a degrading trend on pump hydraulic performance and is capable of performing its safety function.

Table 5. HPSI Pump AB IST Comprehensive Test Differential Pressure Data and Acceptance Criteria

Date	Outage	DP (psid)	Acceptance Range (psid)	Alert Range (psid)	Required Action Range (psid)	
					Low	High
10/28/2009	RF16	1202	1117.9 ≤ DP ≤ 1238.0	1081.8 ≤ DP < 1117.9	DP < 1081.8	DP > 1238.0
04/16/2011	RF17	1184.2				
12/18/2012	RF18	1215				
04/19/2014	RF19	1190.7				
11/03/2015	RF20	1194.5				
11/23/2015	RF20	1202.2				
04/21/2017	RF21	1194.7				

During each TS full flow balance surveillance since RF16, the pump achieved hot leg/cold leg injection flow rates per TS 4.5.2(h) (Table 6). During Operating Cycles 20, 21, and 22 the pump achieved DP requirements per TS 4.5.2(f)(1) (Table 2). This TS surveillance data demonstrates that the HPSI AB pump has consistently been capable of performing its safety function.

Table 6. HPSI Pump AB TS 4.5.2(h) Surveillance Data (Historical)

Date	Outage	TS 4.5.2(h) Cold Leg Flow (gpm)	Cold Leg Flow (gpm)	TS 4.5.2(h)(2) Hot/Cold Leg Flow (gpm)		
				90% Cold Leg Flow	Hot Leg Flow	110% Cold Leg Flow
10/28/2009	RF16	687	441	396.9	463.7	485.1
04/16/2011	RF17	695	466	419.4	455	512.6
12/18/2012	RF18	706	451	405	458	496
04/19/2014	RF19 (Header B)	708	422	379.8	455.2	464.2
05/06/2014	RF19 (Header A)	689	459	413	441	505
11/03/2015	RF20 (Header A)	680	454	408.6	445	499.4
11/23/2015	RF20 (Header B)	694	442	397.8	462	486.2
4/21/2017	RF21 (Header B)	678	417.8	376.0	457.5	459.6
4/21/2017	RF21 (Header A)	679.8	443.5	399.2	457.9	487.8

The mission time for the HPSI AB pump during a design-basis accident is conservatively taken to be 30 days. For the purposes of this discussion, mission time is defined as the duration of Structure, System, or Component (SSC) operation that is credited in the design basis for the SSC to perform its specified safety function. The preceding information demonstrates that even though the HPSI AB pump is in the beginning stages of end-of life, it is capable of performing its safety function for its mission time because the pump bearing vibrations do not improve or worsen with higher flow rates and longer periods of operation (i.e., approximately one hour), the pump has consistently achieved TS 4.5.2(h) flow requirements during each refueling outage, has achieved the TS 4.5.2(f)(1) DP requirement during each quarterly surveillance during Operating Cycle 20 prior to RF20, and has been within IST Comprehensive test DP acceptance criteria with no degrading trend in pump hydraulic performance.

1. ASME Code Component(s) Affected

Pump SI-MPMP-0002AB is the installed spare (may be aligned to either train) HPSI Pump AB. This is a safety-related, horizontally mounted, nine stage, centrifugal pump. The pump manufacturer is Ingersoll Rand (Model 4X9C9). The pump is rated for 405 gpm with 2830 feet of head at 3575 rpm. The HPSI pump AB is categorized as a Group B pump in the Waterford 3 IST Program.

2. Applicable Code Edition and Addenda

Waterford 3 is currently in the Third Inservice Testing (IST) Interval. The start date of the Third IST Interval at Waterford 3 was December 1, 2007. The end date of the Third IST Interval at Waterford 3 is scheduled for November 30, 2017. The applicable code edition and addenda for the Waterford 3 Third IST Interval is ASME OM Code 2001 Edition, 2003 Addenda.

The start date of the Fourth IST Interval at Waterford 3 is scheduled for December 1, 2017. The end date of the Fourth IST Interval at Waterford 3 is scheduled for November 30, 2027. For the Fourth IST Interval, the Waterford 3 IST program is being revised to comply with the ASME OM Code-2004 Edition though OMb 2006 Addenda as currently endorsed by the NRC in 10 CFR 50.55a.

3. Applicable Code Requirement(s)

- ISTB-3300, “Reference Value,” states, in part, that “Reference values shall be established within ± 20% of pump design flow rate for the Comprehensive Test,” and “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 at the highest practical flow rate.”
- ISTB-3400, “Frequency of Inservice Tests,” states that an inservice test shall be run on each pump as specified in Table ISTB-3400-1.
- Table ISTB-3400-1 Requires Group A and Group B tests to be performed quarterly and a Comprehensive Test to be performed biennially.
- Table ISTB-3500-1, “Required Instrument Accuracy,” specifies the instrument accuracies for Group A, Group B, Comprehensive, and Preservice Tests.
- Table ISTB-5100-1, “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,” requires that if the measured test parameter values fall within the alert range of the applicable table [Table ISTB-5121-1], the frequency of testing specified in ISTB-3400 shall be doubled until the cause of the deviation is determined and the condition is corrected.

4. Reason for Request

Vibration monitoring is a component of the Comprehensive Test that is performed every refueling outage based on the frequency of every refueling outage (78 weeks) as required by ISTB-3400. Per ISTB-6200, since the vibration measurement falls within the alert range, Comprehensive Testing would be required to be every 39 weeks until the condition is corrected. This test is normally performed with the reactor in the defueled state with the reactor head removed. The Comprehensive Test flow rate can only be achieved by injecting into the reactor cavity. This test cannot be performed during normal power operations.

The proposed relief would permit the alternative use of the HPSI pump flow path using the pre-October 2013 quarterly test flow rate/path [250 gpm/Hot Leg Injection line to route the flow back to the Refueling Water Storage Pool (RWSP)] to perform Group A tests which require vibration monitoring during the upcoming cycle. This test can be performed safely while online and would eliminate the need to enter into an unnecessary outage reaching Mode 6 in order to perform the additional vibration monitoring.

5. Proposed Alternative and Basis for Use

Prior to October 2013, the quarterly IST pump test was routinely run at a flow rate of approximately 250 gpm using the Hot Leg Injection line to route the flow back to the Refueling Water Storage Pool (RWSP). The quarterly pump test was changed in October 2013 such that only the minimum recirculation line is utilized with flow rates of approximately 30 gpm. This change was to minimize the impact on the hot leg injection and Safety Injection Tank valve leakage by reducing the frequency of flowing water through the path. 30 gpm is the approximate flow rate while using the minimum recirculation flow line during performance of quarterly Group B IST. This flow rate is located at approximately 3% of the pump curve. The pump curve has begun to slope at this flow rate, but not significantly. The HPSI Pump AB characteristic curve is included in Attachment 2.

Entergy is proposing to perform Group A tests using the pre-October 2013 HPSI Pump quarterly test flow rate/path in order to facilitate pump performance monitoring during Operating Cycle 22 as an alternative to entering an outage reaching Mode 6 to perform a Comprehensive Test as required by ISTB-6200(a). Test data will be compared to the Group A vibration and DP acceptance criteria which were established when the pump was known to be operating acceptably. (Note: Group A vibration and DP acceptance criteria were established prior to the Third IST Interval at Waterford 3, when Group A or Group B pump classifications did not exist. At this time, vibration and differential pressure acceptance criteria were established and measurements were taken accordingly. After the Third IST Interval update, Group B pumps no longer required vibration measurements to be taken quarterly; however, the HPSI pump vibration acceptance criteria remained in the testing procedure in the event an online post-maintenance test was required.) The data obtained will be analyzed to ensure there are no indications of unacceptable pump performance and to ensure that the performance data is in the expected range. This will provide assurance that the equipment will continue to be operationally ready for the duration of the fuel cycle. ISTB-6200 shall remain applicable to Group A quarterly testing.

The purpose of performing the Comprehensive Test at double the normal test frequency while in the Alert range is to monitor for additional pump performance degradation until the condition is

corrected. This pump performance monitoring can be tracked and trended from the results of testing at flow rates other than that of the Comprehensive Test. Per ISTB-3300, the reference values shall be established within ±20% of pump design flow for the Comprehensive Test. The design flow for the HPSI AB pump is 405 gpm. The flow rate during the performance of this alternative is expected to be approximately 250 gpm, which would be greater than 60% of the Comprehensive Test point, and is the highest practicable flow rate for online testing. Performing the alternative testing at flow rates that are 60% of the Comprehensive Test point provides sufficient vibration data to assess HPSI pump operation. The vibration, flow, and pressure instrumentation used during the Group A Test shall meet the instrumentation accuracy requirements as stated in Table ISTB-3500-1.

The HPSI Pump AB curve has a maximum flow of approximately 975 gpm. 250 gpm is located at approximately 25% of the pump curve. 250 gpm is located on a sloped portion of the HPSI Pump AB curve where pump degradation can be detected.

Per Table ISTB-5100-1, a Group B test requires the DP acceptable range to be from 90% to 110% of the DP reference value. The reference value for the HPSI AB pump is 1451.8 psid therefore the acceptable range would be 1307 to 1596 psid. However, because the quarterly Group B test is performed using the minimum recirculation line, and TS 4.5.2(f)(1) requires a DP greater than or equal to 1429 psid as indicated on minimum recirculation flow, the lower DP IST acceptable limit has been truncated to 1432.1 psid, which includes instrument accuracy. This truncation brings the lower IST acceptable range limit from 90% to approximately 98.6% of the current DP reference value. Incorporating the TS DP into IST DP acceptance criteria narrows the IST DP acceptable range making degradation in pump hydraulic performance detectable at 30 gpm.

The performance of the Group A quarterly test at approximately 250 gpm will provide assurance of acceptable HPSI AB pump operation and sufficient pump degradation monitoring until the pump can be repaired during RF21 to meet the requirements of ASME OM Code ISTB-6200. During the quarterly tests, data will be collected to provide assurance of continued pump operability.

6. Duration of Proposed Alternative

This is a one-time request until pump refurbishment is performed during RF22. The duration of the proposed alternative will be for Operating Cycle 22. Operating Cycle 22 commenced on June 2, 2017 and is scheduled to complete in the early part of 2019.

7. Precedent

Waterford Steam Electric Station, Unit 3 – Relief Request PRR-WF3-2016-1, Alternative to the Inservice Testing Program (CAC No. MF7485), July 6, 2016 [Adams Accession Number ML16182A270].

8. References

None

Attachment 2

to

W3F1-2017-0048

HPSI AB Pump Curve

(1 page)

G-1226 3M 4-6

CURVE NO. N-603
DATE 17SE74

CURVES ARE APPROXIMATE. PUMP GUARANTEED FOR ONE SET OF CONDITIONS. CAPACITY, HEAD AND EFFICIENCY GUARANTEES ARE BASED ON SHOP TEST AND WHEN HANDLING CLEAR, COLD, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND NOT OVER 15 FOOT SUCTION LIFT.

THIS CERTIFIES THAT THIS CURVE IS BASED ON ACTUAL TEST PERFORMANCE.

Mark S. DeNardo
M. S. DeNardo 17 SE 74

IMPELLER PATT. NO. DIA.

DIFFUSOR PATT. NO.

TOTAL HEAD IN FEET X/00

BRAKE HORSE POWER X/000

NET POSITIVE SUCTION HEAD IN FT. X/00

GHP

MPSH

EFFY.

PER CENT EFFICIENCY

GALLONS PER MINUTE X/00

POOR ORIGINAL OR BEST AVAILABLE COPY

Combustion Engineering, Inc.
Louisiana Power & Light
Waterford Generating Station
C.E.I. P. O. No. 9101519
C.E.I. Contract No. 9270
HPSI Pump
Component Code: SI 15-64-4222-00

CHARACTERISTIC CURVE

NO. 419 TYPE C-9 STAGE PUMP
3570 R. P. M.

PUMP NO. 0672176 ORDER NO. 001-36125

INGERSOLL-RAND COMPANY
CAMERON PUMP DIVISION

DATE OF TEST 16SE74 CURVE N-603