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 2 – REQUESTS FOR ALTERNATIVES AND REQUESTS FOR RELIEF RE: FOURTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL (CAC NOS. MF8333, MF8335, MF8338, MF8339, MF8341, MF8343, MF8345, MF8347, MF8349, MF8358, AND MF8356)

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 2.

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, PR6, PR8, PR10, VR2, and VR3 on the basis that the alternatives provide an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(f)(5)(iii), the licensee requested to use the proposed alternatives in requests PR5, PR7, and PR9 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, PR6, PR8, PR10, VR2, and VR3 for Beaver Valley, Unit 2, 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, PR6, PR8, PR10, VR2, and VR3. Therefore, the NRC staff authorizes the use of the alternatives in requests PR2, PR3, PR4, PR6, PR8, PR10, VR2, and VR3 for Beaver Valley, Unit 2, for the fourth 10-year inservice testing program interval, which begins on September 20, 2017, and is scheduled to end on September 19, 2027.

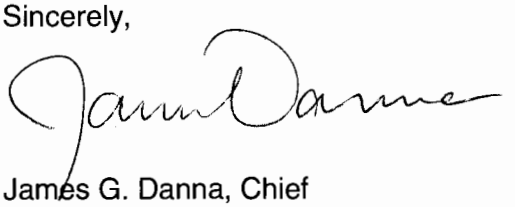
The NRC staff has determined that it is impractical for the licensee to comply with certain testing requirements of the ASME OM Code. The NRC staff has further determined that granting relief requests PR5, PR7, and PR9 in accordance with 10 CFR 50.55a(f)(6)(i) is authorized by law and will not endanger 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, PR7, and PR9 for Beaver Valley, Unit 2, for the fourth 10-year inservice testing 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. 50-412

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, VR2, AND VR3

FOR THE FOURTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL

BEAVER VALLEY POWER STATION, UNIT 2

FIRSTENERGY NUCLEAR OPERATING COMPANY

DOCKET NO. 50-412

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 2 (BVPS-2).

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, PR6, PR8, PR10, VR2, and VR3 on the basis that the alternative provides an acceptable level of quality and safety. Pursuant to 10 CFR 50.55a(f)(5)(iii), the licensee requested to use the proposed alternatives in requests PR5, PR7, and PR9 on the basis that the ASME OM Code requirements are impractical.

The BVPS-2 fourth 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-2 fourth 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 of 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

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

ISTB-3510, "General," (b), "Range," (1) states, "[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
2CHS-PI151A 2CHS-PI152A 2CHS-PI153A	2CHS*P21A 2CHS*P21B 2CHS*P21C
2CHS-PI123A 2CHS-PI123B	2CHS*P22A 2CHS*P22B
2SIS-PI938 2SIS-PI939	2SIS*P21A 2SIS*P21B
2CCP-PI150A 2CCP-PI150B 2CCP-PI150C	2CCP*P21A 2CCP*P21B 2CCP*P21C
2EGF-PI-201A 2EGF-PI201B 2EGF-PI201C 2EGF-PI201D	2EGF*P21A 2EGF*P21B 2EGF*P21C 2EGF*P21D

3.1.1 Instruments 2CHS-PI151A, 2CHS-PI152A, and 2CHS-PI153A

3.1.1.1 Reason for Request

In its submittal, the licensee stated that the suction pressure gauges 2CHS-PI151A, 2CHS-PI152A, and 2CHS-PI153A for the charging pumps 2CHS*P21A, 2CHS*P21B, and 2CHS*P21C have a range of 0 to 160 pounds per square inch gauge (psig). During recirculation flow testing, the suction pressures are approximately 20 to 25% of the range, which is approximately 28 to 29 psig. With a calibrated accuracy of 0.5%, this results in a reading more accurate than ASME OM Code requirements. The use of these pressure instruments is applicable to Group A tests only, since the combination of range and accuracy yields a reading of ±2.86%, 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 2CHS-PI151A, 2CHS-PI152A, and 2CHS-PI153A 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 instruments 2CHS-PI151A, 2CHS-PI152A, and 2CHS-PI153A 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 accuracies of 2CHS-PI151A, 2CHS-PI152A, and 2CHS-PI153A, as derived based upon the current reference value, are as follows:

Minimum reference value = 28 psig
Full scale range = 160 psig
Instrument tolerance = ±0.5% x 160 psig = ±0.8 psig

Therefore, the indicated accuracy is as follows:

±0.8 psig / 28 psig x 100% = ±2.86%

As demonstrated, the indicated accuracies of 2CHS-PI151A, 2CHS-PI152A, and 2CHS-PI153A 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 Instruments 2CHS-PI123A and 2CHS-PI123B

3.1.2.1 Reason for Request

In its submittal, the licensee stated that the suction pressure gauges 2CHS-PI23A and 2CHS-PI23B for the boric acid transfer (BAT) pumps 2CHS*P22A and 2CHS*P22B have a range of 0 to 30 psig. During quarterly testing, the suction pressures are approximately 10 to 15% of the range, which is approximately 3 to 5 psig. With a calibrated accuracy of ±0.5%, this results in a reading more accurate than ASME OM Code requirements. The use of these pressure instruments is applicable to Group A tests only, since the combination of range and accuracy yields a reading of ±3.0 to ±5.0%, 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.

3.1.2.2 Proposed Alternative

The instruments 2CHS-PI23A and 2CHS-PI23B 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).

3.1.2.3 NRC Staff Evaluation

Despite the fact that 2CHS-PI23A and 2CHS-PI23B 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 (documented by NUREG-1482, Revision 2, Section 5.5.1). The indicated accuracies of 2CHS-PI23A and 2CHS-PI23, as derived based upon the current reference value, are as follows:

Minimum reference value = 3 psig
Maximum reference value = 5 psig
Full scale range = 30 psig
Instrument tolerance = ±0.5% x 30 psig = ±0.15 psig

Therefore, the indicated accuracy is as follows:

±0.15 psig / 3 psig x 100% = ±5% and
±0.15 psig / 5 psig x 100% = ±3%

As demonstrated, the indicated accuracies of instruments 2CHS-PI23A and 2CHS-PI23B 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.

3.1.3 Instruments 2SIS-PI938 and 2SIS-PI939

3.1.3.1 Reason for Request

In its submittal, the licensee stated that the suction pressure gauges 2SIS-PI938 and 2SIS-PI939 for the low head safety injection pumps 2SIS*P21A and 2CHS*P21B have a range of 0 to 160 psig. During recirculation flow testing, the suction pressures are approximately 20% of the range, which is 32 psig. With a calibrated accuracy of ±0.5%, this results in a reading more accurate than ASME OM Code requirements. The use of these pressure instruments is applicable to Group B tests only, since the combination of range and accuracy yields a reading of approximately ±2.5%, 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.

3.1.3.2 Proposed Alternative

The instruments 2SIS-PI938 and 2SIS-PI939 may be used for Group B 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 instruments 2SIS-PI938 and 2SIS-PI939 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 2SIS-PI938 and 2SIS-PI939, as derived based upon the current reference value, are as follows:

Reference value = 32 psig
Full scale range = 160 psig
Instrument tolerance = ±0.5% x 160 psig = ±0.8 psig

Therefore, the indicated accuracy is as follows:

±0.8 psig / 32 psig x 100% = ±2.5%

As demonstrated, the indicated accuracies of 2SIS-PI938 and 2SIS-PI939 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 tests.

3.1.4 Instruments 2CCP-PI150A, 2CCP-PI150B, and 2CCP-PI150C

3.1.4.1 Reason for Request

In its submittal, the licensee stated that the suction pressure gauges 2CCP-PI150A, 2CCP-PI150B, and 2CCP-PI150C for the component cooling water (CCW) pumps 2CCP*P21A, 2CCP*P21B, and 2CCP*P21C have a range of 0 to 60 psig. The suction pressures vary

between 27 and 32% of the range, which is 16 to 19 psig. With a calibrated accuracy of ±0.5%, this results in a reading more accurate than ASME OM Code requirements. The use of these pressure instruments is applicable to Group A tests only, since the combination of range and accuracy yields a reading of approximately ±1.57 to ±1.87%, 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.

3.1.4.2 Proposed Alternative

The instruments 2CCP-PI150A, 2CCP-PI150B, and 2CCP-PI150C may be used for Group A tests, as long as the combination of the higher range and better accuracy for the instruments 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 2CCP-PI150A, 2CCP-PI150B, and 2CCP-PI150C 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 (documented by NUREG-1482, Revision 2, Section 5.5.1). The indicated accuracies of 2CCP-PI150A, 2CCP-PI150B, and 2CCP-PI150C, as derived based upon the current reference values, are as follows:

Minimum reference value = 16 psig
Maximum reference value = 19 psig
Full scale range = 60 psig
Instrument tolerance = ±0.5% x 60 psig = ±0.3 psig

Therefore, the indicated accuracies are as follows:

±0.3 psig / 16 psig x 100% = ±1.87% and
±0.3 psig / 19 psig x 100% = ±1.57%

As demonstrated, the indicated accuracies of 2CCP-PI150A, 2CCP-PI150B, and 2CCP-PI150C 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.

3.1.5 Instruments 2EGF-PI201A, 2EGF-PI201B, 2EGF-PI201C, and 2EGF-PI201D

3.1.5.1 Reason for Request

In its submittal, the licensee stated that the discharge pressure gauges 2EGF-PI201A, 2EGF-PI201B, 2EGF-PI201C, and 2EGF-PI201D for the emergency diesel generator fuel oil transfer pumps 2EGF*P21A, 2EGF*P21B, 2EGF*P21C, and 2EGF*P21D have a range of 0 to 30 psig. During bi-monthly testing, the discharge pressures are between 9.5 and 10.5 psig, slightly below one-third of the range. With a calibrated accuracy of ±1.0%, this results in a

reading more accurate than ASME OM Code requirements. The use of these pressure instruments is applicable to Group B tests only, since the combination of range and accuracy yields a reading of ±2.85 to ±3.15%, 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.

3.1.5.2 Proposed Alternative

The instruments 2EGF-PI201A, 2EGF-PI201B, 2EGF-PI201C, and 2EGF-PI201D may be used for Group B 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).

3.1.5.3 NRC Staff Evaluation

Despite the fact that 2EGF-PI201A, 2EGF-PI201B, 2EGF-PI201C, and 2EGF-PI201D 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 2EGF-PI201A, 2EGF-PI201B, 2EGF-PI201C, and 2EGF-PI201D, as derived based upon the current reference value, are as follows:

Minimum reference value = 9.5 psig
Maximum reference value = 10.5 psig
Full scale range = 30 psig
Instrument tolerance = ±1.0% x 30 psig = ±0.3 psig

Therefore, the indicated accuracy is as follows:

±0.3 psig / 9.5 psig x 100% = ±3.15% and
±0.3 psig / 10.5 psig x 100% = ±2.85%

As demonstrated, the indicated accuracies of 2EGF-PI201A, 2EGF-PI201B, 2EGF-PI201C, and 2EGF-PI201D 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 tests.

3.2 Licensee's Alternative Request Number PR3

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

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 differential pressure (d/p).

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
2CHS*P21A 2CHS*P21B 2CHS*P21C	Charging Pumps	3	A
2CHS*P22A 2CHS*P22B	BAT Pumps	3	A
2RHS*P21A 2RHS*P11B	Residual Heat Removal (RHR) Pumps	2	A
2SIS*P21A 2SIS*P21B	Low Head Safety Injection Pumps	2	B
2QSS*P21A 2QSS*P21B	Quench Spray Pumps	2	B
2RSS*P21A 2RSS*P21B 2RSS*P21C 2RSS*P21D	Recirculation Spray Pumps	2	B
2CCP*P21A 2CCP*P21B 2CCP*P21C	CCW Pumps	3	A
2FWE*P22	Turbine-Driven Auxiliary Feedwater (AFW) Pump	3	B
2FWE*P23A 2FWE*P23B	Motor-Driven AFW Pumps	3	B
2SWS*P21A 2SWS*P21B 2SWS*P21C	Service Water (SW) Pumps	3	A
2EGF*P21A 2EGF*P21B 2EGF*P21C 2EGF*P21D	Diesel Fuel Oil Transfer Pumps	3	B

3.2.1 Reason for Request

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 inservice tests. 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.

The licensee described that 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 1.06 times the reference value 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, it proposed that an upper acceptable range limit of 1.06 times the reference value 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 flow rate will be performed for each of these pumps.

The licensee stated that 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 licensee further stated that the upper 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 1.06 times the reference value 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 and Table ISTB-5221-1. 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 Code Case OMN-19 published in the ASME OM Code, 2012 Edition, which the licensee proposed as an alternative, along with the requirements the licensee will apply to the PPV test. The licensee has stated that when implementing a PPV test program, the licensee shall follow the requirements listed in Section 3.2.2, "Proposed Alternative," of this safety evaluation.

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

The licensee will perform a PPV test for the pumps listed in Table 2 every 2 years. The NRC staff determined that a licensee choosing to implement OMN-19 must implement a PPV test program to verify that a pump can meet the required discharge pressure or d/p as applicable, at its highest design-basis accident 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 finds that ASME OM Code Case OMN-19 provides an acceptable level of quality and safety.

3.3 Licensee's Alternative Request Number PR4

This request applies to the vibration requirements of the ASME OM Code.

ISTB-5121(e) and ISTB-5123(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 ["Corrective Action"]. 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 $6V_r$ [V_r = vibration reference value] or 0.7 in./sec [inches/second] (1.7 cm/sec [centimeters/second]) the pump is in the required action range.

ISTB-5221, "Group A Test Procedure," (e), and ISTB-5223(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," (e), and ISTB-5323, "Comprehensive Test Procedure," (e), states:

> All deviations from the reference values shall be compared with the ranges of Table ISTB-5321-1 ["Positive Displacement Pump (Except Reciprocating) Test Acceptance Criteria"] or Table ISTB-5321-2 ["Reciprocating Positive

Displacement Pump Test Acceptance Criteria"], 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 ISTB-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.

The licensee noted that BVPS-2 does not have reciprocating positive displacement pumps in the IST program. Therefore, Table ISTB-5321-2 is not applicable.

The pumps affected by this alternative request are listed in Table 3.

Table 3: Pump Information for Request Number PR4

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
2CHS*P21A 2CHS*P21B 2CHS*P21C	Charging Pumps	3	A
2CHS*P22A 2CHS*P22B	BAT Pumps	3	A
2RHS*P21A	RHR Pump	2	A
2FWE*P23A 2FWE*P23B	Motor-Driven Auxiliary Feedwater Pumps	3	B
2SWS*P21A 2SWS*P21B 2SWS*P21C	SW Pumps	3	A
2EGF*P21A 2EGF*P21B 2EGF*P21C 2EGF*P21D	Diesel Fuel Oil Transfer Pumps	3	B

3.3.1 Reason for Request

In its submittal, the licensee stated that the pumps listed in Table 3 tend to be smooth-running pumps in the BVPS-2 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(a), "Alert Range," states, "[i]f 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 ["Frequency of Inservice Tests"] shall be doubled until the cause of the deviation is determined and the condition is corrected."

The licensee stated that 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, the licensee proposes a minimum value for V_r of 0.05 in/sec. 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 $2.5V_r$, or 0.125 in/sec, which the licensee stated is in the "fair" range of the "General Machinery Vibration Severity Chart" provided by IRD Mechanalysis, Inc. Likewise, the smallest ASME OM Code alert range limit for any IST pump vibration measurement location for which the pump would be inoperable would be no lower than $6V_r$, 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 relief 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.

3.3.2 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 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 Table 3 are included in and will remain in the BVPS PdM program.

The licensee discussed that using the provisions of this 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.

The licensee stated that using the provisions of this alternative request as an alternative to the vibration acceptance criteria ranges specified in Table ISTB-5121-1, Table ISTB-5221-1, or

Table ISTB-5321-1 provides an acceptable level of quality and safety, since the alternative provides reasonable assurance of pump operational readiness and the ability to detect pump degradation.

3.3.3 NRC Staff Evaluation

ISTB-3540, "Vibration," 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. ISTB-3540 also requires that for vertical line shaft pumps that the vibration measurements be taken on the upper motor-bearing housing in three orthogonal directions, one of which is the axial direction. ISTB-3540 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 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, the condition is corrected, and the vibration level returns to the acceptable range level. Pumps whose vibration is measured as greater than $6V_r$ 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, "Reference Values," paragraph (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 3. 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 determined that the alert and required action limits specified in the alternative request 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 NRC staff concludes that the licensee's proposed alternative will provide an acceptable level of quality and safety.

3.4 Licensee's Relief Request Number PR5

The licensee requested relief for RHR pumps 2RHS*P21A and 2RHS*P21B 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 states that "[a]n inservice test shall be run on each pump as specified in Table ISTB-3400-1 ["Inservice Test Frequency"]."

Table ISTB-3400-1 requires Group A pumps to have a Group A test on a quarterly frequency.

3.4.1 Reason for Request

In its application, 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.

3.4.2 Proposed Alternative

The licensee proposed to test the RHR pumps during cold shutdowns and refueling outages (RFOs), not more often than once every 92 days. For a cold shutdown or RFO 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 RFO.

3.4.3 NRC Staff Evaluation

ISTB-3400 of the ASME OM Code states that an inservice test 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 requirements 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 RFOs, but not more than once every 92 days. For a cold shutdown or RFO 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 RFO.

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 alternative proposed by the licensee provides reasonable assurance that the RHR pumps are operationally ready.

3.5 Licensee's Alternative Request Number PR6

The licensee requested an alternative for diesel fuel oil transfer pumps 2EGF*P21A, 2EGF*P21B, 2EGF*P21C, AND 2EGF*P21D from the instrument accuracy requirements of the ASME OM Code. The pumps are classified as ASME Class 3 and ASME OM Code Group B.

ISTB-3510(a), "Accuracy," states, in part, "[i]nstrument 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)."

3.5.1 Reason for Request

There is no flow rate instrumentation installed to measure flow rate directly for the diesel fuel oil transfer pumps. A level sight glass does exist on the side of the diesel generator 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 fuel oil storage tank to the diesel generator fuel oil day tank.

3.5.2 Proposed Alternative

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

PPV test per the emergency diesel generator and fuel oil transfer pump test procedures. The PPV is performed as described in Mandatory Appendix V, "Pump Periodic Verification Test Program," of the 2012 Edition of the ASME OM Code. A restricted reference flow rate (Q_r) acceptance criteria will be used as follows:

Table 4: Acceptance Criteria for Group B Tests

Acceptable Range	Alert Range	Required Action Range	
0.91 to 1.09Q_r	None	Low <0.91Q_r	High >1.09Q_r

Table 5: Acceptance Criteria for Comprehensive Tests

Acceptable Range	Alert Range	Required Action Range	
0.96 to 1.05Q_r	0.94 to <0.96Q_r	Low <0.94Q_r	High >1.05Q_r

In its application, the licensee further stated that during this test, each pump is operated with a fixed flow path from the underground storage tank (suction) to the day tank (discharge). Suction pressure is nearly constant because of the very small change in storage tank level (approximately 1.5 in drop in level during pump operation). This results in no more than a 0.05 psig change in suction pressure during pump operation, and the change is considered to be negligible. The normal rise in day tank level is approximately 12 in, which corresponds to a quantity of approximately 350 gallons pumped during the 10 minutes of pump operation, resulting in a typical flow rate of approximately 35 gallons per minute (gpm). This small rise in day tank level during pump operation could increase pump discharge pressure by as much as 0.4 psig. The resulting increase in pump differential pressure or head (approximately 1 foot) could also decrease pump discharge flow rate by as much as 2 gpm over the course of pump operation based on the shape of the pump curves at approximately 35 gpm for these centrifugal pumps. Therefore, an initial flow rate of approximately 36 gpm would decrease to approximately 34 gpm as the level in the day tank rises during the course of the test. The calculation method described above determines an average flow rate (approximately 35 gpm) over the course of the test.

The licensee described that because flow rate can vary by as much as ±1 gpm from the average flow obtained, the corresponding calculated flow rate is only accurate to within ±2.86 percent. In addition, the level sight glass on the side of the day tank ranges from 12 to 47.25 in and is in 0.125 in increments for a calibrated accuracy of ±0.355%. The stopwatch used to measure the time the pump is operating and pumping fuel oil is accurate to within ±0.3 seconds per minute for a calibrated accuracy of ±0.5%. Combining the accuracy of the flow rate reading, level sight glass, and stopwatch using the square root of the sum of the squares method results in an overall indicated accuracy of ±2.93%. Since this does not meet the ±2% accuracy requirements of Table ISTB-3510-1, the licensee proposes to use the restricted flow rate acceptance criteria that is more conservative than the current flow rate acceptance criteria in Table ISTB-5221-1 for both the Group B and comprehensive tests. The acceptable ranges for flow provided in Table ISTB-5221-1 for the Group B test and comprehensive pump test are as follows:

Table 6: Proposed Acceptance Criteria for Group B Tests

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

Table 7: Proposed Acceptance Criteria for Comprehensive Tests

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

The licensee stated that the accuracy of the proposed flow rate determination and the restricted flow rate acceptance criteria (both described above) meet the intent of the ASME OM Code required accuracy of 2% of actual flow rate, since the restricted flow rate acceptance criteria (that provide a more conservative range of acceptable values) listed above compensate for the 1% less accurate flow rate determination.

In addition, because these tests are performed at nearly the same conditions (a day tank level change from approximately 22 to 34 in over 10 minutes) and use a fixed flow path, repeatable results (for trend analysis purposes) are ensured. The licensee has over 20 years of test experience using this test method (day tank level change over time). The method has demonstrated that it provides adequate capability to monitor for a declining trend in pump performance and reasonable assurance of acceptable pump operation.

Although the diesel fuel oil transfer pumps are vertical line shaft centrifugal pumps, the licensee stated that the 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." Using the provisions of this request as an alternative to the requirements of ISTB-3510(a) provides an acceptable level of quality and safety, since the alternative provides reasonable assurance of pump operational readiness.

3.5.3 NRC Staff Evaluation

The NRC staff has reviewed the licensee's method for determining the flow rate for emergency diesel generator diesel fuel oil transfer pumps 2EGF*P21A, 2EGF*P21B, 2EGF*P21C, and 2EGF*P21D during Group B and comprehensive pump tests along with the acceptance criteria that will be used to evaluate test results. The acceptance criteria that will be used to evaluate test results adequately compensate for the accuracy of the method. The NRC staff concludes that the proposed alternative, as specified in this relief request, provides (1) an acceptable level of quality and safety, (2) an accurate method for determining flow, and (3) reasonable assurance of the operational readiness of the pumps.

3.6 Licensee's Relief Request Number PR7

The licensee requested relief for service water (SW) pumps 2SWS*P21A, 2SWS*P21B, and 2SWS*P21C from the vibration measurement location requirements of the ASME OM Code. The pumps are classified as ASME Class 3 and ASME OM Code Group A.

ISTB-3540(b) states that "[o]n vertical line shaft pumps, measurements shall be taken on the upper motor-bearing housing in three approximately orthogonal directions, one of which is the axial direction."

3.6.1 Reason for Request

In its application, the licensee stated that access to the upper motor-bearing housing on the vertical line shaft SW pumps for the purpose of measuring vibrations in the axial direction cannot be obtained due to the presence of a permanently installed non-rigid metal top hat

covering the entire top of the motor housing. The SW pumps would require modification in order to obtain the vibration measurements at the upper motor-bearing housing as required by ISTB-3540(b).

3.6.2 Proposed Alternative

The licensee proposed to measure vibrations on the upper motor-bearing housing in two orthogonal directions (excluding the axial direction) and measure vibrations on the lower motor-bearing housing in three orthogonal directions (including the axial direction) during each quarterly Group A test and biennial comprehensive test per SW pump test procedures.

The licensee further stated that the vibration measurements in the axial direction are accessible at the lower motor-bearing housing of each pump, which will provide additional information for trending of pump/motor performance. The vibration measurements in the other orthogonal directions (horizontal and vertical) provide another predictor of vibration problems for vertical line shaft pumps.

The proposed locations for taking vibration measurements should not be subject to dampening effects of non-rigid structural contact that could mask potential degradation. In recognition of inherent deficiencies in the vibration testing for vertical line shaft pumps, hydraulic performance requirements are more stringent for vertical line shaft pumps than for horizontal centrifugal pumps.

3.6.3 NRC Staff Evaluation

The licensee requested relief from the ASME Code vibration measurement requirements of ISTB-3540(b) because the upper motor-bearing housing in the axial direction for SW pumps is impeded by a permanently installed non-rigid top hat. ISTB-3540(b) requires that vibration measurements on vertical line shaft pumps be taken on the upper motor-bearing housing in three orthogonal directions, one of which is in the axial direction.

The vibration measurements of vertical line shaft pump upper motor bearings in the axial direction cannot be measured directly without modification of the pump assembly. The licensee has proposed to measure vibration on the upper motor-bearing housing in two orthogonal directions (excluding the axial direction), along with additional measurements of vibration at the lower motor-bearing housing in three orthogonal directions (including the axial direction), during each quarterly Group A test and biennial comprehensive test using SW pump test procedures.

Based on the information provided, the NRC staff determined that it would be impracticable to modify these pumps to measure axial vibration at the upper motor-bearing housing. The licensee will be taking measurements in (1) three orthogonal directions at the lower motor-bearing housing, and (2) two orthogonal directions, which are non-axial, at the upper motor-bearing housing. The licensee's proposed locations for taking vibration measurement should not be subject to the dampening effect of non-rigid structural contact that could mask potential degradation. Furthermore, in recognition of inherent deficiencies in the vibration testing for vertical line shaft pumps, hydraulic performance requirements are more stringent for vertical line shaft pumps than for horizontal centrifugal pumps. Therefore, the proposed alternative locations for taking vibration measurements should provide reasonable assurance that the SW pumps are operationally ready.

3.7 Licensee's Alternative Request Number PR8

The licensee requested an alternative for SW pumps 2SWS*P21A, 2SWS*P21B, and 2SWS*P21C for the instrument accuracy requirement in the ASME OM Code.

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.

Table ISTB-3510-1 requires pressure instruments to be calibrated to ±0.5% when used during the comprehensive pump test.

3.7.1 Reason for Request

In its submittal, the licensee stated that the SW 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 local pump d/p 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% requirement in Table ISTB-3510-1 for comprehensive or preservice tests.

3.7.2 Proposed Alternative

The licensee has proposed to use the installed Ohio River level recorder with a loop accuracy of ±1.8% to determine SW pump suction pressure, and a 0 to 200 psig, 0.1% or better accurate test pressure gauge to determine SW pump d/p. These instrument readings are used to determine SW pump d/p. The d/p for the SW 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 pump discharge centerline and converted to pressure.

Suction pressure for the SW pumps is determined by converting a river elevation reading measured by level recorder to a calculated pressure. This level recorder has a full scale range from 648 to 705 feet (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 SW pumps 2SWS*P21A, B, and C is obtained from a temporary test pressure gauge with a full scale range of 0 to 200 psig. The ASME OM Code would require this discharge pressure reading to be accurate within ±1 psig (200 psig x 0.5% accuracy). In order to compensate for the ±1.8% suction pressure loop accuracy, a

±0.1% accurate temporary test pressure gauge will be used. This temporary test pressure gauge (to be used in place of the installed 0 to 160 psig, 0.5% accurate discharge pressure indicators) will provide a discharge pressure reading over the range of the instrument with an accuracy of ±0.2 psig (200 psig x 0.1%). Adding this to the installed ±1.8% accurate suction pressure instrument reading yields an accuracy of ±0.65 psig (0.45 psig + 0.2 psig) for the combination of instruments.

The licensee explained that when the required instrument accuracy of ±0.5% per Table ISTB-3510-1 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 required instrument accuracy of ±0.5% per Table ISTB-3510-1 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 ±1.0 psig (200 psig x 0.5%). Adding these required instrument accuracies together would yield an overall worst case (allowed) error of ±1.125 psig (0.125 psig + 1.0 psig). Therefore, the overall d/p reading, which can be read to within ±0.65 psig, is better than the effective ±1.125 psig d/p reading required by the ASME OM Code for comprehensive pump testing.

The proposed alternative using the ±0.1% accurate test pressure gauge in place of the installed d/p 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-2 in addition to those required by the ASME OM Code that enhance the ability to detect pump degradation. As part of the BVPS-2 Predictive Maintenance 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-2 Preventive Maintenance Program, the pump motors are inspected, lubricated, and tested every 192 weeks. The pump and motor are completely overhauled every 516 weeks. 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.

3.7.3 NRC Staff Evaluation

The licensee requested an alternative to the ASME OM Code instrumentation accuracy requirements of ISTB-3510(a) and Table ISTB-3500-1 for pressure instruments used to measure SW pump suction pressure. ISTB-3510(a) requires that instrument accuracy shall be within the limits of Table ISTB-3500-1. Table ISTB-3500-1 requires a pressure instrument accuracy of ±0.5% for comprehensive and preservice tests.

The licensee proposed to use the installed Ohio River level recorder with a loop accuracy of ±1.8% to determine the suction pressure and a temporary pressure gauge with an accuracy of ±0.1% and range of the 0 to 200 psig to measure discharge pressure. These instrument readings will be used to determine SW pumps 2SWS*P21A, 2SWS*P21B, and 2SWS*P21C pump d/p during comprehensive and preservice pump tests.

The NRC staff has reviewed the licensee's method and calculations described above. The NRC staff finds that (1) the existing Level Recorder LR-1CW-101 with a loop accuracy of

±1.8% installed at the suction of the SW pumps, along with a temporary discharge pressure instrument calibrated to ±0.1% of full scale with a range of 0 to 200 psig, yield d/p readings at least equivalent to the readings achieved from instruments that meet ASME Code requirements, and (2) the licensee's proposed alternative provides an acceptable level of quality and safety. This is consistent with Section 5.5.1 of NUREG-1482, Revision 2, which allows the NRC staff to authorize a proposed alternative when it yields a reading that is at least equivalent to that achieved using instruments that meet the ASME Code requirements.

3.8 Licensee's Alternative Request Number PR9

The licensee requested relief from the ASME OM Code requirement for Group A and comprehensive test range requirements.

ISTB-5221(e) states, in part, that "[a]ll 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."

ISTB-5223(e) states, in part, that "[a]ll 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."

The pumps affected by this relief request are listed in Table 8.

Table 8: SW Pump Information for Request Number PR9

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
2SWS*P21A	Service Water Pump	3	A
2SWS*P21B	Service Water Pump	3	A
2SWS*P21C	Service Water Pump	3	A

3.8.1 Reason for Request

In its submittal, the licensee stated that the SW system operation is dependent on seasonal Ohio River water temperatures. Based on the most recent 10 years of data, pump flow rates vary between approximately 8,500 gpm in the cool winter months to approximately 15,000 gpm in the warm summer months. Due to variations in pump flow rate and d/p (pump head), a pump curve will be used to compare flow rate with developed pump head at the flow conditions indicated by plant seasonal heat load requirements.

Group A and comprehensive pump test acceptance criteria for d/p is provided in Table ISTB-5221-1. The developed head of a pump is calculated by multiplying the d/p by 2.31 feet/psig. The d/p from the Table ISTB-5221-1 acceptance criteria, where ΔP_r is the differential pressure reference value, is as follows:

Table 9: Acceptance Criteria for Group A Tests

Acceptable Range	Alert Range	Required Action Range Low	Required Action Range High
0.95 to 1.10ΔP_r	0.93 to <0.95ΔP_r	<0.93ΔP_r	>1.10ΔP_r

Table 10: Acceptance Criteria for Comprehensive Tests

Acceptable Range	Alert Range	Required Action Range Low	Required Action Range High
0.95 to 1.03ΔP_r	0.93 to <0.95ΔP_r	<0.93ΔP_r	>1.03ΔP_r

The licensee stated that the SW pumps are typically overhauled in the colder winter months when the demand on the SW system for cooling is less. The reference pump curve is developed during this time period. The SW pump shaft is made from stainless steel and the pump columns are made from carbon steel. As river water temperature increases, the stainless steel shaft expands at a different rate than the carbon steel columns, resulting in a net change in the clearance at the impeller.

Because the carbon steel columns grow slightly more than the stainless steel shaft, a wider gap between the impeller and bowl is created. This causes an increase in pump lift and results in lower hydraulic performance from the reference pump curve. As river water temperature rises above 60 degrees Fahrenheit (°F), pump hydraulic performance decreases, sometimes into the alert range of 0.93 to less than $0.95\Delta P_r$.

As river water temperature begins to cool again, pump hydraulic performance tends to return to the original cold weather reference value. Therefore, the licensee stated that the ASME OM Code limits of Table ISTB-5221-1 are exceeded by the SW pumps when river water temperature is above 60 °F. An allowable variation larger than these ranges is needed for both the Group A and comprehensive pump tests, as applicable, in order to trend pump performance. Historical variations in pump head have caused the pumps to enter the alert range and require double frequency testing of the pumps when real degradation has not occurred.

3.8.2 Proposed Alternative

Expanded ranges, as defined below, will be used for the SW pumps during the Group A and comprehensive pump tests when the river water temperature is above 60 °F in lieu of the acceptance criteria specified in Table ISTB-5221-1. The proposed expanded ranges to be used during both the Group A and comprehensive pump tests, as modified for developed pump head (H), are as follows:

Table 11: Proposed Acceptance Criteria for Group A Tests

Acceptable Range	Alert Range	Required Action Range Low	Required Action Range High
0.93 to 1.10H	0.90 to <0.93H	<0.90H	>1.10H

Table 12: Proposed Acceptance Criteria for Comprehensive Tests

Acceptable Range	Alert Range	Required Action Range Low	Required Action Range High
0.93 to 1.06H	0.90 to <0.93H	<0.90H	>1.06H

The licensee stated that Group A and comprehensive pump testing will be performed in accordance with SW pump test procedures using the expanded ranges when river water temperature is above 60 °F. These expanded ranges will still allow degrading conditions to be identified without needlessly placing the pump on double frequency testing and will provide assurance that the SW pumps will be capable of fulfilling their safety function.

The licensee further explained that decreasing the acceptable range lower limit to 0.93 and the alert range lower limit to 0.90 is consistent with lower range limits required by the ASME Boiler and Pressure Vessel Code, Section XI, 1983 Edition, Table IWP-3100-2. Currently, there are several feet of margin below the lower required action range limit of 0.90 to the minimum operating point (MOP) curve for each pump. SW pump 2SWS*P21A has 16.1 feet (6.74%) of

margin to the MOP curve. SW pump 2SWS*P21B has 21.5 feet (8.78%) of margin to the MOP curve. SW pump 2SWS*P21C has 20.4 feet (8.38%) of margin to the MOP curve. If pump performance were to degrade in the summer months while river water temperature is above 60 °F, enough margin exists above the respective pump's MOP curve to take action before challenging the design-basis limits. In addition, once river water temperature decreases below 60 °F, the more restrictive ASME OM Code limits from Table ISTB-5221-1 would resume, providing additional margin above the MOP curves.

Other activities are in place that enhance the ability to detect pump degradation. In addition to measuring vibrations on the upper motor-bearing housing as required by the ASME OM Code, vibrations are also measured on the lower motor-bearing housing each quarter. Spectral analysis of the vibrations is a good practice that can be 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. Trending of the spectral data could also determine a change in condition of the pump. Included in the BVPS-2 preventive maintenance program is a motor lube oil analysis that is performed every 48 weeks and a complete overhaul of pump and motor that is performed every 516 weeks. The overhaul 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.

3.8.3 NRC Staff Evaluation

SW pumps 2SWS*P21A, 2SWS*P21B, and 2SWS*P21C 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 in accordance with ISTB-5221 and tested biennially in accordance with ISTB-5223. Both tests require that the pump operate at a specific flow reference point. Deviations from the reference value shall be compared with the acceptance criteria ranges of Table ISTB-5221-1 and corrective action taken as specified in ISTB-6200.

The SW system operation is dependent on the seasonal Ohio River water temperatures. The SW pump flow rates vary approximately 8,500 gpm in the winter months and 15,000 gpm in the summer months. The SW pumps are typically overhauled in the winter months when the demand on the SW system is less. This is when the SW pump curve is developed. The SW pump shaft and pump columns are made of different materials (stainless steel and carbon steel, respectively). As the river water temperature increases, the two materials expand at different rates. This results in a net change in the clearance at the impeller. A wider gap between the impeller and bowl is created, and this causes an increase in pump lift. The result is a lower hydraulic performance from the reference pump curve as the river water temperature rises above 60 °F. This has resulted in the pumps sometimes entering the alert range during their surveillance test when the pumps are not actually degrading.

Due to the seasonal changes in the Ohio River that affect pump performance, the licensee has proposed to expand the acceptance criteria range when the Ohio River water temperature is above 60 °F. The proposed lower limit is consistent with lower range limits required by the ASME Boiler and Pressure Vessel Code, Section XI, 1983 Edition, Table IWP-3100-2. The expanded ranges will allow the licensee to identify degrading conditions for the SW pumps without having them enter the alert range, resulting in increased frequency pump testing (i.e., doubling). The pumps will have from 6.74% to 8.78% margin between the lower required action

range and the MOP on the respective pump curve. Since pump degradation does not normally occur rapidly, this margin would allow the licensee to take action for a degrading pump before challenging the design-basis limits.

In addition, the SW pumps are monitored using vibration and spectral analysis. Also, the motor has a preventive maintenance lube oil analysis task that is performed every 48 weeks and a complete overhaul of pump and motor that is performed every 516 weeks. The overhaul frequency is based on the expected condition of the pumps as a result of historical overhauls. These preventive maintenance tasks, coupled with performance of the proposed alternative provide reasonable assurance that the SW pumps remain operationally ready.

3.9 Licensee's Alternative Request Number PR10

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, in part, "[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, in part, "[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 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 13.

Table 13: Pump Information for PR10

Pump Number	Pump Name	ASME Code Class	ASME OM Code Group
2CHS*P21A	Charging Pump	2	A
2CHS*P21B	Charging Pump	2	A
2CHS*P21C	Charging Pump	2	A
2CHS*P22A	BAT Pump	3	A
2CHS*P22B	BAT Pump	3	A
2RHS*P21A	RHR Pump	2	A
2RHS*P21B	RHR Pump	2	A
2SIS*P21A	Low Head Safety Injection Pump	2	B
2SIS*P21B	Low Head Safety Injection Pump	2	B
2QSS*P21A	Quench Spray Pump	2	B
2QSS*P21B	Quench Spray Pump	2	B
2RSS*P21A	Recirculation Spray Pump	2	B
2RSS*P21B	Recirculation Spray Pump	2	B
2RSS*P21C	Recirculation Spray Pump	2	B
2RSS*P21D	Recirculation Spray Pump	2	B
2FWE*P22	Turbine-Driven AFW Pump	3	B
2FWE*P23A	Motor-Driven AFW Pump	3	B
2FWE*P23B	Motor-Driven AFW Pump	3	B

3.9.1 Reason for Request

In its submittal, the licensee stated that 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.

3.9.2 Proposed Alternative

When 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. The Code Case 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.

3.9.3 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. 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 alternative proposed in ASME OM Code Case OMN-21 and found that the proposed alternative is 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 Table 13 above. Therefore, the NRC staff concludes that the licensee's proposed alternative provides an acceptable level of quality and safety.

3.10 Licensee's Alternative Request Number VR2

The licensee requested an alternative to the ASME OM Code requirements for relief valve test frequencies.

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 ASME OM Code allows a 6-year test interval plus an additional 6-month grace period coinciding with an RFO, in order to accommodate extended shutdown periods.

The valves affected by this alternative request are listed in Table 14.

Table 14: Pressurizer Safety Valve Information for VR2

Valve Number	Valve Name	ASME Code Class	ASME OM Category
2RCS*RV551A	Pressurizer Safety Valve	1	C
2RCS*RV551B	Pressurizer Safety Valve	1	C
2RCS*RV551C	Pressurizer Safety Valve	1	C

3.10.1 Reason for Request

In its submittal, the licensee stated that BVPS-2 has three pressurizer safety valves installed to protect the RCS from over-pressure. Since BVPS-2 operates on an 18-month fuel cycle, one valve can be tested each RFO such that each valve is tested over a 4½- year period. In order to avoid outage delays due to valve testing, a pressurizer safety valve is replaced during each RFO 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 RFO. 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 pressurizer safety valve with a spare pressurizer safety valve 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 an RFO, in order to accommodate extended shutdown periods.

3.10.2 Proposed Alternative

As an alternative to the ASME OM Code-2004 Edition, Mandatory Appendix I, paragraph I-1320(a) test interval for pressurizer safety valve testing of at least once every 5 years, the pressurizer safety valves 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.

The licensee stated that 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 pressurizer safety valves will perform their intended function.

The longer test interval will eliminate the need for a valve test within 6 months of installation during each RFO. 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 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-2 Technical Specification Limiting Condition for Operation 3.4.10 for the purpose of determining pressurizer safety valve operability.

The licensee described that since 1989, 21 as-found set pressure tests have been performed for the four Crosby Model HB-86-BP pressurizer safety valves (including the spare valve). 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 2RCS*RV551C, which lifted low (-5.6%) in 1989 due to excessive seat leakage. BVPS-2 Technical Specification Surveillance Requirement 3.4.10.1 requires that following testing, lift settings shall be within ±1%. For 11 of the 21 tests, the valves were found within the as-left tolerance of ±1%. These test results show limited time-related degradation or setpoint drift and demonstrate that it is acceptable to extend the test interval from 4.5 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 pressurizer safety valves 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, the licensee stated that the test and inspection of the valves in accordance with the proposed alternative demonstrates an acceptable level of quality and safety.

3.10.3 NRC Staff Evaluation

The 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 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 safety relief valve 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 safety relief valves 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 pressurizer safety valve 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 determined extending the test interval of pressurizer safety valves 2RCS*RV551A, 2RCS*RV551B, and 2RCS*RV551C to 72 months with a 6-month grace period is acceptable. Extending the test interval should not adversely affect the operational readiness of the pressurizer safety valves because the pressurizer safety valves 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 pressurizer safety valves 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.

3.11 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 15.

Table 15: Valve Information for VR3

Valve Number	Valve Name	ASME Code Class	ASME OM Category
2HCS*SOV133A	Hydrogen Analyzer A Outlet Inside Containment Isolation Valve (CIV)	2	A
2HCS*SOV133B	Hydrogen Analyzer B Outlet Inside CIV	2	A
2HCS*SOV134A	Hydrogen Analyzer A Outlet Outside CIV	2	A
2HCS*SOV134B	Hydrogen Analyzer B Outlet Outside CIV	2	A
2HCS*SOV135A	Hydrogen Analyzer A Inlet Inside CIV	2	A
2HCS*SOV135B	Hydrogen Analyzer B Inlet Outside CIV	2	A
2HCS*SOV136A	Hydrogen Analyzer A Inlet Inside CIV	2	A
2HCS*SOV136B	Hydrogen Analyzer A Inlet Outside CIV	2	A
2HCS*SOV114A	Containment Isolation to Hydrogen Recombiner 21A	2	A
2HCS*SOV114B	Containment Isolation to Hydrogen Recombiner 21B	2	A
2HCS*SOV115A	Backup Containment Isolation to Hydrogen Recombiner 21A	2	A
2HCS*SOV115B	Backup Containment Isolation to Hydrogen Recombiner 21B	2	A

3.11.1 Reason for Request

In its application, the licensee stated that the valves listed in Table 15 are Category A CIVs and are required to be seat leakage tested in accordance with 10 CFR Part 50, Appendix J (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 a solenoid-operated valve (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 explained 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 an RFO, 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 RFO.

3.11.2 Proposed Alternative

As an alternative to the ISTC-3700 test interval of at least once every 2 years, the licensee 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.

The licensee stated that valves 2HCS*SOV114A, 2HCS*SOV115A, 2HCS*SOV114B, and 2HCS*SOV115B may be remote position verified at the longer test frequency specified above, or remote position verified in conjunction with the testing of CIVs 2CVS*SOV151A and 152A (for Penetration No. 93) and 2CVS*SOV151B and 152B (for Penetration No. 92) in accordance with the frequency specified in the surveillance frequency control program referenced by Technical Specification Surveillance Requirement 3.3.3.3 (currently an 18-month frequency).

In addition to position verification testing and seat leakage testing, the SOVs associated with the hydrogen analyzers are stroke-timed open and closed on a quarterly frequency. Because these SOVs are ganged in sets of two valves per control switch, two operators time the valves so that

pre-conditioning is avoided by not cycling the valves more than once. For each valve, the opening stroke time is measured from the time the common control switch is placed in the open position until the red indicating light is the only indicating light remaining illuminated. For each valve, the closing stroke time is measured from the time the common 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 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. The SOVs associated with the Train B hydrogen recombiners are not required to be stroke-time tested, as they are considered to be passive valves.

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 RFOs (based on an 18-month fuel cycle). In order for a valve's seat leakage test frequency to be extended, the individual CIV 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 stated that over the past six RFOs, 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 inservice test 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 two 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.

The licensee stated that 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 proposed alternative to the ISTC-3700 test interval provides an acceptable level of quality and safety.

3.11.3 NRC Staff Evaluation

The licensee proposed an alternative test in lieu of the requirements found in ISTC-3700 for the valves listed in Table 15. 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 RFO 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 RFO or 18 months, until good performance can again be established.

The valves listed in Table 15 are Category A CIVs 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. The NRC staff concluded that the licensee's use of 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, PR6, PR8, PR10, VR2, and VR3 for BVPS-2, 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, PR6, PR8, PR10, VR2, and VR3. Therefore, the NRC staff authorizes the use of the alternative requests PR2, PR3, PR4, PR6, PR8, PR10, VR2, and VR3 for BVPS-2 for the fourth 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, PR7, and PR9 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 Request Numbers PR5, PR7, and PR9 for BVPS-2 for the fourth 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.

Principal Contributors: Robert J. Wolfgang
Michael F. Farnan

Date: June 26, 2017

SUBJECT: BEAVER VALLEY POWER STATION, UNIT 2 – REQUESTS FOR ALTERNATIVES AND REQUESTS FOR RELIEF RE: FOURTH 10-YEAR INSERVICE TESTING PROGRAM INTERVAL (CAC NOS. MF8333, MF8335, MF8338, MF8339, MF8341, MF8343, MF8345, MF8347, MF8349, MF8358, AND MF8356) DATED JUNE 26, 2017

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