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

August 1, 2014

Mr. John Dent, Jr.
Site Vice President
Entergy Nuclear Operations, Inc.
Pilgrim Nuclear Power Station
600 Rocky Hill Road
Plymouth, MA 02360-5508

SUBJECT: PILGRIM NUCLEAR POWER PLANT - RELIEF REQUESTS PR-03 AND PR-05 REGARDING THE INSERVICE TESTING PROGRAM (TAC NO. MF0370)

Dear Mr. Dent:

By letter dated December 6, 2012, as supplemented by letter and emails dated September 19, 2013 and January 31, 2014, Entergy Nuclear Operations, Inc., the licensee, submitted Relief Request PR-03 for authorization of a proposed alternative to the acceptable vibration level of the American Society of Mechanical Engineers (ASME) Code for *Operation and Maintenance of Nuclear Power Plants* (OM Code) requirements of paragraph ISTB-5123(e) for the High Pressure Coolant Injection main and booster pump bearings for Pilgrim Nuclear Power Plant (Pilgrim). The licensee also submitted Relief Request PR-05 for authorization of a proposed alternative to the flow measurement of the ASME OM Code requirements of paragraph ISTB-5300(a)(1) for the Standby Liquid Control pumps for Pilgrim. The relief was requested for the duration of the Pilgrim fifth Inservice Testing (IST) 10-Year Interval, December 7, 2012 through December 6, 2022. Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii), the licensee requested to use the proposed alternatives on the basis that compliance with the specified requirements would result in hardship without a compensating increase of the level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject requests and determined that the proposed alternatives provide reasonable assurance that the component or system is operationally ready. Accordingly, the NRC staff concluded that the licensee adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a, and is in compliance with the ASME OM Code requirements. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff authorizes the licensee's proposed alternatives for Revision 4 of PR-03 and Revision 1 of PR-05 for the fifth IST 10-year interval at Pilgrim for the duration of December 7, 2012 through December 6, 2022.

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

If you have any questions, please contact the Pilgrim Project Manager, Nadiyah Morgan, at (301) 415-1016.

Sincerely,

Benjamin G. Beasley

Benjamin G. Beasley, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-293

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUESTS PR-03 AND PR-05

REGARDING THE INSERVICE TESTING PROGRAM

ENTERGY NUCLEAR OPERATIONS, INC

PILGRIM NUCLEAR POWER STATION

DOCKET NO. 50-293

1.0 INTRODUCTION

By letter dated December 6, 2012 (Agencywide Documents and Management System (ADAMS) Accession No. ML12342A386) as supplemented by letter dated September 19, 2013 (ADAMS Accession No. ML13267A160) and emails dated January 31, 2014 (ADAMS Accession Nos. ML14057A850 and ML14057A851), Entergy Nuclear Operations, Inc., the licensee, submitted Relief Request PR-03 for authorization of a proposed alternative to the acceptable vibration level of the American Society of Mechanical Engineers (ASME) Code for *Operation and Maintenance of Nuclear Power Plants* (OM Code) requirements of paragraph ISTB-5123(e) for the High Pressure Coolant Injection (HPCI) main and booster pump bearings for Pilgrim Nuclear Power Plant (Pilgrim). The licensee also submitted Relief Request PR-05 for authorization of a proposed alternative to the flow measurement of the ASME OM Code requirements of paragraph ISTB-5300(a)(1) for the Standby Liquid Control (SLC) pumps for Pilgrim.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(a)(3)(ii), the licensee requested to use the proposed alternatives on the basis that compliance with the specified requirements would result in hardship without a compensating increase of the level of quality and safety for the duration of the Pilgrim fifth Inservice Testing (IST) 10-Year Interval, December 7, 2012 through December 6, 2022.

2.0 BACKGROUND

The regulations at 10 CFR 50.55a(f) requires, in part, that IST of certain ASME Code Class 1, 2, and 3 components must meet the requirements of the ASME OM Code and applicable addenda.

The regulations at 10 CFR 50.55a(a)(3), states, in part, that alternatives to the requirements in paragraph (f) of 10 CFR 50.55a may be authorized by the U.S. Nuclear Regulatory Commission (NRC) if the licensee demonstrates that: (i) the proposed alternative provides an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Enclosure

The Pilgrim fifth 10-year IST interval began on December 7, 2012 and is scheduled to end on December 6, 2022. The Pilgrim fifth ten-year IST program complies with the ASME OM Code, 2004 Edition with Addenda through OMb-2006 Addenda.

Based on the above, and subject to the NRC's findings with respect to authorizing the proposed alternatives to the ASME OM Code given below, 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

3.1 Relief Request PR-03, Revision 4

Paragraph ISTB-5123, "Comprehensive Test Procedure," (e), states, "All deviations from the reference values shall be compared with the ranges of Table ISTB-5121-1 and corrective action taken as specified in ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5121-1. For example, if vibration exceeds either $6V_r$ or 0.7 inches per second (in/sec) (1.7 cm/sec), the pump is in the required action range."

The applicable ASME OM Code edition and addenda for Pilgrim is the 2004 Edition through the OMb-2006 Addenda.

The licensee requested to use alternative vibration acceptance criteria for the HPCI pump P-205. The pump is a centrifugal, ASME Code Class 2, Group B pump.

Reason for Request

The licensee stated:

> Relief is requested from the ASME OM Code 2004 Edition through OMb-2006 addenda, ISTB-5123(e) required vibration ranges for Acceptable, Alert, and Required Action as specified in Table ISTB-5121-1.
>
> [Pilgrim] requests relief from the Acceptance Range [ASME OM] Code requirements of paragraph ISTB-5123(e) for the HPCI Main and Booster pumps, specifically from the vibration velocity (V_V) acceptance criteria specified in Table ISTB-5121-1 for all Main pump and Booster pump vibration points except for the Main pump outboard vertical vibration point (P4V) and Booster pump outboard horizontal axial vibration point (P8A). [Pilgrim proposes to expand the Acceptable Range (and corresponding Alert Low criteria) identified in Table ISTB-5121-1 for the [ASME OM] Code-specified biennial comprehensive pump vibration monitoring.
>
> [Pilgrim] requests relief from the High Alert Range (and corresponding Required Action Limit) [ASME OM] Code requirements of paragraph ISTB-5123(e) for the HPCI Main pump, specifically from the vibration velocity (V_V) High Alert criteria specified in Table ISTB-5121-1 for Main pump inboard (turbine side) bearing horizontal point (P3H) and Main pump outboard (gearbox side) bearing horizontal

point (P4H). [Pilgrim] proposes to expand the High Alert criteria (and corresponding Required Action Limit) identified in Table ISTB-5121-1 for the [ASME OM] Code-specified biennial comprehensive pump vibration monitoring.

Historic testing and analysis performed on the HPCI System by [Pilgrim] (and the pump manufacturer) have consistently revealed characteristic pump vibration levels that exceed the acceptance criteria stated in Table ISTB-5121-1. High vibration appears on the Main pump bearing housings at approximately 2x RPM [revolutions per minute] in the horizontal direction, which is caused by Booster pump excitation (at 4x RPM of the Booster pump). Under normal circumstances at 4000 RPM, the vibration amplitude at the Main pump bearings in the horizontal direction exceeds the ASME OM Code absolute vibration Required Action Range of > 0.7 in/sec. Additionally under the same conditions, all of the remaining HPCI Main and Booster pump vibration monitoring points, except for three, typically exceed the ASME OM Code absolute acceptable range upper value of 0.325 in/sec.

The vibration characteristics of the HPCI pump are predominantly a function of the pump design and should be identified as such rather than attributed to pump degradation. The high vibration has been present in the same order of magnitude since the pump was new. Although existing vibration levels of the HPCI pump are higher than the acceptance criteria provided in Table ISTB-5121-1, they reflect the unique operating characteristics of the HPCI pump design configuration. The historical data shows that there are no inherent vibrational concerns that would result in pump degradation or would prevent the HPCI pump from performing its design safety function for an extended period of operation.

The purpose of the [ASME OM] Code-required testing is to demonstrate the operational readiness of the HPCI pump by monitoring pump vibration for degradation and taking corrective actions when vibration levels exceed the [ASME OM] Code-specified values. The [ASME OM] Code specifies in ISTB-3300(g) and ISTB-6400 (including footnote) that the reference vibration measurements should be representative of the pump and that the measured vibration will not prevent the pump from fulfilling its function. Accordingly, [Pilgrim] is proposing to perform supplemental performance monitoring to support expansion of the [ASME OM] Code-specified test Acceptance (for Main and Booster pump vibration points P3H and P4H, P3V, P3A, P7H, P8H, P7V, and P8V) and High Alert vibration limits (for Main pump vibration points P3H and P4H) that will be used to demonstrate the operational readiness, which take into consideration the vibration measurements representative of the as-built configuration of the HPCI pump.

[Pilgrim] will perform supplemental testing and performance monitoring activities as follows:

1. A supplemental vibration monitoring activity will be performed to remove the 4x Booster pump RPM frequency component (discrete peak) from the vibration spectrum of the Main pump since its amplitude is not related to

the physical condition or rotating dynamics of the Main pump rotor or bearing system. The Main pump vibration spectrum, with this single 4x Booster pump RPM frequency component removed, has been shown to be stable and more useful for monitoring actual pump condition. When this vibration frequency component at 4x Booster pump RPM is subtracted from the Main pump vibration spectrum, the remaining vibration, which is attributed to the Main pump, is below the ASME OM Code Required Action Range. This modified (corrected) vibration level provides a more representative measurement of the pump condition, and thus, will be reviewed and trended as a supplemental vibration performance monitoring activity. Adverse trends and/or vibration anomalies will be evaluated and dispositioned, as necessary, using the [Pilgrim] Corrective Action Program.

2. As part of a vibration frequency spectrum review, all other discrete vibration peaks observed at the Main pump horizontal vibration points will be evaluated following each pump vibration test and will be reviewed for adverse trends and abnormalities. The reviews of the frequency spectrum data ensure that any significant change in the vibration signature [at these points] will be noted, and when necessary, dispositioned within the [Pilgrim] Condition Monitoring Program regardless of whether the severity causes the overall vibration level to exceed its criteria.

3. [Pilgrim] will increase the ASME OMb-2006, ISTB-3400 required frequency for vibration monitoring (that is part of the comprehensive testing) from once/2 years to once/year. The [ASME OM] Code-required comprehensive test for flow rates would continue to be once/2 years. Given that the HPCI vibration will normally exceed the [ASME] OM Code limiting Alert Range of >0.325 in/sec, the once/year frequency will typically be doubled to twice/year. The twice/year frequency will be the commitment frequency. However, the normal [Pilgrim] practice will be to monitor vibration in the same manner during each of the Quarterly Group B Hydraulic Tests, whenever practicable. Thus, vibration monitoring will be performed up to 8 times in 2 years as part of the Group B Hydraulic Tests; instead of once/2 years as part of the comprehensive pump tests.

4. As normal practice, [Pilgrim] will continue to monitor vibration of HPCI pump during each of the Quarterly Group B Hydraulic Tests in the same manner as required by the [ASME] OM Code. The preventive maintenance (PM) procedure will also typically be performed, which provides for vibration monitoring of specific pumps for PM and balancing, and includes vibration monitoring and trending of the HPCI pump to detect and monitor changes in equipment conditions. As shown in the HPCI pump configuration figure [December 6, 2012 letter], vibration monitoring is performed at locations required by the [ASME] OM Code and at additional locations within the scope of the PM procedure (perpendicular to the shaft in the horizontal and vertical positions at each bearing location and at axial direction to the shaft). Vibration monitoring

is thereby routinely performed for the Main pump, Booster pump, Speed Reduction Gearbox, and Steam Turbine. Using the vibration data collected at these points, when changes to PM program overall vibration occurs, accurate diagnosis may be conducted by analyzing the related vibration point spectrums. Planned maintenance may then be determined and initiated to prevent failures. Thus, HPCI pump vibration monitoring will be performed up to 8 times in 2 years as part of Group B Hydraulic Tests and preventive or corrective maintenance will be implemented as necessary to prevent failures.

5. [Pilgrim] will continue current HPCI pump and turbine monitoring and maintenance activities, with changes as conditions warrant, as follows:

- Quarterly pump and valve operability tests will be performed to ensure the HPCI pump and turbine function for the intended safety function.

- Quarterly lubrication oil sampling and periodic laboratory analysis as appropriate for the pressure-fed bearings on the Turbine, Main pump, and Gear Reducer and once/cycle (once every 2 years) sampling and analysis for the non-pressure fed Booster pump will be performed. The quarterly lubrication oil sampling analysis includes analysis for viscosity, water content, chemical changes, and contaminants including ferrous particles. The laboratory analysis performed once/cycle for the pressure-fed bearings on the turbine, main pump and gear reducer include, but are not limited to, particle wear analysis, acid number readings, analytical ferrogram and oxygen stability. This type of monitoring will detect degradation of the turbine or pump bearings due to accelerated wear, fretting, surface fatigue, or oil contamination. In addition to the above sampling, when the quarterly lubrication oil sampling analysis shows that a more detailed analysis is warranted, then an oil sample is also sent out for the more comprehensive laboratory analysis.

- HPCI pump and Turbine lube oil system will be serviced as needed weekly. HPCI gland seal condenser hot well pump and motor bearings and HPCI auxiliary lube oil pump and motor bearings are serviced semiannually for lubrication.

- HPCI Turbine/Main pump, Main Pump/Reducer, and Reducer/Booster pump gear- type shaft couplings are cleaned, examined, and grease-lubricated every 2 years. The Main Pump/Reducer and Reducer/Booster pump gear-type shaft couplings are cleaned, examined, and grease-lubricated every 4 years. These examinations detect excessive wear, fretting, heating, or fatigue due to any unusual loading conditions.

Past monitoring and maintenance activities have shown no evidence or observations of degradation in the HPCI turbine, Main pump, Gear Reducer, or Booster pump. Historical HPCI Main and Booster pump vibration spectra support this conclusion. Thus, the continuation of the above periodic monitoring and maintenance activities will ensure that the HPCI pump remains in a high level of operational readiness and that degradation of HPCI pump mechanical condition, reliability, or performance will be detected and corrected in a timely manner.

[Pilgrim] has conducted an evaluation of the HPCI pump vibration characteristics. An important finding of this evaluation is that the mechanical condition of the Main pump can be monitored satisfactorily by disregarding the single frequency component caused by the excitation at 4x Booster pump RPM. The four-vane impeller of the Booster pump generates the excitation force hydraulically. This small pressure pulsation force exists at the vane passing frequency (number of vanes times RPM) for all centrifugal pumps and is usually seen as a significant but not particularly troublesome component on the frequency spectrum for vibration measurements taken at the bearing housings. For the HPCI pump, this vane passing frequency is a problem because it coincides with a hydraulic standing wave resonance in the cross-over piping from the Booster pump to the Main pump when the machine is operating at the rated speed of 4000 RPM. There is an acoustic pressure standing wave pattern, at the 4x RPM frequency, whose wavelength in water is equal to an even fraction (1/4 or 1/2) of the dimensional length inside the cross-over pipe. This is the same principle on which an organ pipe generates a pure tone pneumatic pressure standing wave.

In addition, and exacerbating the vibration resonance condition, the Main pump pedestal experiences a horizontal structural primary rocking mode of the pump pedestal at this same frequency when the Main pump is operating at the rated speed of 4000 RPM. The vibration mode is the second fundamental rocking mode, which is a torsional or twisting mode where the two end bearings move 180 degrees out of phase horizontally. The result of these coincident acoustic and structural resonances is that the Main pump exhibits high vibration in the horizontal direction at the 4x Booster pump RPM frequency. This is solely due to the excitation from the booster pump being amplified by the coincident resonances. This level of vibration at 4x Booster pump RPM would be seen on the Main pump bearing housings even if the Main pump was not actually running (which is not possible as both pumps are on the same drive train).

The resonant vibration condition at the 4000 RPM operating speed is not detrimental and will not prevent the HPCI pump from fulfilling its function. At the 134 Hz frequency of the resonant vibration on the Main pump, caused by the excitation at 4x Booster pump RPM, the actual displacement amplitude at 0.7 in/sec peak velocity amplitude is 0.0017 inches peak-to-peak. This displacement imposes negligible alternating stresses on the pump pedestal, housings, and connected piping. The peak-to-peak displacement is also less than the main pump fluid film journal bearing clearances and would impose negligible loading to these bearings.

The purpose of the ASME OM Code for pump testing is to monitor pumps for degradation. The concept of vibration monitoring is to establish baseline values for vibration when the pump is known to be in good working condition, such as after a maintenance overhaul. From that reference point, trending is performed to monitor for degradation based on the ratio of subsequent vibration levels

relative to the reference values. The [ASME] OM Code also establishes absolute vibration level criteria for Alert (> 0.325 in/sec) and Required Action (> 0.70 in/sec). In doing so, it was recognized that absolute vibration level limits (as opposed to relative change or ratio limits) are not always quantitatively linked directly with pump physical condition and the following remarks are stated in the [ASME OM Code 2004 Edition through OMb-2006,
ISTB-3300(g) and ISTB-6400, footnote 1:]

> Vibration measurements of pumps may be foundation, driver, and piping dependent. Therefore, if initial vibration readings are high and have no obvious relationship to the pump, then vibration measurements should be taken at the driver, at the foundation, and on the piping and analyzed to ensure that the reference vibration measurements are representative of the pump and that the measured vibration levels will not prevent the pump from fulfilling its function.

A significant conclusion of the [Pilgrim] HPCI vibration evaluation is that supplemental performance monitoring of the Main pump, by disregarding the single frequency component caused by the excitation at 4x Booster pump RPM, provides an important tool for assessing and trending pump mechanical condition. A single peak frequency component can be effectively deleted from a vibration spectrum using the mean-squared subtraction method; that is, the discrete component amplitude (in/sec peak) is squared and subtracted from the spectrum overall level squared, then the square root of that difference represents the overall vibration level that exists without the energy contributed by the deleted component. It has been found that when this method is used, the remaining overall vibration level is much more consistent, stable, and trendable.

This method of vibration level correction has been applied to historical spectrums. The 4x Booster pump RPM component was taken out of the calculation for the Main pump overall vibration level. This data shows that when the 4x Booster pump RPM component is deleted from the Main pump vibration, the level is below the Required Action Range (>0.7 in/sec) but still within the Alert Range (>0.325 in/sec). It was also shown that the potential effects from the dynamic alignment of pump shaft couplings (at 2x Main pump RPM) can still be monitored effectively.

For the HPCI Main and Booster pumps, it has been determined that the vibration is foundation and piping dependent. To reduce the HPCI Main and Booster pump vibration down to levels that meet acceptable [ASME] OM Code vibration criteria requires modifications to the HPCI pump, mounting components, foundation and/or cross-over (interconnecting) piping.

As suggested in a Byron Jackson Tech Note [No. 9112-80-018], this vibration may be improved by modifying the interconnecting piping and the Main pump mounting pedestal. The alternative modification changes the Booster pump impeller from four to five vanes to alter the forcing function of the standing wave resonance.

The proposed Byron Jackson modifications, other than replacing the Booster pump impeller, are generally very difficult to implement successfully. Altering the natural frequency of a large pump installation requires either considerable additions of stiffening components or substantial additions of mass. Often the results of such design changes are unsuccessful or unfavorable due to the variable speed operation requirements.

> Modification of the HPCI Booster pump would require replacing the current four-vane impeller with an upgraded five-vane impeller. The impeller modification, although yielding predictable results, requires extensive work to the HPCI pump at a time when such a major rebuild of this pump is not otherwise necessary or desired. The expected result would be a modest decrease in the vibration caused on the Main pump at 4000 RPM, although the vibration would remain above the 0.325 in/sec Alert Range criteria. A small decrease in hydraulic performance is also expected when changing from a four to five-vane impeller. The proposed major modification would cost approximately $500,000 without a compensating improvement in the pump vibration. Most HPCI pump vibration points would not achieve the underlying objective of Criteria. Accordingly, the proposed modification would not achieve the underlying objective of performing the Code-required testing without the need for Code relief.
>
> [Pilgrim] has also concluded that none of the possible modifications that could be performed on the HPCI pump, mounting pedestal, or cross-over piping are necessary. This is primarily due to the nature of the HPCI pump service profile. The Byron Jackson Tech Note describes the following consideration in the Technical Discussion:
>
> > Pumping systems in which the vane passing pressure pulsations form standing waves in the attached piping are not unusual, especially if the pumps have a variable speed driver. Standing waves are highly dependent upon water temperature. Thus, measured vibration amplitudes often vary from test to test.
>
> The HPCI pump service is such that the pump runs for short periods of time at highly variable speeds. The pump [IST] at [Pilgrim] is performed with the pump operating at or close to its rated speed (4000 RPM) and flow conditions (4250 GPM [gallons per minute]) that are unique to [Pilgrim]. For this particular pump configuration, this pump speed corresponds to the point where the acoustic resonant vibration is typically most pronounced. In actual service for high pressure coolant injection to the reactor, the pump will operate at the speed that the flow controller requires to maintain reactor water level. The flow rate of 4250 GPM is the maximum makeup flow rate for which the HPCI System was intended to be capable of maintaining reactor water level. This flow rate is far in excess of the decay heat makeup water requirements for the reactor in the isolated condition in the absence of a major leak. The pump speed required is also dependent on reactor pressure with the required speed decreasing along with reactor pressure.
>
> The same general HPCI pump configuration is used at other plants but often with different pump impellers, rated speeds and plant design flow rates. The vibration

monitoring performed (including a frequency spectral review) to date under the IST program and the [Pilgrim] Pump Vibration Monitoring Program has shown that there has not been degradation of these HPCI pump components.

[IST] can be successfully performed for the [Pilgrim] HPCI pump using the methods proposed in this relief request, along with supplemental monitoring and maintenance activities currently in practice. Any significant degradation of the HPCI pump components will be readily identified using the vibration spectral analysis methods and monitoring activities described in the relief request. [...]

To allow for practicable monitoring of vibration levels on the HPCI pump, alternate vibration acceptance criteria are necessary. A full spectrum review will be performed for all IST vibration points during each proposed comprehensive test, utilizing the following criteria.

[Table-1 and Table-2] below provides the acceptance criteria that are applied to the overall vibration level for the Main pump. In addition to the ASME OM Code vibration monitoring as specified in Table-1, administrative (supplement) vibration performance monitoring will be performed by Pilgrim. The supplement performance monitoring activity will look at the modified (filtered) overall values (for point P3H and P4H) resulting from the extraction of the discrete peak at 4xBooster pump RPM (using the mean-squired subtraction method). The modified (corrected/filter) overall values for points P3H and P4H will be reviewed (in addition to the ASME OM Code specified vibration monitoring) separately for change and trend.

The table box data typed in ***bold italics*** have ***Alert vibration range*** values and corresponding ***Required Action vibration limits*** that have been modified from the ASME OM Code vibration criteria as follows:

- P3H & P4H – The ***Alert vibration range of 1.1*** V_r ***to 1.3*** V_r (in lieu of the [ASME] OM Code range of 2.5 V_r to 6 V_r) has been applied as the modified ASME OM vibration criteria (overall vibration) for points P3H and P4H. For these points the absolute limiting **Low** Alert values (i.e. 0.70 and 1.06 in/sec.) and absolute limiting **High** Alert values (i. e. 0.83 and 1.26 in/sec.) are based upon existing pump reference values. These two modified Alert ranges have been compared to historical pump vibration data. (The corresponding ***Required Action vibration limits*** were also modified to be consistent with the limiting High Alert values).

- P3V, P3A, P7H, P8H, P7V, & P8V – The ***Alert vibration range*** of 1.5 V_r to 6 V_r (in lieu of the [ASME] OM Code range of 2.5 V_r to 6 V_r) has been applied as the modified OM vibration criteria (overall vibration) for points P3V, P3A, P7H, P8H, P7V, and P8V. For these points the absolute limiting **Low** Alert values (i.e. 0.400, 0.450, and 0.500) are based upon existing pump reference values, and fall between the values of 1.25 V_r and 1.5 V_r.

- The Table rows for P4V and P8A are in compliance with [ASME] OM Code vibration criteria and have been placed into this Relief Request for information only.

Table-1, Main Pump**

Test Parameter	Vibration Point	Proposed Acceptable Range	Proposed Alert Range	Required Action Limit (Note 2)**
V_v	Main pump (Note 1)** Horizontal Inboard (P3H)	**$\leq$ 1.1V_r but not > 1.06 in/sec**	**> 1.1 V_r to 1.3 V_r or > 1.06 to 1.26 in/sec**	**> 1.3 V_r or > 1.26 in/sec**
V_v	Main pump (Note 1)** Horizontal Outboard (P4H)	**$\leq$ 1.1V_r but not > 0.700 in/sec**	**> 1.5 V_r to 6 V_r or > 0.700 to 0.83 in/sec**	**> 1.3 V_r or > 0.83 in/sec**
V_v	Main pump Vertical Inboard (P3V)	**$\leq$ 1.5V_r but not > 0.450 in/sec**	**> 1.5 V_r to 6 V_r or > 0.450 to 0.70 in/sec**	> 6 V_r or > 0.70 in/sec
V_v	Main pump Vertical Outboard (P4V)	$\leq$ 2.5V_r but not > 0.325 in/sec	> 2.5 V_r to 6 V_r or > 0.325 to 0.70 in/sec	> 6 V_r Or > 0.70 in/sec
V_v	Main pump Axial Inboard (P3A)	**$\leq$ 1.5V_r but not > 0.500 in/sec**	**> 1.5 V_r to 6 V_r or > 0.500 to 0.70 in/sec**	> 6 V_r or > 0.70 in/sec

Notes:

1. ** For the main pump horizontal vibration points P3H and P4H, a frequency spectrum analysis will be performed following each pump vibration operability test, and the discrete peak at 4x booster pump (4xBP) RPM will be extracted (using the mean-squared subtraction method) from the vibration spectrum overall value. In addition to the Alert and Required Action limits, the modified P3H and P4H overall values, resulting from the extraction of the discrete peak at 4xBP RPM, will be reviewed and trended as a supplemental vibration performance monitoring activity.

2. ** The Required Action Range for overall vibration of points P3V, P4V, and P3A meets the Code-required vibration values. The Required Action Range for overall vibration of points P3H and P4H has been increased to 1.3 V_r or 1.26 in/sec for P3H and 1.3 V_r or 0.83 in/sec for P4H.

Table-2, Booster Pump

Test Parameter	Vibration Point	Acceptable Range	Alert Range	Required Action Limit
V_v	Booster pump Horizontal Inboard (P7H)	**≤ 1.5V$_r$ but not > 0.450 in/sec**	**> 1.5 V$_r$ to 6 V$_r$ or > 0.450 to 0.70 in/sec**	> 6 V$_r$ Or > 0.70 in/sec
V_v	Booster pump Horizontal Outboard (P8H)	**≤ 1.5V$_r$ but not > 0.500 in/sec**	**> 1.5 V$_r$ to 6 V$_r$ or > 0.500 to 0.70 in/sec**	> 6 V$_r$ Or > 0.70 in/sec
V_v	Booster pump Vertical Inboard (P7V)	**≤ 1.5V$_r$ but not > 0.400 in/sec**	**> 1.5 V$_r$ to 6 V$_r$ or > 0.400 to 0.70 in/sec**	> 6 V$_r$ Or > 0.70 in/sec
V_v	Booster pump Vertical Outboard (P8V)	**≤ 1.5V$_r$ but not > 0.500 in/sec**	**> 1.5 V$_r$ to 6 V$_r$ or > 0.500 to 0.70 in/sec**	> 6 V$_r$ Or > 0.70 in/sec
V_v	Booster pump Axial Outboard (P8A)	≤ 2.5V$_r$ but not > 0.325 in/sec	> 2.5 V$_r$ to 6 V$_r$ or > 0.325 to 0.70 in/sec	> 6 V$_r$ Or > 0.70 in/sec

3.1.1 NRC Staff Evaluation of PR-03, Revision 4

Paragraph ISTB-5123(d) of the ASME OM Code requires that vibration (displacement or velocity) shall be determined and compared with corresponding reference values. Vibration measurements are to be broad band (unfiltered). If velocity measurements are used, they shall be peak. If displacement amplitudes are used, they shall be peak-to-peak.

Paragraph ISTB-5123(e) of the ASME OM Code requires that all deviations from the reference values shall be compared with the range of Tables ISTB-5121-1 and corrective action taken as specified in paragraph ISTB-6200. The vibration measurements shall be compared to both the relative and absolute criteria shown in the Alert and Required Action Range of Table ISTB-5121-1. For example, if vibration exceeds either 6 V_r or 0.7 in/sec, the pump is in the Required Action Range.

Paragraph ISTB-3540 of the ASME OM Code requires that for centrifugal pumps, measurements shall be taken in a plane approximately perpendicular to the rotating shaft in two approximately orthogonal directions on each accessible pump bearing housing. The Code further states that measurements shall be taken in the axial direction on each accessible pump thrust bearing housing. ASME OM Code, Table ISTB-5121-1 requires pumps with vibration levels between 0.325 in/sec and 0.70 in/sec be classified in the "alert" range and that the testing frequency be doubled until the cause of the vibration is determined and the condition corrected (ISTB-6200(a)). Paragraph ISTB-6200(b) of the ASME OM Code requires that if the measured values fall within the required action range of Table ISTB-5121-1, the pump shall be declared inoperable until the cause of the vibration is determined and the condition corrected.

The HPCI pump at Pilgrim consists of a Main pump and a Booster pump with a speed-reducing gear driven by a common steam turbine. The licensee stated that because of this configuration, both pumps must be tested simultaneously and elevated vibration levels have been recorded at the Main and Booster pump bearings of both pumps. The HPCI pump has exhibited high vibration that exceeds the ASME OM Code Required Action Range of 0.70 in/sec since its installation. The Main pump and Booster pump have historically exhibited an inherently high base vibration (greater than 0.325 in/sec). Additionally, the Main pump has a peak in the horizontal direction that exceeds 0.70 in/sec. The licensee stated that this vibration level is caused by a resonant frequency in the crossover piping that is excited by the Booster pump vane pass frequency. The licensee characterized this high bearing vibration level as the normal vibration level of the HPCI pump bearings. Due to costs associated with potential modifications to address this condition and the low likelihood of their success, the licensee stated that compliance with the ASME OM Code requirements for the HPCI pump would result in a hardship without a compensating increase in the level of quality and safety.

The licensee measures vibrations at the following points on the HPCI main pump and booster pump:

P3H - HPCI Main Pump Turbine-End Horizontal (inboard)

P3V - HPCI Main Pump Turbine-End Vertical (inboard)

P3A - HPCI Main Pump Turbine-End Axial (inboard)

P4H - HPCI Main Pump Gear Box-End Horizontal (outboard)

P4V - HPCI Main Pump Gear-Box-End Vertical (outboard)

P7H - HPCI Booster Pump Gear Box-End Horizontal (inboard)

P7V - HPCI Booster Pump Gear Box-End Vertical (inboard)

P8H - HPCI Booster Pump -End Horizontal (outboard)

P8V - HPCI Booster Pump -End Vertical (outboard)

P8A - HPCI Booster Pump -End Axial (outboard)

The HPCI Main pump and Booster pump vibration measurements provided by the licensee with the alternative request and responses to the NRC staff's request for additional information (RAI) are in the form of velocity curves. The peak values of vibration (unfiltered) are as follows:

Table-3, HPCI Main Pump and Booster Pump Vibration Velocity In/Sec										
Date	HPCI Main Pump Location Point					HPCI Booster Pump Location Point				
	P3H	P3V	P3A	P4H	P4V	P7H	P7V	P8H	P8V	P8A
23-Feb-2005	0.703	0.241	N/A	0.640	N/A	0.223	0.193	N/A	N/A	N/A
25-May-2005	0.969	0.354	N/A	0.611	N/A	0.347	0.253	N/A	N/A	N/A
26-Aug-2005	0.829	0.294	N/A	0.559	N/A	0.323	0.296	N/A	N/A	N/A
22-Nov-2005	0.815	0.327	0.374	0.559	0.155	0.333	0.240	0.367	0.352	0.173
24-Feb-2006	0.682	0.327	0.383	0.661	0.167	0.319	0.249	0.345	0.323	0.169
23-May-2006	0.960	0.307	0.432	0.645	0.162	0.337	0.249	0.410	0.354	0.167
21-Aug-2006	1.053	0.292	0.410	0.676	0.166	0.354	0.237	0.392	0.350	0.162
20-Nov-2006	0.850	0.312	0.368	0.593	0.143	0.345	0.273	0.376	0.352	0.165
21-Feb-2007	0.776	0.312	0.384	0.538	0.140	0.303	0.211	0.368	0.323	0.153
09-May-2007	0.795	0.314	0.357	0.592	0.153	0.307	0.275	0.401	0.305	0.152
21-Aug-2007	1.057	0.278	0.402	0.688	0.151	0.341	0.258	0.420	0.342	0.161
20-Nov-2007	0.793	0.316	0.366	0.576	0.150	0.326	0.256	0.409	0.353	0.162
21-Feb-2008	0.726	0.338	0.363	0.596	0.178	0.307	0.335	0.372	0.332	0.159
05-May-2008	0.931	0.281	0.406	0.617	0.161	0.335	0.248	0.417	0.345	0.162
22-May-2009	0.812	0.320	0.581	N/A	0.156	0.321	0.263	0.348	0.334	0.161
18-Feb-2010	0.736	0.332	0.331	0.467	0.144	0.280	0.223	0.369	0.337	0.155
16-Aug-2011	0.874	0.280	0.341	0.726	0.172	0.326	0.279	0.389	0.359	0.163
14-Feb-2012	0.700	0.353	0.333	0.739	0.177	0.302	0.302	0.394	0.374	0.163
29-May-2013	0.744	0.389	0.312	0.707	0.222	0.317	0.241	0.386	0.353	N/A

Notes:

1. ASME OM Code ISTB Table ISTB-5121-1 Alert Range is 0.325 to 0.7 in/sec and Required Action Range is > 0.7 in/sec.
2. HPCI main pump points (P3V, P3A, and P4V) vibration values are below or within the Alert Range and P3H and P4H are in Required Action Range.
3. All HPCI booster pump points (P7H, P7V, P8H, P8V, and P8A) vibration amplitudes are below or within Alert Range.
4. All the historical vibration data (before 2005) are typically in the same range as in the table.
5. All historical data before 2007 and May 05, 2008 are taken from Entergy letter dated January 31, 2008 (ADAMS Accession No. ML080460065).
6. Booster point P8A vibration amplitude meets the ASME OM Code acceptance criteria.

The licensee proposed to use the acceptance criteria specified in Tables 1 and 2 for the HPCI Main and Booster pump. The proposed acceptance criteria raise the lower alert limit for vibration velocity for the Main pump bearing points P3H, P3V, P3A, P4H, and P4V (Table-1), and for the Booster pump bearing points P7H, P7V, P8H, and P8V (Table-2) beyond the ASME OM Code allowed value. The HPCI Booster pump P8A is the only point that meets the ASME OM Code acceptance range of 0.325 in/sec, and would be evaluated using the ASME OM Code, Subsection ISTB, acceptance criteria. Except the Main pump bearing points P3H and P4H, all the Main pump and Booster pump bearing points meet the ASME OM Code Required Action Range requirements. The Required Action Range for the Main pump bearing points P3H and P4H is modified with upper limits of 1.26 in/sec and 0.83 in/sec, respectively.

The licensee acceptance criteria for the main pump and booster pumps are specified in Table-1 and Table-2. These tables are revised to include the ASME OM Code acceptance criteria. The new tables are Table-4 (same as Table-1) and Table-5 (same as Table-2) with ASME OM Code values. For points Main Pump P3H and P4H, the licensee stated that in addition to the ASME OM Code vibration monitoring as specified in Table-1 (or Table-4), administrative (supplemental) vibration performance monitoring will be performed. The supplemental performance monitoring activity will look at the modified (filtered) overall values for point P3H and P4H resulting from the extraction of the discrete peak at 4x Booster pump RPM using the mean-squared subtraction method. The modified (corrected/filter) overall values for points P3H and P4H will be reviewed, in addition to the ASME OM Code specified vibration monitoring, separately for change and trend. Since the ASME OM Code requires that vibration measurements be broad band (unfiltered), the NRC staff finds that the licensee proposal to use both approach (unfiltered and filtered) peak values acceptable. Table-4 and Table-5 are based on unfiltered vibration values, and therefore, are acceptable.

Table-4, Main Pump (same as Table-1 with ASME OM Code values)

Test Parameter	Vibration Point	Acceptable Range	Alert Range	Required (Note 2)* Action Range
OM Code Table ISTB-5121-1, V_v		**≤ $2.5V_r$**	**> 2.5 V_r to 6 V_r or >0.325 to 0.70 in/sec**	**> 6 V_r Or > 0.70 in/sec**
V_v (Proposed) Notes 1 and 2	Main pump (Note 1)** Horizontal Inboard (P3H)	≤ $1.1V_r$ but not > 1.06 in/sec	> 1.1 V_r to 1.30 V_r or > 1.06 to 1.26 in/sec	> 1.30 V_r Or > 1.26 in/sec
V_v (Proposed) Notes 1 and 2	Main pump (Note 1)** Horizontal Outboard (P4H)	≤ $1.1V_r$ but not > 0.700 in/sec	> 1.5 V_r to 6 V_r or > 0.700 to 0.83 in/sec	> 1.30 V_r or > 0.83 in/sec
V_v (Proposed)	Main pump Vertical Inboard (P3V)	≤ $1.5V_r$ but not > 0.450 in/sec	> 1.5 V_r to 6 V_r or > 0.450 to 0.70 in/sec	> 6 V_r or > 0.70 in/sec
V_v (Proposed)	Main pump Vertical Outboard (P4V)	≤ $2.5V_r$ but not > 0.325 in/sec	> 2.5 V_r to 6 V_r or > 0.325 to 0.70 in/sec	> 6 V_r or > 0.70 in/sec
V_v (Proposed)	Main pump Axial Inboard (P3A)	≤ $1.5V_r$ but not > 0.500 in/sec	> 1.5 V_r to 6 V_r or > 0.500 to 0.70 in/sec	> 6 V_r or > 0.70 in/sec

Notes:

1. **Main Pump vibration ranges are peak values without filtering the peak. Other than peak values at points P3H and P4H, all other measured values at P3H and P4H are below the ASME OM Code allowable values.
2. *Required Action Range for points P3V, P4V and P3A meets the ASME OM Code required vibrations values, and Required Action Range for peak vibration at points P3H and P4H is increased as proposed. to 1.3 V_r (1.26 in/sec for P3H and 0.83 in/sec for P4H)

Table-5, Booster Pump (same as Table-2 with ASME OM Code values)

Test Parameter	Vibration Point	Acceptable Range	Alert Range	Required Action Limit
ASME OM Code Table ISTB-5121-1, V_v		**≤ $1.5V_r$**	**> 1.5 V_r to 6 V_r**	**> 6 V_r Or > 0.70 in/sec**
V_v	Booster pump Horizontal Inboard (P7H)	≤ $1.5V_r$ but not > 0.450 in/sec	> 1.5 V_r to 6 V_r or > 0.450 to 0.70 in/sec	> 6 V_r Or > 0.70 in/sec
V_v	Booster pump Horizontal Outboard (P8H)	≤ $1.5V_r$ but not > 0.500 in/sec	> 1.5 V_r to 6 V_r or > 0.500 to 0.70 in/sec	> 6 V_r Or > 0.70 in/sec
V_v	Booster pump Vertical Inboard (P7V)	≤ $1.5V_r$ but not > 0.400 in/sec	> 1.5 V_r to 6 V_r or > 0.400 to 0.70 in/sec	> 6 V_r Or > 0.70 in/sec
V_v	Booster pump Vertical Outboard (P8V)	≤ $1.5V_r$ but not > 0.500 in/sec	> 1.5 V_r to 6 V_r or > 0.500 to 0.70 in/sec	> 6 V_r Or > 0.70 in/sec
V_v	Booster pump Axial Outboard (P8A)	≤ $2.5V_r$ but not > 0.325 in/sec	> 2.5 V_r to 6 V_r or > 0.325 to 0.70 in/sec	> 6 V_r Or > 0.70 in/sec

The vibration acceptance criteria as specified in Table-4 (Main pump) and Table-5 (Booster pump) are acceptable as discussed below.

In response to a previous concern raised by NRC staff, the licensee submitted an independent vendor report, "Independent Assessment of the Pilgrim HPCI Pump Vibration and Performance," by Mancini Consulting Services, dated January 2008 (ADAMS Accession No. ML080460065). This report provides an independent assessment of the Pilgrim HPCI pump elevated vibration levels and pump performance and acceptance.

The NRC staff is aware that HPCI pumps at various nuclear plants have a history of vibration issues. In response to a RAI, the licensee provided Byron Jackson Technical Note No. 9112-80-018 (ADAMS Accession No. ML040580121). Byron Jackson, the HPCI pump vendor, performed a study of HPCI pump vibration at various nuclear plants, including Pilgrim, and issued their finding as Technical Note No. 9112-80-018. Byron Jackson's Technical Note states that if bearing housing vibration exceeds the Alert limits in the ASME Code, Section XI (now the ASME OM Code), the following actions are recommended: (i) verify correct dynamic alignment of all shaft couplings; (ii) verify acoustic resonant condition from measured flow, pump speed RPM, water temperature, and vibration frequency; and (iii) replace four vane booster pump impeller with a staggered five vane impeller.

The NRC staff finds that the proposed Byron Jackson modifications, other than replacing the Booster pump impeller, are generally very difficult to implement successfully. The NRC staff also notes that altering the natural frequency of a large pump installation requires either additions of stiffening components or additions of mass. The results of such design changes may be unsuccessful or unfavorable due to the variable speed operation requirements. Further, the impeller modification from four vanes to five vanes may yield some unpredictable results and requires extensive work to the HPCI pump at a time when such a major rebuild of this pump is not otherwise necessary or desired. Pilgrim submitted an independent assessment report of HPCI pump vibration which concludes that "(1) crossover piping modification by increasing the pipe length or diameter will reduce the acoustic frequency and a lower acoustic frequency will result in higher vibration at lower speed; and (2) the modified impeller (from four vanes to five vanes) will excite the acoustic resonance when the pumps are running at a lower speed. This scenario is much more troubling than the known condition in which the pump is now being tested."

The NRC staff reviewed the past and present vibration data for the Main and Booster pump, which shows that there has been no major change in the magnitude of vibration. Based on historical and recent vibration data and independent review by a pump consultant, the NRC staff finds that these data ensure the continued operational readiness of HPCI pump to meet its safety function.

While using the alternative acceptance criteria, as reflected in Table-4 and Table-5, the licensee will perform HPCI pump condition monitoring, including spectrum analysis, vibration monitoring and maintenance activities, in addition to the ASME OM Code requirements.

The NRC staff has considered the licensee's proposed enhanced monitoring and maintenance activities as described above, and the fact that vibration measurements show that vibration levels are consistent even though they exceed the ASME OM Code values using the current test methodology. Therefore, the NRC staff finds that the licensee's alternative to raise the alert range and required action range for these specific measurement points (Table-4 and Table-5) provides sufficient assurance of operational readiness of the HPCI pump.

In January 2008, the "Independent Assessment of Pilgrim HPCI Pump Vibration and Performance" by Mancini Consulting Service also concludes that (a) the Pilgrim HPCI pump has not degraded during its 35 years of service due to the observed pump vibration, and (b) the proposed HPCI pump IST and monitoring activities successfully monitor pump health, and ensure the continued operational readiness of this pump to meet its safety function.

The licensee's evaluation of the HPCI pump vibration issue, coupled with the historical pump vibration data, and HPCI pump vibration and performance assessment by an independent consultant show that the pump normally runs at high levels of vibration and has not experienced any failure to date. Due to the costs associated with the potential modification to address the elevated vibration level, and the low likelihood of its success, the compliance with the ASME OM Code requirements for the HPCI pump would result in a hardship without a compensating increase in the level of quality and safety. The proposed alternative coupled with additional pump monitoring, including spectrum analysis, vibration monitoring and maintenance activities provide reasonable assurance of operational readiness because the licensee will maintain consistent (alternative) alert ranges and action ranges.

3.2 Relief Request PR-05, Revision 1

Paragraph ISTB-5300, "Positive Displacement Pumps," (a), "Duration of Tests," (1) states that "For the Group A test and the comprehensive test, after pump conditions are as stable as the system permits, each pump shall be run at least 2 min. At the end of this time at least one measurement or determination of each of the quantities required by Table ISTB-3000-1 shall be made and recorded."

The applicable ASME OM Code edition and addenda for Pilgrim is the 2004 Edition through the OMb-2006 Addenda.

The licensee requested to use a modified biennial comprehensive test for SLC pumps P-207A and P-207B. These pumps are Class 2 pumps and are classified as Group B pumps.

Reason for Request

The licensee stated:

> The SLC pumps are categorized as Group B (standby system) pumps. During the hydraulic portion of the comprehensive pump test, the SLC pumps are tested by pumping fluid from the SLC storage tank into a test tank. The test tank capacity does not allow operation of the pump for much longer than three minutes.
>
> The SLC system was not designed with flow meter instrumentation in the flow test loop and uses a test tank to determine flow rate by measuring the change in tank level over a period of time. Due to physical limitations of the size of the tank, the pump run time for measuring the hydraulic test parameter of flow rate is limited. Design, fabrication, and installation changes would have to be made to

> comply with the ISTB-5300(a) requirement. The two minute hold time is an [ASME] OM Code requirement in order to achieve stable pump performance parameters before the test data is recorded. The present surveillance test procedure has provided consistent hydraulic test results and produces good repeatability.
>
> When using the test tank flow circuit, the pump suction pressure remains constant because the pump suction is aligned to the SLC storage tank (insignificant tank level change), and the pump discharge head remains constant because the test tank discharge piping is not submerged (no back pressure from the test tank fluid level).

In response to a RAI, the licensee stated:

> Ultrasonic (UT) flow instrumentation has been considered for flow measurement of the SLC pumps. Historically, two efforts to install and utilize a UT flow system (both portable and permanent units) through the plant design change process have been attempted for SLC pump flow measurement. These flow systems were later abandoned due to intermittent erratic flow measurement readings and overall unacceptable flow repeatability. The SLC pump system has limited sections of straight piping that are not impacted by upstream tee fittings, elbows, and/or valves in the discharge test line. These pipe sections experience high levels of turbulence, which undermines UT flow signal reliability. Other straight piping sections in the test loop do not remain completely full of fluid (required for reliable UT signal), which also impacts UT flow signal reliability and measured flow rate. Benchmark testing of the previously installed UT flow meters has shown that modification of the SLC test circuit piping will most likely be necessary to implement reliable and repeatable UT flow system testing.
>
> The test tank measurement methods for the SLC pumps are highly accurate, as measuring the volume that a pump system delivers over a specified period of time is a reliable and repeatable method for determining flow rate. Measuring the fluid volume or fluid weight that a pump delivers over a specified period is a commonly applied method for determining actual flow rate when calibrating ultrasonic flow meters. It is believed that replacement of the flow measurement tank with ultrasonic flow meters, and implementation of associated SLC discharge pipe modifications, would not produce flow measurement results that are more accurate or repeatable than the current method of determining system flow rate through measuring test tank level change.
>
> Replacement of the SLC pump test loop flow measurement test tank with a larger size would not significantly increase pump flow measurement accuracy or repeatability, as the current flow measurement configuration meets a high standard for accuracy and repeatability. The marginal benefit that might be realized would not change the observed IST results or improve pump hydraulic performance monitoring.
>
> Therefore, [Pilgrim] believes that installing a larger test tank and/or installing a UT flow measurement system to facilitate pump testing in accordance with the

ASME OM Code would impose a hardship without a compensating increase in level of quality and safety.

Proposed Alternative

The licensee stated:

> During testing, initial test conditions are established by operating each SLC pump in recirculation mode and adjusting the pump discharge test flow (throttle) valve to obtain the test reference discharge pressure. Once the reference test pressure has been established and stable conditions are observed, the pump is stopped and the pump discharge path is realigned to the test tank. Next the pump is started, the reference pressure is again verified while pumping into the test tank, and the pump is again stopped. After the initial test tank level is measured, the pump is restarted and allowed to run for exactly three minutes. The test tank final level is measured and the pump flow rated is calculated. Pump flow rate calculations meet the requirements of Table ISTB-3510-1 for measured values.

3.2.1 NRC Staff Evaluation of PR-05, Revision 1

The ASME OM Code requires that pump flow rate be measured in order to determine the extent of any pump degradation. The two minute run time is required in order to achieve stable pump performance parameters before data are recorded during the test. The positive displacement SLC pumps, P-203A and P-203B, utilized at Pilgrim are designed to pump a constant flow rate, regardless of system resistance. The SLC system was not designed with a flow meter in the flow loop and uses a test tank to determine flow rate by measuring the change in tank level over a period of time. Due to the physical limitations of the size of the tank, the pump run time is limited when using this test methodology. Design, fabrication, and installation changes would have to be made to comply with the ASME OM Code requirements. As an alternative to the ASME OM Code requirements, the licensee is proposing to measure the flow rate by determining the change in tank level over a period of time and calculating an average flow rate into the tank. The change in flow resistance due to the rising tank level will be small in comparison with the pump discharge pressure, thereby having no significant effect on the test results. Provided the tank level at the beginning of each test is approximately the same, repeatable results can be achieved. In addition, the suction is a large source at a constant pressure, which will allow for pump performance parameters to stabilize quickly. This method is consistent with the methodology used during the previous IST intervals and provides reasonable assurance of the pump's operational readiness when the test tank test level is measured in accordance with the accuracy requirements of Table ISTB-3510-1. Implementing procedures include the calculation methodology and any test conditions required to achieve this accuracy.

As a result, the NRC staff has determined that requiring the licensee to install a larger test tank to facilitate the pump testing in accordance with the ASME OM Code would result in hardship without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff has concluded that the proposed alternatives for Relief Requests PR-03, Revision 4 and PR-05, Revision 1 provide reasonable assurance that the components are operationally ready. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a, and is in compliance with the ASME OM Code requirements. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the NRC staff authorizes the licensee's proposed alternatives for Relief Requests PR-03, Revision 4 and PR-05, Revision 1 for the fifth IST 10-year interval at Pilgrim for the duration of December 7, 2012 through December 6, 2022.

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

Principal Contributor: Gurjendra S. Bedi

Date: August 1, 2014

If you have any questions, please contact the Pilgrim Project Manager, Nadiyah Morgan, at (301) 415-1016.

Sincerely,

/RA/

Benjamin G. Beasley, Chief
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-293

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

DISTRIBUTION:

PUBLIC	RidsNrrDorlLpli-1	RidsAcrsAcnw_MailCTR
LPLI-1 R/F	RidsNrrLAKGoldstein	G. Bedi, NRR
RidsNrrDorlDpr	RidsRgn1MailCenter	RidsNrrPMPilgrim
RidsNrrDeEpnb		

ADAMS ACCESSION NO: ML14198A157 ***See dated memo**

OFFICE	LPLI-1/PM	LPLI-1/LA	DE/EPNB/BC	LPLI-1/BC
NAME	NMorgan	KGoldstein (SFigueroa for)	TLupold	BBeasley
DATE	07/30/14	07/25/14	6/19/2014	08/01/14

OFFICIAL RECORD COPY