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

June 26, 2017

Mr. Marty L. Richey, Site Vice President
FirstEnergy Nuclear Operating Company
Beaver Valley Power Station
Mail Stop A-BV-SEB1
P.O. Box 4, Route 168
Shippingport, PA 15077

SUBJECT: BEAVER VALLEY POWER STATION, UNIT NO. 1 – REQUESTS FOR ALTERNATIVES AND REQUESTS FOR RELIEF RE: FIFTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL (CAC NOS. MF8332, MF8334, MF8336, MF8337, MF8340, MF8342, MF8344, MF8346, MF8348, MF8350, MF8351, MF8353, MF8354, MF8355, AND MF8357)

Dear Mr. Richey:

By letter dated August 31, 2016, as supplemented by letter dated February 22, 2017, FirstEnergy Nuclear Operating Company, et al. (the licensee) submitted requests to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives for and relief from certain American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code) requirements at Beaver Valley Power Station (Beaver Valley), Unit No. 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the alternatives in requests PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3 on the basis that the alternatives provide an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the proposed alternatives in requests PR9, PR10, PR11, and PR12 on the basis that the ASME OM Code requirements present an undue hardship, without a compensating increase in the level of quality or safety. Pursuant to 10 CFR 50.55a(f)(5)(iii), the licensee requested to use the proposed alternatives in requests PR5, PR6, and PR7 on the basis that the ASME OM Code requirements are impractical.

The NRC staff determined that for the requests to use the alternatives in requests PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3 for Beaver Valley, Unit No. 1, the proposed alternatives provide an acceptable 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)(1) for requests PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3. Therefore, the NRC staff authorizes the use of the alternative requests PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3 for Beaver Valley, Unit No. 1, for the fifth 10-year inservice testing (IST) program interval, which begins on September 20, 2017, and is scheduled to end on September 19, 2027.

The NRC staff determined that for requests to use alternatives in requests PR9, PR10, PR11, and PR12 for Beaver Valley, Unit No. 1, the proposed alternatives provide reasonable assurance that the affected 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(z)(2) for requests PR9, PR10, PR11, and PR12. Therefore, the NRC staff authorizes the use of the alternative requests PR9, PR10, PR11, and PR12 for Beaver Valley, Unit No. 1, for the fifth 10-year IST program interval, which begins on September 20, 2017, and is scheduled to end on September 19, 2027.

The NRC staff has determined that it is impractical for the licensee to comply with certain testing requirements of the ASME OM Code. The NRC staff has further determined that granting relief requests PR5, PR6, and PR7 in accordance with 10 CFR 50.55a(f)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(f)(5)(iii), and is in compliance with the requirements of 10 CFR 50.55a with the granting of these reliefs. Therefore, the NRC staff grants relief pursuant to 10 CFR 50.55a(f)(6)(i), for the testing alternatives contained in relief requests PR5, PR6, and PR7 for Beaver Valley, Unit No. 1, for the fifth 10-year IST interval, which begins on September 20, 2017, and is scheduled to end on September 19, 2027.

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

If you have any questions regarding this matter, I may be reached at (301) 415-2934 or Booma.Venkataraman@nrc.gov.

Sincerely,

James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-334

Enclosure:
Safety Evaluation

cc w/enclosures: Distribution via Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST NUMBERS PR2, PR3, PR4, PR5, PR6, PR7, PR8, PR9, PR10, PR11, PR12, PR13, PR14, VR2, AND VR3 FOR THE FIFTH 10-YEAR INTERVAL INSERVICE TESTING PROGRAM

BEAVER VALLEY POWER STATION, UNIT NO. 1

FIRSTENERGY NUCLEAR OPERATING COMPANY

DOCKET NO. 50-334

1.0 INTRODUCTION

By letter dated August 31, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16245A320), as supplemented by letter dated February 22, 2017 (ADAMS Accession No. ML17054C280), FirstEnergy Nuclear Operating Company (the licensee) submitted requests to the U.S. Nuclear Regulatory Commission (NRC or the Commission) for the use of alternatives for and relief from certain American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code) requirements at Beaver Valley Power Station (BVPS), Unit No. 1 (BVPS-1).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the alternatives PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3 on the basis that the alternative provides an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(z)(2), the licensee requested to use the proposed alternatives in requests PR9, PR10, PR11, and PR12 on the basis that the ASME OM Code requirements present an undue hardship, without a compensating increase in the level of quality or safety. Pursuant to 10 CFR 50.55a(f)(5)(iii), the licensee requested to use the proposed alternatives in requests PR5, PR6, and PR7 on the basis that the ASME OM Code requirements are impractical.

The BVPS-1 fifth 10-year inservice testing (IST) program interval begins on September 20, 2017, and is scheduled to end on September 19, 2027. The applicable ASME OM Code edition and addenda for the BVPS-1 fifth 10-year IST program interval is the 2004 Edition through the 2006 Addenda.

2.0 REGULATORY EVALUATION

The regulations in 10 CFR 50.55a(f), state, in part, that IST of certain ASME Code Class 1, 2, and 3 pumps and valves must be performed in accordance with the specified ASME OM Code and applicable addenda incorporated by reference in the regulations, except where alternatives have been authorized by the NRC pursuant to 10 CFR 50.55a(z)(1) or 10 CFR 50.55a(z)(2).

The regulations in 10 CFR 50.55a(z), state, in part, that alternatives to the requirements in 10 CFR 50.55a(f) may be used, when authorized by the NRC, if the licensee demonstrates that (1) the proposed alternatives would provide an acceptable level of quality and safety or (2) compliance with the specified requirements would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

The regulation in 10 CFR 50.55a(f)(5)(iii) requires that if a licensee has determined that conformance with certain code requirements is impractical for its facility, the licensee shall notify the Commission and submit information to support the determination.

The regulation in 10 CFR 50.55a(f)(5)(iv) requires that where a pump or valve test requirement by the code or addenda is determined to be impractical by a licensee and is not included in the revised IST program as permitted by 10 CFR 50.55a(f)(4), the basis for this determination must be submitted for NRC review and approval no later than 12 months after the expiration of the initial 120-month interval of operation from the start of facility commercial operation, and each subsequent 120-month interval of operation during which the test is determined to be impractical.

The regulation in 10 CFR 50.55a(f)(6)(i) states that the Commission will evaluate determinations under 10 CFR 50.55a(f)(5) that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

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

3.0 TECHNICAL EVALUATION

3.1 Licensee's Alternative Request Number PR2

In its submittal dated August 31, 2016, the licensee requested alternatives to the instrument range requirements of the ASME OM Code. ISTB-3510, "General," (b) "Range," (1) states, in part, "[t]he full-scale range of each analog instrument shall be not greater than three times the reference value." The licensee has requested to use the proposed alternatives described below for the instruments listed in Table 1.

Table 1: IST Pump Instrumentation for Request Number PR2

Instrument ID	Pump ID
PI-1CC-100A PI-1CC-100B PI-1CC-100C	1CC-P-1A 1CC-P-1B 1CC-P-1C
FI-1CC-117	1CC-P-1A 1CC-P-1B 1CC-P-1C
PDI-1CC-118	1CC-P-1A 1CC-P-1B 1CC-P-1C

PDI-1CC-119	1CC-P-1A 1CC-P-1B 1CC-P-1C
FI-1FW-100A FI-1FW-100B FI-1FW-100C	1-FW-P-3A 1-FW-P-3B
PI-1FW-156 PI-1FW-156A PI-1FW-156B	1FW-P-2 1FW-P-3A 1FW-P-3B

3.1.1 Instruments P1-1CC-100A, PI-1CC-100B, and PI-1CC-100C

3.1.1.1 Reason for Request

In its submittal, the licensee stated that the discharge pressure gauges PI-1CC-100A, PI-1CC-100B, and PI-1CC-100C for the reactor plant component cooling water pumps (CCR) 1CC-P-1A, 1CC-P-1B, and 1CC-P-1C have a range of 0 to 400 pounds per square inch gauge (psig). Typical pressure readings are slightly lower than one-third the range and vary between 115 and 123 psig due to the use of a pump curve. The calibration accuracy of the gauges is ±1 percent (%), which would yield a reading more accurate than the ASME OM Code requirements. The use of these pressure gauges is applicable to Group A tests only since the combination of range and accuracy yields a reading of ±3.5%, which is less than the ±6% required by the ASME OM Code for the Group A test. During comprehensive testing, temporary pressure instrumentation will be used, having a calibrated accuracy of at least ±0.5% of full scale with a sufficient range to satisfy the ±1.5% required by the ASME OM Code for the comprehensive test.

3.1.1.2 Proposed Alternative

The instruments P1-1CC-100A, PI-1CC-100B, and PI-1CC-100C may be used for Group A tests, as long as the combination of the higher range and better accuracy for each instrument yields a reading at least equivalent to the reading achieved from instruments that meet ISTB-3510(b)(1).

3.1.1.3 NRC Staff Evaluation

Despite the fact that the discharge pressure gauges PI-1CC-100A, PI-1CC-100B, and PI-1CC-100C do not meet the ASME OM Code requirement for range, they are capable of providing an indicated accuracy at the reference value that is superior to the minimum indicated accuracy that would be required by the ASME OM Code. Based on the least accurate instrument that would theoretically be allowed by the ASME OM Code, the minimum required indicated accuracy is ±6% for Group A tests. This is documented in Section 5.5.1, "Range and Accuracy of Analog Instruments," of NUREG-1482, Revision 2, "Guidelines for Inservice Testing at Nuclear Power Plants," published October 2013 (ADAMS Accession No. ML13295A020). The indicated accuracy of PI-1CC-100A, PI-1CC-100B, and PI-1CC-100C, as derived based upon the current reference value, is as follows:

Minimum reference value = 115 psig
Full scale range = 400 psig
Instrument tolerance = ±1% x 400 psig = ±4 psig

Therefore, the indicated accuracy is as follows:

±4 psig / 115 psig x 100% = ±3.5%

As demonstrated above, the indicated accuracies of PI-1CC-100A, PI-1CC-100B, and PI-1CC-100C are better than what is theoretically allowed by the ASME OM Code. The reading accuracies achieved from the installed instruments meet the intent of the ASME OM Code and yield an acceptable level of quality and safety for Group A tests.

3.1.2 Instrument FI-1CC-117

3.1.2.1 Reason for Request

In its submittal, the licensee stated that the flow indicator FI-1CC-117 is located in a branch line of the component cooling water system and is used only if the installed pressure differential indicators (PDIs) are over-ranged. In that case, the typical flow expected would be enough to meet the ASME OM Code requirements, except for FI-1CC-117, which could be placed in service with a flow as low as 4,000 gallons per minute (gpm). FI-1CC-117 is sized for all flow conditions with a range of 0 to 14,000 gpm and a loop accuracy of 1.5%. It is in the 24-inch river water CCR header supplying cooling loads inside containment. When the residual heat removal (RHR) system is in operation, the flow through this line is significantly higher. The calibration accuracy of this gauge would yield a reading more accurate than the ASME OM Code requirements. This flow instrument may be used during both Group A and comprehensive tests since the combination of range and accuracy yields a reading of ±5.53%, which is less than the ±6% required by the ASME OM Code.

3.1.2.2 Proposed Alternative

The instrument FI-1CC-117 may be used for Group A and comprehensive tests, as long as the combination of the higher range and better accuracy for the instrument yields a reading at least equivalent to the reading achieved from instruments that meet ISTB-3510(b)(1).

3.1.2.3 NRC Staff Evaluation

Despite the fact that FI-1CC-117 does not meet the ASME OM Code requirement for range, it is capable of providing an indicated accuracy at the reference value that is superior to the minimum indicated accuracy that would be required by the ASME OM Code. Based on the least accurate instrument that would theoretically be allowed by the ASME OM Code, the minimum required indicated accuracy is ±6% for Group A tests (documented by NUREG-1482, Revision 2, Section 5.5.1). The indicated accuracy of FI-1CC-117, as derived based upon the current reference value, is as follows:

Reference value = 4,000 gpm
Full scale range = 14,000 gpm
Instrument tolerance = ±1.58% x 14,000 gpm = ±221.2 gpm

Therefore, the indicated accuracy is as follows:

±221.2 gpm / 4,000 gpm x 100% = ±5.53%

As demonstrated, the indicated accuracy of FI-1CC-117 is better than what is theoretically allowed by the ASME OM Code. The reading accuracy achieved from the installed instrument meets the intent of the ASME OM Code and yields an acceptable level of quality and safety for Group A and comprehensive tests.

3.1.3 Instrument PDI-1CC-118

3.1.3.1 Reason for Request

In its submittal, the licensee stated that the differential pressure (d/p) flow meter PDI-1CC-118 is located in the 8-inch CCR header supplying the cooling loads in the auxiliary building and has a range of 0 to 100 inch water column (inwc). Since the use of a pump curve is permitted by ASME OM Code Case OMN-16, "Use of Pump Curve for Testing," the reference flow may not be at a specific flow point. Typical test flow d/p is approximately 18 to 21 inwc. The accuracy of the gauge is 0.5%, which would yield a reading more accurate than the ASME OM Code requirements. This flow instrument may be used during both the Group A and comprehensive tests, since the combination of range and accuracy yields a reading of ±2.8%, which is less than the ±6% required by the ASME OM Code.

3.1.3.2 Proposed Alternative

The instrument PDI-1CC-118 may be used for Group A and comprehensive tests, as long as the combination of the higher range and better accuracy for the instrument yields a reading at least equivalent to the reading achieved from instruments that meet ISTB-3510(b)(1).

3.1.3.3 NRC Staff Evaluation

Despite the fact that PDI-1CC-118 does not meet the ASME OM Code requirement for range, it is capable of providing an indicated accuracy at the reference value that is superior to the minimum indicated accuracy that would be required by the ASME OM Code. Based on the least accurate instrument that would theoretically be allowed by the ASME OM Code, the minimum required indicated accuracy is ±6% for Group A tests (documented by NUREG-1482, Revision 2, Section 5.5.1). The indicated accuracy of PDI-1CC-118, as derived based upon the current reference value, is as follows:

Reference value = 18 inwc
Full scale range = 100 inwc
Instrument tolerance = ±0.5% x 100 inwc = ±0.5 inwc

Therefore, the indicated accuracy is as follows:

±0.5 inwc / 18 inwc x 100% = ±2.8%

As demonstrated, the indicated accuracy of PDI-1CC-118 is better than what is theoretically allowed by the ASME OM Code. The reading accuracy achieved from the installed instrument meets the intent of the ASME OM Code and yields an acceptable level of quality and safety for Group A and comprehensive tests.

3.1.4 Instrument PDI-1CC-119

3.1.4.1 Reason for Request

In its submittal, the licensee stated that the d/p flow meter PDI-1CC-119 is located in the 24-inch CCR header suppling the cooling loads in the auxiliary building and has a range of 0 to 150 inwc. Since the use of a pump curve is permitted by ASME OM Code Case OMN-16, the reference flow may not be at a specific flow point. Typical test flow d/p is approximately 43 to 51 inwc. The accuracy of the gauge is 0.5%, which would yield a reading more accurate than the ASME OM Code requirements. This flow instrument may be used during both the Group A and comprehensive tests, since the combination of range and accuracy yields a reading of ±1.74%, which is less than the ±6% required by the ASME OM Code.

3.1.4.2 Proposed Alternative

The instrument PDI-1CC-119 may be used for Group A and comprehensive tests, as long as the combination of the higher range and better accuracy for the instrument yields a reading at least equivalent to the reading achieved from instruments that meet ISTB-3510(b)(1).

3.1.4.3 NRC Staff Evaluation

Despite the fact that PDI-1CC-119 does not meet the ASME OM Code requirement for range, it is capable of providing an indicated accuracy at the reference value that is superior to the minimum indicated accuracy that would be required by the ASME OM Code. Based on the least accurate instrument that would theoretically be allowed by the ASME OM Code, the minimum required indicated accuracy is ±6% for Group A tests (documented by NUREG-1482, Revision 2, Section 5.5.1). The indicated accuracy of PDI-1CC-119, as derived based upon the current reference value, is as follows:

Reference value = 43 inwc
Full scale range = 150 inwc
Instrument tolerance = ±0.5% x 150 inwc = ±0.75 inwc

Therefore, the indicated accuracy is as follows:

±0.75 inwc / 43 inwc x 100% = ±1.74%

As demonstrated, the indicated accuracy of PDI-1CC-119 is better than what is theoretically allowed by the ASME OM Code. The reading accuracy achieved from the installed instrument meets the intent of the ASME OM Code and yields an acceptable level of quality and safety for Group A and comprehensive tests.

3.1.5 Instruments FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C

3.1.5.1 Reason for Request

In its submittal, the licensee stated that flow indicators FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C are located in the three lines from the auxiliary feedwater (AFW) pumps to the steam generators and have a range of 0 to 400 gpm. The flow indicators are sized to measure accident flow from the turbine-driven AFW pump, as well as the motor-driven AFW pumps. For the motor-driven AFW pump full-flow tests, each loop measures approximately 110 to 115 gpm, which is 27.5% of the range. The calibration accuracy of the flow indicators is 1.2%, which would yield a reading more accurate than the ASME OM Code requirements. These flow instruments will be used during both the Group B tests and comprehensive tests, since the combination of range and accuracy yields a reading of ±4.36%, which is less than the ±6% required by the ASME OM Code.

3.1.5.2 Proposed Alternative

The instruments FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C may be used for Group B and comprehensive tests, as long as the combination of the higher range and better accuracy for the instrument yields a reading at least equivalent to the reading achieved from instruments that meet ISTB-3510(b)(1).

3.1.5.3 NRC Staff Evaluation

Despite the fact that FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C do not meet the ASME OM Code requirement for range, they are capable of providing an indicated accuracy at the reference value that is superior to the minimum indicated accuracy that would be required by the ASME OM Code. Based on the least accurate instrument that would theoretically be allowed by the ASME OM Code, the minimum required indicated accuracy is ±6% for Group B tests (documented by NUREG-1482, Revision 2, Section 5.5.1). The indicated accuracies of FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C, as derived based upon the current reference value, is as follows:

Reference value = 110 gpm
Full scale range = 400 gpm
Instrument tolerance = ±1.2% x 400 gpm = ±4.8 gpm

Therefore, the indicated accuracy is as follows:

±4.8 gpm / 110 gpm x 100% = ±4.36%

As demonstrated, the indicated accuracies of FI-1FW-100A, FI-1FW-100B, and FI-1FW-100C are better than what is theoretically allowed by the ASME OM Code. The reading accuracies achieved from the installed instruments meet the intent of the ASME OM Code and yield an acceptable level of quality and safety for Group B and comprehensive tests.

3.1.6 Instruments PI-1FW-156, PI-1FW-156A, and PI-1FW-156B

3.1.6.1 Reason for Request

In its submittal, the licensee stated that pressure instruments PI-1FW-156, PI-1FW-156A, and PI-1FW-156B are the suction pressure gauges for the AFW pumps. In 1991, the existing 0 to 160 psig gauges were changed to the present 0 to 60 psig gauges. This range was selected as a compromise between the IST program requirements and possible accident pressures (i.e., river water supplying the AFW pumps). The 0 to 60 psig range will accommodate the accident pressure and typical test pressure of 10 psig. With a calibration accuracy of 0.5%, this results in a reading more accurate than the ASME OM Code requirements. The use of these pressure instruments is applicable to Group B tests only since the range and accuracy yields a reading of ±3.0%, which is less than the ±6% required by the ASME OM Code for the Group B test. During comprehensive testing, temporary pressure instrumentation will be used having a calibrated accuracy of at least ±0.5% of full scale with a sufficient range to satisfy the ±1.5% required by the ASME OM Code for the comprehensive test.

3.1.6.2 Proposed Alternative

The instruments PI-1FW-156, PI-1FW-156A, and PI-1FW-156B may be used for Group B tests, as long as the combination of the higher range and better accuracy for the instruments yield a reading at least equivalent to the reading achieved from instruments that meet ISTB-3510(b)(1).

3.1.6.3 NRC Staff Evaluation

Despite the fact that PI-1FW-156, PI-1FW-156A, and PI-1FW-156B do not meet the ASME OM Code requirement for range, they are capable of providing an indicated accuracy at the reference value that is superior to the minimum indicated accuracy that would be required by the ASME OM Code. Based on the least accurate instrument that would theoretically be allowed by the ASME OM Code, the minimum required indicated accuracy is ±6% for Group B tests (documented by NUREG-1482, Revision 2, Section 5.5.1). The indicated accuracy of PI-1FW-156, PI-1FW-156A, and PI-1FW-156B, as derived based upon the current reference value, is as follows:

Reference value = 10 psig
Full scale range = 60 psig
Instrument tolerance = ±0.5% x 60 psig = ±0.3 psig

Therefore, the indicated accuracy is as follows:

±0.3 psig / 10 psig x 100% = ±3.0%

As demonstrated, the indicated accuracies of PI-1FW-156, PI-1FW-156A, and PI-1FW-156B are better than what is theoretically allowed by the ASME OM Code. The reading accuracy achieved from the installed instrument meets the intent of the ASME OM Code and yields an acceptable level of quality and safety for Group B tests.

3.2 Licensee's Alternative Request Number PR3

The licensee requested an alternative to the comprehensive pump testing requirements of ISTB-5123 and ISTB-5223, "Comprehensive Test Procedure."

The licensee stated that ISTB-5123 refers to Table ISTB-5121-1, "Centrifugal Pump Test Acceptance Criteria," which requires an upper acceptable range limit and required action range high limit of $1.03Q_r$ and $1.03\Delta P_r$, where Q_r is the reference flow rate and ΔP_r is the reference d/p. The licensee also states that ISTB-5223 refers to Table ISTB-5221-1, "Vertical Line Shaft Centrifugal Pump Test Acceptance Criteria," which requires an upper acceptable range limit and required action range high limit of $1.03Q_r$ and $1.03\Delta P_r$.

ASME OM Code Case OMN-19, "Alternative Upper Limit for the Comprehensive Pump Test," states, in part, that "a 1.06 times the reference value may be used in lieu of the 1.03 multiplier for the comprehensive pump test's upper 'Acceptable Range' criteria and 'Required Action Range, High' criteria referenced in the ISTB test acceptance criteria tables."

The pumps affected by this alternative request are listed in Table 2.

Table 2: Pump Information for Request Number PR3

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1CH-P-1A 1CH-P-1B 1CH-P-1C	Charging Pumps	2	A
1CH-P-2A 1CH-P-2B	Boric Acid Transfer (BAT) Pumps	3	A
1RH-P-1A 1RH-P-1B	RHR Pumps	2	A
1SI-P-1A 1SI-P-1B	Low Head Safety Injection Pumps	2	B
1CC-P-1A 1CC-P-1B 1CC-P-1C	Component Cooling Water Pumps	3	A
1FW-P-2	Turbine-Driven AFW Pump	3	B
1FW-P-3A 1FW-P-3B	Motor-Driven AFW Pumps	3	B
1WR-P-1A 1WR-P-1B 1WR-P-1C	River Water Pumps	3	A

3.2.1 Reason for Request

In its submittal, the licensee stated that for some pump tests, there has been difficulty implementing the upper acceptable range limit of 3% above the established hydraulic parameter reference value for the comprehensive pump test. Industry experience has shown that test results outside the criteria can easily occur when normal data scatter yields (1) a low measured reference value and (2) high measured values for subsequent IST. In these cases, some of the test data trend high near the upper acceptable range limit and may exceed the upper limit on occasion. The problem can be more severe for pumps with low d/p (50 pounds per square inch differential (or less) due to the smaller acceptable range.

In these cases, the measured values that would exceed the +3% upper criteria would not represent an actual problem with either the test setup, instrumentation, or the pump itself. The scatter induced collectively by the instrumentation and reference value variance is sufficient to approach or exceed the upper criterion.

ASME OM Code Case OMN-19 from the 2012 Edition of the ASME OM Code allows a multiplier of $1.06Q_r$ in lieu of the 1.03 multiplier for the comprehensive pump test's upper acceptable range and required action range high limits. As described in the code case, a required action range high limit of +6% is a realistic value that should allow any true degradation issues to be identified while alleviating the need to unnecessarily declare pumps inoperable.

3.2.2 Proposed Alternative

In its submittal, the licensee stated for the pumps listed in Table 2, an upper acceptable range limit of $1.06Q_r$ be applied to the comprehensive pump test in accordance with ASME OM Code Case OMN-19. Also, a pump periodic verification (PPV) test at the design-basis accident (DBA) flow rate will be performed for each of these pumps.

As stated by the licensee, the following requirements shall be applied to the PPV test:

- Apply the PPV test to the pumps listed in Table 2.
- Perform the PPV test at least once every 2 years.
- Determine if a PPV test is required before declaring a pump operable following replacement, repair, or maintenance on the pump.
- Declare the pump inoperable if the PPV test flow rate and associated d/p cannot be achieved.
- Maintain the necessary records for each PPV test, including the applicable test parameters (e.g., flow rate, the associated d/p and speed for variable speed pumps) and their basis.
- Account for the PPV test instrument accuracies in the test acceptance criteria.

The upper acceptable range limit for d/p established by the ASME OM Code is not reflective of any possible degradation mechanism but is rather a means to identify a potentially incorrect test setup. Exceeding this upper limit while testing would require the pump to be considered inoperable, but primarily as a means to investigate the test instrumentation or other potential problems. The use of a +6% upper criteria rather than the +3% upper criteria would not mask any actual pump problem and would still function as an adequate trigger to investigate the test setup.

3.2.3 NRC Staff Evaluation

ASME OM Code Case OMN-19 allows the use of a multiplier of $1.06Q_r$ in lieu of the 1.03 multiplier for the comprehensive pump test's upper "Acceptable Range" criteria and "Required Action Range, High" criteria referenced in Table ISTB-5121-1; Table ISTB-5221-1; Table ISTB-5321-1, "Positive Displacement Pump (Except Reciprocating) Test Acceptance Criteria"; and Table ISTB-5321-2, "Reciprocating Positive Displacement Pump Test Acceptance Criteria." Code Case OMN-19 has not been added to NRC Regulatory Guide 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," and the 2012 Edition of the ASME OM Code has not been incorporated by reference into 10 CFR 50.55a. The NRC staff reviewed the proposed alternative OMN-19 published in the ASME OM Code, 2011 Edition, which the licensee proposed as an alternative, along with the requirements the licensee will apply to the PPV test. The licensee stated that it will follow the requirements discussed in Section 3.2.2, "Proposed Alternative," of this safety evaluation when implementing a PPV test program.

The NRC staff notes that the licensee is not required to perform a PPV test for a pump if the pump's DBA flow rate in the licensee's safety analysis is bounded by the comprehensive pump test or the Group A test.

The licensee will perform a PPV test every 2 years for the pumps listed in Table 2. NRC staff determined that licensees choosing to implement Code Case OMN-19 must implement a PPV test program to verify that a pump can meet the required (differential or discharge) pressure, as applicable, at its highest DBA flow rate. The performance of this test provides reasonable assurance that these pumps will perform at design-basis conditions when needed and provides reasonable assurance that the licensee can detect and monitor pump degradation. The licensee's proposed alternative will perform the PPV test along with ASME OM Code Case OMN-19 requirements. The NRC staff determined that ASME OM Code Case OMN-19 provides an acceptable level of quality and safety.

3.3 Licensee's Alternative Request Number PR4

For diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D, the licensee requested an alternative to the ASME OM Code requirements for measuring flow rate. The pumps are classified as ASME Class 3 and ASME OM Code Group B.

As discussed in the application, ISTB-5322, "Group B Test Procedure," states, in part, "[g]roup B tests shall be conducted with the pump operating at a specified reference point. The test parameter value identified in Table ISTB-3000-1, "Inservice Test Parameters," shall be determined and recorded, as required by this paragraph." Table ISTB-3000-1, "Inservice Test Parameters," identifies flow rate as a test parameter. Note 1 of Table ISTB-3000-1 states, in part, "for positive displacement pumps, flow rate shall be measured or determined."

3.3.1 Reason for Request

In its submittal, the licensee stated that the diesel fuel oil transfer pumps transfer fuel oil from the underground emergency diesel generator (DG) fuel oil storage tank to the day tank in order to provide continuous operation of the DG at rated load for up to 7 days during an emergency.

ISTB-5322 requires that the test parameters shown in Table ISTB-3000-1 be determined and recorded during Group B testing. For positive displacement pumps, flow rate is one of the test parameters listed in Table ISTB-3000-1. However, there is no installed instrumentation provided to measure flow rate for these diesel fuel oil transfer pumps. A level sight glass does exist on the side of the DG fuel oil day tank, which can be used to measure a change in level over time as the pumps transfer fuel oil from the underground storage tank to the day tank. The reading scale for measuring the level change over time, and the calculation method, yield an accuracy within ±2%, as required by Table ISTB-3510-1, "Required Instrument Accuracy."

3.3.2 Proposed Alternative

In its submittal, the licensee stated that flow rate will be calculated by measuring the level change over time in the emergency DG fuel oil day tank and converting this data into diesel fuel oil transfer pump flow rate during both the Group B tests and comprehensive tests per emergency DG and diesel fuel oil transfer pump operating surveillance tests.

This proposed alternative is consistent with the guidelines provided in NUREG-1482, Revision 2, Section 5.5.2, "Use of Tank Level to Calculate Flow Rate for Positive Displacement Pumps." Section 5.5.2 states, in part:

> When flow meters are not installed in the flow loop of a system with a positive displacement pump, it is impractical to directly measure flow rate for the pump. The staff has determined that, if the licensee uses the tank level to calculate the flow rate as described in Subsection ISTB-3550, the implementing procedure must include the calculational method and any test conditions needed to achieve the required accuracy. Specifically, the licensee must verify that the reading scale for measuring the tank level and the calculational method yield an accuracy within ±2 percent for Group A and B tests, and Preservice and Comprehensive

Tests. If the meter does not directly indicate the flow rate, the record of the test shall identify the method used to reduce the flow data.

The licensee further states that calculating flow rate by a level change in the day tank is acceptable since the level of accuracy required by Table ISTB-3510-1 (and NUREG-1482, as noted above) is satisfied.

3.3.3 NRC Staff Evaluation

ISTB-3550 states that when measuring flow rate, a rate or quantity meter shall be installed in the pump test circuit. If a meter does not indicate flow rate directly, the record shall include the method used to reduce the data. The licensee proposed, for the Group B tests and comprehensive tests, to calculate the flow rate for the diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D by measuring the level change over time in the DG fuel oil day tank, and converting this data into pump flow rate. The reading scale for measuring the level change over time, and the calculational method yield an accuracy within ±2%, as required by Table ISTB-3500-1. This proposed alternative is consistent with the guidelines provided in Section 5.5.2 of NUREG-1482, Revision 2. Based on the above, the NRC staff determined that this method for measuring flow rate provides an acceptable level of quality and safety.

3.4 Licensee's Relief Request Number PR5

The licensee requested relief for diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D from the requirements of acceptable ranges for Group B and comprehensive testing. The pumps are classified as ASME Class 3 and ASME OM Code Group B.

ISTB-5322, paragraph (d), states, "[a]ll deviations from the reference values shall be compared with the ranges of Table ISTB-5321-1 or Table ISTB-5321-2, as applicable, and corrective action taken as specified in ISTB-6200 ["Corrective Action"]."

ISTB-5323, "Comprehensive Test Procedure," (e), states, in part, "[a]ll deviations from the reference values shall be compared with the ranges of Table ISTB-5321-1 or Table ISTB-5321-2, as applicable, and corrective action taken as specified in ISTB-6200."

3.4.1 Reason for Request

In its submittal, the licensee stated that Table ISTB-5321-1 is applicable to the diesel fuel oil transfer pumps. The Group B and comprehensive test acceptance criteria for P_r and Q_r, given in Table ISTB-5321-1 are as follows:

Table 3: Group B Tests According to Table ISTB-5321-1

Acceptable Range	Alert Range	Required Action Range	
		Low	High
0.90 to 1.10Q_r	None	< 0.90Q_r	>1.10Q_r

Table 4: Comprehensive Tests According to Table ISTB-5321-1

Acceptable Range	Alert Range	Required Action Range	
		Low	High
0.95 to 1.03Q_r 0.93 to 1.03P_r	0.93 to <0.95Q_r 0.90 to <0.93P_r	<0.93Q_r <0.90P_r	>1.03Q_r >1.03P_r

In its submittal, the licensee stated that these limits are too restrictive for the diesel fuel oil transfer pumps. The baseline discharge pressures for these four pumps range from 6.7 psig to 13.0 psig. Applying the acceptable limits from the ASME OM Code for these values, the average allowable degradation from the reference value is only 0.7 psig for the comprehensive test. The discharge pressure has historically varied by as much as 1 psig from one test to the next and between 1 to 2 psig over the course of a year, which is more than the acceptable range for discharge pressure. The baseline flows for these four pumps range from 9.0 to 13.3 gpm. The average allowable degradation for flow is, therefore, only 1.1 gpm for the Group B test and 0.56 gpm for the comprehensive test. The flow values also vary from test to test and between 1 to 1.5 gpm over the course of a year, which is more than the acceptable range for flow.

The licensee stated the ASME OM Code limits are too restrictive, and therefore, impractical to apply. Normal historic variation in discharge pressure and flow would require the pumps to enter the alert or required action ranges. An allowable variation larger than 0.7 psig or 0.56 gpm is needed for both the Group B test and comprehensive test, as applicable, to trend pump performance.

The following expanded ranges for flow during the Group B tests and flow and discharge pressure during the comprehensive tests of the fuel oil transfer pumps are proposed:

Table 5: Proposed Group B Tests for PR5

Acceptable Range	Alert Range	Required Action Range	
		Low	High
0.80 to 1.15Q_r	None	<0.80Q_r	>1.15Q_r

Table 6: Proposed Comprehensive Tests for PR5

Acceptable Range	Alert Range	Required Action Range	
		Low	High
0.90 to 1.15Q_r 0.80 to 1.20P_r	0.80 to <0.90Q_r 0.70 to <0.80P_r	<0.80Q_r <0.70P_r	>1.15Q_r >1.20P_r

The function of these pumps is to be able to deliver fuel oil to the day tank to supply the DG under full load. The amount of fuel that is required to be delivered is 3.6 gpm, significantly lower than the reference values for all of the pumps. In addition, due to the nature of positive displacement pumps, flow should be the more consistent parameter.

The proposed range for the flow value is more restrictive because the flow rate is the more critical parameter for the system. The high flow limit is based on approximately half of the allowable variation expected in pumps with this rated flow rate from the "Hydraulic Institute Test Standard for Rotary Pumps," 14th Edition.

These ranges would only result in an allowed variation of -2.01 psig and +1.34 psig for the lowest expected pressure reading (6.7 psig) of the four pumps and -1.8 gpm and +1.35 gpm for the lowest expected flow reading (9 gpm) of the four pumps. In addition, the licensee stated that during discussions with Ingersoll-Dresser Pumps (the pump manufacturer), when questioned about a limiting value for pump performance, the pump manufacturer explained that as the pump wears and the clearances open, the performance will gradually change. No limiting value for both flow or discharge pressure was provided, and sudden performance degradation is not expected. These expanded ranges will allow degrading conditions to be identified and provide assurance that the fuel oil transfer pumps will be capable of fulfilling their safety function.

Extensive hardware changes would be required in order to comply with the requirements of Table ISTB-5321-1 with little or no enhancement or compensating increase to the quality of the tests or the ability to detect pump degradation.

3.4.2 Proposed Alternative

The licensee proposed the use of the expanded limits shown in Tables 5 and 6 above for test acceptance criteria in lieu of the test acceptance criteria specified in Table ISTB-5300-1. The licensee stated testing will be performed per the DG monthly test procedures using expanded ranges for flow and discharge pressure during the comprehensive tests and for flow during the Group B tests. These expanded ranges will allow degrading conditions to be identified, without needlessly declaring the pumps inoperable, and provide assurance that the fuel oil transfer pumps will be capable of fulfilling their safety function.

3.4.3 NRC Staff Evaluation

The licensee requested relief for diesel fuel oil transfer pumps 1EE-P-1A, 1EE-P-1B, 1EE-P-1C, and 1EE-P-1D from the ASME OM Code-specified acceptance criteria for pressure and flow rate on the basis that conformance with these requirements is impractical. The licensee proposed to test the pumps per their DG monthly test procedures using expanded ranges for flow and discharge pressure as summarized in Tables 5 and 6 above.

The discharge pressure range for these pumps is 6.7 to 13 psig, and the discharge pressure has historically varied by as much as 1 psig from one test to the next, and between 1 to 2 psig over the course of a year. Flow rate for these pumps ranges from 9 to 13.3 gpm, and the flow rates vary from one test to the next and between 1 to 1.5 gpm over the course of a year. In this situation, the ASME OM Code limits are too restrictive, and therefore, impractical to apply.

Without expanded acceptance ranges, normal historic variation in discharge pressure and flow would require the pumps to enter the alert or required action ranges. Trends would not be observed because the pumps would have to be declared inoperable before enough data could be obtained to determine if the data obtained is a true indication of a degrading condition or data scatter. Additionally, the ASME OM Code trending would also pick up variations caused by fouling of the suction strainer or discharge filter, or by relief valve chattering.

Ingersoll-Dresser Pumps stated that as the pumps wear and the clearances open, the performance will gradually change. No limiting value for both flow or discharge pressure was provided, and sudden performance degradation is not expected.

The amount of fuel oil that is required to be delivered by each pump to the fuel oil day tank is 3.6 gpm, which is significantly lower than the reference value for the pumps. The licensee's proposed ranges will allow pump degradation to be identified in a timely manner.

Based on the above evaluation, the NRC staff has concluded that compliance with the ASME OM Code requirement for test acceptance criteria is impractical for the diesel fuel oil transfer pump testing. The proposed alternative provides reasonable assurance that the diesel fuel oil transfer pumps are operationally ready.

3.5 Licensee's Relief Request Number PR6

The licensee requested relief for BAT pumps 1CH-P-2A and 1CH-P-2B from the requirements of flow measurement for Group A testing. The pumps are classified as ASME Class 3 and ASME OM Code Group A.

ISTB-5121, "Group A Test Procedure," states, in part, "[g]roup A tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph." Table ISTB-3000-1 identifies flow rate as a test parameter.

3.5.1 Reason for Request

In its submittal, the licensee stated that testing the BAT pumps using the emergency boration flow path is impractical during power operation because it would inject water with a higher concentration of boric acid into the reactor coolant system (RCS), which would result in a reactivity transient. Therefore, the ASME OM Code-required quarterly Group A testing is performed using an alternate test loop. The pumps are Group A tested quarterly through the restricting orifices in the minimum flow fixed resistance recirculation lines, RO-CH-ORBA-1(2). ISTB-5121 requires that the test parameters shown in Table ISTB-3000-1 be determined and recorded during Group A quarterly tests. Flow rate is one of the test parameters listed in Table ISTB-3000-1. However, there are no installed flow instruments in these recirculation lines to measure flow rate, as required by ISTB-5121 and Table ISTB-3000-1. Because of the restricting orifices, the flow is assumed to be fixed and at its reference value. The d/p and vibration are then measured and compared to the acceptance criteria.

NUREG-1482, Revision 2, Section 5.9, "Pump Testing Using Minimum Flow Return Lines With or Without Flow Measuring Devices," states, in part, that:

> In cases where only the minimum-flow return line is available for pump testing, regardless of the test interval, the staff's position is that flow instrumentation that meets the requirements of Subsection ISTB-3500 should be installed in the mini-flow return line. Installation of this instrumentation is necessary to provide flow rate measurements during pump testing so that this data can be evaluated with the measured pump differential pressure to monitor for pump hydraulic degradation.

The guidance provided in NRC Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," Attachment 1, Position 9, "Pump Testing Using Minimum-flow Return Line With or Without Flow Measuring Devices," dated April 3, 1989, still applies. Since a full-flow loop exists that can be easily instrumented and utilized only during certain plant operating modes, the guidance provided in GL 89-04, Position 9, for non-instrumented minimum flow paths shall be followed during the quarterly Group A test. Position 9 of GL 89-04 states, in part:

> In cases where flow can only be established through a non-instrumented minimum flow path during quarterly pump testing and a path exists at cold

shutdowns or refueling outages to perform a test of the pump under full or substantial flow conditions, the staff has determined that the increased interval is an acceptable alternative to the Code requirements, provided that pump differential pressure, flow rate, and bearing vibration measurements are taken during this testing and that quarterly testing also measuring at least pump differential pressure and vibrations is continued.

In accordance with Position 9 of GL 89-04, the BAT pumps have been shown capable of being tested through their full-flow recirculation flow paths (through valves HCV-1CH-110 [-05]), at a refueling frequency, and are also capable of being tested on-line at the 2-year comprehensive pump test frequency. For the full-flow recirculation test, the flow is measured by a portable ultrasonic flow meter that has been "wet-flow" calibrated to within the ±2% accuracy required by Table ISTB-3510-1. In order to install the flow meters, however, the insulation on the piping must be removed and the heat trace elements must be moved away from where the transducers and tracks will be installed. Moving the heat trace elements places stresses on them, which increases the probability of failure of the heat trace elements. The heat tracing on the boric acid piping is needed to support system operability. Therefore, it is impractical to test the pumps quarterly and at a cold shutdown frequency in this manner. A review of past test results has shown that this combination of quarterly Group A testing and refueling or 2-year on-line frequency comprehensive pump testing is capable of assessing pump performance and detecting degradation.

Use of a portable ultrasonic flow meter and full-flow recirculation flow path was considered for the quarterly test, but was determined to be impractical. Testing quarterly using the temporary ultrasonic flow meter would lead to the increased probability of failure of the heat trace elements.

Also, additional calibrated flow instrumentation would have to be purchased to ensure the availability of equipment. Permanently installing the flow meters would require a design change to the plant and the purchase of additional flow instrumentation. Performing the full-flow test quarterly and during cold shutdowns would not enhance the ability to assess operability of the pumps enough to justify the increased cost of a system design change.

In addition, testing during refueling outages diverts manpower from other refueling tasks. These tests must be scheduled at a time in the outage when the boric acid tanks are not required to be part of the boration flow path and must be coordinated with power supply outages. Even though the actual performance of these tests may be completed in a relatively short time, the set-up and restoration is approximately 8 to 10 hours for each pump. Removing the tests from the outage schedule would allow a greater focus on other safety-related tasks, without impacting the level of quality and safety of the BAT pumps. In addition, a probabilistic risk assessment evaluation has determined that there is no increase in risk for the performance of this test, whether on-line or during refueling outages. Therefore, it is requested to perform the full-flow test at least once every 2 years, which satisfies the biennially IST frequency specified in Table ISTB-3400-1, "Inservice Test Frequency," for the comprehensive test. Overall, proper monitoring of pump performance will be maintained via the quarterly Group A testing and full-flow comprehensive testing at least once every 2 years while on-line or during shutdown conditions.

3.5.2 Proposed Alternative

The licensee proposed to perform the quarterly Group A test through a fixed-resistance non-instrumented minimum-flow recirculation line assuming flow to be constant and measuring d/p in BAT pump operational test procedures. The licensee will also perform the periodic verification test (as described in Mandatory Appendix V, "Pump Periodic Verification Test Program," of the 2012 ASME OM Code), and the full-flow comprehensive test at least once every 2 years.

Separate vibration reference and acceptance criteria values, as shown below, will be used for the different test conditions of the recirculation and full-flow tests. These values were provided in the licensee's supplemental letter dated February 22, 2017.

Table 7: 1CH-P-2A Reference Value and Vibration Limits at Recirculation Flow for PR6

Pump Bearing Locations[1]	Reference (in/sec)	Accept Limit[2] (in/sec)	Alert Limit[2] (in/sec)
Inboard Axial	0.0477	≤ 0.125	≤ 0.300
Inboard Horizontal	0.0420	≤ 0.125	≤ 0.300
Inboard Vertical	0.0423	≤ 0.125	≤ 0.300
Outboard Horizontal	0.0425	≤ 0.125	≤ 0.300
Outboard Vertical	0.0341	≤ 0.125	≤ 0.300

Table 8: 1CH-P-2A Reference Value and Vibration Limits at Full Flow for PR6

Pump Bearing Locations[1]	Reference (in/sec)	Accept Limit[2] (in/sec)	Alert Limit[2] (in/sec)
Inboard Axial	0.0470	≤ 0.125	≤ 0.300
Inboard Horizontal	0.0418	≤ 0.125	≤ 0.300
Inboard Vertical	0.0362	≤ 0.125	≤ 0.300
Outboard Horizontal	0.0323	≤ 0.125	≤ 0.300
Outboard Vertical	0.0310	≤ 0.125	≤ 0.300

Table 9: 1CH-P-2B Reference Value and Vibration Limits at Recirculation Flow for PR6

Pump Bearing Locations[1]	Reference (in/sec)	Accept Limit[2] (in/sec)	Alert Limit[2] (in/sec)
Inboard Axial	0.0423	≤ 0.125	≤ 0.300
Inboard Horizontal	0.0435	≤ 0.125	≤ 0.300
Inboard Vertical	0.0629	≤ 0.125	≤ 0.377
Outboard Horizontal	0.0263	≤ 0.125	≤ 0.300
Outboard Vertical	0.0560	≤ 0.125	≤ 0.336

Table 10: 1CH-P-2B Reference Value and Vibration Limits at Full Flow for PR6

Pump Bearing Locations[1]	Reference (in/sec)	Accept Limit[2] (in/sec)	Alert Limit[2] (in/sec)
Inboard Axial	0.0412	≤ 0.125	≤ 0.300
Inboard Horizontal	0.0398	≤ 0.125	≤ 0.300
Inboard Vertical	0.0522	≤ 0.125	≤ 0.313
Outboard Horizontal	0.0253	≤ 0.125	≤ 0.300
Outboard Vertical	0.0420	≤ 0.125	≤ 0.300

1 The pump outboard axial location is not accessible.

2 BVPS-1 Request Number PR8 would permit maximum vibration values of 0.125 in/sec for the acceptable limit and 0.300 in/sec for the alert limit when the reference vibration is ≤0.05 in/sec. Other vibration limits would be based on Table ISTB-5121-1.

3.5.3 NRC Staff Evaluation

The licensee proposed to implement an alternative to the flow rate determination and recording requirements of ISTB-5121 and Table ISTB-3000-1. The licensee's proposed alternative is to test the BAT pumps quarterly through a fixed resistance minimum flow recirculation line (assuming flow to be constant and measuring d/p), and test them at least once every 2 years at full-flow through a larger recirculation line, using a portable ultrasonic flow meter. Testing the BAT pumps during power using the emergency boration flow path would inject water with a higher concentration of boric acid into the RCS, which would result in a reactivity transient and subsequent reactor shutdown and is impractical to perform. Testing the BAT pumps at cold shutdown, using the emergency boration flow path is impractical. It would result in the addition of water with a higher concentration of boric acid and possibly impact the ability of the plant to restart due to the time required to dilute the excess boron in preparation for startup. This testing would also result in the generation of excess liquid waste.

The licensee's proposed alternative is consistent with the NRC staff's Position 9, outlined in GL 89-04, except for the time (i.e., cold shutdown or refueling outages) of performance of the full-flow test. In Position 9 of GL 89-04, the NRC staff stated:

> In cases where flow can only be established through a non-instrumented minimum flow path during quarterly pump testing and a path exists at cold shutdowns or refueling outages to perform a test of the pump under full or substantial flow conditions, the staff has determined that the increased interval is an acceptable alternative to the Code requirements, provided that pump differential pressure, flow rate, and bearing vibration measurements are taken during this testing and that quarterly testing also measuring at least pump differential pressure and vibrations is continued.

Also, the acceptance criteria for the vibration measurements is in accordance with Table ISTB-5121-1, but if the vibration reference value is ≤0.05 in/sec, the acceptance criteria is in accordance with alternative PR8, as discussed below.

The quarterly test can be performed through a non-instrumented full-flow recirculation line. However, Position 9 of GL 89-04 does not address on-line testing through a non-instrumented full-flow recirculation line. The test using a full-flow recirculation line requires the installation of a portable ultrasonic flow meter to determine the system flow rate. Installation of the portable flow meter requires removal of the piping insulation and movement of the heat trace elements away from where the transducers and tracks will be installed. Moving the heat trace elements places stresses on them, which increases the probability of failure of the heat trace elements. Permanently installing the flow meters would require a design change to the plant and the purchase of additional flow instrumentation. Therefore, it is impractical to test the pumps through the full-flow recirculation line quarterly and at cold shutdown frequency. While performing the Group A test through a fixed-resistance mini-flow recirculation line, the flow may be assumed to be fixed at its reference value, and then d/p and vibration can be measured and compared to the acceptance criteria. Performing a comprehensive pump test at least once every 2 years through a larger recirculation line is consistent with the full-flow test outlined in Position 9 of GL 89-04. Therefore, the NRC staff finds that the licensee's proposed IST alternative to test the BAT pumps: (1) quarterly through a fixed-resistance minimum flow recirculation line, measuring pump d/p and vibration; and (2) once at least every 2 years (while on-line or during shutdown conditions) through a larger full-flow recirculation line, measuring pump d/p, flow rate (using a portable ultrasonic flow meter), and vibration, provides an adequate method to assure operational readiness of the pumps.

3.6 Licensee's Relief Request Number PR7

The licensee requested relief for RHR pumps 1RH-P-1A and 1RH-P-1B from the test frequency requirements for Group A testing. The pumps are classified as ASME Class 2 and ASME OM Code Group A.

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 requires Group A pumps to have a Group A test on a quarterly frequency.

3.6.1 Reason for Request

In its submittal, the licensee stated that the RHR pumps have a design pressure of 600 psig. They take suction from the RCS, pass flow through the RHR heat exchangers, and then discharge back to the RCS. The RHR system is considered to be a low pressure system that could be damaged if exposed to the normal operating RCS pressure of approximately 2,235 psig. In order to prevent this, the RHR inlet and return isolation valves are interlocked with an output signal from the RCS pressure transmitters, which prevents the valves from being opened when the RCS pressure exceeds 430 psig. In addition, these valves are also maintained shut with their breakers deenergized and administratively controlled. Therefore, testing of the RHR pumps during normal operation is not practicable since there are no alternate supply sources and aligning the RCS to the suction of the RHR pumps during operation at power would result in damage to piping and components due to over-pressurization. Major plant and system modifications would be needed to allow quarterly Group A testing of the RHR pumps according to ASME OM Code requirements.

3.6.2 Proposed Alternative

The licensee proposed to test the RHR pumps during cold shutdowns and refueling outages, not more often than once every 92 days, per its procedure 1OST-10.1, "Residual Heat Removal Pumps Performance Test." For a cold shutdown or refueling outage that extends longer than 3 months, the pumps will be tested every 3 months in accordance with Table ISTB-3400-1. In the instance of an extended outage, a Group A test may be performed; otherwise, a comprehensive test will be performed each refueling outage.

3.6.3 NRC Staff Evaluation

ISTB-3400 of the ASME OM Code states that an IST be performed for each pump as specified in Table ISTB-3400-1, which requires Group A pumps to be tested on a quarterly frequency. The licensee has requested relief from the above ASME OM Code requirement because it has determined that quarterly testing of the RHR pumps is impractical. As such, the licensee has proposed an alternative to the requirements that would test the RHR pumps during cold shutdown or refueling outages, but not more than once every 92 days. For a cold shutdown or refueling outage that extends longer than 3 months, the pumps will be tested every 3 months in accordance with Table ISTB-3400-1. In the instance of an extended outage, a Group A test may be performed; otherwise, a comprehensive test will be performed each refueling outage.

The RHR pumps are low-pressure (600 psig design pressure) pumps that take suction from the RCS hot leg, pass flow through the RHR heat exchangers, and discharge to the RCS cold leg. These pumps are in a standby condition during power operation and are only activated when the RCS is at a low pressure and the RHR system is needed for decay heat removal. The RHR system is a low pressure system with motor-operated inlet and return isolation valves that are interlocked with RCS pressure transmitters to prevent the valves from being opened whenever the RCS system pressure exceeds 430 psig.

The NRC staff has reviewed the ASME OM Code requirements with respect to the licensee's request for relief and has determined that due to the standby condition of the RHR pumps and the isolation of the RHR system during power operation, compliance with the quarterly testing requirements is not practical. Major plant and system modifications would be needed to allow quarterly testing of the RHR pumps in accordance with the ASME OM Code requirements. The proposed alternative provides reasonable assurance that the RHR pumps are operationally ready.

3.7 Licensee's Alternative Request Number PR8

The licensee requested an alternative to the vibration requirements of the ASME OM Code.

ISTB-5121, paragraph (e), and ISTB-5123, paragraph (e), state:

> 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. 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 $6V_r$ [vibration reference value] or 0.7 in/sec (1.7 cm [centimeters]/sec) the pump is in the required action range.

ISTB-5221, "Group A Test Procedure," paragraph (e), and ISTB-5223, paragraph (e), state:

> All deviations from the reference values shall be compared with the ranges of Table ISTB-5221-1 and corrective action taken as specified in ISTB-6200. Vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5221-1. For example, if vibration exceeds either $6V_r$ or 0.7 in./sec (1.7 cm/sec) the pump is in the required action range.

ISTB-5321, "Group A Test Procedure," paragraph (e), and ISTB-5323, "Comprehensive Test Procedure," paragraph (e), state:

> All deviations from the reference values shall be compared with the ranges of Table ISTB-5321-1 or Table ISTB-5321-2, as applicable, and corrective action taken as specified in ISTB-6200. For reciprocating positive displacement pumps, vibration measurements shall be compared to both the relative criteria shown in the alert and required action ranges of Table ISTB-5321-2 [Table 5321-1]. For all other positive displacement pumps, vibration measurements shall be compared to both the relative and absolute criteria shown in the alert and required action ranges of Table ISTB-5321-1 [Table ISTB-5321-2]. For example, if vibration exceeds either $6V_r$ or 0.7 in/sec (1.7 cm/sec) the pump is in the required action range.

Therefore, Table ISTB-5321-2 is not applicable.

The pumps affected by this alternative request are listed in Table 10 below.

Table 10: Pump Information for Request Number PR8

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1CH-P-2A 1CH-P-2B	BAT Pumps	3	A
1RH-P-1A 1RH-P-1B	RHR Pumps	2	A
1SI-P-1A 1SI-P-1B	Low Head Safety Injection Pumps	2	B
1FW-P-3A 1FW-P-3B	Motor-Driven AFW Pumps	3	B
1RW-P-1A 1RW-P-1B 1RW-P-1C	River Water Pumps	3	A
1EE-P-1A 1EE-P-1B 1EE-P-1C 1EE-P-1D	Fuel Oil Transfer Pumps	3	B

3.7.1 Reason for Request

In its submittal, the licensee stated that the pumps listed in Table 10 tend to be smooth running pumps in the BVPS-1 IST program. Each pump has at least one V_r that is currently less than 0.05 in/sec. A small value for V_r produces a small acceptable range for pump operation. The ASME OM Code acceptable range limit for pump vibrations from Table ISTB-5121-1, Table ISTB-5221-1, and Table ISTB-5321-1 for both the Group A test and comprehensive test is less than or equal to $2.5V_r$. Based on a small acceptable range, a smooth running pump could be subject to unnecessary corrective action if the measured vibration parameter exceeds this limit.

ISTB-6200, paragraph (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.

For very small vibration reference values, flow variations, hydraulic noise, and instrument error can be a significant portion of the reading and affect the repeatability of subsequent measurements. Also, experience gathered by the BVPS Predictive Maintenance (PdM) group has shown that changes in vibration levels in the range of 0.05 in/sec do not normally indicate significant degradation in pump performance.

In order to avoid unnecessary corrective actions, a minimum value for Vr of 0.05 in/sec is proposed. This minimum value would be applied to individual vibration locations for those pumps with reference vibration values less than 0.05 in/sec. Therefore, the smallest ASME OM

Code acceptable range limit for which the pump would be inoperable would be no lower than 6 times V_r, or 0.300 in/sec.

When new reference values are established per ISTB-3310, ISTB-3320, or ISTB-6200(c), the measured parameters will be evaluated for each location in order to determine if the provisions of this alternative request still apply. In addition to the requirements of ISTB for IST, the pumps in the IST program are also included in the BVPS PdM program. The BVPS PdM program currently employs predictive monitoring techniques such as vibration monitoring and analysis beyond that required by ISTB, bearing temperature trending, oil sampling and analysis, and thermography analysis, as applicable.

If the measured parameters are outside the normal operating range or are determined by analysis to be trending toward an unacceptable degraded state, appropriate actions are taken that may include initiation of a condition report, increased monitoring to establish a rate of change, review of component-specific information to identify the cause of the condition, and removal of the pump from service to perform maintenance.

3.7.2 Proposed Alternative

The licensee proposed that in lieu of applying the vibration acceptance criteria ranges specified in Table ISTB-5121-1, Table ISTB-5221-1, or Table ISTB-5321-1, as applicable, smooth running pumps with a measured reference value below 0.05 in/sec for a particular vibration measurement location will have subsequent test results for that location compared to an acceptable range limit of 0.125 in/sec and an alert range limit of 0.300 in/sec (based on a minimum reference value of 0.05 in/sec). These proposed ranges shall be applied to vibration test results during both Group A tests and comprehensive tests. In addition to the ASME OM Code requirements, the affected pumps listed in this request are included in and will remain in the BVPS PdM program.

The licensee also stated that using the provisions of this alternative request as an alternative to the specific requirements of ISTB identified above will provide adequate indication of pump performance and continue to provide an acceptable level of quality and safety, without unnecessarily imposing corrective action since changes in vibration levels in the range of 0.05 in/sec do not normally indicate significant degradation in pump performance.

3.7.3 NRC Staff Evaluation

ISTB-3540 requires that for centrifugal pumps, vibration measurements shall be taken in a plane approximately perpendicular to the rotating shaft in two approximately orthogonal directions on each accessible pump-bearing housing. Measurement shall also be taken in the axial direction on each accessible pump thrust bearing housing. The paragraph requires that for vertical line shaft pumps, the vibration measurements be taken on the upper motor-bearing housing in three orthogonal directions, one of which is the axial direction. The paragraph requires that for reciprocating pumps, vibration measurements shall be taken on the bearing housing of the crankshaft, approximately perpendicular to both the crankshaft and the line of plunger travel. These measurements are required to be compared with the ASME OM Code vibration acceptance criteria as specified in Table ISTB-5121-1, Table ISTB-5221-1, or Table ISTB-5321-1, as applicable, to determine if the measured values are acceptable.

Table ISTB 5121-1, Table ISTB-5221-1, and Table ISTB-5321-1 state that, if during an inservice test, a vibration measurement exceeds 2.5 times the previously established V_r, the pump is considered in the alert range. The frequency of testing is then doubled in accordance with ISTB-6200(a) until the cause of the deviation is determined and the condition is corrected and the vibration level returns to the acceptable range level. Pumps whose vibration is measured as greater than 6 times V_r are considered to be in the required action range, and, in accordance with ISTB-6200(b), must be declared inoperable until the cause of the deviation has been determined and the condition is corrected, or an analysis of the pump is performed and new reference values are established in accordance with ISTB-6200(c). Per ISTB-3300(c), the vibration reference values shall be established only when the pump is known to be operating acceptably.

For pumps whose absolute magnitude of vibration is an order of magnitude below the absolute vibration limits in Table ISTB-5121-1, Table ISTB-5221-1, or Table ISTB-5321-1, a relatively small increase in vibration magnitude may cause the pump to enter the alert or required action range. These instances may be attributed to variation in flow, instrument accuracy, or other noise sources that would not be associated with degradation of the pump. Pumps that operate in this region are typically referred to as "smooth-running." Based on a small acceptable range, a smooth running pump could be subjected to unnecessary corrective action.

The licensee's proposed alternative testing combines the minimum reference value method with including all the pumps in the IST program in a PdM program, even if certain pumps have very low vibration readings and are considered to be smooth-running pumps. The licensee will assign a vibration reference value of 0.05 in/sec to any pump bearing vibration direction where, in the course of determining its reference value, it has a measured value below 0.05 in/sec. Therefore, the acceptable range as defined in Table ISTB-5121-1, Table ISTB-5221-1, or Table ISTB-5321-1 will be less than or equal to 0.125 in/sec, and the alert range will be 0.125 to 0.30 in/sec.

The licensee's proposed alternative testing also describes the PdM program for the pumps listed in Table 10. The licensee stated the BVPS PdM program goes beyond the IST requirements for pumps. The program includes vibration monitoring and analysis beyond what is required by the ASME OM Code, bearing temperature trending, oil sampling and analysis, and thermographic analysis, as applicable. The licensee stated that if the measured parameters are outside of the normal operating range or are determined by analysis to be trending towards an unacceptable degraded state, appropriate actions will be taken. These actions include initiation of a condition report, increased monitoring to establish the rate of change, review of component-specific information to identify the cause of condition, and removal of the pump from service to perform maintenance. The proposed alternative is consistent with the objective of IST, which is to monitor degradation in safety-related components.

As described above, the NRC staff finds that the alert and required action limits specified in alternative PR8 sufficiently address the previously undetected acute pump problems. The objective of the licensee's PdM program is to detect problems involving the mechanical condition, even well in advance of when the pump reaches its overall vibration alert limit. Therefore, the licensee's proposed alternative will provide an acceptable level of quality and safety.

3.8 Licensee's Alternative Request PR9

The licensee requested an alternative to the ASME OM Code Group B testing requirements.

ISTB-5122, "Group B Test Procedure," states, in part, "[g]roup B tests shall be conducted with the pump operating at a specified reference point. The test parameter value identified in Table ISTB-3000-1 shall be determined and recorded, as required by this paragraph."

Table ISTB-3000-1, "Inservice Test Parameters," identifies flow rate as a test parameter and Note 1 states, in part, that "differential pressure or flow rate shall be measured or determined."

The pumps affected by this alternative request are listed in Table 11.

Table 11: Motor-Driven AFW Pump Information for Request Number PR9

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1FW-P-3A	Motor-Driven AFW Pump	2	B
1FW-P-3B	Motor-Driven AFW Pump	2	B

3.8.1 Reason for Request

In its submittal, the licensee stated that the introduction of relatively cold AFW into the steam generators for quarterly testing would produce a potential for thermal shock to both the main feed piping (thermal sleeves) and the secondary side of the steam generators. Although the thermal sleeves and steam generators are designed for thermal shock, exposure to these events is minimized in order to ensure that the benefits of plant life extension can be realized. In addition, feeding the steam generators with a large volume of relatively cold water would also result in a large level transient in the steam generators and could cause a reactor trip.

Additionally, the licensee stated that the motor-driven AFW pumps receive their suction from the demineralized water storage tank. The water in the demineralized water storage tank is not treated for pH or oxygen; therefore, it could have an impact on the corrosion rates in the steam generators. For this reason, it is preferred to minimize the use of this water while in Modes 1, 2, or 3.

In order to perform the quarterly Group B test, a recirculation flow path must be used that recirculates the demineralized water storage tank. Although the installed suction flow indicating switch for each pump has a 0 to 350 gpm logarithmic scale that is calibrated to an accuracy of ±1% of full scale, the smallest increments between 100 and 200 gpm are 5 gpm. These increments are too large to read flow accurately at a throttled recirculation flow rate of 200 gpm.

ISTB-5122 requires that the test parameters in Table ISTB-3000-1 be determined and recorded during Group B quarterly tests. Flow rate is one of the test parameters listed in Table ISTB-3000-1. Section ISTB-3510(a), "Accuracy," requires that instruments used for testing be accurate within the specifications in Table ISTB-3510-1. Table ISTB-3510-1 requires that the flow rate be accurate to within ±2% of the actual flow rate.

Further, the licensee stated that an allowed ASME accuracy of 2.0% for flow minus the calibrated accuracy of 1.0% for the installed suction flow indicating switches multiplied by the reference flow rate of 200 gpm results in the flow reading needing to be capable of being read to at least ±2.0 gpm. Being able to accurately read flow halfway between the smallest increments of 5 gpm on the flow indicators yields a reading that is only capable of being read to 2.5 gpm.

Therefore, the installed suction flow indicating switches cannot be used for ASME pump testing. The installation of temporary flow instrumentation during the performance of the Group B quarterly test is an undue burden when compared to the limited benefits gained by the results of the quarterly pump tests.

Since an instrumented full-flow loop exists that can be utilized during refueling outages, the guidance provided in GL 89-04, Attachment 1, Position 9, for minimum flow paths shall be followed during the quarterly Group B test.

3.8.2 Proposed Alternative

As an alternative to the requirements of ISTB-5122 and Table ISTB-3000-1, the quarterly Group B test will be performed using the recirculation flow path while measuring d/p per motor-driven AFW pump tests, with flow assumed to be fixed and at its reference value. The periodic verification test (as described in Mandatory Appendix V of the 2012 ASME OM Code) and biennial comprehensive test will be performed during refueling outages when plant conditions permit directing flow to the steam generators. Full flow will be measured using the flow instrumentation in the steam generator supply headers while also d/p and vibrations per motor-driven AFW pump check valve and full-flow tests. Separate d/p reference and acceptance criteria values will be used for the different test conditions of the recirculation and full-flow tests. Motor-driven AFW pump check valve and full-flow test procedures may be performed in lieu of the quarterly tests, if their scheduled performances coincide.

The licensee also stated that the proposed alternative is in accordance with the guidelines provided in GL 89-04, Position 9.

3.8.3 NRC Staff Evaluation

Motor-driven AFW pumps 1FW-P-3A and 1FW-P-3B are centrifugal pumps and considered to be Group B, as defined by the ASME OM Code, which states that Group B pumps are "pumps in standby systems that are not operated routinely except for testing." The ASME OM Code requires Group B centrifugal pumps to be tested quarterly by test procedure ISTB-5122 and tested biennially by the comprehensive test procedure ISTB-5123. Both tests require that the pump operate at a specific flow reference point.

The licensee plans to perform the Group B quarterly test using the recirculation line flow path. This line has permanently installed flow indicating switches. However, due to the flow instrumentation range, these indicators do not meet the accuracy requirement of being able to determine flow rate to within ±2% of recirculation line reference flow of 200 gpm.

The licensee proposes to perform the quarterly Group B test using the recirculation line while measuring the d/p with the flow set to an assumed fixed reference value as best indicated by the permanently installed flow indicating switches. The biennial comprehensive flow test will be performed when the plant is in a condition to allow full-flow testing and using the flow instrumentation in the steam generator supply headers. The NRC staff has concluded that temporary installation of flow instrumentation that meets the ASME accuracy requirement for the quarterly Group B test represents a hardship, without a compensating increase in the level of quality and safety. The performance of the quarterly Group B test using the recirculation line with flow set to an assumed fixed reference value as best indicated by the permanently installed flow indicating switches is an acceptable alternative.

3.9 Licensee's Alternative Request Number PR10

3.9.1 Reason for Request

The licensee requested an alternative to the ASME OM Code Group B testing requirements. ISTB-5122 states, in part, "[g]roup B tests shall be conducted with the pump operating at a specified reference point. The test parameter value identified in Table ISTB-3000-1 shall be determined and recorded, as required by this paragraph."

The pumps affected by this alternative request are listed in Table 12.

Table 12: Turbine-Driven AFW Pump Information for Request Number PR10

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1FW-P-2	Turbine-Driven AFW Pump	2	B

3.9.2 Proposed Alternative

In its submittal, the licensee stated that the introduction of relatively cold AFW into the steam generators for quarterly testing would produce a potential for thermal shock to both the main feed piping (thermal sleeves) and the secondary side of the steam generators. Although the thermal sleeves and steam generators are designed for thermal shock, exposure to these events is minimized in order to ensure that the benefits of plant life extension can be realized. In addition, feeding the steam generators with a large volume of relatively cold water would also result in a large level transient in the steam generators and could cause a reactor trip.

Additionally, this pump receives suction from the demineralized water storage tank. The water in the demineralized water storage tank is not treated for pH or oxygen; therefore, it could have some impact on the corrosion rates in the steam generators. For this reason, it is preferred to minimize the use of this water while in Modes 1, 2, or 3.

The licensee stated that in order to perform the quarterly Group B test, a recirculation flow path must be used that recirculates the demineralized water storage tank. Although the installed suction flow indicating switch has a 0 to 700 gpm logarithmic scale that is calibrated to an accuracy of ±1% of full scale, the smallest increments between 100 and 400 gpm are 10 gpm. These increments are too large to read flow accurately at a throttled recirculation flow rate of 300 gpm.

ISTB-5122 requires that the test parameters in Table ISTB-3000-1 be determined and recorded during Group B quarterly tests. Flow rate is one of the test parameters listed in Table ISTB-3000-1. Section ISTB-3510(a) requires that instruments used for testing be accurate within the specifications in Table ISTB-3510-1. Table ISTB-3510-1 requires that the flow rate be accurate to within ±2% of the actual flow rate.

Based on an allowed ASME accuracy of 2.0% for flow minus the calibrated accuracy of 1.0% for FIS-1FW-152 multiplied by the reference flow rate of 300 gpm, flow readings need to be capable of being read to at least ±3.0 gpm. Being able to accurately read flow halfway between the smallest increments of 10 gpm on the flow indicator yields a reading that is only capable of being read to 5 gpm. Therefore, the installed suction flow indicating switch cannot be used for ASME pump testing. The installation of temporary flow instrumentation during the performance of the Group B quarterly test is an undue burden when compared to the limited benefits gained by the results of the quarterly pump tests.

The licensee also stated that since an instrumented full-flow loop exists that can be utilized during refueling outages, the guidance provided in GL 89-04, Attachment 1, Position 9, for minimum flow paths shall be followed during the quarterly Group B test.

3.9.3 NRC Staff Evaluation

Turbine-driven AFW pump 1FW-P-2 is a centrifugal pump and considered to be Group B as defined by the ASME OM Code, which states that Group B pumps are "pumps in standby systems that are not operated routinely except for testing." The ASME OM Code requires Group B centrifugal pumps to be tested quarterly by test procedure ISTB-5122 and tested biennially by the comprehensive test procedure ISTB-5123. Both tests require that the pump operate at a specific flow reference point.

The licensee plans to perform the Group B quarterly test using the recirculation line flow path. This line has permanently installed flow indicating switches. However, due to the flow instrumentation range, these indicators do not meet the accuracy requirement of being able to determine flow rate to within ±2% of recirculation line reference flow of 300 gpm.

The licensee proposes to perform the quarterly Group B test using the recirculation line while measuring the d/p with the flow set to an assumed fixed reference value as best indicated by the permanently installed flow indicating switches. The biennial comprehensive flow test will be performed when the plant is in a condition to allow full-flow testing and using the flow instrumentation in the steam generator supply headers. The NRC staff has concluded that temporary installation of flow instrumentation that meets the ASME accuracy requirement for the quarterly Group B test represents a hardship, without a compensating increase in the level of quality and safety. The performance of the quarterly Group B test using the recirculation line with flow set to an assumed fixed reference value as best indicated by the permanently installed flow indicating switches is an acceptable alternative.

3.10 Licensee's Alternative Request Number PR11

The licensee requested an alternative to the ASME OM Code flow requirement for comprehensive pump testing.

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

The pumps affected by this alternative request are listed in Table 13.

Table 13: Recirculation Spray Pumps Information for Request Number PR11

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1RS-P-1A	Inside Recirculation Spray Pump	2	B
1RS-P-1B	Inside Recirculation Spray Pump	2	B
1RS-P-2A	Outside Recirculation Spray Pump	2	B
1RS-P-2B	Outside Recirculation Spray Pump	2	B

3.10.1 Reason for Request

In its submittal, the licensee stated that prior to initial startup, the inside and outside recirculation spray pumps were subject to long-term full-flow testing. This testing was performed in 1972 as follows:

(a) With the nozzle openings blocked off (195 per header), temporary connections were made between the nozzle headers and containment sumps.

(b) Sufficient water was then added to the containment sump so that a recirculation spray pump could recirculate water up through its respective cooler and header.

(c) The full-flow test through the shell side of the cooler initially ensured that the required recirculation spray for containment depressurization was achieved.

(d) Upon completion of the above system test, the water was drained from each recirculation cooler, the pumps, the headers, and the sumps. The temporary connections between the header and sumps were removed and the nozzles installed.

The licensee described that since the system was left in a dry, ready condition after the initial full-flow tests, no further testing with water flow through the shell side of the recirculation spray heat exchangers is deemed necessary to ensure system capability. Further, the spray nozzles are inaccessible, without a significant amount of scaffolding. Even if accessibility was not a concern, the plugging of 780 spray nozzles, the installation of temporary piping, the performance of the full-flow test, and the return of the system to its operable configuration present substantial challenges. The effort would present challenges in terms of complexity of the temporary modifications, labor-intensive nature of the modifications, as well as the controls and post-modification testing, to ensure that the system is returned to the original configuration.

Additionally, the licensee stated that reestablishing this full-flow test circuit for the purpose of periodic design flow rate testing would require a similar modification every 2 years. The expensive and time-consuming, temporary changes described above would be necessary to duplicate the initial full-flow tests and would cause a hardship, without a compensating increase in the level of quality and safety. Likewise, replacement of the 4-inch recirculation test line with a line of sufficient size to accommodate design flow rate testing would cause a hardship, without a compensating increase in the level of quality and safety.

The recirculation spray pumps have a design point and best efficiency flow rate of 3,500 gpm. To be within 20% of pump design flow rate on the low end requires a minimum reference flow rate of 2,800 gpm. The code requirements that direct the owner to establish reference values at this flow rate were adopted after the test circuit was installed. Due to the flow restrictions associated with the existing piping configuration, ±20% of the 3,500 gpm design flow rate cannot be achieved through the 4-inch recirculation test line. A maximum flow rate of approximately 2,050 gpm is achievable through the 4-inch recirculation test line.

3.10.2 Proposed Alternative

The licensee stated that as an alternative to testing within ±20% of the design flow rate during the comprehensive test, as required by ISTB-3300(e)(1), the reference values will be established at approximately 2,050 gpm, which is within approximately 41% of the design flow rate and to within approximately 38% to 40% of the maximum required accident flow rates.

The inside and outside recirculation spray pumps have a design point and best efficiency flow rate of 3,500 gpm with varying maximum required accident flow rates. Table 14 shows the maximum required accident flow rates for each pump and the range of values within which test flows are established.

The reference flow rate for inside recirculation spray pump 1RS-P-1A is within 38% of the maximum required accident flow rate of 3,320 gpm. This percentage of the maximum required accident flow rate is specified for recirculation spray pump 1RS-P-1A and the other recirculation spray pumps in the table below.

Table 14: Accident and Test Flow Information for Request Number PR11

Pump ID	Accident Flow	Test Flow	Percent Within Accident Flow
1RS-P-1A	3,320 gpm	2,050 to 2,075 gpm	-38%
1RS-P-1B	3,370 gpm	2,050 to 2,075 gpm	-39%
1RS-P-2A	3,385 gpm	2,040 to 2,060 gpm	-40%
1RS-P-2B	3,340 gpm	2,040 to 2,060 gpm	-39%

The licensee described that presently, the IST reference flow rates are typically established with the existing test circuit in the range of 2,040 to 2,075 gpm. The low reference flow rates result from restrictions due to the small 4-inch recirculation line and the limited volume of water in the test circuit.

With the restrictions described, the highest flow rate that can be measured while maintaining stable test conditions is within approximately 41% of the 3,500 gpm design flow rate and within approximately 38% to 40% of the maximum required accident flow rates.

In the 2,040 to 2,075 gpm range of the head curve for these pumps, the curve is not flat but well sloped. Therefore, as performance degrades due to internal recirculation caused by increasing internal pump clearances, the d/p will measurably decrease for a given reference flow rate.

To be within 20% of pump design flow rate on the low end requires a minimum reference flow rate of 2,800 gpm. To be within 20% of the maximum required accident flow rate on the low end would require minimum reference flow rates ranging from 2,656 to 2,708 gpm, depending on the pump being tested. For the reasons previously stated, reference flow rates are procedurally controlled within a range of 2,040 to 2,075 gpm, which is not within the 20% of the design flow rate required during the comprehensive test.

Testing at near design flow rate conditions is important for pumps with characteristic head-flow curves that are flat or gently sloping in the low flow region (little change in developed head with increasing flow rate). In the low flow region, increasing internal flow rates as a result of internal wear are difficult to detect. Pumps with the flat portion of the curve at low flow rates should be tested at or near design conditions to determine if increasing internal recirculation flow rates have degraded pump performance to the point where design performance cannot be met.

This situation does not apply to the inside and outside recirculation spray pumps if they are tested within approximately 41% of the design flow rate when considering the slope of the curve. Testing at the proposed reference flow rates will detect degradation since the pump head curve is well sloped at the point of testing.

These recirculation spray pumps are Group B standby pumps run only for surveillance testing. The pumps do not see prolonged use. The low number of operating hours makes degradation of each pump unlikely. Significant changes in pump operation are not expected when each pump's run time is typically less than 2 hours once every 18-month cycle.

In order to compensate for testing all four pumps at the reduced flow rates, the inside and outside recirculation spray pumps are included in the PdM program. All pumps have enhanced vibration monitoring with spectral analysis data obtained each refueling outage. The outside recirculation spray pumps are subject to periodic oil sample analysis. The bearings associated with the inside recirculation spray pumps are grease lubricated. These activities are beyond that required by ISTB and provide further assurance as to the ability to detect pump degradation. Also, as a preventive maintenance activity, the outside recirculation spray pumps' mechanical seals are replaced every seventh refueling outage.

If the measured parameters are outside the normal operating range or are determined by analysis to be trending towards a degraded state, appropriate actions are taken. These actions may include monitoring of additional parameters, review of component-specific information to identify cause, and removal of the pump from service to perform corrective maintenance.

3.10.3 NRC Staff Evaluation

Inside and outside recirculation spray pumps 1RS-P-1A, 1RS-P-1B, 1RS-P-2A, and 1RS-P-2B are considered to be Group B as defined by the ASME OM Code, which states that Group B pumps are "pumps in standby systems that are not operated routinely except for testing." The ASME OM Code requires Group B pumps to be tested quarterly and a comprehensive test performed biennially. The quarterly pump test is performed using a recirculation flow test line that is capable of attaining approximately 2,050 gpm, which is about 60% of pump design point and best efficiency flow rate of 3,500 gpm. For the comprehensive test, the ASME OM Code requires that a reference value flow be established to within ±20% of pump design flow rate. To be within 20% of pump design flow rate requires a minimum reference flow rate of 2,800 gpm.

The inside and outside recirculation spray pumps are part of the containment depressurization system that has been designed to provide the necessary cooling and depressurization of the containment after any loss-of-coolant accident. The licensee stated that these pumps were subject to long-term full-flow testing prior to initial startup and that the system has since been left in a dry ready condition. Subsequent full-flow testing would require temporary installation of piping and plugging of 780 spray nozzles. This represents a labor-intensive effort for performing periodic full-flow comprehensive test.

In lieu of establishing pump flows to meet the ASME OM Code requirement of ±20% of pump design flow rate for the comprehensive test, the licensee has proposed to perform the test using the recirculation test line and establishing the reference value at approximately 2,050 gpm, which is within approximately 41% of the design flow rate and to within 38% to 40% of the maximum required accident flow rate. The licensee stated that the proposed test flow is on a portion of the pump curve, which is well sloped. As pump performance degrades due to changes in pump wear, the d/p will measurably decrease for a given reference flow rate.

In addition to the required ASME OM Code testing, the inside and outside recirculation spray pumps are included in the BVPS PdM program. All pumps are monitored using vibration analysis, spectral analysis, and oil analysis. Also, the outside recirculation spray pumps' mechanical seals are replaced every seventh refueling outage. If any measured parameters indicate that the pumps are operating outside their normal operating range or are determined to be trending towards a degraded state, appropriate actions will be taken.

Based on the review of the provided pump curves and information on BVPS PdM program, the NRC staff determined that the alternative provides reasonable assurance of the operational readiness of the inside and outside recirculation spray pumps and that compliance with the specified ASME OM Code requirement would result in a hardship, without a compensating increase in the level of quality and safety.

3.11 Licensee's Alternative Request Number PR12

The licensee requested an alternative to the ASME OM Code flow requirement for comprehensive pump testing.

ISTB-3300(e)(1) states that "[r]eference values shall be established within ±20% of pump design flow rate for the comprehensive test."

The pumps affected by this alternative request are listed in Table 15.

Table 15: Quench Spray Pump Information for Request Number PR12

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1QS-P-1A	Quench Spray Pump	2	B
1QS-P-1B	Quench Spray Pump	2	B

3.11.1 Reason for Request

In its submittal, the licensee stated that prior to initial startup, the quench spray pumps were subject to long-term full-flow testing. Temporary connections were made on the quench spray headers, and pipe plugs were placed in the spray nozzle sockets and the header drain lines. The quench spray pumps were started and tested, circulating water through the spray header supply lines to the spray headers and out the temporary test connections. This system capability test was conducted to ensure that the system meets flow requirements. It also provided a complete flush of the system to remove any particulate matter, which could conceivably result in plugging of the spray nozzles at a future time. At the completion of this test, the temporary test connections were removed, the pipe plugs were removed, and the spray nozzles were installed. The system was then ready for operation. The spray header piping has no remnants of the temporary test connections used to facilitate preoperational full-flow testing.

Reestablishing this full-flow test circuit for the purpose of periodic design flow rate testing would require a similar modification once every 2 years. The expensive and time-consuming, temporary changes described above would be necessary to duplicate the initial full-flow tests and would cause a hardship, without a compensating increase in the level of quality and safety. Likewise, replacement of the 4-inch recirculation test line with a line of sufficient size to accommodate design flow rate testing would cause a hardship, without a compensating increase in the level of quality and safety.

The quench spray pumps have a design point and best efficiency flow rate of 2,500 gpm. To be within 20% of pump design flow rate on the low end requires a minimum reference flow rate of 2,000 gpm. The code requirements that direct the owner to establish reference values at this flow rate were adopted after the test circuit was installed. Due to the flow restrictions associated with the existing piping configuration, ±20% of the 2,500 gpm design flow rate cannot be achieved through the 4-inch recirculation test line. A maximum flow rate of approximately 1,800 gpm is achievable through the 4-inch recirculation test line.

3.11.2 Proposed Alternative

The licensee stated that as an alternative to testing within 20% of the design flow rate during the comprehensive test, as required by ISTB-3300(e)(1), the reference values will be established at approximately 1,800 gpm, which is within approximately 28% of the design flow rate.
At approximately 1,800 gpm, the head curve for the quench spray pumps is not flat but well sloped. Therefore, as performance degrades due to internal recirculation caused by increasing internal pump clearances, the d/p will measurably decrease for a given reference flow rate.

Further, the licensee stated that testing at near design flow rate conditions is important for pumps with characteristic head-flow curves that are flat or gently sloping in the low flow region (little change in developed head with increasing flow rate). In the low flow region, increasing internal flows as a result of internal wear are difficult to detect. Pumps with the flat portion of the curve at low flow rates should be tested at or near design conditions to determine if increasing internal recirculation flows have degraded pump performance to the point where design performance cannot be achieved. This situation does not apply to the quench spray pumps if they are tested to within approximately 30% of the design flow rate. Testing at the proposed reference flow rates will detect degradation since the pump head curve is well sloped at the point of testing.

These quench spray pumps are Group B standby pumps run only for surveillance testing once per quarter. The pumps do not see prolonged use. The low number of operating hours makes degradation of each pump very unlikely. Significant changes in pump operation are not expected when each pump's run time is typically less than 1 hour each quarter.

In order to compensate for testing both pumps at the reduced flow rate, the quench spray pumps are included in the BVPS PdM program. The pumps have enhanced vibration monitoring with spectral analysis data obtained each refueling outage and are subject to periodic oil sample analysis. Also, as a preventive maintenance activity, the pumps' bearing oil is changed and the pumps' couplings are lubricated every 72 weeks.

If measured parameters are outside the normal operating range or are determined by analysis to be trending towards a degraded state, appropriate actions are taken. These actions may include monitoring additional parameters, review of component-specific information to identify cause, and removal of the pump from service to perform corrective maintenance.

Testing the pumps utilizing the current test loops provides for substantial flow testing in a sloped and stable region of the pump curve (that is, at approximately 1,800 gpm) and is well above the minimum continuous flow rate of 1,350 gpm specified by the pump manufacturer. Testing the pumps at reference values established in this region of the pump curves will not cause damage to the pumps and will provide meaningful data to assess pump operational readiness.

3.11.3 NRC Staff Evaluation

Quench spray pumps 1QS-P-1A and 1QS-P-1B are considered to be Group B as defined by the ASME OM Code, which states that Group B pumps are "pumps in standby systems that are not operated routinely except for testing." The ASME OM Code requires Group B pumps to be tested quarterly and a comprehensive test performed biennially. The quarterly pump test is performed using a recirculation flow test line that is capable of attaining approximately 1,800 gpm, which is about 70% of pump design point and best efficiency flow rate of 2,500 gpm. For the comprehensive test, the ASME OM Code requires that a reference value flow be established to within ±20% of pump design flow rate. To be within 20% of pump design flow rate requires a minimum reference flow rate of 2,000 gpm.

The quench spray pumps are part of the containment depressurization system that has been designed to provide the necessary cooling and depressurization of the containment after any loss-of-coolant accident. The licensee stated that the quench spray pumps were subject to long-term full-flow testing prior to initial startup. The testing verified pump performance, as well as flushing the system, to remove any particulate matter left by the initial installation. Upon completion of the testing, the temporary piping was removed and the spray nozzles installed. Subsequent full-flow testing to meet ASME OM Code requirements would require a temporary modification to reinstall piping and test connections. This represents a labor-intensive effort for performing periodic full-flow comprehensive test.

In lieu of establishing pump flows to meet the ASME OM Code requirement of ±20% of pump design flow rate for the comprehensive test, the licensee has proposed to perform the test using the recirculation test line and establishing the reference value at approximately 1,800 gpm, which is within approximately 30% of the design flow rate. The licensee stated that the proposed test flow is on a portion of the pump curve, which is well sloped. As pump performance degrades due to changes in pump wear, the d/p will measurably decrease for a given reference flow rate.

In addition to the required ASME OM Code testing, the quench spray pumps are included in the BVPS PdM program. All pumps are monitored using vibration analysis, spectral analysis, and oil analysis. Also, the pumps' bearing oil is changed and their couplings lubricated every 72 weeks. Should any measured parameter indicate that the pumps are operating outside their normal operating range or are determined to be trending towards a degraded state, appropriate actions are taken.

Based on the review of the provided pump curves and information on BVPS PdM program, the NRC staff finds that the alternative provides reasonable assurance of the operational readiness of the quench spray pumps and that compliance with the specified ASME OM Code requirement would result in a hardship, without a compensating increase in the level of quality and safety.

3.12 <u>Licensee's Alternative Request Number PR13</u>

The licensee requested an alternative to the ASME OM Code instrument accuracy requirements.

ISTB-3510(a) states:

> Instrument accuracy shall be within the limits of Table ISTB-3510-1. If a parameter is determined by analytical methods instead of measurement, then the determination shall meet the parameter accuracy requirement of Table ISTB-3510-1 (e.g., flow rate determination shall be accurate to within ±2% of actual). For individual analog instruments, the required accuracy is percent of full scale. For digital instruments, the required accuracy is over the calibrated range. For a combination of instruments, the required accuracy is loop accuracy.

The pumps affected by this alternative request are listed in Table 16.

Table 16: River Water Pump Information for Request Number PR13

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1WR-P-1A	River Water Pump	3	A
1WR-P-1B	River Water Pump	3	A
1WR-P-1C	River Water Pump	3	A

3.12.1 Reason for Request

In its submittal, the licensee stated that the BVPS-1 river water pumps are vertical line shaft pumps that receive their suction from a pit that communicates with the Ohio River. The d/p is calculated using pump discharge pressure indicators and the calculated suction pressure using river water elevation from the Ohio River level recorder. The transmitter associated with the level recorder is calibrated to 1.5% of full scale, and the recorder is calibrated to 1.0% of full scale, resulting in a loop accuracy of 1.8% of full scale. The overall loop accuracy exceeds the maximum 0.5% required by Table ISTB-3510-1 when performing a comprehensive or preservice test.

The licensee stated that typically, the Ohio River elevation is between 665 and 666 feet, resulting in a small variance between calculated suction pressure when determined by the calculation method provided by the procedure. However, during the spring, river elevations may be higher due to rain. This condition is evaluated with the test results to ensure operational readiness of the pumps.

3.12.2 Proposed Alternative

As an alternative to Table ISTB-3510-1, the licensee proposes to use the installed Ohio River level recorder with a loop accuracy of 1.8% (to determine river water pump suction pressure) and a 0 to 100 psig, 0.1% or better accurate test pressure gauge (to determine river water pump discharge pressure). These instrument readings are used to determine river water pump d/p. The d/p for the river water pumps is determined by taking the difference between the pump discharge pressure measured in psig, minus the river elevation corrected for elevation in feet back to the floor elevation of the pump, and converted to pressure.

Suction pressure for the river water pumps is determined by converting a river elevation reading measured by a level recorder to a calculated pressure. This level recorder has a full scale range from 648 to 705 feet (which corresponds to river elevation above sea level). Normal river elevation is 665 to 666 feet. The loop accuracy for the level recorder is 1.8%. The suction pressure reading over the range of the installed level recorder is accurate to within 0.45 psig. This accuracy is obtained by taking the full scale range of 57 feet, converting it to a pressure ([57 feet]/[2.31 feet/psig] = 25 psig), and multiplying it by 1.8% accuracy. The ASME OM Code would require this suction pressure reading to be accurate within 0.125 psig (25 psig x 0.5% accuracy).

The licensee stated that discharge pressure for the river water pumps is to be obtained from a temporary test pressure gauge with a full scale range of 0 to 100 psig. The ASME OM Code would require this discharge pressure reading to be accurate to 0.5 psig (100 psig x 0.5% accuracy). In order to compensate for the 1.8% suction pressure loop accuracy not meeting the 0.5% accuracy required for comprehensive pump testing, a 0.1% accurate temporary test pressure gauge will be used. This temporary test pressure gauge is to be used in place of the installed 0 to 100 psig; 0.5% accurate discharge pressure indicators will provide a discharge pressure reading over the range of the instrument with an accuracy of 0.1 psig (100 psig x 0.1%). Adding this to the installed 1.8% accurate suction pressure instrument reading yields an overall combined reading able to be read within 0.55 psig (0.45 psig + 0.1 psig) for the combination of instruments.

When the Table ISTB-3510-1 required instrument accuracy of ±0.5% is applied to the river level readings, the suction pressure reading over the range of the instrument is required to be accurate to within 0.125 psig (25 psig x 0.5%). When the Table ISTB-3510-1 required instrument accuracy of ±0.5% is applied to the pump discharge pressure test gauge readings, the discharge pressure reading over the range of the test instrument is required to be accurate to within 0.5 psig (100 psig x 0.5%). Adding these required instrument accuracies together would yield an overall worst case (allowed) error of 0.625 psig (0.125 psig + 0.5 psig). Therefore, the overall d/p reading, which can be read to within 0.55 psig, is better than the effective 0.625 psig d/p reading required by the ASME OM Code for comprehensive pump testing.

The licensee explained that the proposed alternative using the 0.1% accurate test pressure gauge in place of the installed discharge pressure indicator will yield an effective d/p reading (considering both suction and discharge pressure instrumentation together) that is more accurate than the ±0.5% instrument accuracy required by Table ISTB-3510-1 for comprehensive pump testing.

Other activities are implemented at BVPS-1 in addition to those required by the ASME OM Code that enhance the ability to detect pump degradation. As part of the BVPS PdM program, spectral analysis is also used to determine the mechanical condition of a pump. Spectral data can provide information to determine if misalignment, unbalance, resonance, looseness, or a bearing problem is present. Through a review of the spectral data over a period of time, changes in the condition of the pump may also be determined. Additionally, as part of the BVPS Preventive Maintenance program, the pump motors are inspected, lubricated, and tested every 144 weeks. The pump and motor are completely overhauled every 312 weeks and every 624 weeks, respectively. This frequency is based on the expected condition of the pumps as a result of historical overhauls and was established to allow overhaul prior to the point of degradation resulting in questionable operational readiness.

3.12.3 NRC Staff Evaluation

River water pumps 1WR-P-1A, 1WR-P-1B, and 1WR-P-1C are vertical line shaft centrifugal pumps and considered to be Group A, as defined by the ASME OM Code, which states that Group A pumps are "pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operations." The ASME OM Code requires Group A vertical line shaft pumps to be tested quarterly by test procedure ISTB-5221 and tested biennially by the comprehensive test procedure ISTB-5223. Both tests require that the pump operate at a specific flow reference point. When performing the comprehensive pump test, the accuracy of the instrumentation for measuring the pump pressure must be within ±0.5% per Table ISTB-3510-1.

The licensee has proposed to perform the comprehensive pump test using the installed Ohio River level recorder with a loop accuracy of 1.8% (to determine river water pump suction pressure) and a 0 to 100 psig, 0.1% or better accurate test pressure gauge (to determine river water pump discharge pressure). These instrument readings will be used to determine river water pump d/p.

The proposed test pressure gauge (0.1%) for the discharge pressure is more accurate than the 0.5% accuracy required by Table ISTB-3510-1. The combination of the discharge pressure test gauge and the suction pressure gauge accuracies provide an overall d/p indicated accuracy that is better than the accuracy allowed by the ASME OM Code. NUREG-1482, Revision 2, Section 5.5.1, states that relief may be granted when the combination of the range and accuracy yields a reading that is at least equivalent to that achieved using instruments that meet the ASME OM Code requirements. The reading accuracy achieved using the proposed alternative yields an acceptable level of quality and safety for the comprehensive tests.

3.13 Licensee's Alternative Request Number PR14

The licensee requested an alternative to the ASME OM Code requirements for obtaining the test reference point.

ISTB-5121(b), "Group A Test Procedure," states, in part, "[t]he resistance of the system shall be varied until the flow rate equals the reference point."

ISTB-5122(c), "Group B Test Procedure," states, "[s]ystem resistance may be varied as necessary to achieve the reference point."

ISTB-5123(b), "Comprehensive Test Procedure," states, in part, "[f]or centrifugal and vertical line shaft pumps, the resistance of the system shall be varied until the flow rate equals the reference point."

ISTB-5221(b), "Group A Test Procedure," states, in part, "[t]he resistance of the system shall be varied until the flow rate equals the reference point."

ISTB-5222(c), "Group B Test Procedure," states, "[s]ystem resistance may be varied as necessary to achieve the reference point."

ISTB-5223(b) "Comprehensive Test Procedure," states, in part, "[t]he resistance of the system shall be varied until the flow rate equals the reference point."

ASME OM Code Case OMN-21, "Alternative Requirements for Adjusting Hydraulic Parameters to Specified Reference Points," from the 2015 Edition of the ASME OM Code, allows a pump to operate as close as practical to the specified reference point with the requirements that the variance from the reference point does not exceed + 2% or - 1% of the reference point when the reference point is flow rate, or + 1% or - 2% of the reference point when the reference point is d/p or discharge pressure.

The pumps affected by this alternative request are listed in Table 17.

Table 17: Pump Information for Request Number PR14

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
1CH-P-1A	Charging Pump	2	A
1CH-P-1B	Charging Pump	2	A
1CH-P-1C	Charging Pump	2	A
1CH-P-2A	BAT Pump	3	A
1CH-P-2B	BAT Pump	3	A
1RH-P-1A	RHR Pump	2	A
1RH-P-1B	RHR Pump	2	A
1SI-P-1A	Low Head Safety Injection Pump	2	B
1SI-P-1B	Low Head Safety Injection Pump	2	B
1RS-P-1A	Inside Recirculation Spray Pump	2	B
1RS-P-1B	Inside Recirculation Spray Pump	2	B
1RS-P-2A	Outside Recirculation Spray Pump	2	B
1RS-P-2B	Outside Recirculation Spray Pump	2	B
1FW-P-2	Turbine-Driven AFW Pump	3	B
1FW-P-3A	Motor-Driven AFW Pump	3	B
1FW-P-3B	Motor-Driven AFW Pump	3	B
1WR-P-1A	River Water Pump	3	A
1WR-P-1B	River Water Pump	3	A
1WR-P-1C	River Water Pump	3	A

3.13.1 Reason for Request

In its submittal, the licensee stated there is difficulty in adjusting system throttle valves with sufficient precision to achieve an exact flow reference value during pump testing. Paragraphs ISTB-5121(b), ISTB-5122(c), ISTB-5123(b), ISTB-5221(b), ISTB-5222(c), and ISTB-5223(b) do not allow for a variance in flow rate from a fixed reference point for pump testing.

3.13.2 Proposed Alternative

The licensee stated that when the pump flow rate is required to be throttled for the pumps listed above, it will be adjusted by plant operators as close as practical to the reference flow value, but within a procedure flow limit of + 2% or - 1% of the reference value, in accordance with ASME OM Code Case OMN-21, updated January 29, 2013.

NUREG-1482, Revision 2, Section 5.3, "Allowable Variance from Reference Points and Fixed-Resistance Systems," states, in part, that, "Certain pump system designs do not allow for the licensee to set the flow at an exact value because of limitations in the instruments and controls for maintaining steady flow."

ASME OM Code Case OMN-21 provides guidance for adjusting reference flow to within a specified tolerance during pump testing. Code Case OMN-21 states:

> It is the opinion of the Committee that when it is impractical to operate a pump at a specified reference point and adjust the resistance of the system to a specified reference point for either flow rate, differential pressure or discharge pressure, the pump may be operated as close as practical to the specified reference point

> with the following requirements. The Owner shall adjust the system resistance to as close as practical to the specified reference point where the variance from the reference point does not exceed + 2% or -1% of the reference point when the reference point is flow rate, or + 1% or - 2% of the reference point when the reference point is differential pressure or discharge pressure.

The licensee further stated that using the provisions of this relief request as an alternative to the specific requirements of paragraphs ISTB-5121(b), ISTB-5122(c), ISTB-5123(b), ISTB-5221(b), ISTB-5222(c), and ISTB-5223(b), as described above, will provide adequate indication of pump performance and continue to provide an acceptable level of quality and safety.

3.13.3 NRC Staff Evaluation

An inquiry was submitted to the ASME OM Code Committee to determine what alternatives may be used when it is impractical to operate a pump at a specified reference point for flow rate, d/p, or discharge pressure. In response to the inquiry, ASME Code Case OMN-21 was developed to provide guidance on alternatives. The guidance in Code Case OMN-21 states that when it is impractical to operate a pump at a specified reference point for flow rate, d/p, or discharge pressure, the pump may be operated as close as practical to the specified reference point with the following requirements. Code Case OMN-21 specifies that the variance from the reference point shall not exceed + 2% or - 1% of the reference point when the reference point is flow rate, or + 1% or - 2% of the reference point when the reference point is d/p or discharge pressure.

Code Case OMN-21 was approved by the ASME Operation and Maintenance Standards Committee on April 20, 2012, with the NRC representative voting in the affirmative. The licensee proposes to adopt Code Case OMN-21. The applicability of Code Case OM-21 is the ASME OM Code, 1995 Edition through the 2011 Addenda. The language from Code Case OMN-21 has been included in the ASME OM Code, 2012 Edition.

The NRC staff notes that in certain situations, it is not possible to operate a pump at a precise reference point. The NRC staff has reviewed the alternatives proposed in ASME OM Code Case OMN-21 and found that the proposed alternatives are reasonable and appropriate when a pump cannot be operated at a specified reference point. Operation within the tolerance bands specified in ASME OM Code Case OMN-21 provides reasonable assurance that licensees will be able to utilize the data collected to detect degradation of the pumps. Based on the NRC staff's review of ASME OM Code Case OMN-21 and the licensee's commitment to use the bands specified in ASME OM Code Case OMN-21 for flow rate, the NRC staff concludes that implementation of the alternatives contained in ASME OM Code Case OMN-21 is acceptable for the pumps listed in the table above. Therefore, the NRC staff concludes that the licensee's proposed alternative provides an acceptable level of quality and safety.

3.14 <u>Licensee's Alternative Request Number VR2</u>

The licensee requested an alternative to the ASME OM Code test interval for relief valves.

Appendix I, paragraph I-1320, "Test Frequencies, Class 1 Pressure Relief Valves," (a) "5-Year Test Interval," states:

> Class 1 pressure relief valves shall be tested at least once every 5 years, starting with initial electric power generation. No maximum limit is specified for the number of valves to be tested within each interval; however, a minimum of 20%

> of the valves from each valve group shall be tested within any 24 month interval. This 20% shall consist of valves that have not been tested during the current 5-year interval, if they exist. The test interval for any individual valve shall not exceed 5 years."

ASME OM Code Case OMN-17, "Alternative Rules for Testing ASME Class 1 Pressure Relief/Safety Valves," from the 2009 Edition of the ASME OM Code allows a 6-year test interval, plus an additional 6-month grace period coinciding with a refueling outage in order to accommodate extended shutdown periods.

The valves affected by this alternative request are listed in Table 18.

Table 18: Pressurizer Safety Valve (PSV) Information for Request Number VR2

Valve Number	Valve Name	ASME Code Class	ASME OM Category
RV-1RC-551A	PSV	1	C
RV-1RC-551B	PSV	1	C
RV-1RC-551C	PSV	1	C

3.14.1 Reason for Request

In its submittal, the licensee stated that BVPS-1 has three PSVs installed to protect the RCS from over-pressure. Since BVPS-1 operates on an 18-month fuel cycle, one valve can be tested each refueling outage such that each valve is tested over a 4½-year period. In order to avoid outage delays due to valve testing, a PSV is replaced during each refueling outage with one of three spare valves that has been pretested. The removed valve is refurbished and tested to become a spare valve for installation during a future refueling outage. In order to ensure a spare replacement valve does not exceed the 5-year test interval limit from test to test, it must be tested within 6 months prior to installation. Extending the maximum test interval to 6 years with a 6-month grace period would permit the replacement of an installed PSV with a spare PSV without the need to test the spare valve within 6 months of installation.

ASME OM Code Case OMN-17 from the 2012 Edition of the ASME OM Code allows a 72-month (6-year) test interval plus an additional 6-month grace period coinciding with a refueling outage in order to accommodate extended shutdown periods.

3.14.2 Proposed Alternative

The licensee stated that as an alternative to the ASME OM Code-2004 Edition, Mandatory Appendix I, paragraph I-1320(a) test interval for PSV testing of at least once every 5 years, the PSVs will be tested at least once every 6 years plus a 6-month grace period, if required, in accordance with the periodicity and other requirements of ASME OM Code Case OMN-17. Code Case OMN-17 provisions will not be applied to a valve until the valve is disassembled and inspected as described in paragraph (e) of Code Case OMN-17.

Paragraph (d) of Code Case OMN-17 requires disassembly and inspection of each valve after as-found set-pressure testing is performed in order to verify that parts are free of defects resulting from time-related degradation or service-induced wear. Paragraph (e) of Code Case OMN-17 requires each valve to be disassembled and inspected in accordance with paragraph (d) prior to the start of the 72-month test interval. When the proposed alternative is applied to a valve, the valve will be disassembled and inspected after as-found set pressure testing is performed in accordance with Code Case OMN-17, paragraphs (d) and (e). The initial inspection and ongoing inspections will verify that valve parts are free of defects resulting from time-related degradation or service-induced wear. These inspections will provide additional assurance that the PSVs will perform their intended function.

The longer test interval will eliminate the need for a valve test within 6 months of installation during each refueling outage. Eliminating the test will, in turn, remove the risk of any shipping damage when the valve is returned from the offsite testing facility and reduce wear on metal valve seats due to steam testing.

The as-found set-pressure acceptance criteria is ±3% of the valve nameplate set pressure in accordance with paragraph I-1320(c)(1) of the ASME OM Code, 2004 Edition, Mandatory Appendix I, for the purpose of determining the need to test additional valves. The as-found set-pressure acceptance criteria is ±3% of valve nameplate set pressure in accordance with BVPS-1 Technical Specification Limiting Condition for Operation 3.4.10 for the purpose of determining PSV operability.

The licensee further stated that between the years 2005 and 2007, six new Target Rock Model 569C-001-1 relief valves were purchased. All six new valves have been rotated into the three installed locations over the course of the past seven refueling outages, with the old valves discarded. Since 2009 (when the first of the new valves was as-found tested), seven as-found set pressure tests have been performed for the six PSVs. These tests have been performed at an offsite test facility using saturated steam. The majority of the tests were performed after the valve was installed for three operating cycles. As-found tests were within ±3% of the valve set pressure with the exception of valve RV-1RC-551A, which lifted low (- 4%) in 2015. BVPS-1 Technical Specification Surveillance Requirement 3.4.10.1 requires that following testing, lift settings shall be within ±1%. For three of the seven tests, the valves were found within the as-left tolerance of ±1%. These test results show limited time-related degradation or set point drift and demonstrate that it is acceptable to extend the test interval from 4½ years (three fuel cycles) to 6 years (four fuel cycles) with a 6-month grace period.

The ability to detect degradation and to ensure the operational readiness of the PSVs to perform their intended function is assured based on the valve test history and by performing the required inspection and testing initially and at the proposed alternative frequency. Therefore, test and inspection of the valves in accordance with the proposed alternative demonstrates an acceptable level of quality and safety.

3.14.3 NRC Staff Evaluation

ASME published Code Case OMN-17 with the 2009 Edition of the OM Code. Code Case OMN-17 allows extension of the test frequency for safety relief valves (SRVs) from 5 years to 72 months with a 6-month grace period. The code case imposes a special maintenance requirement to disassemble and inspect each SRV to verify that parts are free from defects resulting from the time-related degradation or maintenance-induced wear prior to the start of the extended test interval. The NRC staff recognizes that although Mandatory Appendix I, paragraph I-1320(a) of the ASME OM Code does not require that SRVs be routinely refurbished when tested on a 5-year interval, routine refurbishment provides additional assurance that set-pressure drift during subsequent operation is minimized. Consistent with the special maintenance requirement in Code Case OMN-17, the licensee stated that each PSV will be as-found tested, disassembled, inspected, and repaired prior to installation, to verify that parts were free from defects resulting from time-related degradation or maintenance-induced wear.

The NRC staff finds that extending the test interval of PSVs RV-1RC-551A, RV-1RC-551B, and RV-1RC-551C to 72 months with a 6-month grace period is acceptable. Extending the test interval should not adversely affect the operational readiness of the PSVs, because the PSVs will be disassembled, inspected, and reworked to defect free condition prior to the start of the extended test interval. The additional maintenance, which is beyond what is required by OM Code Mandatory Appendix I when testing PSVs on a 5-year interval, justifies extension of the test interval for up to 72 months, plus a 6-month grace period while providing an acceptable level of quality and safety.

3.15 Licensee's Alternative Request Number VR3

The licensee requested an alternative to the ASME OM Code requirements for valve position verification testing.

ISTC-3700, "Position Verification Testing," states:

> Valves with remote position indicators shall be observed locally at least once every 2 years to verify that valve operation is accurately indicated. Where practicable, this local observation should be supplemented by other indications such as use of flowmeters or other suitable instrumentation to verify obturator position. These observations need not be concurrent. Where local observation is not possible, other indications shall be used for verification of valve operation.

The valves affected by this alternative request are listed in Table 19.

Table 19: Solenoid Operated Valve (SOV) Information for Request Number VR3

Valve Number	Valve Name	ASME Code Class	ASME OM Category
SOV-1HY-102A1	A Hydrogen Analyzer Containment Dome Inlet Flow Sample Valve	2	A
SOV-1HY-102A2	A Hydrogen Analyzer Containment Dome Inlet Flow Sample Valve	2	A
SOV-1HY-102B1	B Hydrogen Analyzer Containment Dome Inlet Flow Sample Valve	2	A
SOV-1HY-102B2	B Hydrogen Analyzer Containment Dome Inlet Flow Sample Valve	2	A
SOV-1HY-103A1	A Hydrogen Analyzer Pressurizer Cubicle Inlet Flow Sample Valve	2	A
SOV-1HY-103A2	A Hydrogen Analyzer Pressurizer Cubicle Inlet Flow Sample Valve	2	A
SOV-1HY-103B1	B Hydrogen Analyzer Pressurizer Cubicle Inlet Flow Sample Valve	2	A
SOV-1HY-103B2	B Hydrogen Analyzer Pressurizer Cubicle Inlet Flow Sample Valve	2	A
SOV-1HY-104A1	A Hydrogen Analyzer Flow Sample Discharge Valve	2	A

SOV-1HY-104A2	A Hydrogen Analyzer Flow Sample Discharge Valve	2	A
SOV-1HY-104B1	B Hydrogen Analyzer Flow Sample Discharge Valve	2	A
SOV-1HY-104B2	B Hydrogen Analyzer Flow Sample Discharge Valve	2	A

3.15.1 Reason for Request

In its submittal, the licensee stated that the valves listed above are Category A containment isolation valves and are required to be seat leakage tested in accordance with 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," (Option B, Type C). Due to the design of the valves, position verification testing is performed in conjunction with the Type C leak test. Each of the listed valves is an SOV designed such that the coil position is internal to the valve body and is not observable in either the energized or deenergized state.

The licensee further explains that the subject valves are seat leakage tested using local leakage rate test equipment as part of the Appendix J, Type C leak test program. As part of the leakage rate test, the position verification test is also performed. This method involves attempting to pressurize the containment penetration volume to approximately 45 psig with the valve open as indicated by its remote position lights on the control room bench board. If the attempt to pressurize the containment penetration fails, the valve position is verified to be open. The valve is then closed using the control switch in the control room, and the containment penetration volume is pressurized to approximately 45 psig. Being able to maintain pressure in the penetration while the valve is indicating closed by its remote position lights on the control room bench board verifies the valve is closed. This method satisfies the requirement for position verification testing and ensures that the remote indicating lights in the control room accurately reflect the local valve position in the field.

Position verification testing is required to be performed once every 2 years and is typically performed during a refueling outage, regardless of whether the containment penetration is due for Type C leakage testing or not. In order to perform Type C leakage testing, piping and valves associated with the individual valve being tested are drained, vented, and aligned. Because the position verification test requires the Type C leakage test to be performed, the above actions are completed during each refueling outage.

3.15.2 Proposed Alternative

The licensee stated that as an alternative to the ISTC-3700 test interval of at least once every 2 years, it is proposed that the required position verification testing of the valves listed above be performed in conjunction with the Type C seat leakage test at the frequency specified by 10 CFR Part 50, Appendix J, Option B, for the Type C leakage test. This test interval may be adjusted to a frequency of testing commensurate with Option B of 10 CFR Part 50, Appendix J, for Type C seat leakage testing based on valve seat leakage performance. If a valve fails a leak test representing an unacceptable remote position verification, the valve test frequency (including position verification testing) will be adjusted in accordance with 10 CFR Part 50, Appendix J, Option B.

In addition to position verification testing and seat leakage testing, each of the valves listed above is stroke timed open and closed one at a time on a quarterly frequency. The opening stroke time for each valve is measured from the time the control switch is placed in the open position until the red indicating light is the only indicating light remaining illuminated. The closing stroke time for each valve is measured from the time the control switch is placed in the closed position until the green indicating light is the only indicating light remaining illuminated. The stroke times are compared to a 2-second limiting time established in accordance with paragraph ISTC-5152(c) of the ASME OM Code. If the stroke time is within the 2-second limiting time, then the valve is considered to have passed and is operating acceptably.

Option B of 10 CFR Part 50, Appendix J, permits the extension of Type C leakage testing to a frequency based on leakage rate limits and historical valve performance. Valves whose leakage test results indicate good performance may have their seat leakage test frequency extended up to 60 months, or three refueling outages (based on an 18-month fuel cycle). In order for a valve's seat leakage test frequency to be extended, the individual containment isolation valve must first successfully pass two consecutive as-found seat leakage tests before it can be placed on an extended seat leakage test frequency.

The licensee explained that over the past six refueling outages, the valves listed above have passed the position verification test performed in conjunction with its Type C leakage test. Valve performance data is recorded in a database and trended by the IST coordinator. If the leak rate exceeds the allowable limit, the valves are repaired or replaced. Any maintenance performed on these valves that might affect position indication is followed by an applicable post-maintenance test, including position verification testing, regardless of the Type C test frequency. Additionally, the SOVs that are required to be stroke time tested with their stroke times measured and compared to the ASME OM Code acceptance criteria of less than 2 seconds are exercised on a quarterly test frequency. For the past 10 years, no quarterly stroke time failures have been noted.

Valve exercise testing each quarter and position verification and seat leakage testing in accordance with the frequency specified by 10 CFR Part 50, Appendix J, Option B, provides an adequate assessment of valve health, and therefore, an acceptable level of quality and safety. Based on past performance of the SOVs and the quarterly valve stroking for the valves subject to exercising, coupled with a 10 CFR Part 50, Appendix J, Option B performance-based program to test for leakage and verify valve position indication, the licensee stated that the proposed alternative to the ISTC-3700 test interval provides an acceptable level of quality and safety.

3.15.3 NRC Staff Evaluation

The licensee has proposed an alternative test in lieu of the requirements found in ISTC-3700 for the valves listed in Table 11. Specifically, the licensee proposes to perform the valve position verification test in conjunction with the Type C valve seat leakage test at a frequency in accordance with the 10 CFR Part 50, Appendix J, Option B schedule. Valves would initially be tested at the required interval schedule, which is currently every refueling outage, or 18 months, as specified by ISTC-3700. Valves that have demonstrated good performance for two consecutive cycles may have their test interval extended to a maximum of 60 months. Any position indication verification test failure would require the component to return to the initial interval of every refueling outage, or 18 months, until good performance can again be established.

The valves listed in Table 19 are Category A containment isolation valves and are required to be leak tested in accordance with the 10 CFR Part 50, Appendix J program. The licensee has implemented Option B of the 10 CFR Part 50, Appendix J program. This places the leakage testing requirements for the valves into a performance-based program. Valves that have demonstrated a history of good performance may have their leakage test interval extended beyond the normal test interval requirement. Extension intervals are not allowed to exceed 60 months. The licensee proposes to synchronize the position indication verification test requirements of ISTC-3700 with the Appendix J leakage rate test requirements. Both tests will be performed together on a 10 CFR Part 50, Appendix J, Option B performance-based schedule.

Performance data indicates that the valves have been relatively maintenance free. Quarterly valve exercise, coupled with a 10 CFR Part 50 Appendix J, Option B performance-based program to test for leakage and verify valve position indication provides an acceptable level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff determined that for alternative requests PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3 for BVPS-1, the proposed alternatives provide an acceptable 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)(1) for requests PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3. Therefore, the NRC staff authorizes the use of the alternative requests PR2, PR3, PR4, PR8, PR13, PR14, VR2, and VR3 for BVPS-1 for the fifth 10-year IST program interval, which begins on September 20, 2017, and is scheduled to end on September 19, 2027.

As set forth above, the NRC staff determined that for alternative requests PR9, PR10, PR11, and PR12 for BVPS-1, the proposed alternatives provide reasonable assurance that the affected 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(z)(2) for requests PR9, PR10, PR11, and PR12. Therefore, the NRC staff authorizes the use of the alternative requests PR9, PR10, PR11, and PR12 for BVPS-1 for the fifth 10-year IST program interval, which begins on September 20, 2017, and is scheduled to end on September 19, 2027.

As set forth above, the NRC staff has determined that it is impractical for the licensee to comply with certain testing requirements of the ASME OM Code. The NRC staff has further determined that granting relief requests PR5, PR6, and PR7 in accordance with 10 CFR 50.55a(f)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest, giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(f)(5)(iii) and is in compliance with the requirements of 10 CFR 50.55a with the granting of these reliefs. Therefore, the NRC staff grants relief, pursuant to 10 CFR 50.55a(f)(6)(i), for the testing alternatives contained in relief requests PR5, PR6, and PR7 for BVPS-1 for the fifth 10-year IST interval, which begins on September 20, 2017, and is scheduled to end on September 19, 2027.

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

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Date: June 26, 2017

SUBJECT: BEAVER VALLEY POWER STATION, UNIT NO. 1 – REQUESTS FOR ALTERNATIVES AND REQUESTS FOR RELIEF RE: FIFTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL (CAC NOS. MF8332, MF8334, MF8336, MF8337, MF8340, MF8342, MF8344, MF8346, MF8348, MF8350, MF8351, MF8353, MF8354, MF8355, AND MF8357) DATED JUNE 26, 2017

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